The Brazilian National System of Forest Permanent Plots

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Abstract.—The Brazilian National System of Forest Permanent Plots (SisPP) is a governmental initiative designed and being implemented in partnership by the Ministry of Environment (MMA), represented by the National Forest Programme (PNF) and the Brazilian Forest Service (SFB) and the Embrapa Forestry (a research center of the Brazilian Agricultural Research Corporation - Embrapa). The proposal was presented, discussed and approved by the Brazilian forest inventory community in a workshop carried out in September 2004. The methodological model converged to a national network organized by biomes, interconnecting existent initiatives (in the biomes Amazonia and Caatinga) and promoting new networks (in the biomes Cerrado, Pantanal and Atlantic Rain Forest). The purpose of SisPP is to congregate the regional networks as its branches (branch, in this case, means the regional and stratified by biomes permanent plots networks and the community of researchers and other individuals who share the same interests and are involved in the subject). This article intends to describe the main objectives and elements of SisPP as well as the strategies that are being used for its implementation. Another important aspect of SisPP is its integration to the new Brazilian national forest inventory, which would use data from the permanent plots as an input to estimate growth and to analyze forest dynamics in the different Brazilian biomes, thus complementing the stock information obtained from temporary sample plots.

Introduction

In forest science and forest research, some distinct existing characteristics require the establishment of specific studies in large areas, through long-term periods, in complex natural and socioeconomic systems, and in systems where sustainable management is fundamental also for the preservation of the systems' functions for future generations. The combination of these aspects turns forest management into a challenge and defines, at the same time, an important role for scientific research (Kleinn and Köhl 1999). Additionally, sustainable forest management requires information on forest production and patterns of development in the present and future and also under different management regimes. That information should be obtained from silvicultural trials and by the observation of forest growth along the time. Estimates on current stocks of volume and on average growth taxes come from forest inventory data (temporary plots, for example); however, present average growth rates do not provide with the necessary accuracy, the tendencies of future behavior of the forest because they are originated from only one measurement in different stands, which tends to represent several development phases (Curtis and Marshall 2005).

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In the extent of forest management, permanent plots are permanently demarcated areas of forest that are periodically remeasured (Alder and Synnott 1992) with the objective of obtaining information on the growth and the dynamics of the forest. In other words, the use of permanent plots aims to obtain information about the variations related to the number of a certain species of tree, the composition of the forest, and the trees' individual dimensions in a certain period of time. Such plots usually present relatively high costs for their implantation and maintenance and require a commitment of resources for a long period, which many corporations' managers consider a disadvantage. However, frequently, permanent plots also can be also used for analyses and purposes other than the study for which they were installed.

In 2004, the Brazilian Ministry of Environment (MMA), in partnership with the Food and Agriculture Organization (FAO) of the United Nations, launched an announcement for the elaboration of a proposal for a methodological model of the Brazilian National System of Forest Permanent Plots (SisPP). Many reasons supported that Federal Government decision, including the following:

- Brazil is the world's largest producer and consumer of forest products. Strategic sectors of the Brazilian economy, such as metallurgy, paper and cardboard manufacturing, and building construction, are highly dependent on the forest sector.
- Since the end of the 1980s, despite the issue's economical and social importance, Brazil has experienced deficiencies regarding the availability of official information of the forest sector.
- There is a lack of systematic information to subsidize decisionmaking regarding public policies and projects from the civil society and private-sector companies. At the same time, in the sense of filling out such a gap, several actions by different institutions were adopted. Until now, however, no such an integrated system existed that could supply periodic information related to forest administration.
- Cooperative efforts among research institutions, private-sector companies, nongovernmental organizations, and universities are vital for establishing a consensual process regarding data collection and data availability to the different participants to compose a national database.
- It is necessary, also, to ensure the acquisition of new data to complement already existing statistics and to extend the monitoring process to species and biomes that have been seldom studied until now. Also, in this case, the magnitude and costs of the establishment of field plots, their measurement, data processing, and data analyses lead to the need for cooperative efforts involving different organizations.

Thus, since 2000, when the National Forest Programme (PNF), was created, and after that, in 2006, when the Brazilian Forest Service (SFB) was established, the formulation of a long-term forest policy has been desired in the country.

In this scenario, the methodological model for SisPP was developed by researchers of Embrapa Forestry (a research center linked to the Brazilian Agricultural Research Corporation - Embrapa) in partnership with other Embrapa research centers and other institutions (Oliveira *et al.* 2005). The model was presented, discussed, and approved by MMA and invited institutions in a workshop held in Curitiba in the State of Paraná, in September 2004.

The idea of "networks" is a trend in the contemporary administration. In this context, the change of paradigm involves cooperative effort instead of isolated actions. The networks should count with advanced communication means to promote the participants' interaction with supplemental qualifications. In this way, the methodological model for SisPP, developed by Embrapa Forestry, converged to the network scheme and is stratified by the six Brazilian biomes: (1) Amazon Rain Forest, (2) Caatinga (scrubland or steppe ecosystem), (2) Cerrado (Brazilian tropical savannah), (4) Pantanal (wetlands of the central west part of the country), (5) Atlantic Rain Forest (coastal rain forest and other vegetation associations), and (6) Pampa (formerly covered by grasslands and some forests). The model was designed for the interconnection among existing initiatives, such as the Dynamic Monitoring of the Brazilian Amazon Forest Network, and the Caatinga Forest Management Network. In a second phase, which was financially supported by MMA, the Cerrado and Pantanal Permanent Plots Network (which

includes two biomes in only one network) and the Atlantic Forest and Pampa Permanent Plots Network (which also includes two biomes in one network) were created. The Planted Forests Permanent Plots Network is still being organized. SisPP will congregate the regional networks as subsystems or network branches and will serve as the database feeder of SisPP. The system's functions will include compilation, systematization, compatibility, data processing, and results publication of each regional network and of the joint activities.

Objectives

This article intends to describe the main objectives and elements of SisPP as well as the strategies that are being used for its implementation. It also presents some guidelines related to the structure, implementation, and coordination of SisPP, whose main purpose is the permanent monitoring of the natural and manmade forests located in the six Brazilian biomes. SisPP will embrace information about forest growth and yield as well as about the forest reaction to direct or indirect disturbances, including the effects of management regimes, silvicultural responses, and climatic changes.

SisPP Design

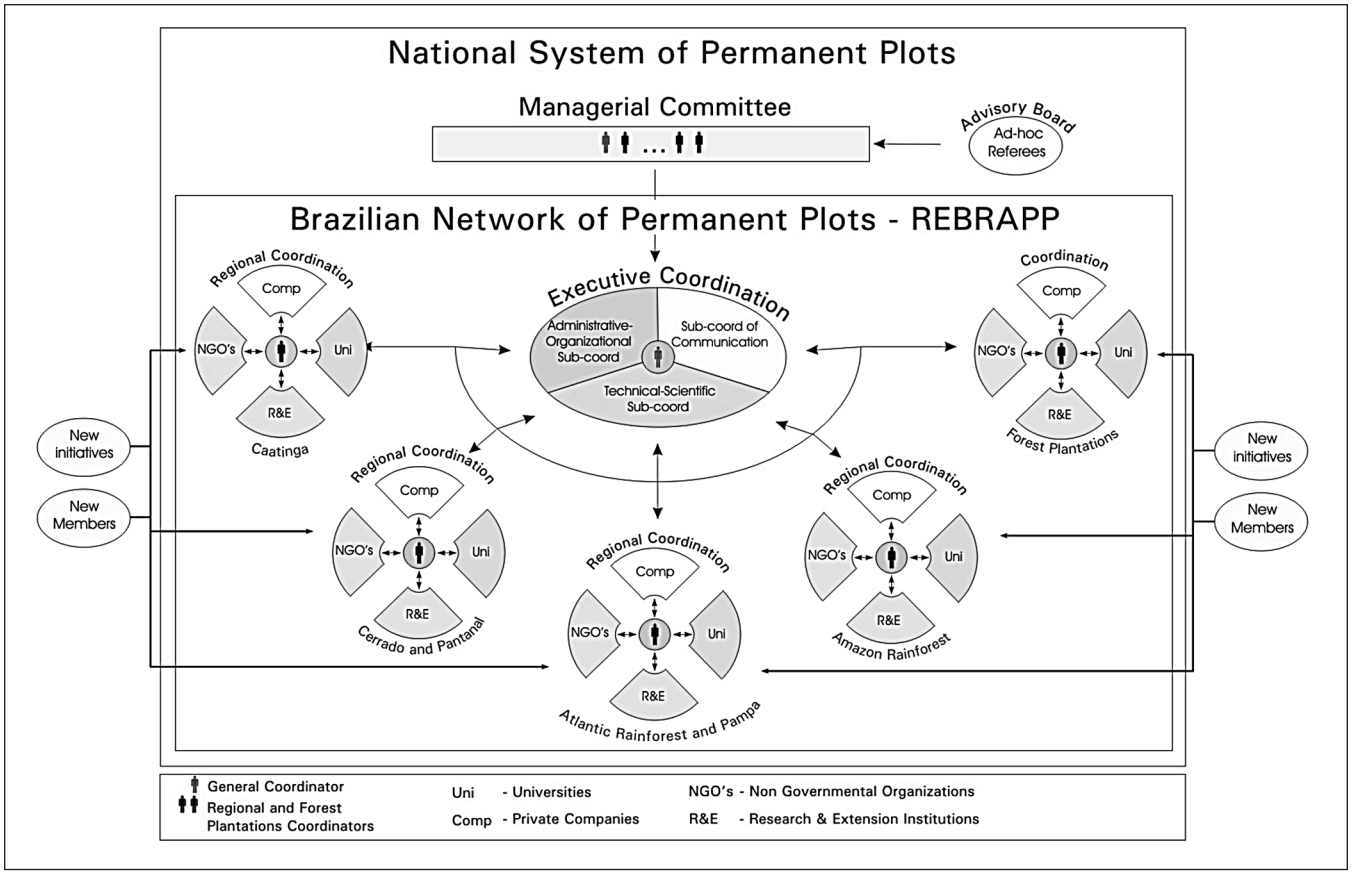
Several network functioning models were studied and none of them fulfilled entirely the basic idea conceived for SisPP; thus, a hybrid model was adopted. The hybrid model includes the following objectives: the independence of the participant institutions, sharing the information generated in each network branch, the definition of mechanisms for information availability, the establishment of a repository of data, and the creation of interconnected sub networks (network branches) agglutinated around a regional coordination. The basic elements idealized for SisPP include the following: system engineering, institutional arrangement, and economical-financial arrangement. The system engineering consists basically of the following initiatives: the establishment of relationships among the network branches; the hierarchization among and inside the Managerial Committee, Advisory Board, and coordination sets (general, regional, and executive); and the system formalization, its organization, and its relationship with the other elements of the system. The institutional arrangement is defined by the integration of public and private institutions potentially involved in the system and the establishment of an organizational chart involving responsibilities that take into account the institutional differences. The analysis of the needs of resources to quantify and qualify equipments, software, and personnel involved in the system results in the economical-financial arrangement.

SisPP has different and interdependent components targeted to enhancing the effectiveness of the system as a whole. The first hierarchical level is the Managerial Committee (figure 1). The committee is composed by a General Coordinator, five Regional Coordinators (one for each biome or biome groups), and an additional coordinator who will represent the planted forests. The General Coordinator manages the network articulation, what means maintaining a continuous data and information flow in the system. The Managerial Committee decides on general matters of SisPP and contributes to constant evaluation and improvement of the system. An *ad hoc* Advisory Board is linked to the Managerial Committee. The board is formed by external elements to SisPP and composed of five researchers of "notorious knowledge" in the subject. The board acts as a referee chamber of the activities developed by the system in meetings to be held at least once a year. The second hierarchical level is the Executive Coordination, which is responsible for the administration of three sub-coordinate sections: (1) Administrative-Organizational, (2) Technical-Scientific, and (3) Communication.

The Executive Coordination will be responsible for the SisPP office, which will also help administer the three sub-coordinate sections. Required human resources include the following: a General Coordinator, a secretary and an administrator linked to the Administrative-Organizational sub-coordinate section, a journalist and a Web designer linked to the Communication sub-coordinate section, and two foresters and a geoprocessing technician linked to the Technical-Scientific sub-coordinate section.

The database of permanent plots is being structured according to the existing protocols of establishment and measurement of permanent plots. All regional networks published specific

Figure 1.—*The Brazilian National Forest Permanent Plots Network organizational chart.*



rules regarding the monitoring process of their permanent plots. SisPP will constitute the forum for technical discussions, aiming for the improvement of those guidelines. For permanent plots already being monitored outside the system, adaptation processes and data conversion formats are being considered. The individuals and participant institutions will have their copyrights and intellectual property guaranteed.

Implementation Strategy

Embrapa Forestry is a research institution that is the forest branch of the Brazilian Agricultural Research Corporation - Embrapa. It is located in Colombo (a metropolitan area of Curitiba) in the State of Paraná, and was designated by MMA to be the institution responsible for SisPP implementation.

The SisPP Executive Coordination is located in a facility (SisPP general building) that permits the collection, storage, manipulation, and updating of the information regarding the existing permanent plots and the creation of a structure for data analyses.

The Executive Coordination is responsible for the following activities:

- Organizing meetings with the permanent plots regional networks.
- Writing and publishing the SisPP statutory agreement.
- Collaborating on the text and publication of the statutory agreement of the regional networks.
- Encouraging the creation of the Planted Forests Permanent Plots Network.

- Building and periodically updating a communication space in the Internet for collaborators and coordinators of the regional networks.
- Publishing a monthly digital informative (newsletter) for the divulgation of the SisPP themes and the regional networks.
- Collaborating on the text and publication of the measurement and maintenance guidelines of the regional networks of permanent plots.

The activities of SisPP also include the creation and updating of a homepage to publish information regarding the concept of the system; its importance, objective, and main expected results in the short, medium and long run; the main team members and their addresses; and recent results. In technical terms, the Executive Coordination is expected to coordinate the trainees' contributions; collaborate on the writing of technical-scientific papers; and organize, coordinate, and promote the First National Congress of Forest Monitoring using Permanent Plots.

Additional activities include: reception, organization, and manipulation of data originated from the regional networks of permanent plots and the documentation and updating of metadata. In addition, they will manage spatialized data using GIS tools.

Results

SisPP has the purpose of providing data for research involving forest growth and yield, surveys and forest inventories, and the monitoring of forest planning. Therefore, is appropriate to define standardized procedures that should be followed as a routine in all permanent plots still to be installed. These procedures should consider the differences in the objectives of the plots that compose SisPP. At the same time, they should represent a compatible group of measurements to be taken on certain basic variables. It is expected that, with the establishment of SisPP, it will be possible to watch aspects regarding such group of variables as well as aspects relative to the plots' size and shape, their physical delimitation in the field, the registration of the initial conditions, the numbering of the trees, the determination of the diameter measurement points and determination of the stands' age, and the mapping of the trees and remeasurement layout.

The computation design to be developed should enable several users to access the system at the same time, control and monitor the updating of data, and permit the obtention of registered information in real time. The information access will take place through the Internet, allowing the registration of any user from any part of the world. The stored data in the centralized base should enable registered queries on the database and queries using raw, processed, or historical data and data crossing from different sites and plots.

SisPP and the Brazilian National Forest Inventory

SisPP has a strong interface with the new Brazilian NFI. The permanent plots installed by the regional networks can contribute with detailed information on forests dynamics and growth as well as give information regarding silvicultural treatments and technical alternatives for multiple use management. On the other hand, it is expected that the Brazilian NFI works in partnership with the regional networks, articulating and sponsoring the installation of some plots in association. The strategy involves the Brazilian NFI protocol that is being followed by the regional networks and also involves the plots' remeasurement and maintenance as part of the structure of the network. This kind of arrangement would be satisfactory for both systems, considering that the network coordinators have been participating actively in the Brazilian NFI project meetings as consultants in the methodology definition and specific measurement protocols for each biome.

Conclusion

The implementation of SisPP is a directive of the Brazilian government and private-sector corporations linked to the forest sector in Brazil. This project is important, especially for those institutions responsible for the elaboration of public policies, forest research, decisionmaking at the strategic and managerial levels, and the medium- and long-run environmental planning. The political circumstances are is quite favorable, considering

the worldwide concerns regarding climate change and the recent creation of the Brazilian Forest Service, which is the head of the National System of Forest Information. On the other hand, the project of the new Brazilian NFI can also strengthen SisPP by articulating an interface between the two systems.

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