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Embrapa

Amazônia Oriental

Secondary Forest Management in Eastern Amazonia

*Research Underway Carried Out by
Embrapa and Its Partners*

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Secondary Forest: its importance, values and the need for research

Secondary vegetation, is presently an important component of land cover in most areas in the Brazilian Amazonia and, considering the present patterns of economic development, the areas covered by this kind of vegetation probably will continue to grow, demanding urgent attention from research towards understanding its role from different perspectives and scales (e. g. functions related to biophysical and biogeochemical processes at local, regional and global scales; as source of biodiversity; as source of useful products; as socio-cultural components) and also trying ways to manage it aiming at a more sustainable land use. Appropriate secondary vegetation management is also seen as a way to relieve the pressure on the natural forest areas.

A number of studies involving the use of remote sensing techniques, mainly towards understanding land use/land cover dynamics in the region, have also been providing reliable information about the role of secondary vegetation and its dynamics, and their links with aspects such as governmental policies, and the introduction of new agricultural options, and should be also faced as tools to plan any management intervention.

The understanding of the processes of biomass and nutrient accumulation and secondary succession development under circumstances differentiated by land use histories, and biophysical aspects, is also providing relevant figures to guide strategies to manage this vegetation under different focus and to support environmental oriented public policies.

On this line, for instance, within the context of slash-and-burn agriculture, practiced by most of the small-scale-farmers in the region, the numbers so far raised by studies on biomass and nutrient stock accumulation and functional biodiversity during different fallow periods and different agricultural practices (i. e. land preparation with versus without mechanization) are helping to develop/validate techniques aiming at avoiding nutrient losses during land preparation for agricultural activities (i. e. slash/mulch in substitution to slash-and-burn land preparation) and at guaranteeing feasible nutrient stocks under relatively short fallow periods, without reducing biodiversity (i. e. fallow vegetation enrichment with nutrient fixing fast growing leguminous trees).

Furthermore, the figures raised on fallow vegetation processes, such as water, energy and nutrient balances and gas emission are strong arguments in building environment concerned policies devoted to family agriculture in the Amazonia scenario.

One important step on that line which is also being considered refers to the secondary vegetation valuation, including monetary and non-monetary valuation of carbon sequestration (aiming to rank in the growing carbon market); biodiversity; nutrient and water cycling, and other secondary vegetation values associated to nature conservation.

Another relevant research line also underway, more limited to secondary forests, is the secondary vegetation management/use towards generating benefits (financial, social and aesthetic) for rural communities.

Aspects such as potential commercial value of secondary forest species; management options of timber and non-timber products; and provision of environmental services, or any combination of those products/benefits are included in research protocols being carried out.

It is important to keep in mind that although secondary vegetation cannot replace many of the roles and services provided by primary forests, it may be seen as a land use feasible to provide several of these roles and services in a comparatively high magnitude and in some circumstances, as in the case of some secondary forests, offering a more productive alternative in the long term than the removal of the natural forest.

For all these reasons, and considering the percentage of land cover represented by secondary vegetation, as well as the tendency of governmental policies toward reducing the agricultural use of primary forests and incentivating the use of previously deforested areas in Amazonia, any attempt to improve the use/management of secondary vegetation may be considered as a way to alleviate the pressure upon the natural forest, thus conserving it.

Embrapa Amazônia Oriental is attempting to contribute to the understanding of the function of secondary vegetation associated to agricultural systems, to the definition of the role and dynamics of secondary vegetation as a component of land cover reality, to the suggestion of strategies to improve secondary vegetation management, and to the offer of tools to foresee future scenarios involving secondary vegetation mainly throughout three cooperative initiatives: 1) The Project "Secondary Forests and Fallow Vegetation in the Eastern Amazon Region- Function and Manipulation" (Projeto Capoeira), a component of the Brazilian/German cooperation in Science and Technology, through SHIFT Program (Bilateral Agreement CNPq/IBAMS- bmb+f/DLR); 2) A component of the Project "Management of Secondary Forests", in collaboration with CIFOR-CATIE; and projects included in the Ecology component of the "Large Scale Biosphere Atmosphere Experiment in Amazonia" (LBA).

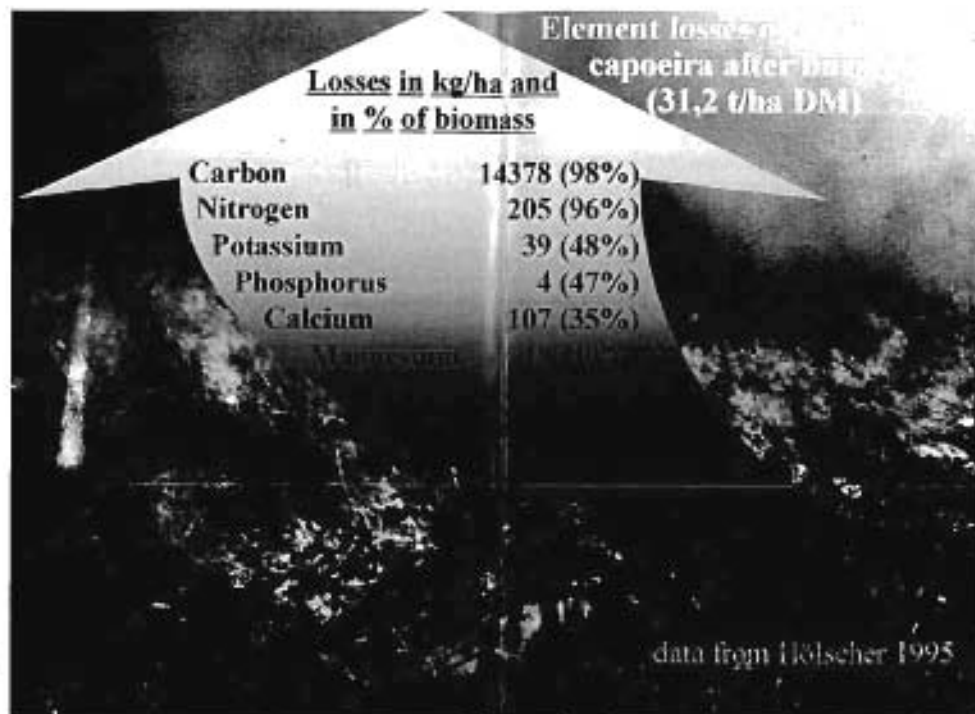
Research and Development Underway

Secondary Forests and Fallow Vegetation in the Eastern Amazon Region - Function and Management

In vast regions of the Eastern Amazon the tropical rain forest has been replaced with secondary vegetation due to anthropogenic activities. SHIFT Capoeira a major component of the program *Studies of Human Impact on Forests and Floodplains in the Tropics - SHIFT*, conducts studies on the farmland of small-holders in the Northeast of Pará (Zona Bragantina), in the municipality of Igarapé-Açu.

The project evaluates the function of secondary vegetation "capoeira" as an integral part of the traditional crop-fallow cycle. In years past, the capoeira had an important regenerative function in maintaining the productivity of the traditional slash-and-burn agriculture. In recent years population pressure and changes in agricultural practices have reduced the functional significance of the fallow period resulting in a decline of productive capacity and an increased demand for additional inputs. Focusing on slash-and-burn agriculture, the project's findings show that a 9-year cycle (2 years cropping and 7 years fallow) results in considerable nutrient losses which are not replaced by fertilization, natural recycling nor fixing processes. Apart from the harvest losses, most losses occur through volatilization during the burning of the biomass.

The main project objectives are to develop modified technologies in the production system of the small-holder, with emphasis on increasing the productive capacity of the system. These modifications are 1) to reduce the loss of nutrients and organic matter by



substituting slash-and-burn with cut, chop and mulch, and 2) to increase the biomass accumulation during fallow periods by introducing fast growing leguminous tree species enriching the capoeira, and still maintaining high biodiversity, thus, allowing to shorten fallow periods. These modifications alter the traditional cycle at two crucial transitional phases: 1) from fallow into cropping, suggesting a land preparation alternative, 2) from cropping into fallow, suggesting fallow improvement.

These management alternatives convert the traditional small-holder system into a semi-simultaneous agroforestry system with fire-free land preparation resulting in an increment of productivity, primarily because of the shortening of the production cycle. Other important advantages include: increase of soil organic matter, carbon

sequestration, reduction of weed pressure, net nitrogen input, nutrient recycling out of deep soil layers, and options for multipurpose use of planted trees (fuelwood and construction material). Current land use pressure will be relieved, resulting in excess sites for secondary forest wood production, intensified home gardening, cash crops, and the raising of livestock. This technology may also reduce the migration of man into primary forest margins or big cities.

Either one of the two suggested alterations, the fire-free land preparation or the enrichment planting, can effectively contribute to the small-holders land use system of the region. However, the positive effect of enrichment plantings with nitrogen fixing leguminous trees and aggressive nutrient re-cycling out of deep soil layers is made up for if the land is

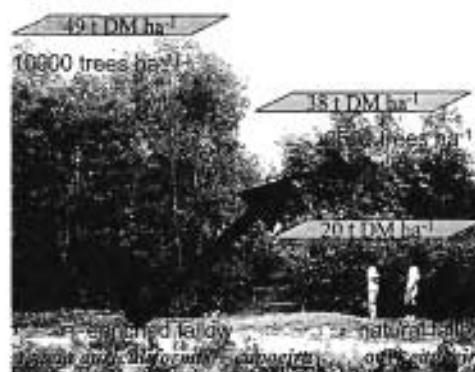


1 - Young capoeira; 2 - Old capoeira; 3 - Stream "Água Branca" and Gallery Forest; 4 - Spring; 5 - Passion fruit; 6 - Manioc; 7 - Farm house; 8 - Road.

prepared by burning, thus volatilizing the nutrients into the atmosphere. Hence, fire-free land preparation, which utilizes majority of the biomass of the chopped fallow vegetation, turns enrichment more effective. If applied together, the two alternatives may work synergistically.

Future research and technology development of the project will include community based watershed studies to assess on- and off-farm impacts. Basic research will be conducted with respect to nutrient and particle transport on a landscape level. At the same time farmers reactions to the suggested technology changes and their adoptability chances will be studied. Feasibility studies on machinery will be part of the research as well as monetary and non-monetary valuation of the utilization of natural resources.

Along with that, first steps will be made to test the fire-free land preparation alternative with respect to its new challenges in agronomic terms, uncoupling land preparation from the dry season. The farmer will be able to react more adequately to market demands and labour distribution over time if non-burning permits land preparation at any time of the year.



Research and Development Underway

Productive Management of
Secondary Forest - PBS



The International Center for Forestry Research, CIFOR, founded in 1993, is an institution based in Washington, D.C. which develops research projects focusing on sustainable forestry management in 16 research centers spread over Asia, Africa and Latin America, involving different international institutions. In Brazil, its partner institutions are Embrapa Amazônia Oriental and the Pará School for Agricultural Sciences. Research involving the management of secondary forests in areas of family-based agriculture are being developed through the "Productive Management of Secondary Forest - PBS" Project.

This project began in 1996 as an initiative of CIFOR and the Tropical Agronomic Research and Teaching Center-CATIE and the participation of international institutions in three countries: Brazil, Peru and Nicaragua. The main objectives of PBS are: Develop and test diverse sustainable forestry



management techniques in collaboration with and with participation of rural communities and the families which belong to them;

Understand the dynamics of economic and social conversion of secondary forests;

Diversify the products which can be obtained from this forest in the way of food, medicinal, fiber and ornamental products, among others.

The region where research is being developed is the Pará Northeast where the oldest settlement area of the State of Pará is located. Out of the original dense tropical forest found there, 90% has been converted into secondary vegetation, forming a mosaic of various stages of growth (capoeira), including areas already in a phase of degradation.

In recent surveys carried out in 5 municipalities of the Pará Northeast, Bragança, Maracanã, Igarapé-Açu, Capitão Poço and Garrafão do Norte, it was found that secondary forests (secondary vegetation taller than 5 meters) occupy around 25% of the total area of agricultural properties. It was also observed that the main function of the existing secondary vegetation is soil recuperation (fallow).

The project's main proposal is to make it possible to utilize secondary vegetation in a diversified manner, in order to produce social and economic benefits which increase the value of the capoeira as such, contributing, at the same time, toward the maintenance of environmental services such as the contention of soil erosion, fixation of atmospheric carbon, a habitat for fauna and flora, among others.

Research on Secondary Vegetation under the Umbrella
of the Ecology Component of LBA

Embrapa is focusing on secondary vegetation as part of the NASA financed Ecology Component of the Large Scale Biosphere Atmosphere Experiment in Amazonia - LBA, through the participation in two projects: "Biogeochemical Cycles in Degraded Lands", and "Measurement and modeling of the Inter-Annual Dynamics of Deforestation and Regrowth in the Brazilian Amazon: Land Use Control on the Annual Net Flux of Carbon".

Biogeochemical Cycles in Degraded Lands: The objectives of the research are to define and describe the types of landscapes that fall under the broad category of "degraded lands", and to study biogeochemical cycles across a range of degradation found in secondary forests of Amazonia. The biogeochemical measurements adopted to quantify degrees of degradation in secondary forests include: productivity measurement (as rates of above ground biomass accumulation) and a suite of biogeochemical processes, including soil respiration, radiocarbon content of soil CO₂ and of soil organic matter, emissions of N₂, NO and CH₄, and net N mineralization, net nitrification, stocks of N, P, and cations in soils and vegetation, fluxes of nutrients in precipitation, throughfall, soil solutions, and streamwater, diversity of plant species, and diversity and activity of soil fauna. A collaborative joint venture of this project and the project SHIFT Capoeira is taking place in Igarapé-Açu, where gases flux started to be measured in some plots where the fallow enrichment technique is under test.

Measurement and modeling of the Inter-Annual Dynamics of Deforestation and Regrowth in the Brazilian Amazon: The project seeks to understand the interannual variability in deforestation and abandonment rates in the Brazilian Amazon region, through six tasks integrating satellite remote sensing



measurements at basin scales, field-based case studies at the farm and household scale, and models. Two questions are proposed to be answered: 1) Are the inter-annual dynamics and rates of deforestation and abandonment to secondary forest significantly different than the decadal mean values in Amazonia, and can this account for a dampening of the biogenic source of carbon apparent in annual observations of atmospheric carbon dioxide and oxygen?; and 2) Through the integration of socioeconomic and satellite data and the development of dynamic deforestation models, can we improve our understanding of the dynamics of the deforestation and the various controls on rates of deforestation and regrowth.

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