FUTURE PROSPECTS FOR NATIONAL FOREST INVENTORIES IN LATIN AMERICA AND THE CARIBBEAN

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3.1 INTRODUCTION

The purpose of this chapter is to summarise the future prospects for NFIs in Latin America and the Caribbean (LAC): the continuous monitoring of forests, the analysis of the main methodological similarities, differences and challenges presented by the countries of the region on the subject. It is considered important to know the trends and plans that NFI officials have for their future development, as well as the concrete actions that can be employed to resolve the challenges they face.

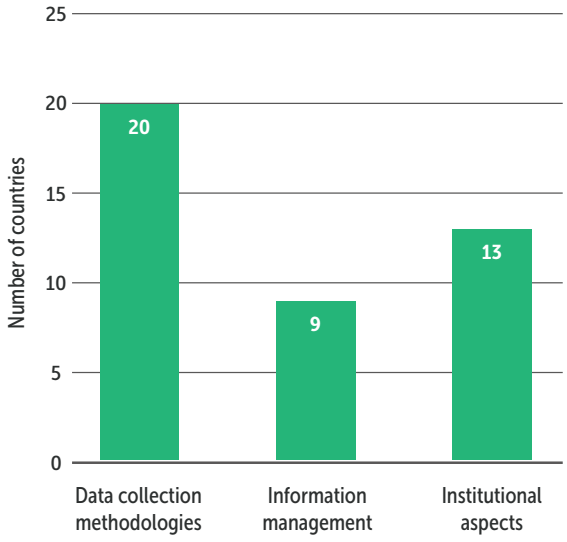
The results and conclusions presented in this chapter are drawn both from the analysis of the reflections in the "future prospects" section of the 21 national chapters in Part II of this book, as well as from a specific questionnaire designed to standardize the criteria for analysis. The questionnaire covered elements of data collection, information management and institutional aspects, and was completed by 20 countries.

The status, characteristics and contexts of national forest inventories (NFIs) in LAC are very diverse and their analysis requires an understanding of the short- and long-term objectives and goals of each country. As described in the national chapters, there are countries that have not yet completed the first measurement cycle (that is, with the complete installation of sampling units), while others have already begun the second or third cycle of forest monitoring. There is also a great diversity of variables sampled and ways of collecting information in the field that enrich the analysis. Continuity in forest monitoring is a priority for most countries in the region, and the institutional or external funding to support this work, as well as the availability and retention of trained human resources, are some of the challenges to meeting this objective.

National forest inventories produce relevant information for the management, planning and establishment of forest policies aimed at conservation and/or sustainable resource management, through the integration of urban and rural communities and society as a whole. Moreover, data obtained from the inventories provide information for the preparation of national and international studies and reports, among other aspects highlighted by the countries included in this publication.

FIGURE 3.1

Perspectives on future improvements of national forest inventories by number of countries and areas of interest (n = 21)



Source: Prepared by the authors.

3.2 FUTURE PROSPECTS IN LATIN AMERICA AND THE CARIBBEAN

Future prospects for the development of NFIs in the LAC region can be drawn from the accumulated experiences in planning, implementation, data analysis and reporting of such initiatives. These issues become important in seeking continuous improvements to strengthen the basis for sustainable management planning of forest ecosystems, according to the specific context of each country.

This section analyses the future prospects of the countries in the region, organized in three blocks: i) data collection methodology, which includes the incorporation of new variables and technologies for monitoring; ii) information management, related to its application in different national, regional and international reports; and iii) institutional aspects, referring to human and economic resources to continue monitoring.

Considering the above-mentioned aspects, according to the national chapters, 95 percent of countries (20 countries) expressed the need to make changes and improvements to the methodology of data collection in their NFIs. A total of 43 percent (9 countries) referred to data management and 62 percent (13 countries) reported the need for improvements related to institutional arrangements (Figure 3.1). It is worth mentioning that very few countries (namely, Guatemala, Honduras, Mexico, Nicaragua, Peru and Uruguay) integrated all three perspectives into their national chapter reflections. In most cases, the final discussion focused on one or two of these thematic areas, the most important being the data collection methodology and the need to rethink it in the future.

3.2.1 DATA COLLECTION METHODOLOGIES

Data collection methodologies in NFIs refer to the strategies and procedures for implementing, developing and completing the planned sample design. This includes aspects related to the collection of field data, protocols, coordination of the staff and use of technology. Methodologies for collecting data are being continuously refined thanks to the exchange of experiences and limitations encountered, as well as the search for improvements and solutions in the process of planning, development and data analysis.

In order to better understand the future prospects of data collection methodologies, the analysis has been divided into two time horizons: i) short term (one to four years) and ii) medium to long term (more than five years).

Short-term outlook

The prospects identified for the short-term time horizon were as follows (Figure 3.2):

- 40 percent of respondents mentioned finalising the installation of field sampling units and implementing new NFI cycles, from which new ideas and needs will emerge in the data collection phase;
- 50 percent of the respondents referred to improvements in sampling design, including the increase of sample size;
- 10 percent of respondents mentioned improvements in field data collection and use of modern technologies.

Medium- to long-term outlook

The medium- and long-term prospects mentioned were as follows (Figure 3.2):

- assessment of new forest types and other land use categories (14 percent);

- assessment of information needs (48 percent);
- introduction of modern technologies in field data collection and remote sensing (38 percent).

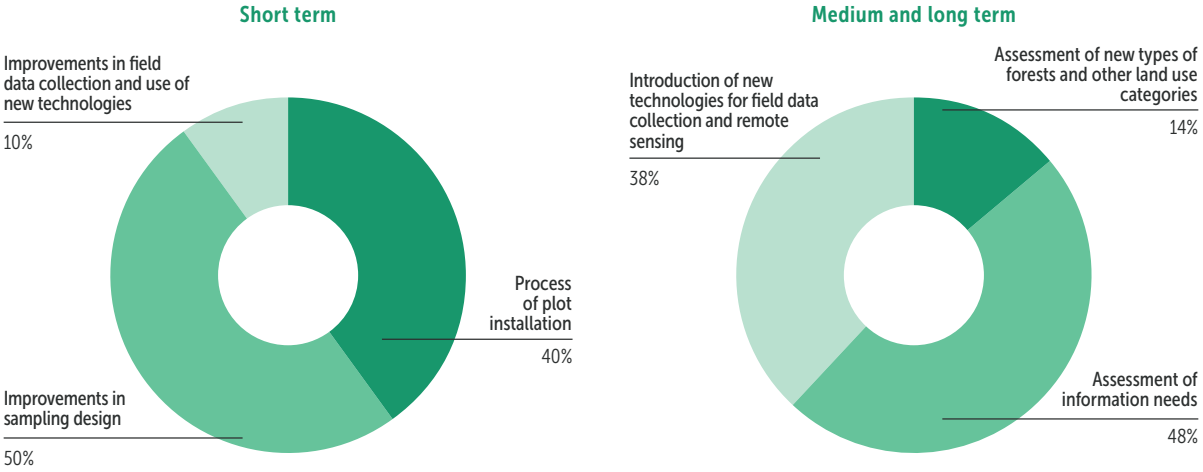
The assessment of new forest types and other land use categories is driven by the need to standardize and define the areas to be assessed when developing forest inventories at the national scale. The increasing diversification of forest resource use is a prominent feature of FAO's series of voluntary guidelines on forest monitoring (FAO, 2017). This situation results in the progressive need to include all land with trees in inventories, and not solely land that is defined as forest. This is particularly important given that there is a group of countries that collect information specifically in forest areas, including Argentina, Chile, Ecuador, Puerto Rico, United States Virgin Islands and Uruguay. Of this group, Ecuador, Puerto Rico, United States Virgin Islands and Uruguay include planted forests, but Argentina and Chile include only native forests. Another group of countries plans to integrate information on forest resources across all types of land use in the future, which implies measuring "trees outside the forest" (El Salvador, Guatemala, Puerto Rico and United States Virgin Islands).

These assessments are needed to generate more reliable information on the state of the different forest ecosystems and resources found throughout the region.

The comprehensive assessment and analysis of the information needs and requirements, as well as the variables to be collected during each measurement cycle, are part of the strategic elements to support the methodological design and implementation of NFIs (FAO, 2017). In this regard, the evaluation of the development and completion of previous cycles is essential for improving implementation and evaluation, in order to determine whether there are any existing needs related to the variables being collected, based on the learning experiences in the previous cycles. This should be undertaken by multiple stakeholders involved in planning, development and information analysis; the requirements of international commitments also need to be included, as well as an assessment of the importance and role of local communities. In general, information needs can be grouped into the following categories: i) harvesting/management of wood products; ii) biodiversity and conservation (other forms of life and wildlife); iii) socioeconomic issues; iv) non-wood forest products; v) greenhouse gas emissions (deforestation, degradation); and vi) ecosystem restoration.

FIGURE 3.2

Future prospects for data collection methodologies as projected in the short term and medium to long term (n = 21).



Source: Prepared by the authors.

Finally, the introduction of modern technologies to improve data capture, recording and storage procedures helps to optimize human and economic resources, as well as time investments. Technology should help to i) generate information that provides better quality measurements, for example, with the use of tablets and terrestrial or aerial LiDAR (light detection and ranging) and drones; ii) improve data accuracy by using satellite images to conduct pre- or post-stratification of measurements; or iii) draw up maps by combining satellite images to show results or aerial LiDAR to extrapolate variables such as volume and biomass based on models in areas where access and field measurements are not possible.

Improvements to national forest inventory designs

This section presents the main improvements to the NFI designs based on the responses to the questionnaire. Among the aspects to be modified in the NFIs, although there is a group of countries (35 percent) that do not envisage any changes to the design, the majority of countries (65 percent) referred to some changes in the future regarding the design, intensification, implementation and inclusion of other categories of land use in the monitoring.

The most relevant aspects mentioned by countries considering changes to their NFI designs in the future were the following (Table 3.1):

- Method for the implementation of measurement cycles, whereby panels or subsampling campaigns are conducted over a specific period of time (for instance, yearly) until the cycle is completed.
- Sampling intensification (refers to the increase of the number of sampling units to be installed in the field).
- Changes to the sampling unit design (for example, changes to the type of sampling unit, such as the transition to a cluster design and/or change in the size of the sampling unit).
- Incorporation of other categories of "other wooded land" as defined by the Global Forest Resources Assessment (FRA) as part of future monitoring.
- Other aspects, such as the inclusion of urban forests and trees outside the forest in the sampling, the inclusion of "other land" as defined by FRA, the time period for completing all NFI sampling units (cycle), and adjustments to the sampling design.

TABLE 3.1

Prospects for methodological improvements to be implemented in the development of national forest inventories

Aspects	Countries	Number of countries (n = 20)
No plans to change the design of the NFI in the future	Argentina, Chile, Colombia, Costa Rica, French Guiana, Honduras, Mexico	7
Cycle implementation method	Belize, Brazil, Guatemala, Jamaica, Nicaragua, Puerto Rico, Uruguay	7
Sampling intensification	Belize, Brazil, Dominican Republic, Ecuador, Jamaica, Nicaragua, Peru	7
Design of sampling units	Jamaica, Nicaragua, Panama, Peru, Uruguay	5
Incorporation of other categories of "other wooded land" (FRA definition)	Belize, Dominican Republic, El Salvador, Jamaica, Panama	5
Incorporation of urban forests	Brazil, Jamaica, Panama, Puerto Rico	4
Cycle (time period to complete all NFI sampling units)	Brazil, Nicaragua, Peru	3
Incorporation of "other land" (FRA definition)	Belize, El Salvador, Panama	3
Include trees outside the forest	El Salvador, Jamaica, Puerto Rico	3
Sampling design	Ecuador, Jamaica	2
Improvement of stratification; implementation in the whole forest area (refers to the fact that only mangroves have been sampled with the methodology designed for NFIs)	Suriname	1
Move from temporary to permanent sampling units and adjusted to the systematic grid used to determine land use	El Salvador	1

Notes: FRA: Global Forest Resources Assessment; NFI: national forest inventory.
Source: Prepared by the authors.

Sampling of new variables

Among the variables to be incorporated in the NFIs in the future, 5 of the 20 participating countries mentioned that they had no plans to include new variables (Table 3.2); this may be because many of the variables mentioned in the questionnaire are already being collected by some of the countries or they simply do not have such information a priori. Among the variables mentioned, the measurement of soil organic carbon, monitoring of carbon in different forest biomass pools, and the evaluation of shrub and herbaceous vegetation stand out as relevant aspects for the future diagnosis of forest ecosystems in the region. The least mentioned areas were the social aspects of forests; the evaluation of non-woody vegetation such as palms, bamboo and/or tree ferns; the description of the soil profile where forests develop; the land use and history of the forest; the phytosanitary status and natural regeneration.

Another group of variables that were mentioned only once by some of the countries relate to the assessment of climatic variables of the ecosystem; the phytosociological structure of the forest, which refers to tree crown structures, tree inclination and tree stratum (dominant/codominant/suppressed); molecular taxonomy of species; quality, salinity and fauna concerning mangroves; measurement of crown diameter and moisture of detritus samples (Table 3.2).

Finally, it is important to take into account that the information collected in the field sampling units is the starting point for the analysis that generates information on the state, dynamics and composition of the diverse types of forests present in the LAC region. The dasometric information is complemented in some cases with edaphoclimatic, social, economic and biodiversity variables, among others, thus creating a more comprehensive analysis.

TABLE 3.2

Variables to incorporate in the development of future national forest inventories

Variable	Countries	Number of countries (n = 20)
Soil organic carbon	Argentina, Chile, Honduras, Peru, Uruguay	5
Carbon monitoring	Argentina, Belize, El Salvador, Honduras, Nicaragua, Uruguay	6
Shrub and herbaceous vegetation	Argentina, Belize, Costa Rica, Dominican Republic, Puerto Rico, Suriname	6
No plans to include new variables	Ecuador, French Guiana, Guatemala, Mexico, Panama	5
Social aspects	Costa Rica, Puerto Rico, Suriname, Uruguay	4
Vegetation of palms, bamboo and/or tree ferns	Costa Rica, Jamaica, Puerto Rico	3
Soil profile description	Belize, Jamaica	2
Forest use and history	Belize, Costa Rica	2
Phytosanitary status	Costa Rica, Suriname	2
Natural regeneration	Belize, Costa Rica	2
Fauna	Costa Rica	1
Climatic variables	Belize	1
Phytosociological forest structure	Costa Rica	1
Molecular taxonomy	Brazil	1
Water quality, salinity and fauna in mangroves	Suriname	1
Crown diameter	Colombia	1
Moisture of detritus samples	Colombia	1

Source: Prepared by the authors.

The guidelines recommended by international organizations such as FAO (2017) highlight the creation and management of National Forest Monitoring Systems with multiple objectives and according to the particular circumstances (biophysical, institutional, economic, among others) of each country. The ultimate goal of forest inventories is to know the state of our resources so that, based on this initial approach and through the management and processing of this information, guidance can be provided on the management, use and conservation of the resources and services offered by forests.

3.2.2 INFORMATION MANAGEMENT AND PROCESSING

The development of a sound policy on data sharing will enable stakeholders interested in the information produced by NFIs to use it in a timely manner for decision-making (FAO, 2017). National forest inventories are key pillars of National Forest Monitoring Systems because they produce data on multiple variables and can respond to a wide variety of national, regional and international information requests.

Over the last three decades, the demand for information from countries has increased due to commitments to track international policy indicators such as the Sustainable Development Goals (SDGs), nationally determined contributions (NDCs), Reducing Emissions from Deforestation and Forest Degradation (REDD+), FRA, criteria and indicators for sustainable forest management

(C&I SFM), the Aichi Biodiversity Targets of the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the European Union Action Plan on Combating Illegal Logging through forest law enforcement governance and trade (FLEGT), the International Tropical Timber Organization (ITTO), and the Convention on Wetlands of International Importance (Ramsar Convention), among others.

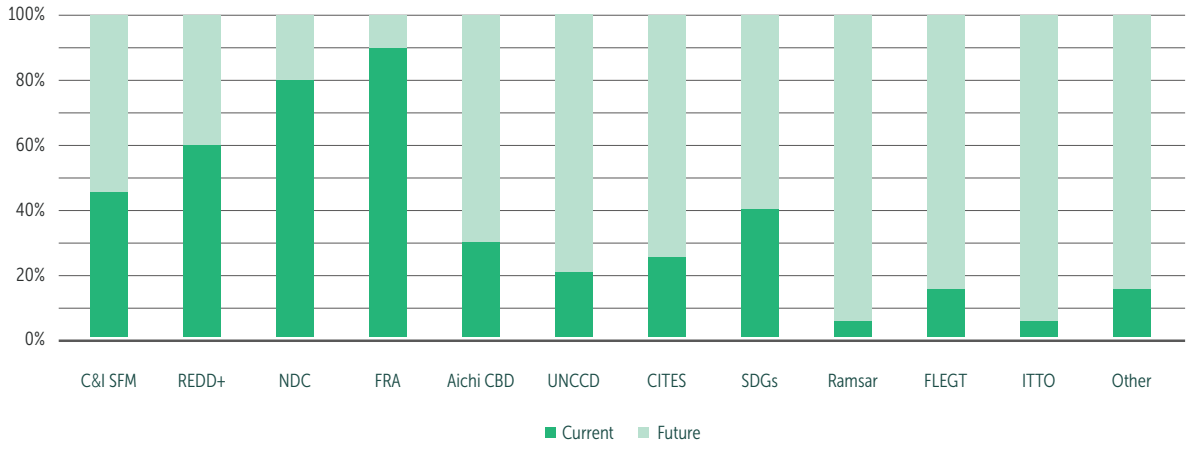
Figure 3.3 shows the use of NFIs by 20 LAC countries to respond to current and future international commitments. As illustrated in the figure, 18 countries use NFIs to respond to FRA. The two countries that do not use their information to meet this requirement is because they have not started collecting data from their NFIs. For NDC, 16 countries use data from their NFIs; for REDD+, 12 countries; for C&I SFM reporting, 9 countries; for SDGs, 8 countries; for Aichi Targets, 6 countries; for FLEGT, 3 countries; for Ramsar and ITTO, 1 country; and for others, 3 countries. On the other hand, most survey respondents said that the future potential of NFIs is for all the above-mentioned requirements.

In addition, due to the relevance of forest information that is directly or indirectly related to different policies (climate change, energy, conservation of natural resources, etc.), countries should make significant efforts to respond to the increasing demands for information. This is why consolidating questionnaires or reports to meet different requirements would be of major help. An example of this is the Joint Forest Sector Questionnaire, an initiative of ITTO, the United Nations Economic Commission for Europe, FAO and Eurostat to compile statistics for the World Timber Situation. The principles of cooperation include that data should be requested only once from each country, that information should be shared among the four organizations, and that each organization should use the information received according to its own mandate (Wardle *et al.*, 2008).

Given the large amount of inventoried data and its relevance, NFIs need to pay special attention to planning tools and platforms to store and manage the information that is collected in a secure way. To this effect, FAO suggests generating a data management model as part of the *Voluntary Guidelines on National Forest Monitoring* (FAO, 2017).

FIGURE 3.3

International requirements where information from national forest inventories is being used or could be used



Notes: Aichi CBD: Aichi Biodiversity Targets of the Convention on Biological Diversity; C&I SFM: Criteria and Indicators for Sustainable Forest Management; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; FLEGT: European Union Action Plan for forest law enforcement, governance and trade; FRA: Forest Resources Assessment; ITTO: International Tropical Timber Organization; NDC: nationally determined contributions; Ramsar: Convention on Wetlands of International Importance; REDD+: Reducing Emissions from Deforestation and Forest Degradation; SDGs: Sustainable Development Goals; UNCCD: United Nations Convention to Combat Desertification.

Source: Prepared by the authors.

Data systems for NFIs can be part of national forest information platforms and should aim for clear and transparent documentation. In addition, harmonizing nationally produced data and developing these data management systems becomes essential for the production of robust forest information (Vidal *et al.*, 2016).

Countries should consider the numerous opportunities for data sharing so that more stakeholders can use the data for decision-making. Since NFIs typically cover a very large set of field variables, often organized in sampling designs that can be complex, the data management model can expand the use of the data by creating protocols for rapid extraction of subsets of data that are appropriate for different users, topics and extensions.

More information on this topic is presented in Chapter 5, which is a call for transparent and open NFI data.

3.2.3 INSTITUTIONAL ASPECTS

The institutionalization of forest inventories is necessary to develop continuous planning and monitoring, through established processes that aim to gather information on the status and dynamics of forests on a regular basis. Defining institutional goals and perspectives is necessary to ensure the permanence of these initiatives, which generate information at national scale.

The countries of the region face different situations in terms of the number of NFI cycles that have been carried out and those that will be developed in the future; however, all countries can draw on their experiences to reflect on technical, administrative and financial aspects. In this sense, one of the greatest challenges is the institutionalization of the NFIs, whereby the needs related to the administration, implementation and financing of activities are covered through government support, considering that the generation of information is the basis for planning the sustainable use of forests.

Institutionalization provides a solid basis to ensure the continuity of NFIs on a regular or cyclical basis, creating linkages to obtain the support of academia, as well as other private organizations, nongovernmental organizations, social groups and any other group that may join in this important work.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Having permanent and trained technical teams for specific tasks in forest monitoring, as well as an institutional budget in line with the activity, are two key aspects underscored by most of the countries. There is also a need for public policies at the state level aimed at guaranteeing forest monitoring with budgets and other resources to ensure the efficient implementation of these projects. In many countries, the continuity and frequency of NFIs will be determined by the availability of funding sources outside the institutional budget, so their continuity may be jeopardised in the medium term.

Analysing the responses related to plans for the permanence and continuity of the NFIs, most of the participating countries indicated the necessity to mobilise national and international financial resources, such as from the REDD+ results-based payment mechanism, climate change-related projects or other international sources (such as credits and other donations) in order to ensure their continuity over time. In addition, the integration of other monitoring initiatives into the NFI (such as remote sensing, permanent carbon monitoring plots and assessment of non-wood forest products) is considered necessary, thereby producing updated information (Table 3.3). Other relevant aspects mentioned were the need to mobilise REDD+ institutional resources.

TABLE 3.3

Plans for national forest inventory permanence and continuity per country

Plans	Countries	Number of countries (n = 20)
Resource mobilisation	Belize, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Peru, Suriname	13
Integration of other monitoring initiatives into the NFI	Belize, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Jamaica, Mexico, Nicaragua, Peru, Puerto Rico, Suriname	12
Improvement of institutional arrangements in the National Forest Monitoring System	Belize, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Jamaica, Nicaragua	9
Integration into institutional annual plans	Belize, Brazil, Colombia, Costa Rica, Guatemala, Jamaica, Nicaragua, Panama	8
Increase of institutional human resources	Belize, Brazil, Colombia, Guatemala, Mexico, Suriname	6
Development of specific legislation	Belize, Colombia, Jamaica, Panama	4
Integration with the national greenhouse gas emission inventories initiative	Brazil	1
The permanence of the NFI is assured	Brazil, Chile, Honduras, Jamaica, Peru, Puerto Rico	6
The permanence of the NFI is currently undetermined	Argentina, El Salvador, Dominican Republic, French Guiana, Suriname, Uruguay	6

Note: NFI: national forest inventory.
Source: Prepared by the authors.

Table 3.3 shows how the following actions are necessary in the medium- and long-term management plans to ensure the permanence of NFIs: improve institutional arrangements in the National Forest Monitoring System for REDD+, integrate NFIs into annual institutional plans, and increase institutional human resources to carry out the NFI activities. A small group of countries (Belize, Colombia, Jamaica and Panama) mentioned the need to develop a regulatory framework and specific legislation to support their continuity. In a third group, there are six countries that have assured the long-term continuity of their NFIs, and six countries that have not ensured their sustainability over time. Finally, only one country mentioned integration with the national greenhouse gas emissions inventory initiative as important for its continuity over time.

Finally, it is important to mention that addressing the institutionalization of NFIs is a process that requires solid planning and continuous improvement to support the necessity and importance of maintaining this activity. The idea is to create a favourable environment in which the entire process – from planning to development to results – may unfold as smoothly and efficiently as possible.

3.3 FINAL CONSIDERATIONS

The analysis of future prospects in the region, in terms of NFIs and forest monitoring, is not a simple task. The homogenisation of the variables presented by each of the countries in this chapter made it necessary to develop a short and simple questionnaire that provided a basis for the discussion, grouping and analysis of these variables.

This analysis shows that in most countries in the region there has been a shift in perspective regarding NFIs, which implies an increasingly systemic vision of the forest ecosystem, incorporating new variables into monitoring. Added to this is the introduction of new desktop and field technologies to optimize human, economic and time resources. There is therefore a clear tendency towards a multipurpose NFI that includes various information sources, which will provide increasingly complete and robust information.

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