Guatemala - National Forest Inventory, 2002-2003.

Instituto Nacional de Bosques

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Overview

Identification

ID NUMBER
GTM_2002-2003_NFI_v01_EN_M_v01_A_OCS

Overview

ABSTRACT
General objective:

To design and carry out the National Forest Inventory (NFI) of Guatemala and create a system for the periodic gathering of forest information at the national level.

Specific objectives:

A. To adapt the methodology provided by FRA to carry out the National Forest Inventory, adequate to the needs of the country. The methodology shall be statistically reliable and allow periodic surveys of information related to forest resources.

B. To carry out the first data collection of the variables that respond to the needs of the country's forestry sector, with emphasis on: forest cover, total and commercial volume of timber species, biomass based on stem volume, non-timber products, biophysical data, and socioeconomic data on the use and management of forest products and services.

C. To design a database to archive and manage the field inventory information, which may be part of the National Forest Information System.

KIND OF DATA
Sample survey data [ssd]

UNITS OF ANALYSIS
Forest types and land use classes

Scope

NOTES
Based on the objectives and approach of the forest inventory, the following target populations are defined in the scope:

1. Land use classes and forest types defined for the national forest inventory that are found within the entire national territory.

2. Trees and stumps within the national territory (108,889 km2), either inside or outside forests.

3. Plants of xate (Chamaedorea sp.), bayal (Desmoncus sp.) and mimbre (wicker or rattan) - within the national territory. These are the non-timber forest products from which information was collected on their productive potential.

4. Users of the country's forest and tree resources, who provided information on the uses and services of the forest.

5. Towns of the national territory with influence on forests.

For each of them, indicators were defined, which are later mentioned, associated to the measured variables

TOPICS

Topic	Vocabulary	URI
Forest production		

Carbon stocks		

KEYWORDS
Forest, Carbon, Tree biomass, Tree volume, Deadwood, Land use, Canopy cover, Tree biodiversity, Forest production, Land cover, Forest fire evidence

Coverage

GEOGRAPHIC COVERAGE
National Coverage

UNIVERSE
Tree and stump population > 10 cm diameter at breast height across the nation, in and out of forest. The socioeconomic surveys focused on users of forest products across the nation.

Producers and Sponsors

PRIMARY INVESTIGATOR(S)

Name	Affiliation
Instituto Nacional de Bosques	

OTHER PRODUCER(S)

Name	Affiliation	Role
Consejo Nacional de Areas Protegidas		
Universidad del Valle de Guatemala		
Facultad de Agronomía Universidad San Carlos		

FUNDING

Name	Abbreviation	Role
Food and Agriculture Organization	FAO	Technical/Financial Support

Metadata Production

METADATA PRODUCED BY

Name	Abbreviation	Affiliation	Role
Office of Chief Statistician	OCS	Food and Agriculture Organization	Metadata adapted for FAM
Javier GarciaPerez		Food and Agriculture Organization	Metadata producer

DDI DOCUMENT VERSION
GTM_2002-2003_NFI_v01_EN_M_v01_A_OCS_v01

DDI DOCUMENT ID
DDI_GTM_2002-2003_NFI_v01_EN_M_v01_A_OCS_FAO

Sampling

Sampling Procedure

The design of the NFI was based on the aforementioned objectives and the methodological design proposed by FAO. It had a low sample intensity, but was statistically reliable. It was designed to cover the total area of the country (108,889 km2). The sampling did not only contemplate forest areas, because it was aiming to carry out periodic surveys in the same plots to know land use dynamics throughout the country. In addition, it aimed to evaluate forest resources outside of forest areas, to expand the forest information towards other land uses where these resources are also managed.

The sampling design is systematic stratified. It has three defined strata based on the map of natural divisions of Guatemala ("Mapa de Divisiones Naturales de Guatemala" in the original document), because it was sought that the strata are stable over time to ensure that the area they occupied was the same in future measurements). The strata are named: Zona Norte, Centro and Sur (North, Central and South), according to the geographical area of the country they represent. The systematic design is predetermined by a grid of geographic coordinates (latitude-longitude).

The sampling intensity is relatively low, compared to larger-scale inventories, such as those carried out on farms where forest harvesting or forest concessions. This low intensity only affects the sampling error, but the data are statistically valid, since they will be developed under a strict statistical design and must be interpreted on a national scale. The number of sampling units (SUs) vary according to the defined strata. The largest number of SUs was collected in the Central Zone (70 SUs - with 15min x 15min grid, approximately 26.8 x 26.8 km) because it is the area with the greatest diversity of ecosystems and socioeconomic activities. In the North and South Zones, 30 and 8 SUs were built, respectively (with SUs every 15 minutes in latitude and 30 minutes in longitude - approximately every 26.8 x 53.6 km).

A specific land use and forest type classification was developed, based on the global FAO classes (Forest, Other Forest Lands, Other Lands and Inland Waters) and the classes used in the country's forest cover map. The global classes are located in the upper hierarchical level and in the next levels the national categories are specified. The definitions of each class are described in the adjunct document "Inventario Forestal Nacional de Guatemala: Manual de Campo". Plots were positioned around the selected center point of the point grid. The SU consists of a square conglomerate, with 4 rectangular plots, whose starting point is located at each corner of the square (Figure 2 in "Inventario Forestal Nacional de Guatemala: Manual de Campo"). The first plot was located in the southwest corner of the square and had a northward direction, the second plot was located in the northwest corner and had an eastward direction, the third one was in the northeast corner with a southward direction and the fourth one in the southeast corner facing west.

The plots, following FAO's NFMA design, had a rectangular shape and a size of 250 x 20 m (0.5 ha). They had a nested structure, according to the size and type of resources measured. There were also measurement points for the soil and topographic variables. Each plot has three groups of nested plots and three measurement points, systematically distributed. The nested structure is described below:
- The SU is a cluster of 500 x 500 m composed by four rectangular plots, depicted below.
- At plot level (250 x 20 m - 0.5 ha) all trees with diameter at breast height DBH=20 cm were measured.
- 3 nested plots below (PAN1, 20 x 10 m - 0.02 ha), all trees 10=DBH<20 cm were measured.
- One PAN2 plot nested per PAN1 plot (3 per main plot). Circle 3.99 m radius (0.005 ha), enumerating all trees DBH<10 cm and height=1.3 m plus regeneration abundance by species.
- One PAN3 plot per PAN1 plot (3 per main plot). 10 x 10 m (0.01 ha) square measuring presence and abundance of bayal and mimbre.
- One PAN4 plot per PAN2 plot (3 per main plot). Northwest quadrant from PAN2 circle (0.00125 ha) measuring presence and abundance of xate.
- Finally in the center of each PAN2, topographic and soil characteristics were recorded.

Besides, data were collected about the villages, which benefitted from the area occupied by the SU. These had to be obtained in the municipalities or auxiliary townships.

Response Rate

98% of projected primary sampling units were finally enumerated. Hence, 2% were inaccessible, mostly due to topography and denied access permissions.

Weighting

Sample weights were determined according to area expansion factors (in regards to a reference 0.5 ha total area per SSU). Hence they are given as:
Weight of whole plot within SU measured trees: 0.5 ha/0,5 ha = 1
Weight of PAN1 plot measured trees: 0.5 ha/(3 PAN1 x 0.02 ha) = 8.333
Weight of PAN2 circular plot measured trees and regeneration: 0.5 ha/(3 PAN2 x 0.005 0.0125ha) = 133.33
Weight of PAN3 plot measured bayal and mimbre: 0.5 ha/(3 PAN2 x 0.01 ha) = 16.66
Weight of PAN4 circular quadrant measured rate: 0.5 ha/(3 PAN2 x 0.0035 ha) = 55.55133.33

Interview weighting followed the naive approach.

Questionnaires

No content available

Data Collection

Data Collection Dates

Start	End	Cycle
2002-06-01	2003-06-01	N/A

Data Collection Mode

Face-to-face paper [f2f]

Data Collection Notes

Biophysical information was collected directly though the biophysical survey in the field filling of paper forms. The socioeconomic information was collected though face to face interviews also through paper forms.

For the biophysical survey, as part of the organogram, two types of teams were formed, and some trainings took place:
• Consultants for the field survey: independent consultants were hired, who formed field teams, made up of forestry or agronomists, survey technicians and local personnel from each SU area.
• Consultants for processing and analysis: experts on specific topics were hired to facilitate processing and analysis.
• Technical advice: the project received continuous advice from the FRA Forest Resources Assessment program staff in FAO, for which 5 missions took place:
1. February 2002, to present an approach to the FRA methodology and support in the design and planning of the inventory.
2. June 2002 to support the field survey training and start of activities.
3. October 2002, follow-up to the field survey and review of the methodology for collecting socioeconomic information through interviews.
4. June 2003, participate in the taxonomic verification process during field work with a national expert and present the development of the database made for Guatemala.
5. October 2003, participation in the statistical discussion workshop together with an expert from the region.

Capacity building for the field data collection teams took place through training workshops that were scheduled for the field crews and the technical supervisors of INAB and CONAP. Additionally, workshops were scheduled for teachers and students of the country's forestry schools, in order to broaden national knowledge and disseminate the project process. In total, 12 forestry engineers, field team leaders, 36 field assistants from the different regions of the country, 28 forestry technicians from INAB and CONAP, 8 municipal technicians, 5 professors of forestry universities, 20 university students and 6 forest ranger students.

The training workshops were held between 4-5 days and were scheduled as follows:
• 1-2 days to explain the methodology, based on the field manual, where the definitions, design, variables, field forms, location and measurement techniques, contact with owners, interview techniques were detailed.
• 2-3 days for field work, which was preferably carried out in the sampling units already established for NFI 2002-03. The practices were carried out on location with GPS and topographic maps, organization of crews, location of permanent marks, homogenization of measurements of plots and trees, identification of land uses and forest types, filling out forms and entering the database.

Each field crew was made up of the following people:
• Field team leader: Forest engineer with the function of coordinating field activities, and overseeing the responsibilities of each member, ensure the correct use of the measurement equipment and complete the information on the forms.
• Field assistant: with the function of supporting the correct location of the plot and performing dasometric measurements.
• Two local assistants: in charge of guiding the team, opening the way, assisting in the measurement and identification of species.

In total, 1086 permanent and 6 temporary sampling units were measured. 2 sampling units were not lifted surveyed because they were located in water. The data collection in each sampling unit carried out by the crews is described below:
• Contact with owners, the Technical Unit provided letters of presentation of the project. Due to the great socio-cultural diversity of the country, each team had to contact the INAB or CONAP regional government offices, local governments and community leaders. It was recommended to use different strategies according to the conditions of each site.
• Access and transportation, each team had to analyze the form of access to each sampling unit relying on information from institutions and local guides. Each team was responsible for its own transportation (vehicle, boat, or pack animals).

• Location of sampling units and plots: it had to be done through navigation with GPS and topographic maps. At the starting point located, they placed a permanent mark (galvanized iron pipe) and made a strict description following the field forms. They drew the cartographic details of each plot and located the position of each measured tree.
• Data collection, based on the manual and field forms.
• Interviews, they collected information through 30-minute interviews with three types of users or knowledgeable people of each sampling area:
- owner or manager of the area
- user different from owner
- staff from government institutions or researchers.
- a local language-speaker was hired as a guide, facilitating plot access and tree identification.
• Collection of samples for herbarium. Due to the difficulty of identifying forest species due to the linguistic diversity of the country, the teams had to collect the doubtful specimens for taxonomic determination in the herbarium of the Faculty of Agronomy of the University of San Carlos, with whom they have a cooperation agreement.
• Field reports, which should have the following information:
- Geographic location, accesses and description of the sampling unit, including maps.
- Description of each measurement plot, emphasizing the location of the permanent mark and the land uses and forest types measured.
- Observations on the measurement of variables and interviews.
- Photo catalog with their descriptions.
- Field forms with complete information.

All field forms were in Spanish, and the design was based on the FAO-NFMA design (see “National Forest Monitoring and Assessment – Manual for integrated field data collection” at http://www.fao.org/3/ap152e/ap152e.pdf for more information). The forms are summarized below:
• Form 1: Data of the sampling unit. Location, registration of the crew, data of nearby towns and access.
• Form 2: Data for each plot. Register of owners and farms (2a), location of permanent mark (2b), sketch or plan of the plot (2c).
• Form 3. Data on land use classes and forest types. Biophysical and management registry (3a), registry on forest uses and services (3b).
• Form 4. Topography, soil and registration data of the regeneration plots.
• Form 5. Tree registration.
• Form 6. Registration of non-timber products (bayal, mimbre and xate).
More information can be obtained in the adjunct documents “Inventario Forestal Nacional de Guatemala: Manual de Campo” and “Evaluación Nacional Forestal: Inventario Nacional Forestal de Guatemala 2002-2003”.

To obtain the best data quality, several quality assurance and supervisory monitoring activities and control routines were implemented:
• The technical support unit (TU) participated in the survey of the first plot of each field crew group (hot check), to solve doubts about the methodology and classification of forest types, in addition, to observe the good,
execution, measurement and recording of data in the forms.
• With the support of several regional technicians from INAB, CONAP, and municipalities, the data collection was supervised and monitored in 28 sampling units (26%).
• As a routine control in the measurements, 9 sampling units were measured again (cold checks), this also allowed obtaining the experience of relocating the plots and measurements with the information provided in the field reports.
• At the end of half of the field surveys, a meeting was held with the consultants to discuss the difficulties encountered and standardize criteria on issues such as classification of forest types, interview and identification of common tree names.
• All sampling units passed through different control filters. Field forms and databases had to be delivered 1-2 weeks after the survey, for the TU review. Reports and databases were returned for presented inconsistencies to be corrected. The corrected reports and databases were sent back to the TU, where they were reviewed again and if they did not contain errors they were accepted and submitted to the central data base.
• The location of all sampling units was checked by digitizing the information from the GPS.
• At the end of half of the field surveys, a meeting was held with the consultants to discuss the difficulties encountered and standardize criteria on issues such as classification of forest types, interview and identification of common tree names.

Data Processing

Data Editing

The databases of each sampling unit were entered into the general NFI database by the field crews, after the approval of the reports and field forms. Subsequently the last control filter was performed by the technical unit, based on a protocol of review of the database: scientific names of species were normalized, development of outlier analysis, data gaps, discussions and decisions of data management. The review criteria for each registered attribute were reported. The data processing rout map was performed for the estimation and reporting with the support of national and international specialist.

The processing and analysis was carried out in Microsoft Excel. This program has certain advantages, although it is not the most suitable for all processing, however, since it was the most accessible tool at the beginning of the project, it was decided to use it. However, the importance of building a more adequate database was discussed, and that is how FAO-FRA created a Microsoft Access Data Management System for all the projects they have worldwide, so the data was migrated from Excel. Certain adaptations were made to each of the countries, according to the information requirements.

The structure of the Excel and Access databases are quite compatible, since from the design of the forms, easy links were sought between all the information of the NFI. In the documentation (“Evaluación Nacional Forestal: Inventario Nacional Forestal de Guatemala 2002-2003”) the field forms can be found. For each field form, there is an Excel sheet and an Access form.

Data Appraisal

Estimates of Sampling Error

All the estimates were made with the estimation error, which is the limit of the estimator with a confidence level of 95% (alpha/2) expressed as a percentage of the mean.

The NFI 2002-03 design has a multidimensional approach, that is, it includes information on various topics related to forest resources and areas outside the forest. That is why there are several target populations from which various measurements were obtained according to the variables that were initially proposed. On the other hand, a design was sought that is practical and economical that provides information at the strategic level for the country, and not at the specific planning level of management units. Under these considerations, it is necessary to interpret the results of the estimates obtained and their respective sampling errors, where each user decides their use depending on the level of risk that this error can determine. There is no scientific way to decide which error is acceptable, because it is an administrative, pragmatic and even political decision. The estimation error is a function of the variability of the data for each variable. In addition, they are also affected by the number of samples that we have of each variable in the sample. The greater the number of samples, the more precise and potentially more accurate the data.

Forest inventories are designed depending on the geographical distribution of the elements to be measured. The largest elements of IFN 2002-03 are forests and the smallest were the leaves, roots and stems of non-timber forest products. Thus, the design tried to focus on the range of intermediate elements, obviously the trees being the most important according to the objectives and information needs. Currently a stratified systematic design was used, which had a direct effect on the size of the units to be measured, which is why in general better precision was achieved in the elements that occupy more area than in those scarce. However, high errors should not totally disqualify the data, since they only indicate that the probability of not being close to reality is high, a reality that will not be known exactly without an accurate, difficult and expensive measurement. The data can be used as long as these considerations are taken into account and that there is no better data so far.

Errors in variables that depend on a mathematical function or equation are also affected by its quality. During IFN 2002-03, acceptable functions were achieved for each of the coniferous species, which come from a study with known protocols. But on the other hand, the function used for broadleaves was general for all species and no specific information was obtained on their elaboration, however it is the most currently used in the country. The biomass functions, for their part, are also general and elaborated with trees of tropical species from several countries. Due to these drawbacks, for the variables of volume and biomass of trees, the use of basal area estimation errors is recommended, since it is a simpler calculation, thus providing better data on the variability of the estimates.

Other forms of Data Appraisal

Documentation available includes results tables based on aggregation at different levels in field manuals, all in Spanish:
- “Inventario Forestal Nacional de Guatemala: Manual de Campo”.
-“Evaluación Nacional Forestal: Inventario Nacional Forestal de Guatemala 2002-2003”
- "Aportes de la información del inventario forestal nacional a las políticas que involucran en sector forestal de Guatemala"
-- "Resumen de resultados del Inventario Forestal Nacional 2002-2003"