

## **Forest plantations in central Africa: A powerful tool for natural forest management, conservation and restoration**

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### **Summary**

Forest plantations have a long history in Central Africa, and although they have been undervalued due to the prominent tropical natural forests, the concept of forest plantations, with their flexibility and adaptability, is now considered a powerful tool for meeting local, national and regional needs.

Of the benefits of forests plantations, this paper emphasizes on of the impact of such plantations on lowering the human induced impacts on natural forest degradation through logging or shifting cultivation.

A review of past and existing forest plantation experiments in Central Africa has been carried out and examples are presented for various situations.

The results show that forest plantations have tremendous potential and will have a significant impact, over the next few decades, on the global issues relating to tropical forests management systems. Natural forest management will progressively include plantations as a tool for landscape rehabilitation and economic value improvement. Large areas under sustainable management will shift towards a land use specialization, some of which will be dedicated to high production objectives.

Forest plantations enhance the long term economical benefits and national needs through sustainable management of tropical forests and are fully compatible with high value conservation, biodiversity or social issues.

### **I - MANAGING NATURAL FORESTS : A PRIORITY**

To mention forest plantations in central Africa may seem to be a paradox. Indeed, the Congo basin, straddling the equator, is considered to be one of the most forested regions on the planet. The natural forest still covers close to 60% of the total area of the countries concerned (Cameroon, Gabon, Democratic Republic of Congo, Republic Of Congo, Central African Republic, Equatorial Guinea). Forest fragmentation remains relatively sparse and impacts of human activities such as forest logging or clearing related to agriculture and the migration of populations are less pronounced than in other regions of the world, for example South East Asia. However, it is estimated that 500 000 hectares (FAO, 2001) of the Congo Basin are currently deforested. Low population densities, with the notable exception of Cameroon and some areas of the Democratic Republic of Congo (DRC), constitute a major element for the conservation of this heritage.

One of the major challenges for this region is the sustainable management of the natural forests. At the origin of an important socio-economic value, such management implies the simultaneous taking into account of the necessities of social and economic development in the concerned countries and their populations, and the preservation of these forests and their environmental as well as productive functions. However, beyond this general observation, the countries present a large variability, both on the

intra and inter country level, of ecological, social, institutional and economic situations.

The development of forest logging, the expansion of shifting agriculture and the necessity of privileging economic development brought foresters themselves the question of the reconstitution of their forest heritage. As early as 1934, the constitution of arboreta in **Mbuku Nsitu**, in the Mayombe massif north of Pointe Noire (Congo Brazzaville), in **Sibang** south of Libreville (Gabon), and other sites (such as **Yangambi** in DRC), are as much historical proof of the interest certain forestry services or researchers had in the concept of plantations. It is no coincidence that these parcels were placed nearby coasts, in zones which were the first to be traveled and degraded because of their ease of access, and thus subject to intensive and repeated logging.

It is the complexity of natural forests and the lack of knowledge concerning their dynamics and their regenerative processes that first led forestry services and research centers in these countries to develop courses of action regarding plantations. More recently, towards the 70s and 80s, the issues related to sustainable management of natural forests were tackled and as the 90s approached, studies aiming at the implementation of forest management plans were developed. The syntheses established permitted to edict an initial assessment of the research conducted in view of a sustainable management of these natural forest massifs.

Nowadays, most of the countries have launched very strong policies for a long term sustainable management of the natural forests. They have joined in COMIFAC (Conférence des Ministres des Forêts d'Afrique Centrale) and put many efforts in the CBFP (Congo Basin Forest Partnership), one of the initiatives emerged from the second World summit, in Johannesburg (2002)

## **II - AN ALREADY ANCIENT PLANTATION DYNAMIC**

Forestry plantations have therefore been initiated by research centers (in particular the CTFT (Centre Technique Forestier Tropical) in partnership with the research and development bodies present in the Congo basin countries and by forestry administrations in these nations for several decades, with varying objectives:

- economic valorization of savanna areas by the planting of fast-growing exotic species for the production of wood to be used in paper production (Eucalyptus) or the supply of fire wood and utility wood (Eucalyptus, Pine) (Republic of Congo)
- will for industrial development with the implementation of paper production units based on the exploitation of the natural forest and their subsequent replacement with plantations of fast-growing exotic species (Cameroon)
- implementation of mono-specific plantations of local species from the natural forest (*Terminalia superba* - Limba, *Okoumea klainea* - Okoumé,...) in order to compensate for the depletion of these species in certain zones of natural forest and to participate in the supply future industrial wood, (South Congo, Gabon)

- plantations in areas of extremely degraded forest and enrichment with moderately fast-growing local (mahogany, Frake, Framire, ...) or exotic (Teck, Gmelina) species for the production of industrial wood in order to reconstitute the productive capacity of the forestry zones in question (Gabon, Cameroon)
- integration of species with high commercial value (Sipo, Sapelli, ...) under tracks of natural forest following exploitation in order to reconstitute biodiversity and enhance economic value of secondary forests (North Congo, Cameroon)

A large diversity of experiments (arboreta, species introduction trials, behavioral trials, agroforestry trials, provenance trials, ...) were also implemented in these countries with a large number of local or exotic species, whether they be forest species (wood production) or agroforestry species (fruit production, shade supplying, fertility maintenance, ...).

### **III - PLANTATIONS AND NATURAL FORESTS**

#### **31 - New demands for plantation forestry**

After a relatively long period during which plantations were not considered to be a major stake in the Congo basin (with the exceptions of particular cases such as eucalyptus plantations in south Congo), a renewed interest can be observed in relation to:

- the evolution of certain silent partners' forestry politics (recent studies financed by the World Bank on plantations in Gabon, Cameroon);
- willfulness to transfer management from the state to private partners and communities, with the potential to stimulate the emergence of new parties;
- the strong environmental pressures on natural forests as well as the wood industries dependent on these forests;
- the apparition of concepts such as "forest landscape restoration" which give varying methods of plantation a place in more "ecological" approaches;
- the implementation of management plans for forestry concessions, imposing on exploiters the maintenance of environmental, social, and economic capacities in the massifs which they manage;
- the decisions resulting from the implementation of the Convention on Climate Change stipulating that only "forestation and reforestation" would be eligible during the first (until 2012) implementation of "Clean Development Mechanism CDM";
- the evolution of market demands and valuation tools permitting the valuation of woods of smaller diameters, and with the reaching of exploitability of certain plantations;
- the apparition of a strong social demand concerning the development of rural employment and the economic and social reintegration of ex soldiers and militia in post-conflict countries, etc...;

## 32 – why plantations will

- **The evolution of temperate forests**

The example of European temperate forests evolutions in term of dynamics and management may suggest that things will also evolve in the tropical forests, and we do not know exactly in what way. This point does not mean that sustainability will not be achieved or preserved.

The concept of sustainability has been a key issue in temperate forests since many years. After centuries of decline, due to increased agricultural needs and later industrial energy requirements, the global forest cover of European forests is increasing rapidly, in area and in volume.

We notice, since 50 years, that we are moving towards a specialization of the forest landscape. The constant increase in costs, the need for the industry to get large quantities of standard quality wood, the new ecological services have led to a spatial organization of forestry. Some regions, with high potential and relatively low costs are progressively becoming “wood factories”. Others, in difficult conditions, primarily because of mobilization costs, are progressively devoted to other uses and logging is restricted to high value timber.

- **Increased pressure on productive tropical forests**

The on going management plans of natural forests propose a general (spatial and temporal) organization of the forest concessions, in a long term perspective of sustainability. Nevertheless, many factors are going to impact on the future trends in natural forests management: We can identify some, as for example:

↳ Decrease of the production areas

Production areas in commercial concessions are going to be smaller for various reasons. The ecological value of the tropical forest will increase the conservation priorities and some areas (compartments, areas,...), formerly defined as productive, will be transferred as conservation areas. Another trend is that in some places, the economical value of the forest will be smaller and smaller, due to repeated logging bag natural regeneration. Human impact is also very important through shifting cultivation, but also with permanent change from forests to cultures or pastures, depending of the country.

↳ Increase in the costs of resource mobilization.

The cost of energy will induce a significant increase in logging and transportation costs. This is already a very important part of the total cost of the wood. The distances between the concession and the harbor, and from the export place to the consumers location, is already a limiting factor.

↳ Decrease in the mean size of the trees

No doubt that the first trees logged in pristine forests will progressively disappear as most of the forests have now been logged at least once. Those trees were old and often oversized. The future shifts in logging will collect smaller trees, even if the minimum size stays at a reasonable level (e.g. 60 cm diameter for most of the commercial species). That means that there will be an increase in the mobilization cost per volume unit. Also, sawmills will have to adapt to those smaller diameters.

#### ↳ Heterogeneity in forest management

Sustainable management and certification will not cover 100% of the forests. Not all the customers' countries are positively implicated in sustainability principles. They do not mind the sustainability of the forests. There is a threat of over and illegal logging, with a depletion of the resource in low standards concessions.

#### • **Managing economic sustainability in forest concessions**

Forest industry is becoming more and more important in tropical countries and may represent a big part of the gross income. This means jobs, taxes and all direct and indirect benefits. The trend towards sustainable management and certification is going to accelerate and be a major segregation point between high standards concessions and low standard concessions.

Some solutions already exist and play an important place in economical sustainability of forest sector:

↳ An important part of the wood is now processed near the logging areas, and that gives added value to exported products. Furthermore, this deals with the national forest laws (e.g. 85% in Congo must be transformed in the country)

↳ Promote the use of new species. Actually, most of the production is made with a very small number of species (in the Congo, 2 species represent about 70% of the total volume). There are much more species and some have real potential. About 40 more species could be logged if the market accepts them.

↳ But a new opportunity is to include in the long term management of sustainable managed forest concessions the opportunity to renew the productive stock. That means :

- a technique or a group of techniques allowing low cost operation
- a small number of species with standard industrial and commercial value
- a good growth rate sufficient for a 30 years rotation.
- A good choice of land suitable for this operation.

This provides us a large spectrum of opportunities from which new values are expected.

### **33 - New values**

Plantation research has traditionally been carried out following a heavily silvicultural input, resulting in propositions and actions for development generally reliable but often too sophisticated or expensive, and thus incompatible, with social and economic contexts of the countries in question. As such, unconvincing, if not objectionable, results can be observed.

The evolution of concepts and expectations in the domain of tropical forestry (such as biodiversity, carbon, certification, sustainability, implementation of development plans, ecological restoration, ...) and the necessary taking into account of social and economic values mean that the reconsideration of the concepts upon which the development of forest plantations in tropical regions was built has become vital. This is all the more true in the Congo basin as a short term analysis could lead one to think

that the immensity of the natural forests does not justify an interest in plantations in this region.

One question to ponder is the position that the “plantation tool” could take in a global perspective of the development of a natural forest concession, as well as being an element of “ecological restoration” in the area. Enriching forest tracts following logging is an old process which has been practiced in view to rebuild the productive potential by introductions under cover over several tens of thousands of hectares. This has been met with extremely mixed results, and rarely with any real long term re-questioning. These practices were subsequently progressively abandoned in the 70s out of pure loss of interest.

These approaches are being reconsidered in certain countries as a result of the demand (if not compulsory) made to forest concessions to replant or enrich the natural forest following exploitation. These demands are formulated in the absence of a more global reflection upon the appropriateness of practices and techniques in relation to objectives. In particular, objectives can be extremely diverse, from a genuine will to participate in the reconstruction of natural heritage to a simple showing off of actions undertaken in relation to biodiversity, with the ultimate goal being the facilitation of the acquisition of a “sound management” certificate.

Past and present plantation experiences facilitate the identification of silvicultural norms through their providing of information and lessons learned. Assimilating this information can lead to the fine-tuning and optimization of technical practices and management.

More strategic research needs to be undertaken in order to analyze the suitability of different types of potential silvicultural interventions in relation to the degree of “degradation” of natural forest formations. In this manner the following courses of action, for example, can be taken: the privileging of the growth of young populations present, the reinforcing of natural regeneration, or the use of silvicultural techniques such as when the structure of populations is poor in species of value. Methods of intervention and forestry species to be privileged will obviously not be identical in differing scenarios, such as the closing of forests roads, the enrichment of a zone presenting a marked deficit in the regeneration of certain species, the replanting of an abandoned zone cleared for agricultural purposes, the promotion of agroforestry associations around villages, or the realization of a plantation block near a transformation unit. Possibilities to implement pure or mixed plantations could also exist, as well as undercover or “whole” plantations, and plantations of shade tolerant/intolerant species.

#### **IV – NEW OPPORTUNITIES IN CONGO**

- **Preliminary results in old stands**

Old plantations in degraded forests have been made on large scale in the years’70 to 80 in the Congo. More than 5000 ha of degraded forest were replanted, mostly with *Terminalia superba*, but also with other species. Various techniques were used, going from global mechanical soil preparation to tracks manually done and managed.

The most important areas of plantations were in the south, in the locations of Ngouha 2, Bilala and Malolo.

Then, the national priorities and the confusing war period stopped all the work. Those plantations were set aside, but fortunately survived, due to low population and poor transportation system.

Surveys were undertaken on such plantations and measurements were made on some plots. The results are very encouraging.

- 20 years *Terminalia superba* clonal test (Mbaya - Mayombe)

This clonal test was installed in 1978 on degraded forest area in southern Congo, with 6 clones derived from selected trees. It was measured after 20 years. The mean height is 22.1 m and the mean diameter is 144.8 cm. That is a mean increment of more than 12 m<sup>3</sup>/ha/year

- 13 years *Terminalia superba* provenance test (Ngoua 2 - Niari)

This provenance trial has been installed in 1981 and compares 31 provenances from the natural occurrence (from Ivory coast to Congo). The mean increment at age 13 varies between 1.5 m<sup>3</sup>/ha/year to 12,9 m<sup>3</sup>/ha/year, depending on the geographical origin.

Many other experiments have been implemented and give us a reasonable idea of the potentiality of the natural species productivity.

- **The CIB project.**

The CIB (Congoise Industrielle des Bois), based in Pokola, is a large forest concession in northern Congo, with near 1 300 000 ha of natural forests. The land is nearly 100% covered with tropical lowland forests.

It is divided into 5 forest management units and the annual logging permit is about 350 000 m<sup>3</sup>. The length of time between 2 rotations is about 25 to 40 years. The main species are *Entandrophragma cylindricum* (sapelli) and *Entandrophragma utile* (sipo). This company is managed according to the national regulations and especially the new forest law (2000). CIB has 6 sawmills, drying kilns and provides about 2000 jobs.

This company is the first in Congo to have one UFA (Management Forest Unit) been certified by FSC and the process is going on for the others. The whole company should be certified by the end of 2007.

Furthermore, CIB has launched various projects in order to get the best possible level of sustainability and shows a high level of perception of the future challenges:

- Adapted management of large areas near the National Park of Nouabale Ndoki to enhance biodiversity and nature conservation purposes in production areas.
- Agroforestry program around the town of Pokola in order to provide livelihoods to the 15 000 people and limiting the degradation of the nearby forests by traditional shifting cultivation.

- Reforestation program with natural tree species in various parts of the concession in order to restore some degraded areas and enhance the economic value of the secondary forests.

National regulations explicitly order the forest concessions to set programs devoted to the restoration of forests after logging. This regulation is in no way feasible according to the traditional techniques and the first attempts, done with the help of the SNR (Service National de Reboisement) in the frame of a project called UPARA (Unité Pilote d’Afforestation et d’Agroforesterie) on more than 500 ha between 1998 and 2003, provided the expected results. Even with a good choice of species, adequate plant quality and acceptable growth rate, the total cost of the operation, including years of monitoring, weed and natural re-growth controls is so high that it is not economically feasible.

The decision which was then made was to explore new routes.

#### 1- Define priority spots for forest restoration.

Most areas do not present regeneration problems and then are managed according the management plan. Three main types of land are now selected for further investigations:

- Areas with significant **regeneration problems**. That is the case of the old stands e.g. with *Maranthaceae* species. The age structure of those stands is very unbalanced and show now to very little young trees. The logging of those areas, if done, is not followed by any regeneration. Several thousands of hectares are eligible.
- Areas with **highly degraded forest**, mainly due to shifting cultivation. This occurs around the villages and along the roads. Natural regeneration is active, but mostly with pioneer but unproductive species e.g. **parasolier**. Agroforestry or forest restoration will be used depending of the neighborhood of the villages and populations.
- The **road network** of a forest concession is a dense web of primary, secondary roads, logging tracks or opened areas after tree felling. After a lot of discussions and field visits, it was decided that we would put emphasis on the secondary roads. Those roads are opened once and used during one year. After, they are closed during the rotation length (25 to 40 years). On both sides, there is a large clear-felled width suitable for plantation.

#### 2 – Select tree species

Special requirements are needed for the choice of the species. They must be naturally present in the nearby stands, provide good quality wood for the industry, at an economical reasonable cost. A small list of natural tree species, with good growth, easy to propagate and install and providing standard quality of wood products, are selected.

The most important species, defined together with the CIB staff, are *Terminalia superba* (fraké or limba) and *Triplochyton* (ayous) and *Entandrophragma cylindricum* (sapelli).

#### 3 – Select the best available technique

We then check the list of the techniques available, refine the technical options and operating costs and choose one (or a combination of) tools. Those tools are known since along time. New options to be considered are the seed quality and the plant production technique in nursery. This is a key point very often underestimated. For example, some vegetative propagation can be made for very low fertility seeds (e.g. *Triplochyton* sp.), using stock plants from the natural stands around. It is clear that the technique must be low cost and very easy to manage. No long term weed control must be accepted.

#### 4 – Implementing the work

We are still at the early ages of large scale forest restoration at CIB. But this project is going on and 2007 will be a key year, with a new nursery available to provide enough quality seedlings for restore the secondary roads opened for the 2006 logging year.

### CONCLUSION

Tropical forest plantations (in particular in the Congo basin) constitute, as we have seen, one of the major restoration and rehabilitation tools for degraded and secondary natural forests. This dynamic is in addition to the creation of richness conducive to the supply of woods and related services. The natural forests of the Congo basin will inevitably be logged in a more or less controlled manner and be the object of developments, with the notable exception of protected zones and areas. We are therefore faced with a major challenge for which it is necessary to be prepared.

The diversity of natural habitats as well as that of the types of human intervention render impossible the task of significantly narrowing down the typology of perturbations. A veritable schematic continuum exists from the natural forest prior to intervention to forest clearing, if not savanna. At each level of degradation (or perturbation) there exist several tools of restoration to be inserted into development, regeneration (natural or assisted), enrichment, plantation, agroforestry... The heavily synthetic schema presented here illustrates the positioning of these different techniques and tools.

Forest restoration must also encompass all of its gradients and questions that can be asked at different scales such as: spatial (parcel, management unit, forest, region), and genetic (species groups, species, intraspecific variation).

A better understanding of the typology of secondary and degraded forests and progress in the knowledge of the autoecology of main tree species remain indispensable prerequisites to building a true politic and for defining development modalities in ecological restoration operations.

The natural forests of the Congo basin remain, to a small degree, essentially undisturbed. This is a major strength for the defining and implementation of ambitious politics designed to assure that these forest massifs retain their full functionality: production of an economic nature, of course, but also biological diversity and full satisfaction of the needs of the populations of the Central African populations.

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