The other broad category concerns the management of artificially established forest stands. Forest plantation as encompassed by forest farmers in the region can lead to at least five derived models

**a - Integrated forest management by enrichment planting**

This model concerns mainly old growth forests. It relies on the substitution of some selected natural resources by cultivated stands of the same --or related-- species with the global conservation of the original forest structure. It could also allow to divert natural structures for a targeted production: "canopy farming" as conceived by Oldeman (1996) thus relies on the channelled production of selected components --as epiphytes for ornamentals, or chemicals for pharmaceutic industries-- present in the forest canopy. In-situ production of NTFPs through cultivation or farming is a promising technique that could allow to either increase natural production and/or improve its quality or its regularity without disrupting the ecosystem. This technique, being presently tested for Brazil nut production in the Amazon (), could be implemented in large extractive reserves and special use areas or buffer zones in and around protected areas.

**b - Improved fallow/rotational agroforestry systems**

This model concerns early successional vegetations integrated in indigenous cultivation cycles. It aims at actively enriching natural regrowths with relatively fast-growing NTFPs that can be totally harvested after a given period compatible with existing cultivation/fallow cycles. The extreme version of it leads to the total replacement of natural regrowth by cultivated stands of short to medium-cycle forest crops. Improved fallows and rotational agroforestry systems have a bright future in areas where permanent food cropping is too costly.

**c - Agroforest**

Agroforests can be defined as permanent forest structures, integrated into agricultural lands, established by plantation of forest species. Agroforests are targeted at specific forest production(s), but also play an active role in the conservation of secondary forest resources as well as of forest biodiversity as a whole. As forests, agroforests need space to sustainably exist: they should preferably constitute large continuous blocks rather than isolated plots. Improved agroforests derived from existing models can easily be conceived through the integration of improved tree genotypes generated by an adapted domestication research, as well as through the systematic incorporation of timber as a major secondary production. Agroforests could be targeted at the management of buffer zones around protected areas, or at the development of presently more or less degraded forest margins. In such areas, they could represent a highly valuable alternative to large-scale forest plantations.

**d - Multistrata agroforestry systems**

Multistrata agroforestry systems combine different forest productions --eventually mixed with agricultural crops-- designed to make the best use of vertical space with superimposed layers from the ground to canopy. They are biologically less diverse and technically more controlled than agroforests. Contrary to agroforests, they can be conceived as small tree islands in an ocean of openfields. Their main implementation area lies in the restoration of degraded lands far from any forest source, as well as the intensification of production systems through diversification.

**e - Specialized plantation**

Specialized plantation represents the "conventional" model in plantation forestry as well as in commercial agriculture. It favours production at the expenses of diversity and is therefore perfectly adapted in land planning schemes that promote segregation between production and conservation areas (van Noordwijk & al, 1997).

The specialized model can be declined along either the smallholder or the estate modes. Most of the current examples of specialized plantation, specially when trees are involved, are encountered under the estate version. Economic justifications are usually given for this preference: establishment and maintenance costs are said to be far too high for smallholders, the cost/benefit ratio is better if large surfaces are involved, etc... . However, the underlying reasons of such a preference are probably more political than technical or economic, and a full comparative assessment of the two versions taking into account all these parameters should be conducted.

## 4 . A hierarchy of models? Criteria and questions for quality and impact assessment

All these models operate at different scales in space and time and with different levels of inputs --capital, labour, machinery, chemical--. They obviously address different types of technical/ecological knowledge, and different levels of artificialization of both the cultivated ecosystem itself and the plant genetic material. They rely on different economic and social logics and operate with different ecological, economic, cultural and social efficiencies. They depend upon different institutional bases -- property, control, access-- and social foundations --production organization, labour division, profit sharing--. Finally, they all have different merits and qualities, in terms of profitability, sustainability, equitability, flexibility, reversibility, stability or resilience. Their potential impact on the natural environment --resources to humans, biodiversity, soils, water, air-- or on the human environment -- local communities, regions, cities, political or business elites-- are diverse as well.

How can these differences between models, as well as the extent of possible variations inside the models themselves, be assessed? Some leading questions can help focusing the analysis:

1/ How does the model address the trade-offs between increased productivity and local or global ecological issues like soil erosion and run-off, control of deforestation or promotion of reforestation, watershed protection with particular reference to water flows, carbon sequestration, biodiversity conservation, green house gas emission, etc... ? Answers will allow to refine the ecological merits of the various production models

2/ How does the model address profit issues? in terms of efficiency --income generation, capitalization--? of strategies --short term versus long term, maximization versus optimization--? of equity --profit sharing--? In order to highlight some of the economic merits and shortcomings of the models, this analysis has to be carried-out at different levels: household, community, region, (nation). As far as possible, it should also integrate an economic appraisal of ecological considerations. It should particularly tackle the costs/benefits issues related to the maintenance of diversity, and highlight risk management strategies. It should also analyze the degree of ecological as well as economic flexibility/reversibility of the management option.

3/ How does the model address social or cultural issues? This last series of questions should try to find out whether each given management model relates to a particular socio-cultural model: Who is more likely to gain access to/to own the key resources? to control the production process? Where is the authority more likely to be? What is the degree of knowledge specialization/availability

and sharing among the farmers? and how does this knowledge relate to traditional cognitive bases? Is there a potential impact on social differentiation?

4/ How does the model fit into present policies at local/regional/national levels? This last series of questions might be the most important one as it will point on potential areas of conflicts between "science" and policy. It is nevertheless essential, as the main need for future change in NTFP management is not as technical as it is political.

## Conclusion

All present examples of NTFP management, and the models derived from them, have different levels of representativeness and acceptance, different degrees of technical or political support. Before engaging on discussions on the merits of the models per se, it is important to understand when and why their "archetypes" did emerge, how they have succeeded, how and why they are surviving --or, more likely, gradually disappearing--. Characterization of determining factors and driving forces that have led to the present situation is essential to assess their future. In this analytical process, bio-ecological or economic factors should be constantly put in parallel with political or socio-institutional ones, as the present extension and importance of these "archetypes" reflect not only the technical or economic validity of the models to which they refer, but, ultimately, the enforcement of socio-political choices from the governing spheres. In Indonesia, the last 20 years of national policies granting concession rights over forest lands and resources exclusively to large corporations, combined to more recent development policies promoting estate agriculture, has concretely erased many indigenous systems of NTFP management[3]. This direct inter-relation between different options of NTFP development at regional and national levels has to be clearly understood and stated.

The strong preference of governments in the region for a productivist openfield model in forestry is certainly, directly as well as indirectly, the main leading force for the future of NTFP management. If this model has obvious economic advantages over extraction from natural forests -- rationalization and homogenization of commodity production, geographical concentration of production and increased yields per unit of land--, its socio-political attributes are also significant: increased control of private or state corporations over land, resources and peoples through geographical concentration of products and producers, homogenization of cultures through uniformization of cultural practices, acculturation of farmers through the replacement of indigenous knowledge by exogenous practices and of a familiar forest environment by an alien cultivated milieu, increased dependency of farmers on external plant material and technical expertise, through the promotion of a segregation between extensionists and practitioners. Forest production through input-demanding techniques and specialized knowledge born in the forest science circles might clearly lead to the marginalization of smallholder forest farmers, or even to their total exclusion from the future management of NTFPs. The alternative production models as mentioned in this paper do secure, like specialized plantations, a notable increase of the income-generating capacity of the forest resource. But, as they maintain the pre-existing resource and knowledge bases of indigenous management systems, rely on techniques based on local knowledge shared by every farmer, and do not imply high energy inputs, they allow local communities to maintain control and authority over its management.

[3]this includes the destabilization or the destruction of indigenous extractive systems in concession areas by logging operations, but also the illegal harvest of trees planted by farmers by logging companies --damar in Bengkulu, damar and honey trees in West Kalimantan, fruit trees in East Kalimantan-- as well as past or present destruction of NTFP gardens by private firms for oil palm or accacia plantations --rattan gardens in Pasir and Bentian, East Kalimantan, benzoin gardens in North Sumatra, fruit gardens in East Kalimantan, illipe-nut gardens in West Kalimantan, damar gardens in Bengkulu and Lampung.

Therefore, here also, the inter-relation between technical matters and socio-political consequences has to be understood and stated.

Whereas the colonial model of NTFP development through production has resulted in a total partition between the domesticated forest species and the forest itself (Michon, 1997), indigenous models, that also start from the transfer of selected forest species to agricultural lands, rely on processes that replicate forest patterns and structures in these agricultural land. Their interest for future development of NTFPs do lie in this conception: an ecological, cultural and socio-economic replicate of forest structures and features in agriculture that allows, among others, an optimum combination between production[4] and conservation functions and maintains a continuity with local

[4]this production aspect includes foods as well as materials and combines income-generating strategies with diversified subsistence

representation and knowledge systems evolved from former forest traditions. These alternative models should really be considered not as intermediate stages in the linear path leading to the domestication of forest species, but as alternative pathways to domestication, not only of forest trees but of forest themselves. These pathways urgently require help from scientific research and technical extension, specially in the field of a joint expertise and experimentation from plant breeders and ecologists.

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