

# Nigeria - Nigeria National Forest (Carbon) Inventory

**Federal Department of Forestry, Federal Ministry of Environment**

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## Identification

### SURVEY ID NUMBER

NGA\_2017\_2021\_NFI\_v01\_M\_v01\_A\_ESS

### TITLE

Nigeria National Forest (Carbon) Inventory

### ABBREVIATION OR ACRONYM

NFI

### COUNTRY

Name	Country code
Nigeria	NGA

### STUDY TYPE

Forest resource survey

### SERIES INFORMATION

Previous forest inventories in Nigeria were conducted in the 1930s, 1964–1967, and 1973–1977. Between 1985 and 1987, the Federal Department of Forestry initiated the High Forest Monitoring, while from 1996 to 1999 the Federal Government of Nigeria carried out a national forest inventory named Forest Resources Study (FRS). No national inventory was carried out between 1999 and this study.

### ABSTRACT

The Nigeria National Forest (Carbon) Inventory was conducted to estimate forest biomass, carbon stocks, and carbon dioxide equivalents across the country's ecological zones in support of the National Forest Monitoring System (NFMS) and REDD+ reporting.

Using a stratified random cluster sampling design, field data were collected from sample plots distributed across major ecological zones.

Measurements included live trees, standing and lying deadwood, stumps, and litter. Wood density samples and tree height-diameter models were used with allometric equations to estimate above- and below-ground biomass and carbon stocks. Data collection combined digital tools and manual forms to improve accuracy.

Results showed the highest biomass and carbon stocks in montane forests, followed by mangroves and lowland rainforests, while Sudan and Sahel savannas had the lowest. The study also assessed species diversity, which was highest in lowland rainforest ecosystems. The inventory provides emission factors for national greenhouse gas estimation and recommends expanding field measurements to improve accuracy and credibility of future carbon assessments.

### KIND OF DATA

Sample survey data [ssd]

### UNIT OF ANALYSIS

Fields/plots

## Scope

### NOTES

The study covers forest carbon pools including above-ground biomass, below-ground biomass (indirectly estimated), deadwood, litter, and vegetation attributes, as well as species diversity and ecological distribution across Nigeria's forest ecosystems.

### TOPICS

Topic
Environmental study

Biomass
Carbon
REDD+

## KEYWORDS

<b>Keyword</b>
Forest inventory
Biomass
Carbon stock
REDD+
Measurement, Reporting, Verification (MRV)
Greenhouse Gases (GHG)
Species diversity

## Coverage

## GEOGRAPHIC COVERAGE

National coverage across major ecological zones (mangrove, freshwater swamp, lowland rainforest, derived savanna, Guinea savanna, montane forest, Sudan and Sahel savannas).

## UNIVERSE

Forest ecosystems across Nigeria, including trees, deadwood, litter, and vegetation within defined ecological zones. Not all carbon pools were directly measured (soil and some components estimated indirectly).

## Producers and sponsors

## PRIMARY INVESTIGATORS

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## PRODUCERS

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Food and Agriculture Organization of the United Nations	FAO	United Nations	
Federal Government of Nigeria	FGN		

## FUNDING AGENCY/SPONSOR

Name	Abbreviation
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## Sampling

### SAMPLING PROCEDURE

The Nigeria National Forest (Carbon) Inventory adopted a stratified random cluster sampling design to ensure representation of all major ecological zones in the country. The ecological zones served as strata and included mangrove forest and coastal vegetation, freshwater swamp forest, lowland rainforest, derived savanna, Guinea savanna, montane forest, Sudan savanna, and Sahel savanna. This stratification allowed the inventory to capture variations in forest structure, biomass, and carbon stocks across environmental gradients. Sampling units were distributed using a systematic grid-based approach. A 10 km × 10 km grid was applied in most ecological zones, while a 5 km × 5 km grid was used in mangrove areas. Each sampling unit consisted of a cluster of three square plots (35 m × 35 m) arranged in an L-shaped configuration and spaced 100 meters apart.

Within each 35 m × 35 m plot, a nested subplot system was applied:

- Nest 1 (35 m × 35 m; 1,225 m<sup>2</sup>): All trees and standing deadwood with DBH > 40 cm;
- Nest 2 (25 m × 25 m; 625 m<sup>2</sup>): Trees and standing deadwood with DBH 20–40 cm;
- Nest 3 (7 m × 7 m; 49 m<sup>2</sup>): Trees and standing deadwood with DBH 5–20 cm;
- Nest 4 (2 m × 2 m; 4 m<sup>2</sup>): Saplings with DBH < 5 cm

For lying (downed) deadwood, all fallen trees with diameter greater than 10 cm were measured across the entire 35 m × 35 m plot, while those between 2 cm and 20 cm were measured within the 7 m × 7 m subplot. Standing deadwood followed the same diameter thresholds as live trees.

For litter and non-tree vegetation, measurements were conducted within small quadrats (clip plots) established inside the sampling plots. Litter was collected, weighed, and used to estimate biomass and carbon content.

The number of clusters allocated to each ecological zone followed an optimal allocation procedure based on previous inventory data to reduce variance and improve reliability of biomass and carbon estimates. Due to time, funding, and security constraints, only part of the initially planned 240 clusters were enumerated, but they remained distributed across ecological zones to preserve national representativeness.

Overall, the inventory was designed as a low-intensity national survey aimed at providing baseline estimates of forest biomass, carbon stocks, and greenhouse gas emission factors.

### DEVIATIONS FROM THE SAMPLE DESIGN

The initial sampling design envisaged data collection from 240 clusters distributed across the ecological zones of the country. However, due to constraints related to security, accessibility, logistics, funding, and time, only 114 clusters were successfully enumerated during the initial inventory phase. Nevertheless, representation across the major ecological zones was maintained.

Based on the distribution of enumerated clusters reported in Table 4 of the modified Forest Reference Emission Level (FREL) submission to the UNFCCC (2019), available in the Downloads section, field data collection during the initial inventory phase was conducted in the following States: Jigawa, Katsina, Kebbi, Nasarawa, Ogun, Ondo, Oyo, and Taraba.

Consequently, compared with the original NFI manual, the following States were not included in the implemented inventory phase: Akwa Ibom, Anambra, Bauchi, Benue, Borno, Ebonyi, Edo, Ekiti, Enugu, Imo, Kaduna, Kano, Kwara, Lagos, Niger, Osun, Sokoto, and the Federal Capital Territory (FCT).

The slight discrepancy between the 114 clusters reported in earlier inventory records and the 116 clusters reflected in the modified Forest Reference Emission Level (FREL) submission is likely attributable to differences in reporting stages, dataset harmonization, and subsequent data consolidation processes.

These exclusions were primarily driven by security concerns, difficult terrain conditions, and accessibility limitations, all of which constrained field operations and safe deployment of inventory teams. It is important to note that the NFI was designed as a low-intensity reconnaissance inventory intended to capture variability across ecological zones rather than achieve exhaustive spatial coverage at the State level.

Despite the exclusion of several States, sampling coverage across the major ecological zones was preserved. In addition, supplementary inventory activities were conducted in some previously inaccessible States after publication of the manual. However, these additional datasets remain in raw form and have not yet been fully processed, validated, analyzed, or officially published; therefore, they are not included in the present dataset.

## RESPONSE RATE

Response rates varied considerably across ecological zones. Higher response rates were observed in Montane Forest (100 percent), Sahel Savanna (83.3 percent), and Mangrove Forest (70.6 percent), while lower response rates were recorded in Sudan Savanna (16 percent), Guinea Savanna (36.1 percent), and Derived Savanna (36.1 percent). These variations likely reflect differences in accessibility, security conditions, terrain difficulty, and operational constraints encountered during field implementation.

## WEIGHTING

Each sample plot represents a known land area derived from the sampling grid and plot design used in the National Forest Inventory (NFI). Biomass and carbon measurements collected from the plots were converted into per hectare estimates using scaling factors derived from plot area. Carbon stock estimates were subsequently aggregated and reported separately for each ecological zone.

The sampling design was stratified by ecological zone, with cluster allocation across strata defined in the sampling framework. Although the total area of each ecological zone was not explicitly reported in the primary inventory dataset, ecological zone statistics are available in Appendix 6, page 61, of the modified Forest Reference Emission Level (FREL) submission to the UNFCCC (2019), available in the Downloads section. These statistics can be used to derive approximate stratum weights based on the proportion of the total land area represented by each ecological zone.

However, explicit area based weighting coefficients were not included in the published dataset. Instead, the estimation approach relied primarily on plot level expansion factors and stratified aggregation procedures consistent with the stratified random cluster sampling design adopted for the inventory.

Consequently, no separate weighting variable was directly provided in the dataset. Estimates were generated through ecological zone level aggregation and scaling procedures embedded within the inventory methodology rather than through externally applied post stratification weights.

## Data collection

### DATES OF DATA COLLECTION

Start	End
2017	2021

### DATA COLLECTION MODE

Field measurement

## Data Processing

### DATA EDITING

Data were verified and cleaned after collection; digital tools (FAO Collect Mobile App) and manual forms were used to reduce errors, particularly in species identification and field measurements.

## Access policy

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**CONFIDENTIALITY**

The confidentiality conditions will be based on the external repository, owned by the country.

**ACCESS CONDITIONS**

Data available on an external repository. The access conditions will be based on the external repository, owned by the country.

**CITATION REQUIREMENTS**

FAO. 2020. Nigeria - National forest (carbon) inventory field manual. Abuja. <https://doi.org/10.4060/cb2087en>

## Disclaimer and copyrights

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**DISCLAIMER**

The user of the data acknowledges that the original collector of the data, the authorized distributor of the data, and the relevant funding agency bear no responsibility for use of the data or for interpretations or inferences based upon such uses.

## Metadata production

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**DDI DOCUMENT ID**

DDI\_NGA\_2017\_2021\_NFI\_v01\_M\_v01\_A\_ESS\_FAO

**PRODUCERS**

<b>Name</b>	<b>Abbreviation</b>	<b>Affiliation</b>	<b>Role</b>
Statistics Division	ESS	Food and Agriculture Organization of the United Nations	Metadata adapted for FAM

**Data Dictionary**

<b>Data file</b>	<b>Cases</b>	<b>Variables</b>
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