

# NATIONAL FOREST INVENTORY LAO PDR 2019

## OVERVIEW

### Study type

Forest Survey

### Abstract

The objectives of the 3rd NFI are first to update the emission factors for the five natural forest classes (Evergreen forest, Mixed Deciduous forest, Dry Dipterocarp forest, Coniferous forest, and Mixed Conifer and Broadleaf forests) used for the first Lao national MRV and second to measure the carbon emission caused by selective logging and assess the impact of PM 15 with the stump data collection.

The main target of the survey was to measure the forest carbon, however, other information, such as observed disturbances and NTFP (Non-Timber Forest Products) were also recorded.

The 3rd NFI was conducted by following the Standard Operation Procedures (SOP) Manual for Terrestrial Carbon Measurement which was updated after the 2nd NFI. The updated SOP essentially improves the previous SOP without changes to the underlying technical methodology.

The 3rd NFI involved also a Quality Control (QC) survey conducted by a separate team of more experienced FIPD staff to re-measure more than 10% of the total number of survey plots (i.e. 47 plots out of the total 415 plots).

The QC survey plots were distributed to secure a minimum 10% for each forest class at the national level. The QC survey followed the same methods with the main survey.

### Past similar studies

The 1st NFI that focused on Timber Volume estimation was conducted between 1991 and 1999. For the requirements of REDD+, a new approach focusing on biomass stock measurements and NTFP observation was developed and tested in 2015. The 2nd NFI took place in 2016-2017 and the results were used for the establishment of the Lao FREL/REL. It was implemented by the Forest Inventory and Planning Division (FIPD) of the Department of Forestry (DOF) within the Ministry of Agriculture and Forestry (MAF), triggered to report REDD+ under the UNFCCC.

### Unit of analysis

A forest inventory survey measuring trees and standing dead wood (including stumps) in Natural forest area According to Forest Type Map. Presence/absence of Non-Timber Forest Products is recorded.

### Geographical coverage

National coverage

### Universe

Trees and standing dead wood  $\geq 10$  cm DBH (diameter at breast height) were surveyed only in the five natural forest classes.

### Scope

The scope of the 3rd NFI is limited to natural forest classes, and excludes forest plantations, due to the relatively small expanse and availability of applicable IPCC default factors for biomass estimation for the purpose of REDD+ results estimation. Bamboo and Regenerating Vegetation classes which fall outside the national forest definition of "current forest" (stand DBH: minimum of 10cm, crown density: minimum of 20%, area: minimum of 0.5ha) were also excluded.

Although Bamboo was measured in 2nd NFI as one of the components of the AGB for the surveyed forest classes.

The biomass of Regenerating Vegetation was separately surveyed in the “2nd RV Survey”. See DOF, et al. (2018). Update survey of a Lao specific biomass prediction model for regenerating vegetation and confirmation of the threshold number of years since abandonment, as Regenerating Vegetation, before becoming current forest.

## **Keywords**

forest, carbon, tree biomass, tree volume, deadwood, land use, canopy cover, tree biodiversity, forest production, land cover, forest fire evidence, non-timber forest products, random sampling.

## **SAMPLING**

### **Sampling strategy**

The sampling strategy is a two-stages stratified random sampling with floating clustered plots and nested subplots design. Primary Sampling Units (PSU) were 3 km width squares. Within each PSU, 4 circular plots of 20 m radius were measured (Secondary sampling units, SSUs).

All lands were stratified in 5 forest type-based strata. A 3 km width square grid was laid out on the country map and within each square (i.e. PSU), an anchor plot, i.e. SSU, was located randomly in one of the forest strata. Up to 9 additional plots were randomly located within 300 m (but not closer than 75 m) of the anchor plot in forest lands for the field teams to be able to find 3 additional measurable plots.

Within each plot all living trees, standing deadwood and stumps were measured in nested subplots. Small trees (diameter at breast height, DBH, less than 30 cm) were measured in 6 m radius subplot, medium trees (DBH between 30 and 50 cm) in 15 m radius plots, and large trees (DBH bigger than or equal to 50 cm) in 20 m radius subplots.

### **Weighting**

Sample weights per stratum and on a per ha basis were determined according to area expansion factors (regarding a reference 0.126 ha. total area per SSU). Hence, they are given as:

- Weight of  $DBH \geq 50$  cm circular plot measured trees:  $1 \text{ ha}/0,126 \text{ ha} = 7.96$
- Weight of  $49.9 \geq DBH \geq 30$  cm circular plot measured trees and regeneration:  $1 \text{ ha}/0.071 \text{ ha} = 14.15$
- Weight of  $29.9 \geq DBH \geq 10$  cm circular plot trees measured:  $1 \text{ ha}/.011 \text{ ha} = 88.42$

### **Response Rates**

Out of the 415 plots originally included, only 359 were finally within forests. Hence 86.5% response rate can be considered.

### **Deviations from the sample design**

Given the particularities behind the design, where only 359 out of 415 originally designed plots ended up accounting for the sampling universe, it is considered that 13.5% of the plots constituted a deviation from the original design.

## **DATA COLLECTION OPERATIONS**

### **Data collection period**

The survey period was from January to April 2019. The data reference period is 2015-2019

### **Data collection mode**

The field survey was conducted by 6 field survey teams. One field survey team was composed of members from FIPD, provincial and district level Agriculture and Forestry Offices, villagers, and drivers (Table 7). Each of the team leaders were selected from the FIPD staff who were involved in the 2nd NFI and experienced

with field surveys. Measurements are made with measuring tapes and clinometer and are recorded by the team leader on the sub-plots site on a tablet using ODK form.

## **DATA PROCESSING**

### **Data editing**

- Data collection in field:

During all data collection in the field, the crew member responsible for recording must repeat all measurements called by the crew member conducting the measurement. This is to ensure the measurement call was acknowledged and that proper number is recorded on the data sheet. In addition, all data sheets should include a 'Data recorded by' field with the name of the crew member responsible for recording data. If any confusion exists, the transcribers will know which crew member to contact.

After data is collected at each plot and before the crew leaves the plot, the crew leader shall double check to make sure that all data are correctly and completely filled. The crew leader must ensure the data recorded matches with field conditions, for instance, by verifying the number of trees recorded.

- Data sheet checks:

After data sheets have been validated by crew leaders, the data entry process can commence. When using tablet based data collection methods, a significant degree of data sheet checks is automatically integrated into the electronic forms. Data parameter limits are integrated into the electronic form to prevent erroneous entries being entered (for e.g. a DBH of 1000cm instead of 100.0cm) or data entries being missed (the electronic form will not allow you to progress unless certain data parameters have been entered into the form. Nevertheless, the team leader should re-check data entered into the forms before being submitted to the cloud server.

- Field data collection Hot Checks:

After the training of field crews has been completed, observations of each field crew and each crew member should be made. A lead coordinator shall observe each field crew member during data collection of a field plot to verify measurement processes and correct any errors in techniques. It is recommended that the crew chiefs switch to a different crew to ensure data collection procedures are consistent across all field crews. Any errors or misunderstandings should be explained and corrected. These types of checks should be repeated throughout the field measurement campaign to make sure incorrect measurement techniques have not started to take place.

- Data Entry quality control check:

This step is not necessary is making using of tablet-based data collection methods as the data is automatically collected and collated into tab delimited files in the cloud server.

- Data storage in the field

In the field one person (the Team Leader) is responsible for carrying, operating and recording field data into an Android-based tablet computer. The tablet and data collection form automatically record many types of data, including data collection start/stop time, GPS position and other features of the data collection process. Once the field team had finished the plot, the tablet automatically sent data to the cloud-based data aggregation server or any other server designated by the inventory team.

- Data storage in the office

Once the field team returned to the office or laboratory, data were downloaded from the server in all available formats (.xlsx, .csv, .pdf) and stored electronically. Specific details can be found in the Lao PDR National Forest Inventory Standard Operating Procedures (SOP) Manual for Terrestrial Carbon Measurement, available in the documentation.

### **Other forms of data appraisal**

Field measurement error estimation: A total of 13% of the clusters were remeasured as part of the Quality Control (QC). Where clustered tree-plots were used, all tree-plots within a selected cluster were measured. All trees were remeasured in each plot. Field crews taking measurements were not aware of which plots were remeasured whenever possible. The QC results showed no significant difference with the initial measurements ( $p$ -values  $> 0.05$ ).

Non-response: no corrections were implemented for the 13.54% non-response rate.

## **Estimates of sampling errors**

Non-sampling error is considered negligible as a 13% of plots remeasured showed no significant difference with the field measurements. Sampling error is estimated to 5-14 % of the resulting Carbon stock estimates depending on the strata.

## **PRODUCERS & SPONSORS**

### **Principal investigators**

Forest Inventory and Planning Division (FIPD) from the Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF)

### **Other producers**

Winrock: revision of the SOP

Forest Carbon: preparation and monitoring of the survey

### **Funding**

Sustainable Forest Management and REDD+ Support Project (F-REDD), JICA

## **CONTACT**

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