A tropical forest minimum impact management system

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Village meeting in Boliviae.
Photo Cirad, F. Besse.

A minimum impact management system (MIMS) is proposed[1]. It is based on the minimum viable logging intensity regulated through a cutting cycle which determines the logging frequency and the proportion of stand removed per cycle under reduced impact logging (RIL) techniques. The challenge is to achieve the lowest possible impact with low management investment but productivity will be low. The assumption is that low productivity is accepted in compensation for a low impact and costs.

The proposed MIMS involves a regulated and monitored management system based on the principle of harvesting only what the forest can produce spontaneously without treatment (what the author refers to as "passive management"), under area regulation with possible production volume control and integration of reduced impact logging (RIL) techniques. "Passive" simply means that no overt attempt is made to alter stand structure and composition. Some form of experimental "active management" can be implemented for selected forest areas with the aim of enhancing production when post-logging stand monitoring and stand projections suggest that management objectives are not likely to be met. "Active management" combines silvicultural practices and logging, which can involve planting or natural regeneration. Area regulation guarantees that there will be only one logging operation per cutting cycle and tends to limit annual logging to a single compartment (a second year of logging in a given compartment is only allowed when timber extraction cannot be completed due to weather or other factors), while providing a basis for harvest intensity regulation. Adequate provisions must be made to ensure that the local community participates and benefits from the management. Openness is also essential, and environmental NGOs should be partially involved in the planning and monitoring procedures.

MIMS is based on an approach to sustainable tropical high forest (THF) productive management under uncertain conditions, which means achieving the lowest possible economically feasible intensity in order to reduce ecological and economic risks. Low intensity implies low impact and investment, i.e. the latter is mainly allocated to information rather than dubious costly stand treatments. By the "productive management" concept, timber is the main target in multi-objective planning. The uncertainty factor refers to the lack of sufficient information on THF ecosystem responses to treatment. Low intensity tends to minimize the adverse effects on stand structure and biodiversity, while also minimizing management investment risks.

The role of silviculture The role of silviculture in the proposed MIMS is mainly the regulation of harvesting intensity. Experimental production can also be enhanced through enrichment planting or natural regeneration when spontaneous production is insufficient, often due to timber quality, i.e. world market demand is for higher value timber species. The proposed enrichment planting strategy is not like that unsuccessfully implemented over the past century of tropical silviculture in Asia, Africa and the Americas, i.e. line planting, strip or group planting under forest canopy opened up by girdling and poisoning. Economic and environmentally sustainable enrichment planting should involve small clearcut areas similar to native American migratory farming patterns in the West Indies and Amazon regions. Planting areas of 1-5 ha can be set up following strict soil-site selection. The total annual area is determined as a function of specific production goals and plantation yield estimates. For example, a quality timber production goal of 3 000 m^3 could be met by planting 30 ha/year in each annual compartment (or another corresponding designated area), assuming a mean yield of 100 m^3/ha. This would involve from 6 to 30 5-ha areas and 1-ha areas, respectively, or somewhere in between. For a mean annual compartment of 3 000 ha, clear-cutting would account for only 1% of the area. Clear-cutting may sound drastic, but its impact depends upon the areas involved, which should not be larger than necessary to attain the goals. The overall impact of this strategy should not be greater than the cumulative effect of line planting with mandatory canopy opening. Line planting under forest cover is an ecological contradiction. It is necessary to produce fast-growing valuable species which are usually light demanding (relatively intolerant of shade). Hence, under-planting is bound to fail for biological and especially economic reasons due to the slow growth rates and the resulting prolonged weeding intervals. Production enhancement through natural regeneration is less likely but includes, for instance, the CELOS silvicultural system.

The problem is that it is unknown how much the forest can produce due to the lack of sufficient growth information and, to a lesser extent, forest use criteria. This is why the proposed low impact management strategy is based on minimum viable logging intensity, as a safety measure, combined with RIL techniques and effective systematic stand monitoring to assess forest responses to logging, estimate future production and establish a valid basis for certification. Systematic monitoring of logged compartments will generate information to enhance assessment of productivity and, the bottom line, productive sustainability.

Logging intensity is quantitatively defined in static and dynamic terms. “Static intensity” is the amount or proportion of stand removed in a single logging operation under RIL guidelines. “Dynamic intensity” is the frequency of logging, i.e. the cutting cycle, which must be assumed (with a safety margin of not less than 20 years) due to the lack of growth information. For dynamic intensity regulation, self-sustainable management units subdivided into “n” annual compartments, where “n” is equal to the cutting cycle (years), have to be delineated. Furthermore, management units must be large enough for annual compartments that are large enough to allow viable annual timber flows while maintaining static logging intensity at a minimum. MIMS thus requires large management units of around 50 000 ha (20 x 2 500-ha compartments without any internal preserved bio-reserve areas), preferably 100 000 to 200 000 ha. For example, in a 150 000-ha unit with a 20-year cutting cycle, annual compartments would be 5 000 ha, while allowing for 50 000 ha of internal “imbedded” biological reserves representative of different ecosystems that would not be logged and they would be protected by buffers of managed forest. An average 5 000-ha compartment could produce 50 000 m^3 of timber, assuming a logging intensity of 10 m^3/ha. This is well under 10% of total standing volume in most tropical forests and in most cases would amount to only 4-6 trees/ha of over 300 (trees DBH ≥ 10 cm). A balance between productive use and preservation is thus maintained within the management unit to complement the “external” balance achieved by designating certain forest areas for preservation in addition to areas placed under MIMS management within the framework of general land-use planning on regional and national scales.

The 50 000-ha forest management unit is not an absolute minimum. Smaller sustainable forest estates (units) can be feasible, depending on the forest characteristics, market conditions (merchantability of a wide range of species and diameters), management objectives (including management modes such as community forests). A 20 000-ha management unit under a 20 year cycle, for instance, would only allow harvesting of 1 000 ha/year (without any internal preserved areas). At the same 10-m^3-ha intensity, mean annual production would be around 10 000 m^3. This could be sufficient for a small business not committed to a given industry or a community as a source of supplementary income. Smaller areas could also be considered on the basis of this rationale. Again, the two main variables that serve as manipulating levers, i.e. static and dynamic intensity, can be adjusted within certain limits. Obviously, the smaller the management unit, the greater the pressure for more intensive logging and silvicultural practices, i.e. a greater proportion of stand removed in a single logging campaign and/or shorter cutting cycle, and hence a greater risk of a negative impact and of not achieving sustainability.

The main parameter The main parameter that needs to be defined is the minimum static logging intensity that is economically viable, i.e. the lowest amount of timber that can be economically harvested per hectare. "Economically" means that not only logging costs are covered but also management costs, with a reasonable return on investment. Management costs mainly involve RIL stand preparation, information gathering (monitoring, various forms of forest inventory), road infrastructure, administration and protection. A benchmark, based on over 30 years of experience in Venezuela, is around 5 m^3/ha log volume (standing round wood solid volume equivalent is around 7-8 m^3/ha) on over 2 million ha of managed forest in eastern Venezuela under long-term concessions (30-40 years). Current volume tables are very general and not very accurate. Such low yields are possible due to the management unit size, i.e. around 150 000 to over 200 000 ha with mostly 30-year cutting cycles. Hence, annual harvest compartments are around 3 000 to 5 000 ha, allowing annual timber flows of around 15 000 to 25 000 m^3 log volume (i.e. approximate lumber volume) per concession (management unit).

Systematic stand monitoring is an essential element of MIMS. Forest inventories through sampling in the year following logging are needed to establish baseline conditions for projections. Continuous forest inventories through permanent plots are essential to estimate growth, mortality and recruitment rates for stand model development. Harvested stand monitoring and harvest intensity regulation constitute a form of feedback and control system. Harvest intensity initiated at the minimum viable level can be adjusted upward (larger proportion of stand removed and/or shorter cutting cycle) according to forest ecosystem responses, as determined by monitoring. In addition, environmental monitoring (soils and biodiversity) and social monitoring are essential elements required to determine sustainability.

MIMS is a viable option for large management units, and attractive due to the minimal ecological and economic risks. As more information becomes available over the first cutting cycle from systematic stand monitoring, logging intensity could most certainly be increased to attain higher productivity levels, which also may be attained through silvicultural practices. Allocating resources to information gathering activities, mainly preharvest inventory and postharvest monitoring, rather than silvicultural treatment should help to attain the minimal risk objectives while generating economic value for the forestry sector in countries like Venezuela, Bolivia, Brazil and Peru where there are extensive THF areas. Additional resources should be allocated to experimental projects with active management options to explore ways of enhancing productivity.

[1] For more information:
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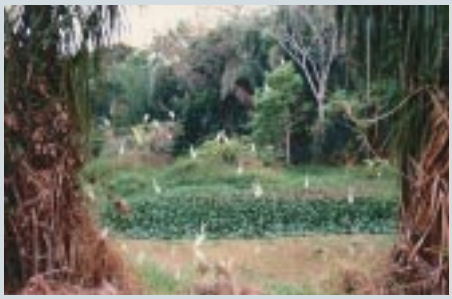
Secondary forest in Venezuela.
Photo L. W. Vincent. M. Jerez, Universidad de Los Andes, Mérida, Venezuela.



Floodplain forest in Venezuela.
Photo M. Jerez, Universidad de Los Andes, Mérida, Venezuela.