CHAPTER 6: THE IMPACT OF INDUSTRIAL LOGGING ON ECOLOGICAL DIVERSITY

In Chapter 6 the ecological impacts of industrial logging are described as well as some of the available measures to mitigate these. Article 6.1 provides an overview of the main ecological impacts of industrial logging – forest canopy disturbance, soil erosion, pollution and decline in biodiversity.

Techniques are available to lessen these – for example, reduced impact logging, described by Sylvain Angerand in Article 6.3 – but these are often not implemented. Thus, even though ecological principles are included within national forest programmes, the reality on the ground is often very different, as James Mayers describes in the case of Mozambique.

In Bas Congo, DRC, where logging has been taking place for many years, the degradation of the landscape is cleary visible. Photo: Jan Thomas Odegard

6.1 THE ECOLOGICAL IMPACTS OF INDUSTRIAL LOGGING IN THE CONGO BASIN

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Introduction

The loss and degradation of tropical forests poses one of the most serious threats to biodiversity. During the last few decades, forest exploitation has resulted in the depletion and destruction of many of the more accessible forests in Central Africa. Increasingly, attention is turning to the Democratic Republic of Congo (DRC), whose forests are still relatively untouched.

The Congo Basin covers 4.1 million square kilometres and has a population of 74 million; DRC accounts for 57% of this total area and 68% of the population.[352] Therefore, this country is a major stakeholder in determining the future of African tropical forests, and is a priority for efforts to reduce the impact of industrial logging and promote sustainable forest management systems.

This paper presents the main ecological impacts of industrial logging. Four types of impact are analysed – canopy disturbance, soil erosion, pollution and biodiversity – and some potential solutions presented that may help to limit the impacts of industrial logging operations.

Canopy disturbance and shifting land use

One of the main effects of timber extraction is canopy disturbance. The increased penetration of light through the canopy causes significant changes in the microclimate and leads to drying of the soil. This increases susceptibility to forest fires, a cause of long-term ecosystem damage. Burnt forests may be taken over by secondary vegetation or such land is often converted to agricultural use.[353]

By opening up the canopy, commercial timber harvesting not only increases susceptibility to fire, but also results in greater damage when fires do occur. Research at a number of sites in the Amazon found that selective logging increased the amount of ground litter available to burn, so increasing the fire damage inflicted in comparison to un-logged forests, including markedly higher tree mortality.[354]

The opening up of the forest also facilitates agricultural encroachment.[355] Cash crop and subsistence farming carried out by workers, landless farmers and opportunistic migrants can lead to rapid conversion of forest to farmland. This shift in land use upsets the sensitive equilibrium of nutrients in tropical forest soil - erosion and leaching of top-soil increases and soil productivity declines, making both farming and forest rehabilitation much harder in the future.[356] Without the use of expensive and environmentally damaging fertilizer, such land will only be productive for an average of 3 years, after which it will usually be abandoned.

Soil erosion

Soil erosion is a natural phenomenon, caused by the wind and water run-off. However, timber-harvesting practices intensify this process. The primary cause of soil erosion in concession areas is skid track and road construction and tyre pressure on the roads. In fact, it has been found that logging roads may produce more erosion and sediment yield, than the logged areas themselves.[357] Operational processes also contribute to significant soil erosion and compaction. For example, export-oriented logging concessions are particularly damaging, because they require heavy equipment as the main commercial trees are very large. Soil erosion results in top-soil entering the streams and rivers where it reduces the amount of light available to aquatic

[352] Ruiz Perez, M. et al. (2005) Logging in the Congo Basin: a multi-country characterization of timber companies. Forest Ecology and Management 214: 221-236;[353] Lapuyade, S. et al. (2000) Etude d'impact social et environnemental de l'exploitation forestière dans la concession de la compagnie forestière du Cameroun (C.F.C), Province de L'Est, Cameroun. April 2000. Forests Monitor.;[354] Holdsworth, A. & Uhl, C. (1997) Fire in Amazonian Selectively Logged Rain Forests and the Potential for Fire Reduction. Ecological Applications 7(2): 713-25;[355] Lanly, J.-P. (2003) Deforestation and Forest Degradation Factors. FAO, Italy.;[356] Kobayashi, S. (2004) Landscape rehabilitation of degraded tropical forest ecosystems. Case Study of the CIFOR/Japan project in Indonesia and Peru. Forest Ecology and Management 201: 13-22;[356] Alexander, L. & R. Forman (1998) Roads and their major ecological effects. Annual Review of Ecology and Systematics 29: 207-31;[357] Alexander, L. & R. Forman (1998) Roads and their major ecological effects. Annual Review of Ecology and Systematics 29: 207-31

fauna and flora.[358] It has been calculated that 0.5km of road per square kilometre of forest is all that is required for river siltation to significantly decrease fish stocks.[359]

Pollution

There are two main types of pollution generated by industrial timber extraction in tropical forests: water and noise pollution. Water pollution takes the form of sediment deposits and chemical leakage. Products used to treat the timber enter the hydrological system when the logs are transported by river to the ports.[360] Chemicals that have been found to be in use in Cameroon, Gabon and Kenya include CCA creosote, BFCA and TBT,[361] all of which are known to be toxic and damaging to the environment.[362]

Furthermore, noise and air pollution created by tree felling, processing sites and timber transportation frighten away many large mammals and bird species, so reducing the diversity of animals to be found in logged forest.[363]

Biodiversity

Flora

Numerous factors lead to the reduction of biodiversity within logging concession areas, but one of the main threats to the flora is the destruction of habitats. The targeting of high value tree species has resulted in ever younger specimens being logged, and the felling of mature trees hinders the ability of populations to recover, because these are often the main seed producing individuals. Consequently, certain species have been decimated. During an Environmental Impact Assessment carried out in a Cameroon Forestry Company concession area it was discovered that more than 76 per cent of the trees logged are threatened species;[364] this included Assamela / Afromosia (*Pericopsis elata*), listed on CITES Appendix I as an endangered species.[365]

Fauna

The consumption of bushmeat by forestry workers is usually unsustainable. A study conducted in 1999 in one logging camp of 648 people in the Republic of Congo reported an annual harvest of 8251 animals, equivalent to 124 tons of meat.[366] Not only does this level of hunting lead to local extinction, but the mammals that are being hunted play a key role in forest regeneration through tree pollination and seed dispersal.[367] Consequently, the mere presence of industrial logging operations in the forest and the associated consumption of bushmeat, is preventing natural ecological processes from occurring.

However, the biggest impact of commercial logging on wildlife is linked to roads, which provide access to previously remote forest areas. Each year, the network of roads created by logging operations increases, linking previously inaccessible forests to the national road system.[368] The increasing access to previously isolated forests both facilitates hunting and improves market accessibility. In the Congo Basin, road construction has turned a 3-4 day hunting trip into a one-day event.[369] The network of roads also impedes the movement of some mammals, resulting in isolated breeding populations. As fragmented forest patches increase in number "biomass declines, community structure changes, pest invasions increase and the rate of species loss skyrockets".[370]

Possible solutions

Reduced Impact Logging (RIL) is generally regarded as the main technical solution to canopy disturbance, as will be discussed in

[358] Alexander & Forman (1998) *op.cit.*;[359] Wilkie, D. *et al*. (2000) Roads, Development and Conservation in the Congo Basin. Conservation Biology 14(6): 1614-22;[360] CIAJE (2000) Impacts des Activités des Compagnies Forestières Européennes sur les Populations locales et l'environnement – Gabon;[361] CCA = Chromated Copper Arsenate; BFCA = boron-fluoride-chromium-arsenic; TBT = tributyltin;;[362] Venkatasamy, R. (2004) Wood preserving chemicals in Kenya: health and environmental issues. Department of Wood Science, Moi University, Kenya. Paper presented at The Environmental Impacts of Preservative-Treated Wood Conference, 8-11 February, 2004, Orlando, Florida;[363] Lapuyade *et al*. (2000) *op.cit.* ;[364] Lapuyade *et al*. (2000) *op.cit.*;[365] IUCN (2004) 2004 IUCN Red List of Threatened Species;[366] Robinson, J.G. *et al*. (1999) Wildlife harvest in logged tropical forests. Science 284(5414): 595-596;[367] Chapin, F.S. *et al*. (2002) Principles of Terrestrial Ecosystem Ecology. Springer, New York;[368] Robinson *et al*. (1999) *op.cit*;[369] Wilkie *et al*. (2000) *op.cit*.;[370] Wilkie *et al*. (2000) *op.cit*.

detail in Article 6.3 by Sylvain Angerand. However, the challenge of reducing forest susceptibility to fire, which is increased by the damage resulting from commercial logging operations, has not yet been met.

There are technical solutions available to reduce soil erosion, and it is much more effective, both ecologically and financially, to prevent these problems rather than trying to rehabilitate the soil after logging operations.[371] One measure that has had proven results is Variable Tyre Inflation (VTI) – the reduction of tyre pressure to reduce the amount of soil erosion from logging trucks and skid towers. This spreads the pressure over a greater surface area and has been shown to significantly reduce sediment yields from between 54% to 84%.[372] CIFOR has produced indicators and guidelines to minimise erosion and run-off during harvesting, but the extent to which they have been adopted by industry has not been assessed.

Noise and air pollution are particularly badly dealt with by industry, and furthermore, more research is required on alternative safe chemicals that can be used to treat timber.

Four critical entry points have been identified in relation to the bushmeat crisis: hunters, consumers, traders and the logging industry. The logging industry has a part to play in all of these, from curbing hunting of wild bushmeat to providing alternative sources of protein for their workers and families. The success of each approach will vary according to the local circumstances. However, none have yet proved to be an overwhelming success.[373] In practise, little can be done, because when logging camps and towns are established, nothing can be done to stop people migrating to them; and these people will inevitably go hunting. So, the fact is that logging results in hunting.

Conclusion

Unfortunately, the broad application of technical solutions to reduce the ecological impact of industrial forest logging concessions in the Congo Basin is unlikely. The lack of enforcement of environmental regulations and management plans, as well as the exclusion of local people from forest concession management, means that the best techniques are not being implemented. The simple fact is that logging companies do not have the motivation, and governments do not have the resources, to enforce the regulations.

Recommendations

- Incentives should be provided for local people to continue their traditional forest management practices by recognising their traditional land rights while simultaneously addressing development issues through alternative routes to industrial logging.
- Community involvement in ecological land use mapping should be established prior to concession allocation.
- Workers' camps should be built along ecological guidelines. Logging concession operators and associated industries based in the forest should be obliged to provide adequate living accommodation, sanitation and other facilities to reduce the environmental impact of the sites.
- Land use and river system mapping criteria should be applied during land use allocation and road construction.

[371] Asdak, C. *et al*. (2003) Factors affecting runoff and soil erosion: plot-level soil loss monitoring for assessing sustainability of forest management. Forest Ecology and Management: 180: 361-74, 2003; ITTO (2005) Technical Series 23;[372] Brown, C. & J. Sessions (1996) Variable tire pressures for tropical forests? "Synthesis of Concepts and Applications" FAO Engineering and Technology 3.;[373] Bowen-Jones, E. *et al*. (2002) Assessment of the solution–orientated research needed to promote a more sustainable bushmeat trade in Central – West Africa. DEFRA, UK.

Where concessions have already been allocated:

- The existing laws and contractual procedures that provide technical solutions should be enforced.
- Community protein programmes and campaigns to protect endangered species and limit bushmeat consumption should be implemented.
- Regulations limiting the species and age of trees that can be felled should be enforced.
- Ridge-topping (banking road sides) of all roads should be carried out and "Variable Tyre Inflation" used by all logging trucks.

6.2 ECOLOGICAL STABILITY OF THE CONCESSIONS SYSTEM REFLECTED THROUGH NATIONAL FOREST PROGRAMMES

JAMES MAYERS, IIED, UK

All evidence suggests that, as people use and affect the products and services of ecosystems, an "adaptive management" approach is needed to achieve ecological resilience. If commercial timber harvesting is going to play its part in this, it needs to be embedded in governance frameworks that develop and integrate the many conditions on which ecological resilience relies.

Two frameworks dominate international attention on governance systems in developing countries – both attempt such integration of ecological, social and economic priorities at the national level. Firstly, National Sustainable Development Strategies were committed to by nations at the 1992 Earth Summit and reiterated in the 2000 Millennium Development Goals. There are few national sustainable development strategies, although the more recent development of guidance and lessons for practitioners[374] may stimulate more. Secondly, Poverty Reduction Strategies were initially required by the IMF and World Bank as a basis for access to debt relief in highly-indebted poor countries and have since been required by all countries supported by the International Development Association since July 2002. Bilateral donors are also increasingly subscribing to poverty reduction strategies and they have thus emerged as a central determinant of the development agenda in many countries. However, their recognition of forests as a development asset has so far received very little recognition in the process.[375]

Ecological sustainability is imbedded in both National Sustainable Development Strategies and Poverty Reduction Strategies. The implementation of the concessions system so far has proved to be in contradiction to this objective. The case study on Mozambique demonstrates this (see Box 1).

Forest policy has been formulated in a number of Central Africa counties through national forest programmes (NFPs); one of their stated goals is conservation. NFPs are being strongly promoted on the understanding that they follow a country-led approach, rather than an international formula in the style of the old Tropical Forest Action Plan.[376] The notion of NFPs was developed by the international Forestry Advisers Group (an informal group of aid agency forestry advisers), adopted by FAO[377] and then endorsed by the Intergovernmental Panel on Forests. The ailing United Nations Forum on Forests action plan commits countries to pursuing NFPs.[378] Thus, all countries that have taken part in UN forest policy dialogues have adopted the requirement for a national forest programme. It is consensus-based "soft" international law.

The NFP concept currently promoted at the international level[379] puts particular emphasis on the following:

- Multi-stakeholder involvement in forest decision making;
- Means for co-operation, co-ordination, and partnership;
- Secure access and use rights;
- Research and traditional knowledge;
- Forest information systems;
- Study and policies on underlying causes of deforestation/degradation;
- Integrating conservation and sustainable use, with provisions for environmentally sensitive forests, and for addressing low forest cover;
- Codes of conduct for the private sector; and
- Monitoring, evaluating, and reporting on NFPs and other international commitments.

[374] OECD & UNDP (2002) Sustainable Development Strategies: a resource book. Dalal-Clayton, B. & S. Bass (Eds.) Earthscan, London;[375] Oksanen, T. & C. Mersmann (2002) Forests in Poverty Reduction Strategies: An assessment of PRSP processes in Sub-Saharan Africa. In: Oksanen, T. *et al*. (Eds) (2003) Forests in Poverty Reduction Strategies: Capturing the Potential. European Forestry Institute Proceedings 47, Joensuu, Finland.;[376] FAO (2005) National Forest Programmes; UNFF (2002) Report of the Secretary-General on National Forest Programmes.;[377] FAO (1996) Formulation, execution and revision of national forest programmes: Basic principles and operational guidelines. FAO, Rome.;[378] UNFF (2002) *op.cit.*;[379] FAO (2005) *op.cit.*; World Bank (2002) A revised forest strategy for the World Bank Group. 31 October 2002. World Bank, Washington, D.C.

Few, if any, contemporary NFPs have achieved optimal systems for all of the above. Malawi, Uganda, Tanzania, Brazil, Costa Rica, Guatamala, Columbia, Vietnam, India, Finland, Germany, and Australia would appear to be leading the way.[380] However, it is too early to see significant results. Many NFPs were judged to be "stalled" by implementing countries due to a lack of institutional, human and financial capacity, as well as a lack of adequate policies, poor institutional co-ordination and deficient mechanisms for public participation.[381] Not surprisingly, widespread agreement on the need for "country-driven, holistic" processes is not matched with implementation.

Box 1. Mozambique – even with a good Poverty Reduction Strategy and a Sector-Wide Programme the forest concession system is out of control[382]

Mozambique has considerable high-value forest resources and much poverty. Development of macro policy in the country has been the focus of much attention in recent years. A national Action Plan for the Reduction of Absolute Poverty (PARPA) is in place - which includes emphasis on participatory development of the forest and wildlife resources of the country. The PARPA is well integrated with a sector-wide National Agriculture Programme (PROAGRI) which includes a development strategy for forestry and the rural sector – and has many elements of what, in other countries, might constitute a national forestry programme. Both PARPA and PROAGRI have received substantial attention and support from national institutions and donor agencies alike.

Under these programmes, a forest concession system is supposed to replace a previously chaotic system of forest licensing. Concessions are granted for 50 years over areas ranging from under 10,000 to over 100,000 hectares. Concessionaires are expected to establish processing industries and management plans of considerable complexity. Out of 98 approved concessions (2001-2005), 46 have submitted the required management plan, out of which 28 were approved by June 2005.

But in practice the forest concession system in Mozambique is currently doing little for ecosystem resilience or local livelihoods, or indeed for the national economic coffers. Only a few concession holders are capable and willing to practice forestry in a way that might be deemed sustainable, whilst only about 10 people in the whole country are approved to develop the complicated management plan required by law. This is good business and they would like to keep it that way. Likewise there is a strong incentive at national and provincial levels to keep the bureaucratic red tape in place. Meanwhile, little processing capacity is emerging – log and lumber exports to China have become the norm – and the vast majority of logging continues under "simple licenses". These are held by hundreds of operators who sell to the larger buyers, including concessionaires who fill their quotas and meet their orders in this way.

It can be concluded that well-meaning and well-integrated national planning frameworks can have perverse consequences on the ground if not followed through. Inappropriate expectations from the government for investment and scale, and excessive complexity in concession management in the context of low capacity and "joined up" systems – has led to a situation where control of, and local benefit from, the concession system in Mozambique is negligible.

Experience in Mozambique and elsewhere suggests that it is futile to attempt to reform everything in a sector at once. Yet without progress on policy and implementation capacity going hand in hand, little will be achieved or

[380] Bird, N. (2002) National Forest Programmes. Key Sheets for Sustainable Livelihoods No.17. ODI, London; European Tropical Forest Research Network (2004) National Forest Programmes. ETFRN News 41-42/04; Humphreys, D. (Ed.) (2005) National Forest Programmes in a Pan-European Context, Earthscan, London; Mayers, J. *et al*. (2001) Forestry tactics: lessons learned from Malawi's National Forestry Programme. Policy that works for forests and people series No.11. IIED, London; Savenije, H. (2000) National Forest Programmes: From political concept to practical instrument in developing countries. Theme Studies Series 3, Forests, Forestry and Biological Diversity Support Group, Wageningen, Netherlands; Thornber, K. (2001) NFPs: Agent or Product of Institutional Change? Unpublished draft. Available at: http://www.fao.org/forestry/foris/;[381] FAO (2005) *op.cit*.;[382] Johnstone, R. *et al*. (2005) Forestry legislation in Mozambique: compliance and the impact on forest communities. Terra Firma, Maputo & IIED, London; Norjamaki (2006) Pers. comm.

perverse consequences will result. Even though forest policy, in the form of national forest programmes or national agricultural programmes, might address ecological stability on paper, in reality ecological objectives are sacrificed under the concession system for short-term financial gain.

6.3 ECOLOGICAL SUSTAINABILITY: REDUCED IMPACT LOGGING

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The 1950s marked a major turning point in tropical rainforest logging practices. The post-war economic boom fuelled the development of new industrial techniques, leading to the intensification of logging on a global scale.

The last 20 years have seen the emergence of numerous initiatives aimed at defining and promoting sustainable forest management. In 1992, during the United Nations' Conference on Environment and Development (UNCED) in Rio de Janeiro and following on from a great deal of scientific research, it became clear to all that the intensive mechanisation of logging practices is causing serious degradation of both the soil and the residual forest. Around the same time initial studies on reduced impact logging (RIL, otherwise known as low impact logging, LIL or low impact harvesting, LIH) were published, appearing to be a timely life-saver for logging companies accused of forest destruction.

RIL differs from conventional logging in that it outlines new techniques and concepts for planning and organising timber extraction activities, the main aims of which are to reduce environmental damage while at the same time improve logging efficiency.[383] As noted by Van der Hout and Van Leersum, the word "reduction" implies a comparison between two models, the more widespread of which is conventional logging, this currently experiencing notoriety for the damage it causes. As regards "low impact", it remains to be seen whether the RIL method is the hoped-for effective, environmentally-friendly solution which follows sustainable management principles. The present paper will try to answer this question.

Defining reduced impact logging: a rationalisation of industrial activities

Reduced impact logging emerged largely as a result of the international community waking up to the alarming rate at which tropical deforestation is taking place, combined with twenty years of ineffective sustainable forest management initiatives.[384] The increasing volume and sophistication of the research being conducted in this area has given rise to new logging techniques which allow forest areas to be harvested in a more rational manner. The RIL method is generally characterised by:

- a pre-determined cutting cycle of at least 20 years;
- a removal rate not exceeding one third of the cutting area;
- the production of a pre-operation inventory;
- the construction of access roads prior to harvesting;
- a liana cutting programme, where necessary, over a two-year period prior to the harvest;
- a felling plan consisting of marking the trees to be felled, recording their felling direction and determination of the optimal, minimal-length skid trails;
- the storage of trees on minimally-sized landings;
- the need to work in favourable harvesting conditions (e.g. on dry soil);
- the training of workers and supervisors so that they can ensure negative impacts are kept to a minimum, limit any damage to residual trees, and rehabilitate the sites following logging operations;
- the staff being suitably qualified to carry out a post-harvest assessment.[385]

[383] Van der Hout, P. & G.J.R. Van Leersum (1998) Reduced impact logging: a global panacea? Comparison of two logging studies. Publ. The Tropenbos Foundation, Wageningen;[384] Rice, R.E. *et al*. (2001) Sustainable Forest Management: A Review of Conventional Wisdom. Advances in Applied Biodiversity Science 3;[385] FAO (2004) Reduced impact logging in tropical forests. Literature synthesis, analysis and prototype statistical framework. Forest Harvesting and Engineering Working Paper, FAO, Rome, November 2004

This method has been received favourably in particular by the United Nation's Food Agriculture Organisation (FAO) which, in 1996, published its own model code of forest harvesting practice.[386]

Many studies have shown the benefits that RIL can bring to the industrial logging of forests. At the same time there is universal agreement on the need to make rationalisation of timber extraction practices a priority. For example, a study carried out under the Bulungan Research Forest Project run by CIFOR in the East Kalimantan Province of Indonesia, compared the impact of conventional versus low impact logging techniques on forest structure. The study concluded that the total damage which results from using RIL techniques was 33% less than that caused by conventional logging. The study's results are summarised in table 1 below.

Table 1: The impacts of conventional logging (CL) compared to those of reduced impact logging (RIL)[387]

	RIL	CL	Reduction (%)
Total damage (% of initial tree density)	34	51	-33
Mortality (% of initial tree density)	13	25	-48
Injuries	21	26	-19
Surface are affected (m2 per m3 of timber extracted	8.6	18.6	-53
Total width of main roads (m)	6.3	8.3	-25
Total width of secondary roads (m)	5.4	7	-23
Total length of skid trails	9090	17301	-47
Canopy gap along main roads (%)	35.3	49.2	-28
Canopy gap along secondary roads (%)	26.8	40.3	-33

The so-called "low impact" logging method is above all a technical response intended to rationalise the industrial logging of forests. Even if it would now appear that the widespread adoption of RIL methods can eliminate certain negative impacts on forest structure, it would be a mistake to believe such methods offer a universal panacea to the issues surrounding industrial logging.

Limitations of RIL techniques

Residual population damage is due more to logging intensity than to logging methods

Logging in Central Africa is often described as being of only limited intensity when compared to logging in either America or South-East Asia.[388] In Central Africa an average of between one and three trees are harvested per hectare as opposed to an average of between two and five trees per hectare in America and between six and twenty trees per hectare in South-East Asia. These differences are explained by the fact that Central African logging practices are hyper-selective, concentrating on twenty or so internationally marketable species. In Gabon, okoumé (*Aucoumea klaineana*) and ozigo (*Dacryodes buettneri*) represent approximately 65% of the species exported.[389] It has been shown that the land area degraded by logging is related exponentially to the number of stems harvested.[390] Most of the low impact logging work done in forest concessions is focussed on planning roads and skid trails, as well as on training in directional felling techniques. These are not sufficient however if a maximum timber harvest level is not set during the management stage.[391] Once the operator has begun to manage the forest in order to meet international demand for timber, the maximum harvest level is hardly ever taken into account. In addition, logging, even using RIL methods, can cause serious damage when species for which there is high commercial demand are concentrated in a small area (in aggregates or clumps).

[386] Dykstra, D.P. & R. Heinrich (1996) FAO Model Code of Forest Harvesting Practice. FAO, Italy;[387] Chabbert, J. & H. Priyadi (2001) *Exploitation à faible impact dans une forêt à Bornéo. In: Bois et forêts des tropiques. Cirad-Forêts* 269(3): 83;[388] NASA LCLUC Program. An Integrated Forest Monitoring System for Central Africa. Final report April 2003-2004. Principal Investigator, Dr. Nadine Laporte, The Woods Hole Research Center.;[389] ATIBT (2004) 2003 Statistics. In: The ATIBT Newsletter, N° 20, Summer 2004;[390] Durrieu de Madron, L. *et al*. (1998) *Les techniques d'exploitation à faible impact en forêt dense humide camerounaise.* Forafri Series, Document 17. CIRAD.

Reduced impact logging techniques do not necessarily guarantee good regeneration

The fundamental principle of forest management in Central Africa is that of minimum cutting diameter (MCD). This diameter is specified for each harvested species according to generally accepted rules of timber felling. It is therefore surprising to find that the MCD value for any given species can vary greatly between countries. For example, the MCD for azobé (Lophira alata) is set at 110 cm in Ghana, 100 cm in Cameroon, 90 cm in Liberia, 70 cm in Gabon and 60 cm in Côte d'Ivoire.[392] If forest regeneration is to occur, the MCD has to be greater than the minimum diameter for fructification (MDF).[393] What is more, despite the fact that logging practices concentrate on just a handful of species, knowledge of their autecology and phenology is still only fragmentary. The minimum fructification diameters, variances and seed dispersal dynamics are all still unknown for many timber species despite the fact that an accurate knowledge of MCD would seem vital if regeneration is to be ensured. Instead it seems that MCD has increasingly been defined according to the timber processing industry's technical capabilities, taking no account whatsoever of either the ecological or the silvicultural requirements of the harvested species.

To facilitate regeneration and compensate for the lack of knowledge of minimum fructification diameters, the post-harvest preservation of a proportion of the seed trees is often considered as one effective solution. However, when the operator does agree to conserve seed trees after logging – which is not always the case – these trees are more often than not made up of ill-formed specimens having low commercial value.[397] If such deviation is not due to environmental influences but is instead due to particular genetic traits, the operator may find himself "genetically" selecting for ill-formed trees which in turn is likely to reduce the quality of the gene pool of the regenerated plots.

In addition, while this forest management principle might have merit because it is simple, it does not take account of the specific traits of any given species: some trees are able to regenerate easily in a highly disturbed area despite there being only a very small number of seed trees (as in the case of helophytes such as okoumé, *Aucoumea klaineana*,[398] or obeché, *Triplochiton scleroxylon*[399]) whereas others are highly destabilised by significant "creaming off" where 75% of the seed trees may be removed (e.g. moabi[400]). Furthermore, tree population dynamics are currently still not being taken into account on a regional scale: thus even low impact logging of a species already in decline and at the limit of its distribution range (such as the moabi in eastern Cameroon) could result in its localised disappearance. Conversely, it has been shown in the Democratic Republic of Congo's Ituri region that regeneration of African mahogany (*Khaya spp*., and more specifically acajou, *Khaya anthothec*), sipo (*Entandrophragma utile*) and sapelli (*Entandrophragma cylindricum*), whose seedlings require strong sunlight, is favoured not by selective logging (where the bulk of the seed trees are removed and small gaps are opened up in the canopy to enable regeneration to occur), but instead by slash and burn rotation agriculture which opens up large gaps in the canopy close to forest stands rich in seed trees.[401]

[391] Dupuy, B. (1998) *Bases pour une sylviculture en forêt dense tropicale humide africaine*. FORAFRI Project;392 Palla, F. *et al*. (2002). Forafri Datasheet on Azobé, CIRAD;[393] The fructification diameter for trees in natural forests is essential for determining reproductive capacity. If the MCD is less than the diameter at which the tree produces fruit abundantly then regeneration of the exploited species is put at serious risk;[394] Fargeot, C. *et al*. (2004) *Réflexions sur l'aménagement des forêts de production dans le bassin du Congo. Bois et Forêts des Tropiques*, 2004, N° 281;[395] Durrieux de Madron, L. *et al*. (2003) *Fructification du sapelli par classe de diamètre en forêt naturelle en Centrafrique. Canopée*, 23, January 2003.;[396] Sist, P. (2001) Why RIL won't work by minimum-diameter cutting alone. Tropical Forest Update 11(2);[397] Dupuy (1998) *op.cit.*;[398] Brunck, F. *et al*. (1990) L'okoumé. CTFT, CIRAD, Paris;[399] Palla *et al*. (2002) *op.cit.*;[400] Debroux, L. (1998) *L'aménagement des forêts tropicales fondé sur la gestion des populations d'arbre : l'exemple du moabi (Baillonella toxisperma Pierre) dans la forêt du Dja, Cameroun*. PhD Thesis, *Faculté des Sciences agronomiques de Gembloux, Belgium*.

"Reduced impact" techniques do not necessarily allow for "low impact" logging

While there may be a good many studies showing the effectiveness of RIL techniques, most of them draw the same conclusion: these methods allow for "better" management of forest resources at least when compared to conventional methods. However, despite these techniques appearing to be indispensable and irrespective of the logging type, it has to be said that the tangible benefit[402] which RIL can bring is not really very well understood. Systematically comparing conventional logging with RIL practices does not reveal whether resource exploitation is sustainable. While it can now be shown that these techniques reduce environmental damage, to state that RIL is "low" impact *per se* is in fact neither demonstrable nor justifiable.

In addition, while the impact of conventional logging on fauna and flora is well documented, research done on the impact of RIL on biodiversity is scant[403] and insufficient to make any claims that these techniques address adequately any concerns regarding ecological sustainability.

Reduced impact industrial logging is always accompanied by the opening up of forest roads and trails, which hunters then use to penetrate the forests. Other research has shown that RIL techniques do not significantly reduce the negative effects of hunting.[404] The spread and pollination of many tropical forest tree species depend on animals (zoochory) and in particular large animal species. Such is the case with trees like the moabi which produce large fruit and depend on elephants and gorillas to spread the seeds they contain over long distances, thus explaining why the species is found across vast areas. To date, the disappearance of large fauna has not been quantitatively integrated into any calculations of the rate of regeneration of commercial tree species.

The RIL method: forest management or harvest planning?

Forest management failure

Reduced impact logging is a technical response to a question which falls within the much wider sphere of forest policy in general. The big question is whether systematic adoption of RIL methods could result in sustainable industrial logging whilst remaining within the framework of the forest concession system. Many environmentalists denounce the incompatibility between economic profitability and sustainable environmental management. According to Hallé[405] "it is time to accept that the sustainable logging of tropical forest timber is simply not possible on an industrial scale. Economic profitability inevitably implies destruction". This statement comes from the fact that what passes for sustainable forest management in Central Africa is more a timber harvesting plan than a management plan covering the ecological, social and economic aspects equitably.

The underlying reasoning behind this statement is structural: the logging company is responsible both for the extraction of timber and forest management. To entrust the same company with both roles, as is the case throughout Central Africa, with the possible exception of the Central African Republic,[406] leads to a forest management policy which meets the needs of the logging company, that being to harvest timber. Countries such as Cameroon, Gabon and the Democratic Republic of Congo apply a policy where the operator is exclusively responsible for the production of both the technical and the financial aspects of its management plan, "the role of the State being limited to the validation of the documentation produced and to the monitoring and verification of its implementation".[407] The ecological and social aspects of management are, for their part, relegated to second place.

[401] Makana, J.R. (2004) Ecology and sustainable management of African mahoganies and other selected timber species in northeastern Congo Basin, Democratic Republic of Congo. PhD Thesis, University of Toronto;[402] "Tangible benefit" in this case means the positive impact of RIL in economic, ecological, social and even cultural domains.;[403] Jonkers, W. (2002) Reduced impact logging in Sarawak, Guyana and Cameroon - the reasons behind differences in approach. In: Applying reduced impact logging to advance sustainable forest management, FAO, Bangkok;[404] Jonkers (2002) *op.cit.;*[405] Hallé, F. (2000) *Le radeau des cimes. Lattès*. p.56;[406] The 1990 Forestry Laws state that the forest management plans are the responsibility of the State. The operators are required to work to such plans. With the support of the *Agence française de développement*, the regulating Ministry should be able to equip itself with a management committee having the technical and human resources needed to direct operations and train the operators.

This situation explains why RIL methods, which concern only the harvesting of timber, are presented by industrial logging companies working in the Congo Basin as the cornerstone of sustainable management practices in Central Africa.

Obstacles to the application of RIL techniques

Reduced impact logging techniques are still only rarely implemented in forest concessions. This is especially true in the Congo Basin. Several reasons have been cited for why operators are disinterested in these techniques:

- the perception that RIL systems are costlier than conventional methods;[408]
- conventional logging accounting systems fail to recognise the direct and indirect costs associated with wasted wood;
- the lack of personnel qualified in RIL methods;
- a high profit margin will always be favoured over any long term approach;
- the cost of replacing machines and of training personnel are discouraging;
- standing timber prices may be undervalued;
- environmental regulations are not fully enforced.[409]

It is very clear that environmental concerns do not sit well alongside the aim of industrial companies to maximise profit. RIL implies additional investment for planning and training which is hardly appealing to logging operators. In addition, with local authorities not putting in place strict regulations or methods of policing these, it is difficult to see how RIL methods will ever be widely adopted.

Conclusions

Despite the indisputable benefits of "low impact" logging methods, they would appear to be insufficient - as long as forest management is entrusted to logging companies whose sole interest is to ensure they satisfy international market requirements. This phenomenon is not confined to Central Africa: all of the world's forests are suffering in the same manner. The current system places ever-increasing pressure on forest resources in order to meet industrial requirements and global demand. Therefore, the sustainable management of forest resources continues to be of only secondary importance.

The result is that low impact logging methods are reduced to purely civil engineering issues (road/track optimisation, heavy plant adaptation) without any real effort to integrate ecological or political considerations. The current intense level of logging of a very limited number of species whose ecology is only partly understood, and the lack of data available on the impact of such methods on biodiversity, both tend to suggest that there would be very little benefit from promoting such techniques for the purpose of sustainable logging. As long as policies favour economic interests, it seems futile to hope that sustainable ecological practices will ever see the light of day.

[407] Liabastre, T. & J.M. Borie (2005) Aménagement forestier en Centrafrique. Available at: http://www.cbfp.org/documents/rca/amenagement_rca.pdf;[408] Putz, F. *et al*. (2000) Why poor logging practices persist in the tropics. Conservation Biology 14(4): 951-956;[409] Holmes, T.P. et al. (2000) Financial Costs and Benefits of Reduced-Impact Logging Relative to Conventional Logging in the Eastern Amazon. Available at: http://www.fs.fed.us/global/globe/l_amer/reports/tomholmes/Tom_Holmes_report.doc

Recommendations

Forest management needs to be readjusted so that it takes better account of ecological factors and improves the effectiveness of low impact logging methods. To achieve this, the following recommendations are made:

- Disassociate responsibility for logging activities from forest management activities. Forest management should be the responsibility of the State and local communities;
- Encourage research on the ecology of the main commercialised species and on how the whole forest ecosystem functions;
- While keeping the total harvest level constant, encourage diversification of the number of species extracted to prevent over-harvesting of those species most in demand on international markets. In addition, develop both local and national markets for these so-called "secondary" species;
- Impose high minimum regeneration values for the most sought-after species in order to prevent their over-harvesting. This minimum may be anything from 50 to 80% depending on the ecology of the species being harvested;
- Require the operator to provide a minimum level of regeneration following felling. As already practiced by some countries in Central America, the State could demand financial security before logging begins, which could then be used to enrich the forest if the operator does not meet his obligations.

Community management of forests will play an essential role in any effective forest management: community members in Equateur Province, DRC, are already mapping and discussing forest use.
Photo:Cath Long