

Bangladesh Forest Inventory 2019

Forest Department, Ministry of Environment, Forest and Climate Change, Khulna University

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Identification

SURVEY ID NUMBER

BGD_2019_BFI_v01_M_v01_A_ESS

TITLE

Bangladesh Forest Inventory 2019

ABBREVIATION OR ACRONYM

BFI 2019

COUNTRY

Name	Country code
Bangladesh	BGD

STUDY TYPE

Forest resource survey

SERIES INFORMATION

Multiple forest inventories have been conducted in Bangladesh for different purposes and at various geographic scales. The first inventory, conducted from 1769 to 1773, was limited to selected forest areas in the Sundarbans. Subsequently, various inventories were undertaken to prepare forest management plans for major forest types, focusing primarily on forest area and estimates of growing stock within designated forest reserves.

The first national forest and tree resource assessment, called the "National Forest Assessment (NFA)," was carried out in Bangladesh from 2005 to 2007. This comprehensive assessment covered both forests and trees outside forests, employing remote sensing analyses and a ground inventory with 299 systematically designed sampling plots across the country. While the NFA successfully provided national estimates of forest resources, its effectiveness for monitoring tree and forest resources over time was limited due to difficulties in re-locating field inventory plots and the inadequate documentation of the previous field data collection process.

ABSTRACT

The Bangladesh Forest Inventory (BFI) was developed to support sustainable forest management and promoting forest monitoring system. BFI contains the biophysical inventory and socio-economic survey. The design and analysis of the components was supported by remote sensing-based land cover mapping. The inventory methodology was prepared with technical consultations with national and international forest inventory and land monitoring experts and employed by the Forest Department under the Ministry of Environment, Forests and Climate Change to establish the BFI as an accurate and replicable national forest assessment.

Biophysical inventory involved visiting of 1781 field plots, and the socioeconomic surveying covered 6400 households. Semi-automated segmented land cover mapping used for object-based land characterisation, mobile application for onsite tree species identification, Open Foris tool for data collection and processing, R statistical package for analysis and differential GPS for plot referencing used. Seven major criteria and relevant indicators were developed to monitor sustainable forest management, informing both management decisions and national and international reporting. Biophysical and socioeconomic data was integrated to estimate these indicators. BFI provided data and information on tree and forest resources, land use, and ecosystem services valuations to the country. BFI made the sample plots as permanent for the continuous assessment of forest resources and monitoring over time.

KIND OF DATA

Sample survey data [ssd]

UNIT OF ANALYSIS

Fields/plots

Scope

NOTES

The Bangladesh Forest Inventory (BFI) encompasses a comprehensive range of topics designed to inform sustainable forest

management through detailed data collection and analysis. The inventory is structured around seven key criteria, each addressing crucial aspects of forest and tree resources in Bangladesh.

Forest Extent and Tree Cover Changes:

This criterion examines the spatial extent and changes in forest and tree cover, providing insights into forest area distribution and trends over time, including major forest types and tree cover in non-forest areas.

Biological Diversity and Conservation:

This criterion assesses the biological diversity within various land cover types, highlighting species richness, the prevalence of native versus introduced species, and the presence of threatened species, crucial for conservation planning.

Growing Stock, Biomass, and Carbon:

This criterion evaluates the volume of growing stock, biomass distribution, and carbon storage in different forest and non-forest areas, essential for understanding the role of forests in carbon sequestration and climate regulation.

Forest Management and Ownership:

This criterion explores forest management practices, land ownership patterns, and the extent of managed land, including plantations and agroforestry systems, providing insights into resource management and land use dynamics.

Tree and Forest Disturbances:

This criterion identifies and quantifies natural and anthropogenic disturbances affecting forests and trees, such as cyclones, erosion, and infrastructure development, crucial for developing mitigation and adaptation strategies.

Support for Forestry Activities:

This criterion assesses the support received by households for sustainable tree and forest management, including access to seedlings, training, and other resources, important for promoting community engagement in forestry activities.

Trees and Forests Services and Livelihoods:

This criterion examines the socio-economic benefits derived from trees and forests, including materials, energy, nutrition, and income, highlighting the economic significance of forest resources to rural livelihoods.

TOPICS

Topic
Tree and Forest Resource Assessment

KEYWORDS

Keyword
National Forest Inventory
Forest Resources
Forest Monitoring
Carbon Sequestration

Coverage

GEOGRAPHIC COVERAGE

National

UNIVERSE

The country was divided into five distinct strata/zone for allocation of sample plots to represent the forest and trees outside forest properly. Also, the interaction of community with forest and trees and their dependency were also considered. For monitoring purposes, the samples were made permanent, and the boundary of the zones are defined in such a way that may not change easily. The five zones of Bangladesh Forest Inventory are Sundarbans (natural Mangrove Forest) Zone, Coastal (coastal plantations including mangrove plantation) Zone, Hill (evergreen and semi evergreen hilly forest areas) Zone, Sal (Deciduous Forest) Zone and Village (mainly tree outside forest and social forestry) Zone. The universe is the tree populations across the country, included trees in and outside forest land in all five subpopulations.

Producers and sponsors

PRIMARY INVESTIGATORS

Name

Forest Department
Ministry of Environment, Forest and Climate Change
Khulna University

PRODUCERS

Name	Abbreviation
Food and Agriculture Organization	FAO
Silvacarbon	

FUNDING AGENCY/SPONSOR

Name	Abbreviation
United States Agency for International Development	USAID

Sampling

SAMPLING PROCEDURE

The sampling strategy for the National Forest Inventory (NFI) in Bangladesh comprises multiple steps, including Zoning, Land Cover development, Biophysical Inventory, and Socioeconomic Survey.

Zone: The country is divided into five zones—Sal, Sundarbans, Village, Hill, and Coastal—based on geographical conditions, species diversity, forest types, and human interaction. The socioeconomic survey zones correspond to the biophysical zones, with the Sundarbans zone referred to as the Sundarbans periphery zone.

Land Cover: The Land Representation System of Bangladesh (LRSB) was developed using an object-based classification approach with the Land Cover Classification System (LCCS v3) and satellite imagery. The 33 land cover classes from the 2015 Land Cover Map were aggregated into Forest or Other Land categories following FRA definitions.

Biophysical Inventory Design: The biophysical component employs a pre-stratified systematic sampling design with variable intensities for each zone. Sample intensity was determined by a 5% confidence interval target for tree resource estimates, utilizing Neyman allocation for plot distribution. Plots were randomly placed within a hexagonal grid, with distances ranging from 5900 to 10400 meters, resulting in 2245 plot locations, of which 1858 required field visits. Each plot included subplots of 19m radius in the Sundarbans and 5 subplots in other zones. Trees with DBH \geq 30 cm, 10-30 cm, and 2-10 cm were measured in 19m, 8m, and 2.5m radius plots, respectively. Soil samples were collected at 8m from the subplot centre at a 270° bearing.

Socioeconomic Survey Design: The socioeconomic survey utilized a multi-stage random sampling method. It was based on the hypothesis that tree and forest ecosystem services correlate with tree cover per household. Tree cover data from 2014 Landsat images and household data from the 2011 Census were used to calculate Household Tree Availability. The five zones were divided into four strata each, based on tree cover availability. In each pre-selected union, 20 households were surveyed (totalling 6400 households) by navigating to random GPS points. Additionally, 100 qualitative surveys were conducted through Focus Group Discussions across the zones, involving community leaders and special forest user groups.

This comprehensive sampling strategy ensures robust data collection on forest resources and their socioeconomic interactions.

DEVIATIONS FROM THE SAMPLE DESIGN

Biophysical inventory: around 4% deviation took place because of inaccessibility issues mostly in hill regions

Socioeconomic survey: 0 deviation from the sample design

RESPONSE RATE

Biophysical Inventory: 1781 sample plots were inventoried among the total of 1857 plots, which is around 96%.

Socioeconomic Survey: 100% of targeted household numbers were surveyed, which is 6400.

WEIGHTING

The Inventory followed a stratified random sampling. This process was repeated for each zone using initial precision requirements. However, the ultimate requirements are at the national level. An efficient way to allocate the plots to the zones is to use Neyman allocation. As followed that the plots are allocated based on weights computed as reflecting the zone's contribution to the variance of the total. The larger and more variable zones get more plots. A tool to estimate and

manage resources in national NFI designs “FRIED”; were used to compute the Coefficients of Variation (CV) which were known from prior inventory data.

Data collection

DATES OF DATA COLLECTION

Start	End
2016	2019

DATA COLLECTION MODE

Field measurement [field]

data_processing

DATA EDITING

In BFI field data collection, data cleaning, quality control, and data archiving were part of a simultaneous process performed both in the field and in the central office. Open Foris Collect was used for data collection and processing. Collected data were submitted to the central office unit for managing, cleaning, archiving and further processing. As field data were collected, they were checked for outliers or suspect data entries, both manually and with R scripts. If an obvious correction was needed, it was updated in the Open Foris database, otherwise the field teams were consulted about suspect data to understand the problem and take further decision.

At the same time, four QA/QC teams performed quality assessments of data collection directly in the field through hot and cold checks. Hot checks allowed for the opportunity to improve data in the field. Cold checks provided the issues to be considered and identify the check list also the data will be acceptable or not, in case of unacceptable data remeasurement of plot took place. In the biophysical inventory, 39 hot checks, 54 cold checks were conducted, which is about 5% of the sampled plots. The total number of plots re-measured was 52. For the socio-economic survey, 254 hot checks, 13 cold checks, which is about 4% of the total number of households sampled.

Microsoft Access database was prepared using the data exported from collect, which also enabled to generate reports with images collected from the field. With new data, the database was updated accordingly.

Data cleansing conducted using Collect desktop and R statistical tool. Manual checks for records were done in Collect. R generated quality control checks were also used to identify possible inconsistencies. Inconsistencies were confirmed and corrected through consulting to the field crews or data collectors by and updated later in the collect database.

data_appraisal

ESTIMATES OF SAMPLING ERROR

Please refer to Table 5.10 of the Report on the Bangladesh Forest Inventory for more information on the estimates of sampling error.

DATA APPRAISAL

Socioeconomic survey had nonresponse 0%, whereas Biophysical inventory had non-response around 4%. However, knowing the fact that non-response introduce bias, and to minimize the bias estimates methods developed.

1. Treat as zeros but show the area by inaccessible class. This is transparent, so it is recommended to always present the proportion of inaccessible plots.
2. Partition inaccessible zones and report them as such. This clearly identifies regions that could not be sampled.
3. Drop the plots from estimation. This treats the inaccessible plots as if they had the strata mean. For partially accessible plots, a special estimator must be used, such as the ratio-to-size estimator or that used by FIA (Bechtold and Scott 2005) to account for the missing portion of the plot.

Mostly methods 1 and 3 used. Method 2 were used if there are inaccessible regions.

Access policy

CONTACTS

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CONFIDENTIALITY

The confidentiality conditions will follow the conditions set by the external repository (owned by the country).

ACCESS CONDITIONS

Data available on an external repository. The access conditions will follow the conditions set by the external repository (owned by the country).

CITATION REQUIREMENTS

Use of any content requires acknowledgment and will follow the conditions set in the external repository (owned by the country).

Disclaimer and copyrights

DISCLAIMER

Any user of the data must acknowledge and agrees with disclaimer set by the external platform called the "Bangladesh Forest Information System" owned by the country.

Metadata production

DDI DOCUMENT ID

DDI_BGD_2019_BFI_v01_M_v01_A_ESS_FAO

PRODUCERS

Name	Abbreviation	Affiliation	Role
Dissemination and Outreach Team, Statistics Division		Food and Agriculture Organization	Metadata adapted for FAM
Development Economics Data Group	DECDG	The World Bank	Metadata adapted for World Bank Microdata Library

DDI DOCUMENT VERSION

Identical to a metadata (BGD_2019_BFI_v01_EN_M_v01_A_ESS) published on FAO microdata repository (<https://microdata.fao.org/index.php/catalog>). Some of the metadata fields have been edited.

data_dictionary

Data file	Cases	variables
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study_resources

reports

Bangladesh Forest Inventory Report (Tree and Forest Resources of Bangladesh)

title Bangladesh Forest Inventory Report (Tree and Forest Resources of Bangladesh)
country Bangladesh
filename BFI-Report_final_08_02_2021.pdf

technical_documents

Bio-physical Manual (Field Instructions for the Bangladesh Forest Inventory)

title Bio-physical Manual (Field Instructions for the Bangladesh Forest Inventory)
country Bangladesh
filename BFI_manual.pdf

4. QA/QC manual for Biophysical survey

title 4. QA/QC manual for Biophysical survey
country Bangladesh
filename 6086-f.pdf

QA/QC manual for socioeconomic survey

title QA/QC manual for socioeconomic survey
country Bangladesh
filename 3148.pdf

Estimation Procedures of Indicators and Variables of the Bangladesh Forest Inventory

title Estimation Procedures of Indicators and Variables of the Bangladesh Forest Inventory
country Bangladesh
filename BFI_analysis_document_final_v4.pdf

Socioeconomic survey design

title Socioeconomic survey design
country Bangladesh
filename 384b.pdf

Soil measurement manual

title Soil measurement manual
country Bangladesh
filename 6087.pdf

Bangladesh Forest Inventory data management protocol

title Bangladesh Forest Inventory data management protocol
country Bangladesh
filename 9001.pdf

Socioeconomic field instructions Manual

title Socioeconomic field instructions Manual
country Bangladesh
filename 966.pdf
