

# Chapter 10

## Brazil

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### 10.1 The Brazilian National Forest Inventory

#### 10.1.1 History and Objectives

Brazil is the largest country in Latin America, occupying an area of 8.5 million km<sup>2</sup>, of which approximately 4.9 million km<sup>2</sup> are covered by forests (FAO 2015). Despite the importance of its forest resources, until recently the country did not have a national forest inventory to support public policies and strategic projects to promote the use and conservation of forest resources.

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In the 1980s Brazil had the unique edition of a national forest inventory, the main objective of which was to generate information on timber stock of natural and planted forests (Brena 1995; Machado 1984). Until that time, most national forest inventories had mainly focused on timber production (Holmgren and Persson 2002), covering specific regions to meet particular demand of information, as to support colonisation or planning programs. More recently, with the recognition of the wide range of values that forests provide, for production of goods, environmental services and social benefits, as well as for the emergence of new technologies, some Brazilian states have taken the initiative to undertake state forest inventories (Vibrans et al. 2012; Scolforo et al. 2008). Despite the positive aspects of state initiatives, for a country the size of Brazil, considering the high biodiversity, environmental, anthropogenic and economic gradients, the most appropriate alternative is to produce information about Brazilian forests based on a nationwide system, with a standardised methodology that meets the main national demands for forest information.

In 2005, the Ministry of Environment began a participatory process to develop a standard methodology for a national forest resource inventory, with the participation of national and international institutions. This is considered the starting point of the new National Forest Inventory of Brazil (NFI-BR) (Freitas et al. 2008).

The NFI-BR aims at producing information on forest resources, to support the formulation of public policies of use, restoration and conservation. The Brazilian Forest Service (BFS), an agency of the Ministry of Environment, is responsible for its coordination, in partnership with other institutions such as Embrapa, state environmental agencies, universities and research institutions.

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Among the motivations for the NFI-BR development is the strategic importance of forest resources, at national and global scales. However, there is still a lack of qualitative and quantitative information about Brazilian forests, to support national demands and also the Brazilian participation in the international agenda on forests, such as the FAO Global Forest Resources Assessment and the conventions on climate change (UNFCCC) and biodiversity (CBD) (Freitas et al. 2010).

This document aims at describing the main features of the National Forest Inventory of Brazil (NFI-BR), addressing methodological aspects and the status of its implementation.

### ***10.1.2 Sampling Methods and Sources of Data***

The demand for different data at varied scales makes the NFI-BR a multisource forest inventory, with a methodological framework that uses different databases to produce results on the state of forest resources nationally and allows the monitoring of forest resources over time.

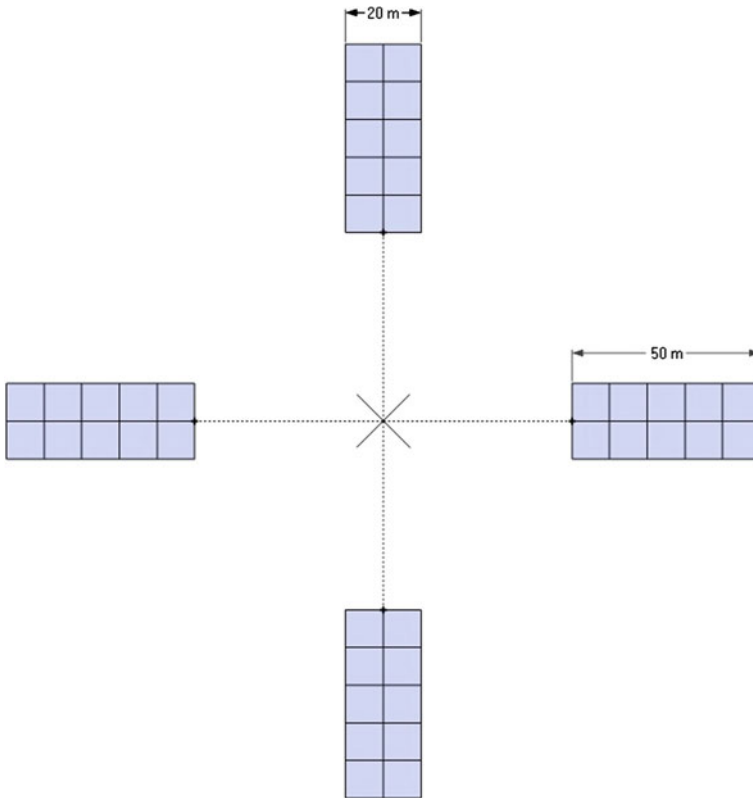
#### **10.1.2.1 Field Plots Sampling Design**

The procedure for field data collection is based on systematic sampling with the distribution of clusters on a national network of sample points 648 seconds equidistant, which is approximately 20 km between sample points at Equator Line. The NFI-BR cycle is 5 years, although the first cycle is taking more than that. For the first cycle it is planned to collect data on all sampling points of the grid, whether or not they are on areas covered by forests. The grid of NFI-BR can also be applied at different intensities, such as  $10 \times 10$  km,  $5 \times 5$  km,  $2.5 \times 2.5$  km, etc., to meet different goals and levels of accuracy. The intensification of the grid can be required, for example, to meet specific demands of states and municipalities, becoming a as a complementary part of the national network.

#### **10.1.2.2 Sample Plots for Biophysical Data**

The cluster is the sample unit and consists of four rectangular subunits of fixed area in a cross-shaped spatial arrangement (Fig. 10.1). The size of each cluster subunit is  $1000 \text{ m}^2$  ( $20 \times 50$  m), where all trees with diameter at breast height (dbh)  $\geq 10$  cm are measured. Exclusively for the Amazon region, the subunits are  $2000 \text{ m}^2$  ( $20 \times 100$  m) to improve data capturing of larger trees (dbh  $\geq 40$  cm). At the end of the first NFI-BR cycle approximately 15,000 clusters will have been measured.

Plot configuration for the NFI-BR is one cluster of 4 subunits of  $1000 \text{ m}^2$  ( $20 \times 50$  m), a distance of 50 m from the grid sampling point, north-south oriented. Each subunit is divided into  $10 \times 10$  m subplots. Two perpendicular 10 m transect lines crossing the centre of the cluster are used to measure necromass and litter. For



**Fig. 10.1** NFI-BR sample plot design

Amazon region the size of each subunit is  $2000 \text{ m}^2$  ( $20 \times 100 \text{ m}$ ), extended to capture data of larger trees, with  $\text{dbh} \geq 40 \text{ cm}$ .

Data collected within each subunit comprise variables such as the tree species name, some classic dendrometric variables (dbh, height), qualitative variables such as stem quality and tree health, as well as some less traditional variables in forest inventories as necromass, litter and soil characteristics. Within each cluster subunit a classification of the predominant land use is recorded for each subplot of  $10 \times 10 \text{ m}$ .

This large dataset will facilitate the characterisation of the forest environment in each sample point. Data collection is carried out by hired companies through a competitive process.

### 10.1.2.3 Interviews for Socio-environmental Data

As part of the field data collection, NFI-BR socio-environmental component aims to assess the relationship between people and forest resources. Around each cluster (2 km radius) up to four residents are interviewed to provide qualitative information

to characterise how local communities perceive and use their forest resources. The interviewees respond, among many issues, about the importance of the forest in contributing to family income, the use of timber and non-timber forest products and which forest services are most valued by them. One part of the questionnaire is designed to capture the individual perception on the importance of forests and other sections cover topics. These topics encompass the demand on planted forests and forest restoration, adaptation to climate change and how much the respondents know about Brazilian laws related to forest uses and on public policies that may encourage them to manage forest resources.

#### 10.1.2.4 Sample Units for Landscape Analysis

The landscape component of NFI-BR aims to analyse portions of the Brazilian territory through some qualitative indicators, such as the degree of forest fragmentation and the presence of riparian vegetation alongside rivers. Remote sensing techniques are used in digital image processing and spatial analysis, based on Rapid Eye and Landsat 8 satellite images.

The data are extracted from Landscape Sample Units (LSUs), which represent a source of intermediate data between the mapping and field data. Each LSU consists of a 100 km<sup>2</sup> polygon, with a center point that coincides with the NFI-BR grid, but at 40 × 40 km. Data from field clusters are integrated into the LSUs in order to provide information about ground truth in image classification procedures using Object Based Image Analysis (OBIA). The classification of LSUs into land cover/land use classes is based on satellite imagery and is an important source of information, as well as serves as input for other types of analysis on landscape. The following classes are being mapped: natural forest, planted forest, agriculture/pasture, natural grasslands, bare soil, urban areas and water bodies. Trees Outside Forest (TOF) represent a specific theme within the LSUs analysis and different approaches are being tested to discriminate and classify them using Rapid Eye imagery. By means of Morphological Spatial Pattern Analysis (MSPA) it is possible to assess the connectivity among forest patches (Vogt et al. 2007; Saura et al. 2011). Furthermore, the LSUs' analysis will also allow the identification of structural riparian corridors and connectors as well as their ranking (Clerici and Vogt 2012) with reference to conservation priority. This is especially important due to recent changes in the Brazilian Forest Law (BRAZIL 2012) concerning the extent of forest vegetation to be restored along rivers and water bodies.

#### 10.1.2.5 Vegetation Mapping for Area Estimates

There are several government and non-government initiatives for vegetation mapping across the country. Many of them are adding good quality information on the vegetation types distributed all over the territory. They are state or regional initiatives, with different purposes and using different methods. The NFI-BR standard

procedure will be also used to evaluate available initiatives aimed at updating these maps to support the planning of field activities, the national forest area estimates and the inferences made by the integration of field data and remote sensing.

### ***10.1.3 Programmes Associated with the NFI***

A set of associated programmes are intended to support the NFI-BR by improving methods and procedures, as well as producing additional information, that by its nature will not come from data collected in the regular procedures and components described in previous sections.

#### **10.1.3.1 Field Crew Training**

The standard NFI field crew consists of five people, which may be directly involved in biophysical data collection within the cluster and the social-environmental interviews. The team leader is responsible for coordinating the work and recording data; a technical assistant coordinates botanical sample collection and the second assistant is responsible for interviewing people. Besides these three technicians, there are two workers for hard tasks, such as path opening, climbing trees and sampling.

Each field crew must participate in eight-day training on NFI-BR methodology before starting the fieldwork. The training program comprises all procedures to collect data of each NFI-BR variable, how to use a GPS as well as first aid, safety and how to proceed in dealing with local communities. During the training all teams also have the opportunity to practice on the installation of clusters in several situations that may happen during fieldwork.

There are already over 300 people trained and able to participate in field teams. The experience of training adopted by NFI-BR format has proven necessary in order to assure standardisation of the proposed methodology, which is considered complex due to the large number of variables and the limited time of measuring in each cluster.

#### **10.1.3.2 Quality Control and Assessment**

The evaluation of quality control is one of the key points to assure credibility and the quality of national forest inventories. Quality control of NFI-BR is carried out at different levels.

The first level is an inspection and evaluation of each crew in the field, immediately after the field data collection starts. The evaluation and Quality Control teams monitor the work of data collection by the field teams for a few days, interacting with them and observing their difficulties, clarifying doubts and

assessing compliance with the protocols, procedures and the use of recommended materials and equipment.

At a second level, during the data collection season a BFS Quality Control team visit several randomly selected clusters, having at hand the registration forms that were filled by the field teams. At this point the degree of compliance to NFI-BR methodology is carefully checked. This is done by recording a set of verifiers, including aspects such as proper allocation of the cluster, plot size, number of trees measured, number of identified species and land use classification, among others. In addition, to confirm the application of the social-environmental interview, at least one indicated residence is visited.

Moreover, each dataset sent to Brazilian Forest Service by the contractors goes through an evaluation process. It is evaluated to ensure that all fields are filled and that the data is of good quality and is consistent. This assessment is made for each set of data that is sent by the company and may imply a return to the field to data re-collection where issues have been identified.

The quality of botanical samples collected in the field are also assessed by experts as soon as the samples are received by the herbarium, aiming at checking the quality for botanical identification by comparison with herbarium's collection. Similar procedures are adopted by the laboratory in charge of the analysis, in order to verify the quality of soil samples, by checking if there was no violation of the packaging and any material loss during transport. Soil samples are collected at the cluster central point, at two depths (0–20 and 30–50 cm) for chemical analysis.

### **10.1.3.3 Botanical Identification in National Herbaria**

Estimates suggest that there are more than 16,000 tree species in the Amazon region alone, many of which are still unknown and rare (ter Steege 2013). Of course, this great diversity impacts directly the NFI-BR fieldwork. Furthermore, a wide variety of tree species are known by different common names in different regions and it has been increasingly difficult to find para-taxonomists able to identify tree species in the field. Thus, the NFI-BR main strategy is to collect as much tree species botanical samples as possible for identification by experts in herbaria. The Brazilian Forest Service has established partnerships with herbaria in each state where data collection is ongoing. These herbaria receive the samples for identification by scientific name. The result is sent to the Brazilian Forest Service to merge with data of trees originally recorded in the field forms. By December 2014 approximately 126,000 field samples had been collected and sent to 14 different herbaria. One of each fertile sample collected in the country is also sent to Rio de Janeiro Botanical Garden, where a collection of species identified by NFI-BR is being formed. A challenge faced is the difficulty of collecting botanical samples, especially in the Amazon region due to the large size of the trees. Another challenge has been the identification of sterile specimens in herbaria, as it is not possible to find reproductive material for all species during field work.

#### **10.1.3.4 Forest Research**

The Research Program, coordinated by BFS in partnership with Embrapa Forestry, is designed to (i) improve the methodology adopted in all NFI-BR components and other associated programs; (ii) identify gaps of information or knowledge in the currently adopted methodology; (iii) establish partnership with research institutions enhancing NFI-BR results; (iv) provide NFI-BR with results that may be incorporated into the core methodology.

One of the main results expected from the NFI-BR is to improve the estimates of volume, biomass and carbon stocks existing in Brazilian forests. This will be possible because the field dataset will report the wide variation in carbon density among forest types, environmental gradients, stages of regeneration and degree of use and degradation of forests across the country. However, to improve actual estimation, appropriate allometric equations for each region, forest type and forest conditions should be used. The Brazilian Forest Service is carrying on a compilation of allometric equations available in literature to use in data processing and to identify gaps. For the identified gaps new data will be collected to develop new equations in partnership with research institutions. This initiative covers not only new allometric equations for standing trees, but other mathematical relationships to estimate carbon in all pools proposed by the IPCC (2006).

#### ***10.1.4 Data Processing and Analysis***

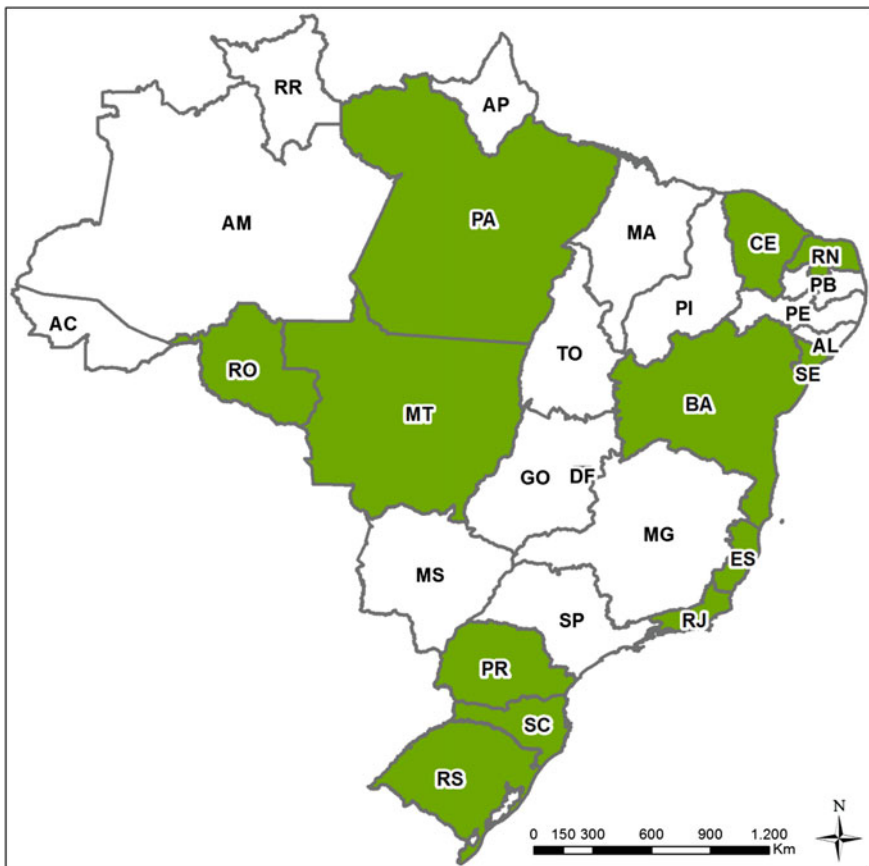
Field data are sent to the Brazilian Forest Service, samples of plant material to an accredited herbarium for species identification and soil samples are sent to a laboratory for chemical analysis and carbon stock determination. The result of these analysis returns to BFS for data processing and analysis.

As the NFI-BR is based on a systematic sampling with clusters uniformly distributed over the entire country territory on “forest” and “non-forest” sites, the field data are also used to estimate the area of forest. The determination of volume, biomass and the number of trees is done by ratio estimators. The assessment of forest quality is based on the analysis of qualitative variables such as stem quality and health, evidence of harvesting and the general environmental condition within each subunit. Each sampling point of the grid is permanent and the changes are estimated by the difference in stocks among two occasions. Up to six months after the end of data collection, a summary report on forest conditions is prepared by state. This report presents strategic results on the extent of forests, biological diversity, forest production and environmental importance of forests for that state. In some cases, this period may be longer since the data processing depends on the completion of the botanical identification of tree species by herbaria. At the end of the cycle, detailed results will be presented and data will be available on internet.



### 10.1.5 NFI Cycle 1: Status of Implementation

The field data collection began in 2012 and up until December 2015 it was carried out simultaneously in 13 Brazilian states (Fig. 10.2). At the end of 2015, nearly 4,500 clusters were assessed, corresponding to approximately 148 million hectares. Two thousand tree species were already identified and 11,000 people interviewed in the NFI-BR socio-environmental component. The completion of the first cycle is scheduled for 2018. Among the challenges are the size of the country, the need for partnerships with states and institutions, as well as to guarantee funds for the second cycle.



**Fig. 10.2** NFI implementation by 2015 in 13 states (*RS* Rio Grande do Sul; *SC* Santa Catarina; *PR* Paraná; *RJ* Rio de Janeiro; *ES* Espírito Santo; *BA* Bahia; *DF* Distrito Federal; *SE* Sergipe; *RN* Rio Grande do Norte; *CE* Ceará; *MT* Mato Grosso; *RO* Rondônia; *PA* Pará)

### ***10.1.6 NFI Results: Potential Applications***

NFI-BR produces estimates at national and regional scale, per biome, state and in some cases by municipality. The data will be used to support strategic planning by federal government and states as well as to improve reporting to the international agenda on forests. This agenda includes the global assessment of forest resources (FRA/FAO), as well as demands for forest information from international conventions on climate change (UNFCCC), endangered species (CITES), biological diversity (CBD), and to combat desertification (UNCCD). More specifically, the NFI-BR results will be used to:

1. Estimate biomass and carbon stocks of forests
2. Provide knowledge on the Brazilian flora and regular production of biodiversity indicators
3. Estimate the stock of timber and non-timber forest products
4. Identify areas for expansion of planted forests and forest management
5. Identify priority areas for protection and forest restoration
6. Identify the occurrence and geographical distribution of forest species, including endangered species
7. Characterise the importance and use of forests by rural population
8. Support and plan of forest concessions
9. Support forest management at the municipal level
10. Landscape analysis and planning, as design programs to reduce forest fragmentation and forest restoration
11. Provide society with data and information, including uses for research, education, private sector and non-governmental institutions.

## **10.2 Land Classification and Forest Resources**

### ***10.2.1 Classification of Land Use and Forests***

#### **10.2.1.1 Forest Classification, Land Cover and Land Use**

The NFI-BR adopts the definition of forest proposed by the United Nations Food and Agriculture Organization (2010), which establishes minimum values for evaluation in situ for area (0.5 ha), tree height (5 m) and canopy cover (10 %), besides the land use. For evaluations based on remote sensing the Brazilian vegetation classification (IBGE—Brazilian Institute of Geography and Statistics 2012) and the FAO definition, based on the attributes considered in FAO forest definition are both used. Thus, each type of vegetation mapped can be computed as forest or no forest.

For field evaluations, however, NFI-BR uses a land cover and land use classification that is more practical (Table 10.1) and requires no special knowledge on the different forest types in the country by the team leaders. This classification is used to describe the main land cover and land use class on each  $10 \times 10$  m subplot, within each subunit of the cluster. It is important to note that the purpose of this classification in the field is to allow area estimates for different land classes, especially forested area, and also to facilitate data processing according to specific vegetation type characteristics. By doing so, the most appropriate allometric equation can be more appropriately chosen. Each of NFI code is ultimately linked to seven grand classes (Forest; other land with trees; Shrub; Natural grassland; Agriculture; Other anthropogenic areas; Other natural areas). NFI field classification also allows processing data for different purposes (FAO/FRA or IPCC classes, for example).

### 10.2.1.2 Classification by Ownership Categories

Since 2006, the BFS coordinates the National Registry of Public Forests (CNFP), in order to support forest concession system in public lands. Until November 2015, near 315 million ha of public forests were registered, including national forests, national parks, state forests, indigenous land, military areas, community forests and other lands of public domain. After the adoption of the new forest code (Law 12651/2012), BFS is also organising a national registry for private lands, called Environmental Rural Registry (CAR). This registry is focused on the compliance of each private landowner with environmental laws, including the requirement of maintaining a proportional area of each property covered by forest or any previous natural vegetation. This proportion varies according to the biome where the property is located. For example, for Cerrado biome, a minimum of 35 % of each private property should be covered by natural vegetation, while for Amazon biome it is required to keep 80 %. Law enforcement is being successfully achieved through the implementation of the CAR system. It is publically available on the internet, based on an open map server system, where updated satellite imageries allow each owner to register the property boundaries and land cover/land use classes. The information added by each owner is then validated by the government. The CAR registry will be soon considered a pre-requisite for obtaining financial credit for agriculture practices. By January 2016, approximately 263 million ha were registered in CAR, corresponding to approximately 66 % of the expected total area of private lands to be registered. Both CNFP and CAR systems are important to identify forests by ownership categories. As NFI data collection is based on a systematic sampling, its processing can provide results that will aim to characterise and to report on the quality of forests in public and private lands.

**Table 10.1** Land cover/land use classes adopted in field work. Each 10 × 10 m subplot within each cluster subunit is assigned with the predominant land cover/land use (NFI code)

Grand class	Equivalent FAO class	National land classes	
		Intermediate category	Land use/cover classes or typical vegetation type
1	Forest	Natural forest	Typical forest
1	Forest	Natural forest	Mangrove (wooded)
1	Forest	Natural forest	Restinga
1	Forest	Natural forest	Cerrado
1	Forest	Natural forest	Caatinga
1	Forest	Natural forest	Campinarana
1	Forest	Planted forest	Any planted forest
2	Other land	Other land with trees	Forest fragments (<0.5 ha)
2	Other land	Other land with trees	Urban wooded lands
2	Other land	Other land with trees	Other areas with scattered trees
3	Other wooded land	Shrub	Any vegetation type with natural predominance of shrubs
4	Other land	Natural grassland	Natural grassland in any biome
5	Other land	Agriculture	Fruit tree plantation
5	Other land	Agriculture	Perennial bush crops
5	Other land	Agriculture	Short-cycle crops
5	Other land	Agriculture	Agroforestry system
5	Other land	Agriculture	Cultivated pasture
6	Other land	Other anthropogenic areas	Exposed soil, bare land
6	Other land	Other anthropogenic areas	Mining
6	Other land	Other anthropogenic areas	Rural infrastructure
6	Other land	Other anthropogenic areas	Roads
6	Other land	Other anthropogenic areas	Urban influence
7	Other land	Other natural areas	Beaches, dunes and sand areas
7	Other land	Other natural areas	Rocky outcrop
7	Water	Other natural areas	Open water

A correspondence with FAO definitions is also presented

### 10.2.1.3 Forest Management, Wood Resources and Their Use

Balancing forest protection and production is a permanent challenge for any country, but Brazil has made impressive progress toward this objective. For example, natural forest area estimation for 2015 is around 58 % of the country. The statistic considers all six biomes (Amazon, Caatinga, Savanna, Atlantic Forest, Pampa and Pantanal), given the FAO definition of forests (FAO 2015). Deforestation rates in the Brazilian Amazon have decreased significantly since 2004, stabilising around 6,000 km<sup>2</sup> year<sup>-1</sup> in the last five years, according to researchers of Brazil's National Space Research Institute and other institutions (Aguilar et al. 2016).

Forest management for timber production from natural forests, in Brazil, is carried out mainly in the high tropical forests of Amazon region and the dry forests of Caatinga. For Amazon, forest management is based on a polycyclic system, with selective logging of commercial trees with dbh  $\geq$  50 cm, given a maximum allowable cut of 30 m<sup>3</sup> ha<sup>-1</sup> and a 35-year cutting cycle. A pre-harvesting 100 % inventory of commercial species is required for authorising cut and low impact logging techniques are required to avoid damage to soil and remaining tree species. For the dry forests of Caatinga, the forest management system is based on clear cutting, over a 15-year cutting cycle. The large majority of tree species of Caatinga have the ability to coppice. In both, Amazon and Caatinga, the total area is generally divided into stands, according to the annual cutting cycle. Although so far there is no formal role of the NFI in monitoring the quality of forest management, an indicative may be obtained by analysing data from NFI clusters located within areas licensed for forest management, though differences in scale and approaches shall not be disregarded.

Regarding wood forest products, in 2014, Brazilian native forests have contributed with around 50.8 million m<sup>3</sup>, of which 13.8 million m<sup>3</sup> for industrial purposes (pulp, sawnwood, laminate flooring and wood panels) and 37 million m<sup>3</sup> for fuel (28.9 million m<sup>3</sup> for firewood and 8.1 million m<sup>3</sup> for charcoal) (BFS 2015).

In addition to the natural forest areas, of the 851 million hectares of Brazilian lands, 23.3 % is occupied by pasture, 6.2 % is planted with crops and 3.5 % accounts for infrastructure networks and urban lands. Brazil has 7.74 million hectares of planted eucalyptus, pine and other species used in the production of wood panels and laminate flooring, pulp, paper, energy production and biomass. That area equals 0.9 % of domestic territory. The Brazilian planted tree industry is responsible for 91 % of all the wood produced for industrial purposes in the country (IBÁ 2015). In 2014, gross revenue of the planted tree industry represented 5.5 % of the Industrial Gross Domestic Product (GDP) (IBÁ 2015) and planted forests produced near 239 million m<sup>3</sup>, of which 132.7 million m<sup>3</sup> for industrial purposes and almost 106 million m<sup>3</sup> for fuel (56 million m<sup>3</sup> for firewood and 50 million m<sup>3</sup> for charcoal) (BFS 2013).

Below the umbrella of NFI-BR, some land use and land cover (LULC) classes, such as mangroves and planted forests have received special attention to ensure the development of appropriate methodology to capture reliable information, considering specific spatial characteristics that make them difficult to be monitored. Nevertheless, for planted forests it is necessary a specific and complementary methodology, aiming to capture information on genus, age classes and management regime. This methodology is being designed by the NFI team and will be tested in a pilot area still in 2016.

Despite all of these challenges, Brazil's activities in the overall effort against climate change and in the commitment regarding monitoring LULC represent one of the most important covenants made by any single country to date, having reduced its emissions by 41 % (GWP-100; IPCC SAR) in 2012 in relation to 2005 levels (MCTI 2014). Additionally, Brazil intends to adopt further measures (intended Nationally Determined Contribution—iNDC) that are consistent with the 2 °C temperature target. Specifically regarding land use change and forests, it is worthy to mention the commitment of restoring and reforesting 12 million hectares of forests by 2030, for multiple purposes and enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with the purpose of decreasing illegal and unsustainable practices (BRASIL 2015).

### 10.3 Conclusion

The NFI-BR is an important source of information on Brazilian forests even before completing its first cycle. The major difference and strength compared to other Brazilian monitoring systems is undoubtedly the field data collection using a standardised methodology throughout the national territory, including the challenging socio-environmental and the landscape analysis components. The existence of associated programs, such as training and quality control ensures the reduction of non-sampling errors and improves data quality. The NFI-BR sampling design also enhances the sample data by intensifying the grid. Flexibility to change variables at each cycle, depending on the demand for information, is also a benefit.

Another advantage of the NFI-BR is that it captures field data on forest and non-forest sites. Furthermore it also provides information on other land use classes and trees outside forests. Compared to traditional inventories, although a higher investment in time and funding is demanded due to the absence of any pre-stratification analysis, this type of information is still considered of high relevance, as it will track transition between land use classes, when data of different occasions are available.

Data produced by the NFI-BR will be useful to improve national estimates of volume, biomass and carbon stocks in Brazilian forests. The NFI-BR will also provide updated information on the state of forests and its relation to other land use/land cover classes at country level, playing an important role in the monitoring

of national programs, whether aiming at the forest restoration or conservation, expansion of productive forestry systems or stimulating planted forests, in order to achieve SFM goals. The completion of the survey will enable Brazil to fulfill national and international reporting obligations and to monitor the sustainable development of the forest resource in the country.

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