The 2nd National Forest Inventory Survey in Lao People's Democratic Republic

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Department of Forestry, Ministry of Agriculture and Forestry, Lao PDR

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

Contents

Acronyms

Acronym	Name
ADB	Asian Development Bank
AGB	Above Ground Biomass
B	Bamboo
BGB	Below Ground Biomass
CF	Coniferous Forest
CI	Confidence Interval
CliPAD	Climate Protection through Avoided Deforestation
DAFO	District Agriculture and Forestry Office
DBH	Diameter at Breast Height
DD	Dry Dipterocarps Forest
DOF	Department of Forestry
DOFI	Department of Forestry Inspection
DW	Dead Wood
EF	Emission Factor
EG	Evergreen Forest
ER-PD	Emission Reduction Program Document
FCPF	Forest Carbon Partnership Facility
FIM	Forest Information Management Project
FIPD	Forest Inventory and Planning Division
FREL/ FRL	Forest Reference Emission Level /Forest Reference Level
GIS	Geographic Information System
GPS	Global Positioning System
ITPP	Industrial Tree Plantation Project
JICA	Japan International Cooperation Agency
JICS	Japan International Cooperation System
Lao PDR	The Lao People's Democratic Republic
MAF	Ministry of Agriculture and Forestry
MCB	Mixed Coniferous and Broadleaved Forest
MDF	Mixed Deciduous Forest
NAFES	National Agriculture and Forestry Extension Service
NAFRI	National Agriculture and Forestry Research Institute
NFI	National Forest Inventory
NFIS	Capacity Development Project for Establishing National Forest Information System for Sustainable Forest Management and REDD+
NTFP	Non Timber Forest Products
NTV	Non Tree Vegetation
PAFO	Provincial Agriculture and Forestry Office
PAREDD	Participatory Land and Forest Management Project for Reducing Deforestation in Lao PDR
PKK NPA	Phou Khao Kouay National Protected Area
PSUs	Primary Sampling Units
QC	Quality Control
REDD+	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation of forests and enhancement of forest carbon stock
SD	Standard Deviation

SE	Standard Error
SOP	Standard Operating Procedure
SSUs	Secondary Sampling Units
SUFORD	Sustainable Forest Development Project
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance

1. Introduction

1.1 Background

In Lao PDR, various field survey of forests in the country have taken place in the past (Table 1) including what is regarded as the country's first National Forest Inventory (1st NFI) conducted in 1991-1999. The primary objective of the 1st NFI was standing timber volume estimation. Triggered by Lao PDR's participation in the Reducing Emissions from Deforestation and Forest Degradation – Plus (REDD+) initiative under the UN Framework Convention on Climate Change (UNFCCC), a second NFI (2nd NFI) was considered necessary, and commissioned by the Government, and implemented by the Forest Inventory and Planning Divisions (FIPD) of the Department of Forestry within the Ministry of Agriculture and Forestry (MAF). Technical and financial support was provided from JICA. Lao PDR plans to submit its Forest Reference Emission Level and Forest Reference Level (FREL/FRL) for REDD+ to the UNFCCC in 2018, using data from the 2nd NFI.

This report summarizes the objectives, methods and results of the 2nd NFI conducted over the two dry seasons of 2015-2016[1] and 2016-2017.

Table 1: Brief summary of forest inventories conducted in Lao PDR

Survey name	Main objective	Survey period	Surveyed area (provinces)	Implementing Agencies	Supporting projects / donors
National level					
1st NFI	Timber volume estimation	1991-1999	Entire country	DOF/FIPD	Sweden
2nd NFI	Biomass stock measurement	2015-2017	Entire country	DOF/FIPD	JICA, FCPF Readiness
Project-based					
SUFORD (Phase 1-3)	Timber volume estimation	2003-2017	Khammouane, Savannakhet, Salavanh, Champasack, Xekong, Attapeu, Bolikhamxay, Vientiane, Xayabouly	DoF, DOFI, NAFES, NAFRI, PAFO, DAFOs, VFUs	Worldbank, Finland

[1] The survey for the dry season 2015-2016 actually started from March 2016 after the technical support from F-REDD project became available.

Industrial Tree Plantation Project (ITPP)	Timber volume estimation	2006	Bolikhamxay, Champasack Salavanh, Savannakhet, Vientiane	ITPP	ADB
CliPAD	Biomass stock measurement	2009-2018	Xayabouly Houaphanhh	MAF, DoF, PAFO, DAFO	GiZ, KfW
PAREDD	Biomass stock measurement	2009-2014	Luang Prabang	NAFES, PAFO, DAFO	JICA
FIM	Biomass stock measurement	2010-2013	Entire country	DOF/FIPD	JICS

1.2 Objectives

The objectives of the 2nd NFI was to survey the forest biomass[2] of the five natural forest classes (i.e. Evergreen forest, Mixed Deciduous forest, Dry Dipterocarp forest, Coniferous forest, and Mixed Conifer and & Broadleaf forests). Forest plantations were excluded from the survey scope due to its relatively small area coverage and availability of applicable IPCC default factors for biomass estimation. Bamboo and Regenerating Vegetation classes were also excluded as they fall outside the national forest definition. The scope of the 2nd NFI covered the entire country, but there was specific focus on the six Northern provinces that were pre-selected as the scope for the Emissions Reduction Program (ER Program) of Lao PDR, under the Carbon Fund of the Forest Carbon Partnership Facility (FCPF).

Prior to the implementation of the 2nd NFI, a pilot survey was conducted in Khammouane province[3], and a manual for the NFI was developed[4].

Quality Control (QC) was also conducted by a team of experienced FIPD staff to re-measure 10% of the total number of survey plots (i.e. 58 plots out of the total 583 plots). The QC survey plots were distributed to secure a minimum 10% for each forest type at the national-level, and 10% of the plots for the 6 Northern provinces targeted in the ER-Program. The QC survey followed the same methods with the main survey.

[2] The main target of the survey was to measure the forest biomass, however, other information, such as observed disturbances and NTFP (Non-Tree Forest Production) were also recorded.
[3] Lao PDR National Forest Inventory Standard Operating Procedures (SOP) Manual for Terrestrial Carbon Measurement

2. Preparation

2.1 Determining the number of survey plots

The number of survey plots for the 2nd NFI (excluding the QC survey) was determined based on parameters of 'mean', 'standard deviation' and 'target precision' for each of the five forest classes. The 'mean' and 'standard deviation' of each forest class was derived from the 1st NFI data, while the 'target precision', was based on the expert judgement of FIPD and international experts after examining the existing data. The number of survey plots was calculated by applying the equation developed by Winrock International through the "Sampling Plot Calculator" tool[5].

$$number\ of\ plots\ for\ strata\ = (z * \frac{standard\ deviation}{\mathrm{t} * x})\text{^}2$$

Where:

z= score for the required confidence interval
t = level of error
x= the mean estimated biomass value of a strata (t dry matter ha-1)

The preliminary target number of survey plots for each forest class are in Table 2.

Table 2 : Preliminary target number of survey plots

Forest class	Preliminary plot number (n)	Target precision
Evergreen forest	70	<10% Error at 90% CI
Mixed Deciduous forest	200	<10% Error at 90% CI
Dry Dipterocarp forest	120	<10% Error at 90% CI
Coniferous forest	50	<20% Error at 90% CI
Mixed Conifer & Broadleaf forest	30	<20% Error at 90% CI
Total	470	

To be able to estimate carbon stocks not only for the national scale, but also for the six provinces of the ER Program, an additional 89 plots were added to maintain the same level of precision for plots at the two scales for estimating the carbon stock. The final number of survey plots are as in Table 3.

[5] Winrock International, sample plot calculator (Excel), <https://www.winrock.org/document/winrock-sample-plot-calculator-spreadsheet-tool/>.

Table 3: Final number of survey plots

Forest class	Final plot number (n)	Number of plots added (n)
Evergreen forest	95	25
Mixed Deciduous forest	264	64
Dry Dipterocarp forest	120	
Coniferous forest	50	
Mixed Conifer & Broadleaf forest	30	
Total	559	89

2.2 Distribution of survey plots

The sampling design started from selecting the primary sampling units (PSUs) and then the secondary sampling units (SSUs). This approach ensures that any location has an equal probability of being sampled. The PSUs were chosen by applying systematic sampling with random approach. Grid cells were placed across the areas to be sampled in a randomly selected orientation. The grid cells will then serve as the 'primary sampling unit' (PSUs). Once the PSUs are chosen, a particular location within the PSU is randomly chosen to initiate field sampling. This is referred to in the figure below as "SSU1".

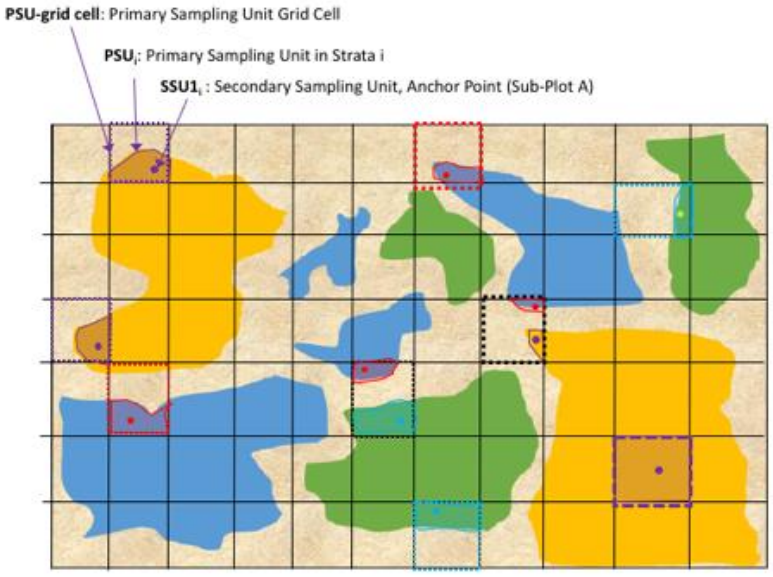


Figure 1: Example of selected PSU-grids in dashed lines and selected PSUs (polygons) with SSUs (dots) assigned within. Note, some PSU-grids may randomly be selected for two different forest classes.

A manual was developed outlining in detail the methods and procedures; "Lao PDR NFI Standard Operating Procedures (SOP); Manual for Terrestrial Carbon Measurement"[6].

The result of survey plot distribution is shown in Figure 2. The detailed information of the surveys plot are shown in Annex 8.3.

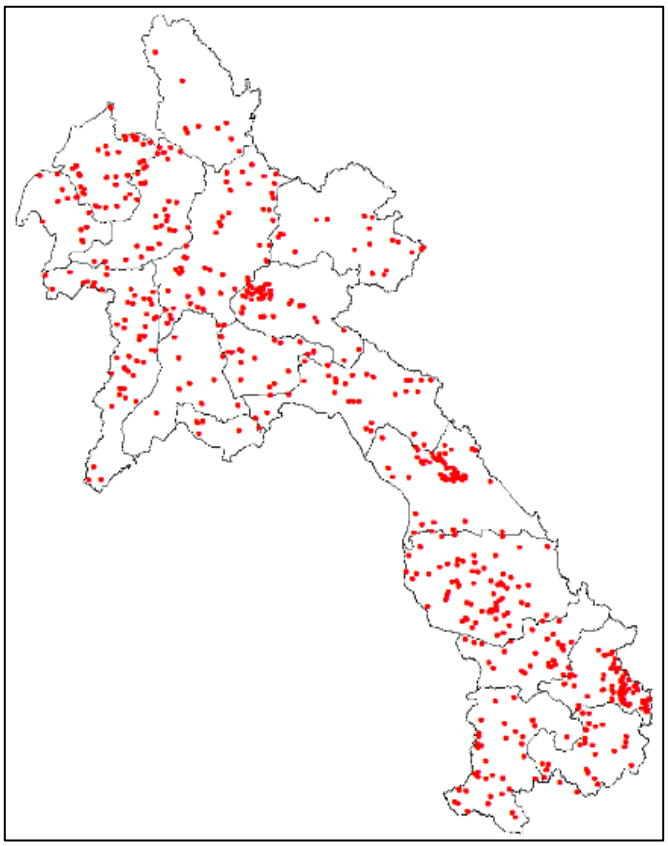


Figure 2: Surveyed plots in the 2nd NFI

2.3 Obtaining permission and list of equipment for the survey

A proposal for the 2nd NFI was prepared by FIPD and submitted to MAF for approval. The proposal included information related to the purpose of the survey, survey site (province), survey method, survey team members and budget. Then, FIPD sent request

[6] The original version was developed by "Capacity Development Project for Establishing National Forest Information System for Sustainable Forest Management and REDD+ (NFIS)" funded by JICA, and modified for the purpose of the 2nd NFI.

letters to PAFO and DAFO of each province with the MAF approval letter, to request for their support in the survey implementation. This process took four weeks.
A summary list of the equipment used for the survey is shown in attachment 8.2.

2.4 Cost for 2nd NFI

The total cost for the 2nd NFI, which include per diems, accommodation and transportation fees for the survey teams, equipment and miscellaneous costs was approximately USD 470,000. This cost was shared among projects including F-REDD under JICA[7], FCPF Readiness, and Forestry Resource Development Fund of DOF.

2.5 Training and field work supervision

Before starting the field surveys, trainings were provided to the survey team as well as the QC team. The trainings were conducted in mid-February and late October 2016 respectively. The trainings consisted of three components as summarized below:

1. **Classroom training**: the training aimed at familiarizing the field survey teams with the SOPs for the NFI, and to ensure the teams were capable and confident with the use of tablet-based data collection system and other equipment for the survey.

2. **Field-based training**: the field based training was conducted in Phou Khao Kouay National Protected Area (PKK NPA). The training took 2.5 days and included: (i) a half-day session for all the field survey teams to carry out the survey following the SOP process in an experimental sub-plot; (ii) a full-day session where two field survey teams worked together to navigate themselves to, and measure two sub-plots; and (iii) a full-day session where each field team navigated themselves to, and measured one entire plot which consists of four sub-plots.

3. **Field work supervision**: The four field teams which conducted the field survey in dry the season 2015-2016, and four out of six field teams which conducted the field survey in dry season 2016-2017 were assisted by the experts from F-REDD and its sub-contractors. The two teams which did not receive supervision during its field survey in dry season 2016-2017 were considered as the most experienced teams, therefore did not require additional support.

[7] Excluding the costs of F-REDD experts who technically supported the 2nd NFI.

3. Survey method[8]

3.1 Establishment of plot

The survey used a 'floating' clustered design with four sub-plots located in one cluster. A sub-plot consists of nested tree-plots with different nested radius and objects to measure. In addition to trees, for the sampling of non-tree pools, lying dead wood was measured in all sub-plots, and other non-tree vegetation (NTV) were measured in the clip-plots. The plot design is described below.

In the 'floating' cluster nested tree-plot design, all sampling at each sampling point takes place only in locations under the same stratum. The location of the 'anchor point' and of each nested tree-plots was determined prior to field sampling and in a GIS environment. Due to the highly fragmented landscape and the terrain causing some locations to require significant time to access, a set of four potential subplot locations are chosen in GIS. In GIS, for a given stratum an Anchor Point is placed using the two-staged sampling design described above. The first tree-plot center (tree-plot A) is then placed on this Anchor Point. Three additional points (B, C, D) are then randomly placed within the given stratum within a 300 m radius of the Anchor Point, but no closer than 75 m from each other or the Anchor point.

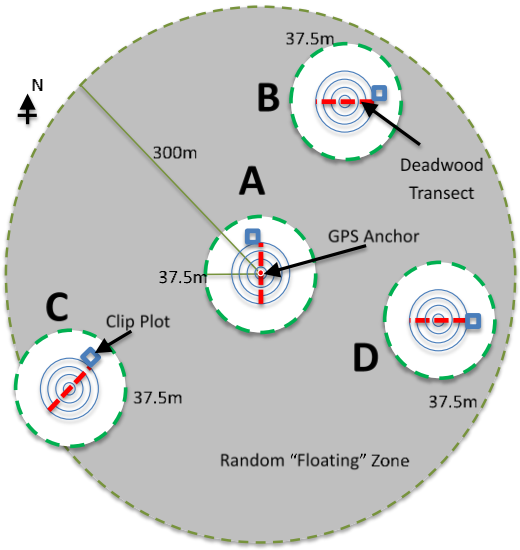


Figure 3: A "floating" cluster plot with a fixed center subplot. Red lines represent 40 m lying deadwood transects while blue boxes represent clip plots (50cm*50cm) for NTV.

[8] The detail methods and procedures are described in "Lao PDR NFI Standard Operating Procedure (SOP) Manual for Terrestrial Carbon Measurement".

Nested Tree-plots

The design of the nested tree-plots are shown in Figure 4 below.

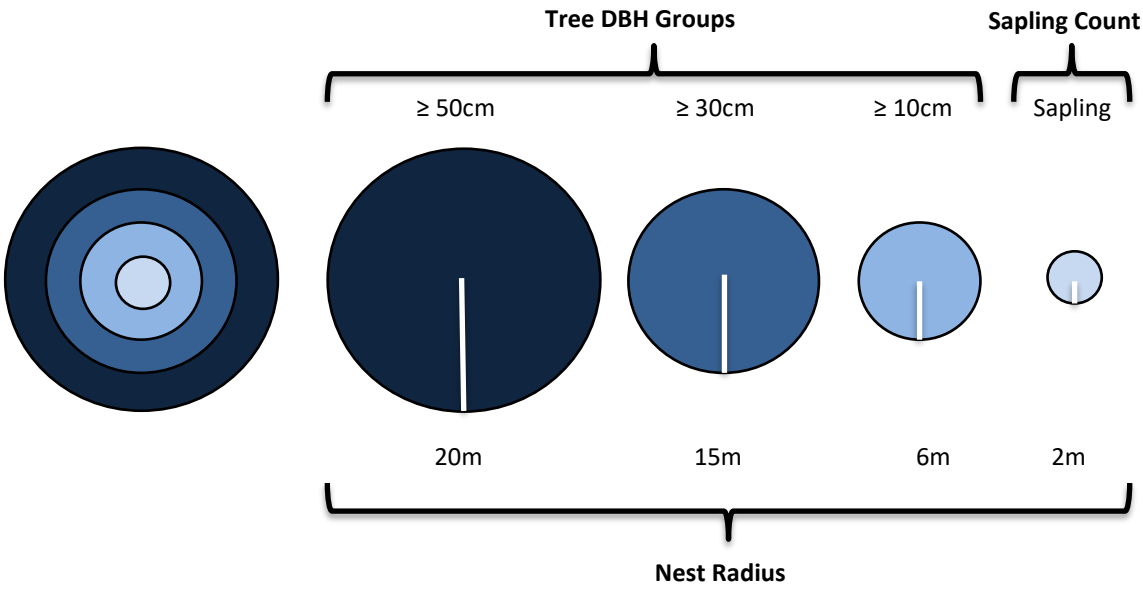


Figure 4 Nest radius of nested tree plots[9]

Other vegetation and carbon pools

NTV was measured in the clip plots located adjuscent to the nested tree plots as shown in Figure 3 above and following the SOP process.

3.2 Field measurement

In the established plot, trees, saplings, dead wood (standing and lying), bamboo and NTV were measured.

Trees

Record the species name and tree diameter at breast height (DBH 1.3m). Tree diameters should be measured to the nearest 0.1 cm (e.g. diameter of 10.2 cm *not* 10 cm).

[9] This is the design for a site condition when slope <10%. 'Tree DBH Groups" are the size classes of trees to be measured for each nest. 'Sapling' is defined as tree with height >1.3 m and DBH of <10 cm.

Saplings

Count the number of saplings (trees <10 cm DBH, and >1.3 m height) in the smallest nest (2 meter radius) and record on the data sheet.

Bamboo

Measure the bamboo in the second smallest nest (6m radius). Count the number of culms in the patch, and 5 culms should be randomly selected and their DBH measured with a caliper. Each of the 5 selected culms should be cut at their base and pulled out from the patch to measure their length with a tape measure.

Dead wood (Standing)

Standing dead woods were separated into two categories, i.e: Class 1 - dead trees with twigs and branches; and Class 2 -dead trees with large branches or no branches, and tree stumps. The two classes were measured with the following methods.

Class 1 dead trees: measure the trees using the same methods with living trees, and mark them as 'dead' on the datasheet.

Class 2 dead trees (standing): measure DBH using same methods for living trees. Measure the diameter at the base of the tree (Dbase). Measure height of stem (H) both using a clinometer and measuring tape or laser range finder or through direct measurement using tape measure. Measure diameter at top of the stump (Dtop,) through direct measurement. Alternatively, do not take a measurement at the top of the stump and write 'None' or 'NA' on datasheet.

Class 2 dead trees (stumps): stumps are measured in all sub-plots.

Three parameters were measured: Height (H)[10]; Smallest Diameter (D_1) - smallest diameter across the top of the stump; D_2 - diameter at 90^o angle to D_1.

Dead wood (Lying)

Lying dead wood is defined as any woody materials on the ground with a diameter >10 cm. Along the length of the line, measure the diameter and length of each intersecting piece of coarse dead wood (> 10 cm diameter).

[10] Stumps with heights > 1.3m are considered as standing dead woods.

Non tree vegetation (NTV)

All non-tree vegetation (NTV) in the clip plots were measured. These included shrubs and herbaceous vegetation but excluding bamboo. NTV were cut at their base. All the collected NTV were put in the sample bag and weighed, and the samples were sent to the laboratory to be dried and analyzed on their wet-dry ratio.

3.3 Data entry, compilation and analysis

As the first step of the data entry and analysis process, the field measurement data were collected using the ODK form pre-installed in an android-based tablet computer. After all the measurement items at a survey cluster are collected, the data were entered into the form by the survey team and automatically sent to the Ona cloud-based server when the tablet comes into the range of 3G internet or Wi-Fi. All the data collected from the survey teams were aggregated at the server into a single CSV file and made available for downloading.

"NFI-Dash" is an application developed to support the data collection and analysis for the NFI; its functions are shown in Figure 5 below. It allows the calculation of the results of and presents them graphically through easy-to-use interface. The NFI – Dash is a script based web application written in statistical program language "R" and the R Package "Shiny".

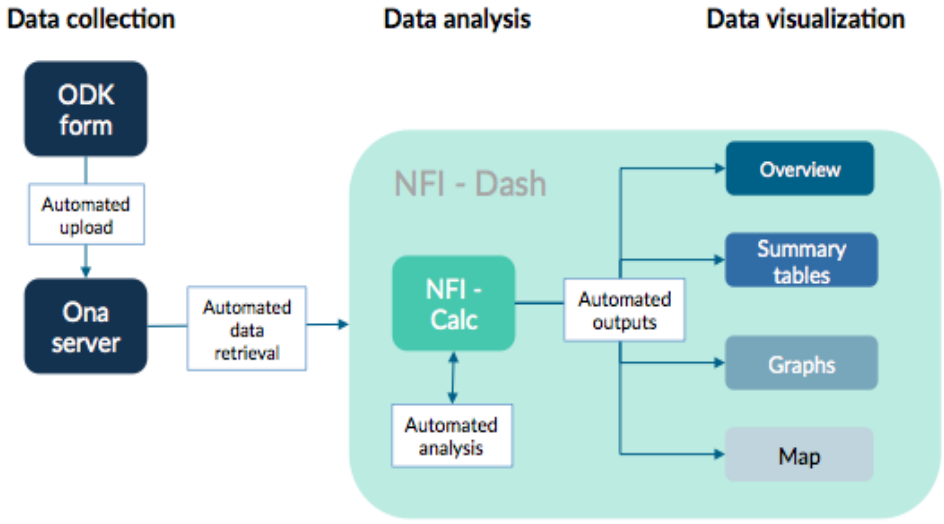


Figure 5 : Overview of the data collection and analysis process

When the NFI-Dash application is opened in a web-browser, it automatically retrieves the raw data from the Ona server, uses the script "NFI-Calc"[11] to preform various types of analysis and automatically generates a summary of the data collected to date. Two additional scripts ("NFI-Server" and "NFI-Interface") allow for developing various summary tables and graphs, and display the plot locations on a map.

4. Survey implementation

4.1 Implementation structure (team organization)

The field survey team was composed of the following members.

Table 4: Survey team composition

Institution	Number of staff
FIPD (Forest Inventory and Planning Division)	3
Driver	2
PAFO (Provincial Agriculture and Forest Office)	1
DAFO (District Agriculture and Forest Office)	1
Villager	2

The survey for the 2015-2016 dry season was conducted by 4 teams. The survey for the 2016-2017 dry season was conducted by 6 teams including the 4 teams who implemented the survey in previous dry season.

4.2 Survey schedule

Forest Type Maps (FTM) were used to distribute the survey plots. For the survey of the dry season of 2015-16, a portion of the plots for the three natural forest classes (i.e. Evergreen forest (EG), Coniferous forest (CF) and Mixed Coniferous and Broadleaf Forest (MCB)) were surveyed, using the FTM 2010 for distributing the sample plots, as FTM 2015 was not yet completed at the time. The remainder of the three natural forest classes above-mentioned, and all Mixed Deciduous forest (MD) and Dry Dipterocarp forest (DD) forest classes were surveyed in the dry season of 2016-17 based on FTM 2015 for distributing the sampling plots.

[11] The "NFI – Calc" script is the backbone of the application and was developed and thoroughly tested during the NFI piloting phase in 2015, to ensure all possible quality issues were automatically flagged before moving to the full NFI implementation in 2016 and 2017. The first version of "NFI – Calc" during piloting stage essentially scripted the equivalent of all the calculations conducted in an excel spreadsheet that was used for the data analysis. Thus, each step of the "translation" process from excel to the script was verified by comparing the results of the script with the results of the spreadsheet.

Table 5: Survey schedule

Year	Schedule
2015-2016	March-2016 to June-2016
2016-2017	October-2016 to April-2017

4.3 Monitoring

The web application "NFI – Dash" was used to monitor the progress and data quality through its web-based browser. Through frequent confirmation of the progress, the survey team were able to survey the optimal number of survey clusters and plots, which led to efficient delivery of the entire 2nd NFI.

5. Results

This chapter presents the analyzed results of the 2nd NFI for the national level, for the areas targeted under the ER-Program, and also the QC.

5.1 National Level

Forest types

Across the five forest classes surveyed, among the 559 plots distributed, a total of 420 plots were included in the estimation of forest carbon stocks. The remaining 139 plots were not included because of their land condition (contrary to the identification from the FTM, the land was actually found as non-forest in the field survey), or in case of a split classification of forest classes for a plot (i.e. two sub-plots being identified as one forest class and the other two sub-plots identified as another forest class). The locations of surveyed plots by forest class are shown in Figure 6.

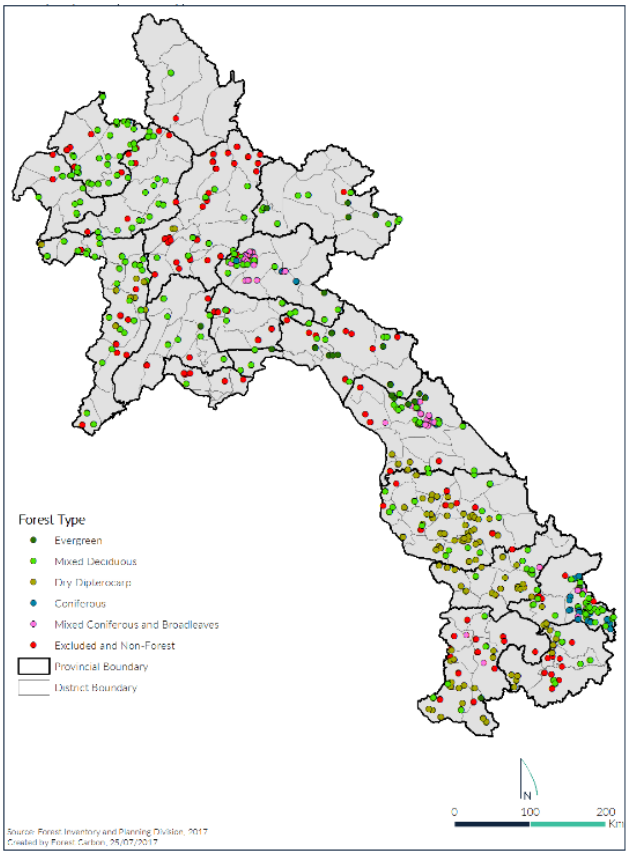


Figure 6: Surveyed plot by forest class in the 2nd NFI

The Below Ground Biomass (BGB) was estimated by using the best available Root-to-Shoot (R/S) ratios corresponding to each forest class and their average AGB.

Table 6 : Root-to-Shoot ratios by forest type and AGB threshold

Forest type	AGB threshold	Root-to-Shoot ratio (R/S ratios)	Source
EG, DD, MD, and MCB	AGB < 125t/ha	0.20	IPCC GL 2006 for National Greenhouse Gas Inventories (Chapter 4: Forest land, Table 4.4)
	AGB > 125t/ha	0.24	
CF	AGB < 50t/ha	0.46	2003 IPCC Good Practice Guidance for LULUCF (Chapter 3: LULUCF Sector Good Practice Guidance, Table 3 A.1.8)
	AGB = 50 - 150t/ha	0.32	
	AGB > 150t/ha	R/S = 0.23	

The estimated biomass was converted into carbon stock with the generic formula below:

$$Ci = TBi \times CF$$

Where:
TBi = total biomass of plot i (include AGB and BGB), expressed in kg.
CF = IPCC default carbon fraction value 0.46 or 0.47 depending on the land/forest class (2006 IPCC GL Volume 4, Chapter 4)

The resulting average carbon stock by forest class and analytical considerations are shown in Table 7. The analysis includes three carbon pools, namely Above Ground Biomass (AGB), BGB and Deadwood (DW) in order to assess the significance of DW (as explained later).

The DD forests represent the lowest carbon stock value of 46.64 tC/ha among all forest classes. The MD and CF forests showed similar carbon stocks of 95.56 tC/ha and 103.83 tC/ha. The MCB forests, by comparison held 125.43 tC/ha, while the larger and generally more remote EG type held 208.17 tC/ha.

Table 7: Nation-wide total carbon stocks by forest type

Forest Type	N	Carbon stock (tC/ha)	S.D. (tC/ha)	S.E. (tC/ha)	CI (95%)	Uncertainty (95%)	Minimum (tC/ha)	Maximum (tC/ha)
Including AGB, BGB and DW								
EG	23	208.17	71.26	14.86	29.13	13.99	91.94	372.29
MD	227	95.56	38.15	2.53	4.96	5.19	19.92	239.66
DD	101	46.64	19.42	1.93	3.79	8.12	13.15	147.06
CF	24	103.83	40.37	8.24	16.15	15.56	32.98	189.22
MCB	45	125.43	91.90	13.70	26.85	21.41	28.34	464.44
Including AGB and BGB								
EG	23	200.03	68.40	14.26	27.95	13.98	90.28	362.03
MD	227	87.69	33.92	2.25	4.41	5.03	19.92	238.16
DD	101	43.18	19.22	1.91	3.75	8.68	10.47	147.06
CF	24	92.60	30.50	6.23	12.20	13.18	32.98	139.66
MCB	45	114.74	87.46	13.04	25.55	22.27	27.78	464.44

In distributing the sample plots, a minimum of 30 plots per forest class was targeted for. This target was not achieved for the CF and EG classes, despite the intentions, as a large number of the pre-selected plots turned not to be CF and EG classes in the field (most often turning out to be MD class). Notwithstanding, the uncertainty of the

measurement results for these two classes were well below the maximum uncertainty threshold of 20%.

MCB forests which has 45 plots resulted in uncertainty of 21.41% at 95% CI. Relatively high variance in this class is assumed to be due to the difference of the MCB forests surveyed. The MCB forests in Nakai plateau area of Khammouane province showed higher biomass compared to the MCB forests of Xiengkhouang province where the forests were less dense due to their ecological nature or possibly due to human disturbance. The MCB standard deviation (91.90 tC/ha) and C min/max plot range of 28 - 464tC/ha are illustrative of the level of variability in these strata.

Carbon Pools

The 2nd NFI was the first nation-wide survey which collected the biomass data by forest classes allowing detailed analysis and estimation of carbon stock within the carbon pools measured. Table 8 below shows the detailed breakdown of carbon stock by different components of a carbon pool: AGB consisting of living trees, saplings, bamboo and non-tree vegetation (NTV), BGB, and DW consisting of standing deadwood, lying deadwood and stumps. This allows assessment of the significance of each carbon pool and their impacts to CO2 emission and removals.

Table 8. Nation-wide carbon stock by carbon pool and forest type

Carbon pool and its components	Forest Class	N	Carbon stock (tC/ha)	S.D. (tC/ha)	% of forest class
AGB	**EG**	**23**	**161.57**	**55.05**	**77.62%**
	MDF	**227**	**72.11**	**27.26**	**75.45%**
	DD	**101**	**35.91**	**15.44**	**76.99%**
	CF	**24**	**73.71**	**25.87**	**70.99%**
	MCB	**45**	**93.25**	**70.18**	**74.35%**
Living trees	EG	23	160.63	55.07	77.16%
	MDF	227	67.82	27.37	70.97%
	DD	101	34.28	15.5	73.50%
	CF	24	72.23	25.57	69.57%
	MCB	45	91.98	70.23	73.33%
Saplings	EG	23	0.42	0.16	0.20%
	MDF	227	0.65	0.37	0.68%
	DD	101	0.32	0.24	0.69%
	CF	24	0.3	0.26	0.29%
	MCB	45	0.48	0.39	0.38%
Bamboo	EG	23	0.03	0.1	0.01%
	MDF	227	3.02	7.92	3.16%
	DD	101	0.24	1.14	0.51%

	CF	24	0.11	0.51	0.11%
	MCB	45	0.07	0.25	0.06%
NTV	EG	23	0.5	0.2	0.24%
	MDF	227	0.62	0.44	0.65%
	DD	101	1.06	0.44	2.27%
	CF	24	1.07	0.72	1.03%
	MCB	45	0.72	0.45	0.57%
BGB	**EG**	**23**	**38.46**	**13.36**	**18.47%**
	MDF	**227**	**15.58**	**6.88**	**16.30%**
	DD	**101**	**7.27**	**3.8**	**15.59%**
	CF	**24**	**18.89**	**4.71**	**18.19%**
	MCB	**45**	**21.49**	**17.28**	**17.13%**
DW	**EG**	**23**	**8.14**	**5.86**	**3.91%**
	MDF	**227**	**7.88**	**13.83**	**8.25%**
	DD	**101**	**3.46**	**4.06**	**7.42%**
	CF	**24**	**11.23**	**17.85**	**10.82%**
	MCB	**45**	**10.69**	**18.03**	**8.52%**
Standing DW	EG	23	5.33	4.94	2.56%
	MDF	227	5.21	12.38	5.45%
	DD	101	2.04	3.28	4.37%
	CF	24	9.91	17.98	9.54%
	MCB	45	8.48	18.12	6.76%
Stump	EG	23	0.44	0.65	0.21%
	MDF	227	0.19	0.33	0.20%
	DD	101	0.35	0.39	0.75%
	CF	24	0.17	0.38	0.16%
	MCB	45	0.36	0.46	0.29%
Lying DW	EG	23	2.38	2.73	1.14%
	MDF	227	2.47	4.31	2.58%
	DD	101	1.07	1.49	2.29%
	CF	24	1.14	1.26	1.10%
	MCB	45	1.85	1.7	1.47%

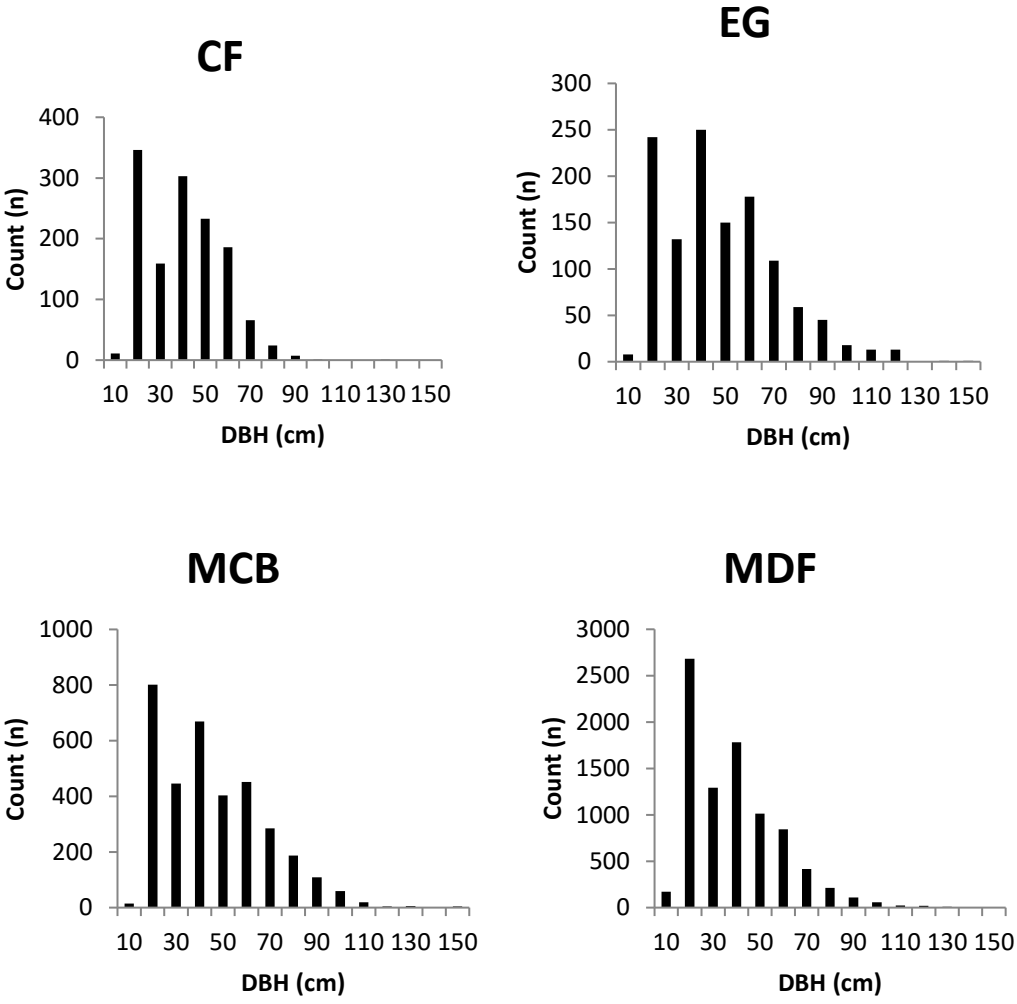
The AGB pool represented about 70 - 74% of the total carbon stock for each forest class. This was almost entirely from living trees, in fact, saplings, bamboo and NTV constituted an insignificant part of the overall AGB component, often contributing to less than 1% of the total carbon stock of each forest class.

The BGB pool ranges between 18 - 27% of the total carbon stock for each forest class. This is a significant carbon pool.

DW, on the other hand, comprised less than 10% of the total stock in all but the CF forests. Of the DW pool, standing dead trees were the largest contributors and if DW is to be considered for inclusion in future NFIs, then the DW pool should focus on this sub-DW pool.

DBH Distribution

Stand tables for each of the five forest class across all provinces are summarized below. The tables show a largely uniform pattern across the forest classes. The distribution is a normal and expected distribution for secondary and disturbed forests, having a large population of smaller individuals in the 10-50cm DBH range, tapering off as individual trees of larger DBH become scarcer and harder to locate.



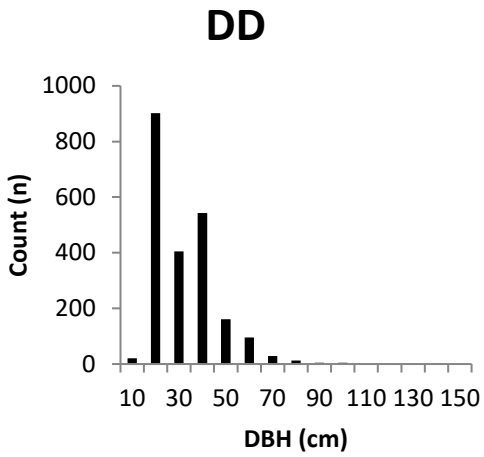


Figure 7: DBH (cm) distribution by forest class

Such DBH distributions can be explained in a number of ways depending on forest class, locality and influence/role of human populations on the landscape. Normal distribution curves generally shifted to the left are often indicative of selective logging, forest fire and subsequent secondary regrowth which can be hampered from full-scale recovery by the presence of more aggressive bamboo species.

Non Tree Vegetation (NTV)

NTV were measured in each sub-plot by establishing a small plot (50cm*50cm). All vegetation, except for the living trees, saplings and bamboos were taken and measured for weight. Samples were brought back to the laboratory to measure the dry-wet ratio.

Table 9: Average carbon stock of non-timber vegetation (NTV) by forest class

Forest class	Sample size	C stock (tC/ha)
EG	78	1.12
MD	358	1.09
DD	84	0.50
CF	133	0.75
MCB	764	0.57

Non Timber Forest Products (NTFPs)

NTFPs were found in 75% of all sampled plots. Some form of NTFP was found in all EG plots, while a majority of MCB and MD plots also featured some form of NTFP (78% and

88% respectively). NTFPs were only present in 42% and 46% of CF and DD respectively. Edible plants were the most common NTFP, followed by medicinal plants, fibers, ornamentals, animals or animal products, and extracts.

Table 10: Occurrence of NTFPs in plots as percentage of total number of plots.

Forest Type	Edible plants	Medicinal plants	Fibers	Extracts	Ornamentals	Animal products	*Total*
EG	91%	52%	35%	0%	0%	0%	*100%*
MD	83%	52%	45%	4%	26%	27%	*88%*
DD	46%	15%	8%	0%	3%	0%	*46%*
CF	38%	8%	4%	4%	17%	8%	*42%*
MCB	62%	40%	16%	0%	20%	13%	*78%*
Total	*70%*	*39%*	*30%*	*3%*	*18%*	*16%*	*75%*

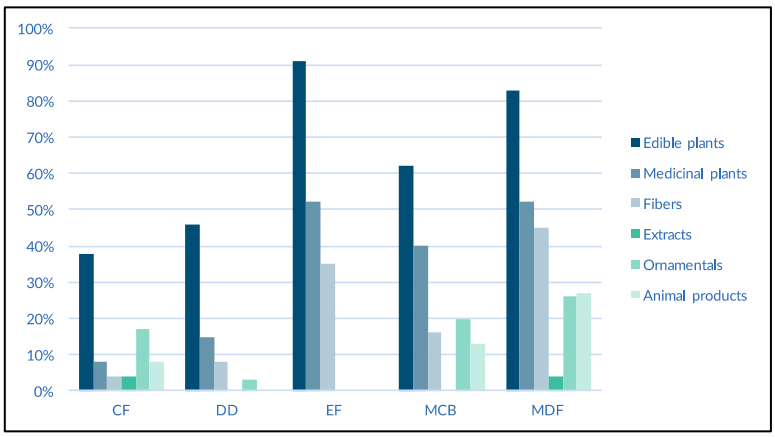


Figure 8. Percentage occurrence by type of NTFP per forest type

While EG contained NTFPs in all of its surveyed plots, the breadth of NTFPs found was limited to only edible plants, medicinal plants and fibers. This is on contrast to MD and CF where all six types of NTFPs surveyed were found. In MCB plots all NTFPs but extracts were found, while in DD extracts as well as ornamentals were missing.

5.2 ER-Program Provinces

Lao PDR is engaged in the Carbon Fund's Emissions Reduction Program (ER Program) covering Northern six provinces: Houaphanh, Bokeo, Louangnamtha, Louangphabang, Oudomxai and Xaignabouly. As such, the NFI was designed to attempt to collect data from a sufficient number of plots from within these six provinces so that carbon stock

inferences from only these six provinces could be made. Analyzed and presented below are the results for carbon stocks by forest class and carbon pools for these six provinces.

Forest Classes

Table 11 below shows the corresponding carbon stocks in the represented forest classes from these six provinces. These results are shown for all three carbon pools (AGB, BGB and DW) as well as for only the AGB and BGB pools.

Overall sampling within the EG and DD forest types was very low within the six provinces, despite initial planning attempts to identify sufficient plots to meet minimum survey requirements. Only four EG plots and ten DD plots were found in the field. This resulted in high standard error values for these two forest types when calculating carbon stocks and, subsequently, the survey did not meet the maximum uncertainty threshold of 20 at either the 90% or 95% CI.

As compared to national averages, EG and MD within the ER-Program area show lower carbon stocks: 158.40 tC/ha as compared to 208.17 tC/ha for EG, and 92.07 tC/ha as compared to 95.56 tC/ha for MD. DD, on the other hand, shows higher carbon stocks: 64.07 tC/ha as compared to 46.64 tC/ha. Because MD comprises the vast majority of forest across the country and the differences is effectively non-significant; this is good news in terms of using MD as a viable carbon strata at both national and sub-national/ER-Program levels. However, both the EG and DD forest classes are both under sampled within the ER-Program area, correspond with a high degree of uncertainty and differ significantly as compared to national figures.

Table 11: Carbon stocks by forest type within the 6 provinces of the ER-Program area

Forest Type	N	Carbon (tC/ha)	S.D.	S.E.	CI (95%)	Uncertainty (95%)
Including AGB, BGB and DW						
EG	4	158.40	61.07	30.53	59.85	37.78
MD	100	92.07	33.44	3.34	6.55	7.12
DD	10	64.07	35.29	11.16	21.87	34.13
Including only AGB and BGB						
EG	4	151.08	57.96	28.98	56.80	37.60
MDF	100	86.32	31.26	3.13	6.13	7.10
DD	10	62.71	35.96	11.37	22.29	35.54

Carbon Pools

Table 12 below breaks down each carbon pool by forest class. These results should be considered in light of both the EG and DD forest types not meeting the minimum uncertainty thresholds.

As with the national level, AGB was by far the largest pool across all forest classes ranging from 69% to 75% of total carbon. BGB was the next largest and represented between 23% and 27% of total carbon stocks. Again, as with the national level, the DW pool was the smallest pool and in all forest classes represented less than 10% of total carbon in each forest type.

Table 12: ER-P-Province-wide carbon stock by carbon pool and forest class

Carbon pool	Forest class	N	Carbon stock (tC/ha)	S.D. (tC/ha)	% of forest class
AGB	EG	4	122.20	46.42	77.14%
	MDF	100	71.01	24.97	77.13%
	DD	10	51.72	28.57	80.71%
BGB	EG	4	28.88	11.54	18.24%
	MDF	100	15.31	6.45	16.63%
	DD	10	11.00	7.40	17.16%
DW	EG	4	7.32	4.35	4.62%
	MDF	100	5.75	12.26	6.25%

5.3 Quality Control (QC)

Random re-sampling of plots was conducted in the field on a total of 58 plots in 10 Provinces. The QC team managed to re-survey 57 plots. This being said, even with the exact surveyed GPS coordinates loaded in their tablet, the QC team encountered difficulties finding the metal poles set by the initial field teams to represent the center of the sub-plot. This was particularly the case in Khammouane, Oudomxai and Louangnamtha provinces. The metal detector provided to the QC team proved to be ineffective at locating the metal pole. Furthermore, in some cases, despite being able to locate the samplings at the center of the plot (these were marked with spray paint) the QC team was unable to location the metal pole.

These difficulties could also be seen comparing the GPS coordinates collected for each plot by both the field team and QC team, as well as the recollection of the QC Team leader. Consequently, where GPS coordinates for any sub-plots differed between the field team and QC team by more than 20m, then the entire plot was excluded from the

QC analysis. Similarly, if GPS sub-plot locations differed by more than 15m and the QC Team Leader remembered having difficulties locating the center of a sub-plot plot at that location, then this plot was also excluded. Otherwise, the quality control would represent a quality control of the forest class and not the plot itself. In doing so, 22 plots were excluded, leaving 35 valid plots to conduct the comparison analysis. This, therefore represents a check on 8% of the total plots surveyed (35/420).

Non-parametric multiple comparison significance tests were carried out to determine if the measurements between the quality control sampling and the normal sampling on 2 levels. T-tests were not considered suitable in this case due to the lack of normal distribution of the data. We first tested the means of each quality control plot with the corresponding plot of the normal sampling (Appendix 1), and secondly compared the means of each forest type between the quality control and normal sampling (Table 13). P values of less than 0.05 indicate that there was a statistically significant difference in sampling time 1 (normal sampling) as compared to sampling time 2 (quality control sampling) across the entire forest type. P values greater than 0.05 indicate that there is no significant difference between the normal and the resampled QC measurements of each forest type.

As shown in Table 13 below, P-values for all forest types were greater than 0.05, indicating that there is no significant statistical difference between the carbon stocks as determined by the quality control vs. normal sampling of the same selection of plots.

Table 13: Comparison of carbon stocks by forest class between the QC sampling plots and respective the normal field sampling plots, including the results of the test for significant differences

		QC sampling				Normal Sampling				
Forest class	N	Carbon stock (tC/ha)	S.D.	S.E.	CI (95%)	Carbon stock (tC/ha)	S.D.	S.E.	CI (95%)	p value
EG	2	127.33	34.91	20.15	39.50	166.82	14.34	8.28	16.23	0.94
MDF	18	77.19	33.67	7.94	15.56	79.57	33.89	7.99	15.65	1.00
DD	11	48.64	10.34	3.12	6.11	44.00	10.34	3.12	6.11	0.99
CF	1	99.93	-	-	-	57.61	-	-	-	-
MCB	3	56.15	51.29	29.61	58.04	53.56	40.32	23.28	45.62	1

It should be noted that only 8% of plots were resampled, rather than the target of 10%, giving a less robust QC check. While none of the P-values indicate a significant difference in QC vs normal sampling, the count of plots only represents 8% of plots overall and in the case of CF, EG and MCB only represent 1 to 3 QC plots each, not

enough to robustly control at forest class level. This being said, individual CI at 90% and 95% for individual forest classes are below target thresholds (see Table 13) and should be considered reliable in the absence of a more rigorous QC result.

6. Recommendations

The following recommendations are provided for consideration in the design and implementation of Lao PDR's third NFI.

6.1 NFI Design

The overall design of the NFI proved to be appropriate for the task of determining carbon stocks nationally across Lao PDR.

Number of Sub-Plots

The 2nd NFI included 4 sub-plots for each cluster. The field teams assessed the forest class for each sub-plot and this was considered in the determination of the dominant forest class for the plot. It was found, however, that a large number of plots became unusable when there was a split classification of forest classes for a plot (i.e. two sub-plots being identified as one forest class and the other two sub-plots identified as another forest class). Due to the decision to include an even number of sub-plots in the design this "split decision" issue arose.

To avoid this situation in the next iteration of the NFI it is worth considering changing the number of sub-plots to an odd number. For example, 5 sub-plots could be considered for each plot (in which case the overall radius of the plot would need to increase to 400m to accommodate the additional sub-plot).

Carbon Pools

As no national inventory focused on carbon stocks had been conducted prior to the 2nd NFI, three carbon pools, namely AGB, BGB and DW were considered. However, as the Results section demonstrates, the only significant carbon pools were AGB and BGB; the DW pool represents less than 10% of overall carbon stocks. Within the AGB pool, the focus should be kept entirely on living trees as the other pools within this larger pool were determined to be minor contributors (i.e. bamboo, saplings, NTV).

With DW representing less than 10% of total carbon stocks, it can be ignored in future iterations of the NFI. However, if the choice is made to include the DW pool, then the data collection should focus on standing deadwood as this represented the largest pool within the overall DW pool.

It is also noted that the data collected on stumps was used in a separate analysis to determine biomass loss and emissions from logging. In the case that this method to estimate emissions from logging is considered robust and significant, then data collection on stumps may be required in future iterations of the NFI.

Data Measurements and SOP

Based on the two recommendations above, some changes to the SOP and field data to be collected will need to be made. Based on the recommendation to include only AGB and BGB (and potentially a subset of the DW pool) in the next iteration of the NFI, the amount of field based data to collect will be diminished. It will no longer be necessary to collect data on saplings, bamboo, NTV or lying deadwood. No longer needing to destructively sample bamboo culms will greatly reduce the time required to sample each plot, as this proved to be the most laborious and time intensive portion of the field data collection protocol. This was particularly an issue in the MD class, which was the dominant forest class.

If the next iteration of the NFI will consider a greater number of sub-plots, then the SOP will also need to be updated to take into account this additional sub-plot.

Finally, with regards to data collection, for the purposes of supporting the quality assurance process, it is recommended that the SOP be amended to require that Team Leaders take a picture of any tree larger than 100 cm DBH. Considering the large impact these larger DBH trees have on the carbon stock of a plot, it is worth including an additional quality assurance step that confirms the presence of this large tree instead of being the result of a data entry error (for e.g. entering 103 cm instead of the actual tree DBH of 10.3 cm).

6.2 Plot Identification

Plots per Forest Class

Whether due to the inaccuracies of the satellite image classification or inconsistencies with the field teams' classification of forest classes, there was low congruence between the predicted and actual classification of forest classes for the NFI plots. This resulted in lower than desired samples for non-MD forest classes. Most notably, the 30-plot target for CF and EG was not reached at the national level. Also, the QC inventory resulted in only one CF plot, two EG plots and three MCB plots. The inventory of ER-Program province plots also resulted in a low sample size, especially for EG.

As such, for the future iteration of the NFI, unless there is much greater confidence in the satellite image based classification, it is recommended to greatly increase the number of non-MD plots - knowing that once in field a large number of these will end up being MD – to ensure minimum thresholds are met for all forest classes.

Pre-Screening of Plots for Difficult to Access Areas

The field teams mentioned that on several occasions the selected plots were in either restricted or difficult to access areas. Examples of restricted areas included military zones, concessions, border areas (for e.g. in southern Champasak Province) or sensitive areas (for e.g. areas of Saysomboun Province). While the field seasons were designed to accommodate a certain number of missed plots, greater efforts should be taken to verify whether plots fall in areas that are likely to be considered "off-limits". For the current NFI, the team was limited by the lack of accurate shapefiles identifying concession boundaries and military zones. If available for the next iteration of the NFI, these should be used to confirm whether some plots should be re-selected. Similarly, a review of the pre-selected plots with the provincial staff that come for the training (see below) can also be a chance to confirm whether some areas may be "off-limits" due to sensitivities.

Steep slopes were also mentioned as a factor making both access and measurement of plots difficult. For the current NFI, a slope constraint of 35 degree was included when selecting plots; no plots on slopes steeper than this were selected. However, for the next iteration of the NFI, it might be prudent to further constrain this to 30 degree, particularly in the interest of safety.

Training

Overall, the Team Leaders and field teams felt the training was largely sufficient to feel comfortable with the SOP and knowledgeable on how to use the various equipment provided to conduct the NFI. However, Team Leaders did express a desire for more field based training than what was provided before beginning the actual inventory process. This is so that field teams can learn how to deal with field based realities that are hard to capture in a SOP. Learning how to troubleshoot these scenarios before beginning the actual inventory was considered important for the next NFI.

Team Leaders also requested that additional time be spent learning how to both conduct the data inputting in the tablets and how to troubleshoot tablet issues. This can be achieved through both additional classroom training as well as the extended field training where Team Leaders will be actively using the tablets to enter field data.

FIPD staff have only had limited formal training in the identification of forest classes. While the training included a session on forest class identification, Team Leaders would benefit from additional training to ensure that each Team Leader, when in the field, is classifying forest classes in standardized manner. This will help to ensure that minimum accuracies are achieved more quickly when collecting field data.

6.3 Field Implementation

Field Teams

Team Leaders assessed the team composition as being mostly sufficient to complete all the field based inventory tasks. However, a challenge they encountered was the need to field-train the accompanying provincial and district staff once in the field, as it was only those who were properly trained on the SOP who could effectively help. As such, it is recommended to invite an identified PAFO staff member from each province to join the NFI training in Vientiane to ensure they have a common understanding of the SOP and the field protocols. In this way, their assistance will be of even greater value and the teams do not have to spend time training these staff themselves when in the field. If not possible to invite the provincial staff to Vientiane for the training, then an additional national staff should be made available to support the teams. As such, the role of the district staff is mostly to facilitate access and coordinate with villagers, and would be a less active member of the field based measurements.

In addition to the above, the QC team requires that all efforts be made to ensure that the same district staff and villagers that accompanied the main teams, be the people to accompany the QC team when conducting the re-measurements. This greatly facilitates the difficult task of locating the exact location of the plot as these people are generally able to remember the path and approach to the plot.

Field Safety

Implementation of the 2nd NFI unfortunately resulted in one serious incident. One field team member was gravely injured when a farmer's truck flipped over on a steep road and landed on the member's chest. The member needed to be evacuated urgently, underwent several surgeries, and only after an extended time in hospital was able to, fortunately, make a full recovery.

This incident heightened the need for even greater field safety protocols and training in the future. Specific recommendations for this include:

Risk assessment training. Team Leader's should be given a specific field risk assessment and safety training. Staff need to be able to properly assess various risks and make an informed decision as to whether proceeding will put their teams in jeopardy. This should include topics such as terrain and navigation, vehicle use and operation, atmospheric conditions, and UXOs, among others.

First aid training. Besides being provided with a first-aid kit, there was no formal first aid response training for the teams. This should be considered mandatory and provided to all staff conducting future NFIs. This should be complemented by first aid SOPs, to be included in the first aid kit, on how to respond to different emergency and non-emergency medical situations.

Enforced rest days. To complete the NFI field season quickly, NFI teams often neglected the need for rest days. An enforced rest day, for example after every 5 days of conducting field measurements, could be considered as a way to ensure field teams remain healthy and alert. Enforced rest on monthly religious days (Buddha days) can also be considered as an alternative or in addition to the above rest days.

Navigation to Plots

The field teams greatly appreciated the availability of both the GPS units and tablets loaded with the maps to support navigation to the plots. Besides the often-difficult terrain to cross to reach the plots, the teams found these two pieces of technology to consistently find their way to the inventory plots. The teams only recommended two small improvements.

The first is that the tablet loaded maps include the name of rivers and mountains as this will support the field navigation. District staff and, especially villagers, are often familiar with the names of these natural features and being able to cross-reference this on the maps would help teams to orient themselves, especially when deep in the forest.

The second is for the primary field teams to provide a narrative description of how to access each plot that will act as a guide for the QC team when they return to the plot. This can be an additional data field in the data collection form that will explain the primary team's approach to the plot, such as from which village the plot was accessed, which roads and paths were taken and other features to be aware of. This, in addition to making use of the same district staff and villagers that accompanied the first inventory team, will greatly facilitate the ability of the QC team to find the plots for re-measurement.

Tablet Use and Data Collection

All teams were greatly appreciative of the tablets, their multi-functionality and the extent to which they facilitate the data collection process. Although no tablets were damaged during the implementation of the NFI, greater attention should be placed on protecting these tablets and ensuring their continued functionality throughout the field season, considering the central role they play in the NFI. As such, for future NFIs it is recommended to purchase heavy duty, waterproof tablet cases. Additionally, while spare battery packs were provided for the current field season, the teams recommend that higher storage battery packs be provided next time for the times when the teams must spend upwards of two days in the forest to inventory a plot.

Quality Control

In addition to the above recommendation that a greater number of non-MD plots be pre-identified when designing the QC process, there are two additional practical steps that can be implemented to improve the overall QC process.

Firstly, greater oversight should be provided by the quality assurance staff member to ensure that the QC team has met minimum sampling sizes per forest type before allowing these teams to return to Vientiane. This can be done in a similar way to what was done for the main inventory teams.

Secondly, the tablet form for the QC team should be adjusted to require this team to answer a question as to whether the QC team actually found the center of the plot and take a picture of the metal pole to confirm this.

7. References

- JICA(2014):Validation and Registration of the Project on REDD plus through Participatory Land and Forest Management for Avoiding Deforestation in Lao PDR(Technical Cooperation Report)

- JICA(2014):Lao PDR NFI Standard Operating Procedure (SOP) Manual for Terrestrial Carbon Measurement

- Kiyono et al(2007):Predicting chronosequential changes in carbon stocks of pachymorph bamboo communities in slash-and-burn agricultural fallow, northern Lao People's Democratic Republic

8. Attachment

8.1 Activity photos

	
Team members (After classroom training)	On-Site discussion
	
Plot setting	Measure of tree DBH
	
Dead wood measurement	Data entry

8.2 Equipment list

	Equipment	Quantity
Field Sampling Crew		
	Machete	2
	First Aid Kit	1
	Chalk sticks	many
	Durable plastic tarp ~2 m x 2 m	1
	Tablet	1
	Tablet charging cable/cord	1
	Internet SIM	1
	Telephone card(50000kip)	1
	Extra battery for tablet	1
	Camera (or use Tablet)	1
	GPS	1
	GPS memory	1
	AA batteries for GPS	many
	clip board	1
	Compass	1
	Bright colored spray paint	many
	DME distance measuring unit (grey box)	At leaset 1
	DME pole	1
	DME transponder (yellow piece)	1
	AA batteries for transponder	many
	9V batter for DME grey box	many
	Clinometer (slope)	1
	Measuring Tape - 50 m	2
	Flagging tape	2
	Diameter tape measure	2
	Backpack or hipsack	2
	Pens	many
	Pencils	many
	Pencil sharpeners	many
	Erasers	many
	small notebooks	1/person
NTV and bamboo		
	Small calipers	1
	hanging scale - 500 g	1
	hanging scale - 5 kg	1
	Weight for caliburation(250g)	1
	Weight for caliburation(1kg)	1
	Cloth bags.	Number of plot
	Clip Plot (pvc)	1

8.3 Survey Plot Information

Plot ID	Forest Type	Province	Coordination		AGB		BGB	
			X	Y	tB/ha	tC/ha	tB/ha	tC/ha
1	MCB	Xiengkhouang	102.86158	19.54622	162.39	76.32	38.4	18.05
4	MCB	Xiengkhouang	103.004645	19.604862	70.22	33	13.28	6.24
6	MCB	Xiengkhouang	103.02593	19.599873	60.25	28.32	11.62	5.46
7	CF	Xiengkhouang	103.145601	19.621843	90.4	42.49	28.48	13.39
8	EF	Houaphanh	103.30237	20.212317	157.04	73.81	35.05	16.47
18	MDF	Houaphanh	104.357649	20.402886	47.95	22.53	4.07	1.91
22	MDF	Houaphanh	104.976315	20.088335	42.25	19.86	7.67	3.61
30	CF	Xekong	107.059537	15.405704	116.25	54.64	35.69	16.78
31	CF	Xekong	107.131844	15.786707	126.23	59.33	35.07	16.48
32	CF	Xekong	107.171301	15.297576	171.47	80.59	42.7	20.07
33	MCB	Xekong	107.168997	15.329152	87.35	41.05	18.36	8.63
34	MDF	Xekong	107.263676	15.358765	217.32	102.14	51.04	23.99
35	CF	Xekong	107.293143	15.281495	169.7	79.76	44.33	20.83
37	CF	Xekong	107.326202	15.265665	53	24.91	17.17	8.07
40	CF	Xekong	107.533807	15.275099	219.06	102.96	49.72	23.37
41	CF	Xekong	107.528225	15.293464	214.66	100.89	48.2	22.65
44	CF	Xekong	107.562756	15.246793	225.19	105.84	51.17	24.05
45	CF	Xekong	107.553581	15.262137	165.07	77.58	42.53	19.99
46	CF	Xekong	107.556271	15.284201	156.04	73.34	39.39	18.51
47	CF	Xekong	107.567383	15.180835	215.15	101.12	48.71	22.89
48	MCB	Xekong	107.575978	15.289522	143.1	67.26	33.09	15.55
50	MDF	Xekong	107.606253	15.321665	185.05	86.98	41.38	19.45
59	MDF	Xekong	106.630043	15.481175	148.74	69.91	32.19	15.13
75	MCB	Khammouane	105.231763	17.911057	303.15	142.48	72.31	33.98
81	MDF	Khammouane	105.765902	17.615302	182.28	85.67	43.14	20.28
85	MDF	Khammouane	105.902624	17.085786	307.52	144.54	73.25	34.43
112	MDF	Xiengkhouang	104.036501	18.887641	118.8	55.84	26.6	12.5
121	MDF	Xiengkhouang	102.824663	19.561147	200.98	94.46	46.13	21.68
124	MDF	Xiengkhouang	102.88733	19.592515	146.59	68.9	32.95	15.49
125	MDF	Xiengkhouang	102.899625	19.660923	132.59	62.32	29.85	14.03
126	MDF	Xiengkhouang	102.928983	19.524534	100.28	47.13	21.12	9.93
127	MCB	Xiengkhouang	102.944905	19.585697	127.32	59.84	29.17	13.71
129	MDF	Xiengkhouang	102.982996	19.625935	97.01	45.59	20.84	9.8
130	MDF	Xiengkhouang	103.010271	19.533423	113.65	53.41	26.08	12.26
131	MDF	Xiengkhouang	103.047633	19.563296	91.27	42.9	19.17	9.01
132	MDF	Xiengkhouang	103.085553	19.5805	76.68	36.04	16.07	7.55
133	MDF	Xiengkhouang	103.151735	19.563781	82.83	38.93	16.11	7.57
134	MDF	Xiengkhouang	103.157109	19.585729	165.94	77.99	35.57	16.72
138	MDF	Xiengkhouang	NA	NA	73.4	34.5	14.5	6.81
141	MDF	Houaphanh	103.691826	20.365434	101.06	47.5	16.24	7.63
149	MDF	Houaphanh	104.836084	20.029768	102.4	48.13	19.73	9.27

150	EF	Khammouane	104.877342	17.983054	379.67	178.45	90.68	42.62
151	MDF	Khammouane	104.903191	17.870948	159.89	75.15	36.69	17.25
152	EF	Khammouane	104.88981	17.983508	285.43	134.15	68.1	32
154	EF	Khammouane	104.910074	17.951765	356.56	167.58	84.95	39.93
156	MDF	Khammouane	104.963973	17.807493	140.17	65.88	30.96	14.55
157	MDF	Khammouane	104.941219	17.832798	309.83	145.62	33.5	15.74
158	MDF	Houaphanh	104.955967	20.055737	79.01	37.14	14.43	6.78
159	MDF	Houaphanh	104.956637	20.069965	81.53	38.32	15.11	7.1
161	MDF	Khammouane	105.003523	17.837602	157.57	74.06	35.68	16.77
163	EF	Khammouane	105.085014	17.880278	182.53	85.79	42.48	19.97
165	MCB	Khammouane	105.119541	17.857652	310.8	146.08	73.85	34.71
167	MDF	Khammouane	105.176082	17.691201	131.32	61.72	29.03	13.64
168	MDF	Khammouane	105.19052	17.836454	157.9	74.21	35.36	16.62
169	EF	Khammouane	105.204264	17.646003	474.6	223.06	113.23	53.22
170	MDF	Khammouane	105.220014	17.666018	409.12	192.29	97.6	45.87
171	MDF	Khammouane	105.223324	17.664973	283.09	133.05	67.53	31.74
173	MDF	Khammouane	105.256528	17.641225	189.03	88.84	43.82	20.59
175	MDF	Khammouane	105.3221	17.675219	242.75	114.09	57.83	27.18
176	MCB	Khammouane	105.320423	17.694333	555.55	261.11	132.95	62.49
179	MCB	Khammouane	105.337551	17.676272	376.68	177.04	89.95	42.28
180	MCB	Khammouane	105.344738	17.743016	797.2	374.68	190.97	89.75
183	MCB	Khammouane	105.407935	17.659994	414.39	194.76	99.16	46.61
184	MDF	Khammouane	105.466206	17.648313	297.42	139.79	70.6	33.18
185	MDF	Khammouane	105.470142	17.676218	177	83.19	39.78	18.7
186	MDF	Khammouane	105.453612	17.687139	164.74	77.43	37.99	17.85
191	CF	Xekong	107.06803	15.524276	240.91	113.23	56.24	26.43
194	CF	Xekong	107.086542	15.777687	239.82	112.72	54.79	25.75
197	MDF	Xekong	107.096196	15.776649	250.15	117.57	59.3	27.87
200	MDF	Xekong	107.172994	15.450349	154.92	72.81	33.87	15.92
202	MCB	Xekong	107.170293	15.645163	323.81	152.19	76.59	36
205	MDF	Xekong	107.173237	15.797745	149.48	70.26	32.65	15.35
206	MDF	Xekong	107.177307	15.805447	139.15	65.4	31.66	14.88
207	CF	Xekong	107.1883	15.384795	165.84	77.95	40.81	19.18
208	CF	Xekong	107.18085	15.403843	156.66	73.63	37.89	17.81
210	CF	Xekong	107.184975	15.81405	220.38	103.58	52.01	24.45
211	MDF	Xekong	107.230162	15.5985	289.02	135.84	68.2	32.06
212	MDF	Xekong	107.20816	15.737491	120.32	56.55	27.36	12.86
213	MDF	Xekong	107.2499	15.380986	192.93	90.67	44.29	20.82
214	MDF	Xekong	107.269531	15.405673	242.23	113.85	57.39	26.98
215	MCB	Xekong	107.277672	15.436179	60.71	28.53	11.63	5.47
222	MDF	Xekong	107.311098	15.440749	98.95	46.51	19.9	9.35
223	MDF	Xekong	107.299623	15.450793	158.27	74.39	34.49	16.21
224	MDF	Xekong	107.305429	15.546496	76.67	36.04	14.84	6.98
225	MDF	Xekong	107.333904	15.395353	143.22	67.31	32.88	15.45

228	MDF	Xekong	107.384621	15.25996	114.53	53.83	23.68	11.13
233	MDF	Xekong	107.477106	15.40144	146.72	68.96	34.07	16.01
237	MDF	Xekong	107.511873	15.217384	201.71	94.8	44.41	20.87
239	MCB	Xekong	107.588667	15.300231	160.55	75.46	37.01	17.4
240	MDF	Xekong	107.594436	15.301672	165.66	77.86	38.59	18.14
243	MCB	Xiengkhouang	103.073469	19.348793	90.79	42.67	19.61	9.22
244	MCB	Xiengkhouang	103.08199	19.346119	93.61	44	20	9.4
245	CF	Xiengkhouang	103.497458	19.45857	133.91	62.94	37.31	17.54
246	MCB	Xiengkhouang	103.527772	19.455092	94.68	44.5	18.59	8.74
247	MCB	Xiengkhouang	103.54097	19.462064	85.35	40.12	16.72	7.86
248	CF	Xiengkhouang	103.677852	19.3389	119.23	56.04	35.19	16.54
249	CF	Xekong	107.077702	15.569196	168.4	79.15	47.15	22.16
251	MDF	Xekong	107.274408	15.316121	221.24	103.98	51.21	24.07
252	CF	Xekong	107.317244	15.371531	141.83	66.66	38.3	18
253	MDF	Xekong	106.614818	15.475413	158.02	74.27	31.13	14.63
254	MDF	Xekong	106.680546	15.54748	185.57	87.22	42.76	20.1
255	EF	Khammouane	105.163808	17.911059	361.5	169.91	86.09	40.46
257	EF	Khammouane	105.227464	18.000654	212.7	99.97	50.71	23.83
258	EF	Khammouane	105.300039	17.954555	455.45	214.06	108.86	51.16
260	MDF	Houaphanh	103.2382	20.185431	109.27	51.36	23.81	11.19
261	MDF	Houaphanh	103.258916	20.21488	148.58	69.83	23.88	11.23
262	MDF	Houaphanh	103.821754	20.374	54.86	25.78	10.32	4.85
265	EF	Xekong	107.194865	15.685005	468.82	220.35	112.07	52.67
266	MCB	Xekong	107.219195	15.631434	199.2	93.62	45.04	21.17
267	MCB	Xekong	107.230406	15.638338	328.88	154.58	77.49	36.42
269	MCB	Xekong	107.250015	15.638508	349.05	164.06	82.26	38.66
270	MDF	Xekong	107.262288	15.369821	214.12	100.64	49.81	23.41
271	MDF	Xekong	107.269713	15.494192	163.92	77.04	37.5	17.62
272	MDF	Xekong	107.294527	15.507252	154.64	72.68	34.66	16.29
273	MDF	Xekong	107.375753	15.424759	187.1	87.94	42.65	20.04
274	MDF	Xekong	107.417512	15.383131	139.63	65.63	23.72	11.15
279	MDF	Xiengkhouang	103.066105	19.538434	88.89	41.78	17.54	8.24
280	MCB	Xiengkhouang	103.153548	19.62326	119.46	56.14	25.24	11.86
281	CF	Xiengkhouang	102.923484	19.579447	71.66	33.68	24.03	11.3
282	MCB	Xiengkhouang	103.060836	19.5754	72.04	33.86	14	6.58
283	MCB	Xiengkhouang	103.142366	19.533213	62.62	29.43	12.24	5.75
284	MDF	Xiengkhouang	103.151075	19.586632	118.11	55.51	26.58	12.49
289	MCB	Khammouane	105.300546	17.637771	281.23	132.18	66.87	31.43
290	MCB	Khammouane	105.330111	17.619282	374.51	176.02	89.34	41.99
1016	DD	Khammouane	104.886137	17.277617	98.02	46.07	20.9	9.82
1018	DD	Khammouane	105.10552	17.185933	84.48	39.7	16.64	7.82
1019	DD	Khammouane	104.962052	17.166338	48.13	22.62	9.4	4.42
1020	DD	Khammouane	105.079041	17.096986	90.8	42.68	18.94	8.9
1022	DD	Savannakhet	105.187246	17.029228	99.12	46.59	21.1	9.92

1024	MDF	Savannakhet	104.800627	16.838619	63.19	29.7	12.42	5.84
1025	DD	Savannakhet	105.380758	16.794906	70.55	33.16	14.89	7
1026	DD	Savannakhet	105.442307	16.776112	76.09	35.76	14.83	6.97
1027	DD	Savannakhet	105.5784	16.766879	50.55	23.76	9.31	4.38
1028	DD	Savannakhet	105.262199	16.751928	54.4	25.57	10.52	4.94
1029	DD	Savannakhet	105.365709	16.739138	40.32	18.95	7.52	3.54
1030	MDF	Savannakhet	105.160785	16.720831	63.04	29.63	12.13	5.7
1033	DD	Savannakhet	NA	NA	78.56	36.92	16.21	7.62
1034	MDF	Savannakhet	104.893107	16.647424	92.2	43.34	17.59	8.27
1035	DD	Savannakhet	105.03642	16.643663	44.3	20.82	8.47	3.98
1036	MDF	Savannakhet	104.85076	16.589447	111.4	52.36	25.26	11.87
1037	DD	Savannakhet	105.366086	16.56346	61.55	28.93	11.71	5.5
1038	DD	Savannakhet	105.567477	16.545999	73.68	34.63	13.87	6.52
1039	DD	Savannakhet	NA	NA	67.42	31.69	12.63	5.93
1040	DD	Savannakhet	105.883342	16.549293	47.07	22.12	8.65	4.07
1041	DD	Savannakhet	105.383694	16.529345	78.58	36.93	16.76	7.88
1042	DD	Savannakhet	105.849004	16.531053	49.75	23.38	9.26	4.35
1043	DD	Savannakhet	105.908849	16.522572	76.76	36.08	14.57	6.85
1044	DD	Savannakhet	105.387707	16.514013	81.58	38.34	16.93	7.96
1045	DD	Savannakhet	105.951571	16.499726	55.19	25.94	10.08	4.74
1046	DD	Savannakhet	106.090781	16.505579	81.11	38.12	15.68	7.37
1047	DD	Savannakhet	105.793915	16.433142	110.58	51.97	22.55	10.6
1048	DD	Savannakhet	105.899387	16.382925	99.88	46.94	21.16	9.95
1049	DD	Savannakhet	105.86416	16.363666	61.76	29.03	11.47	5.39
1050	DD	Savannakhet	105.480772	16.337466	141.2	66.37	32.97	15.5
1051	DD	Savannakhet	105.531422	16.32794	86.02	40.43	16.51	7.76
1053	DD	Savannakhet	106.192825	16.308423	80.01	37.61	15.27	7.18
1054	DD	Savannakhet	105.017947	16.294039	105.12	49.41	21.64	10.17
1055	DD	Savannakhet	105.772922	16.274888	72.84	34.23	13.82	6.5
1056	DD	Savannakhet	105.824091	16.295832	87.83	41.28	18.44	8.66
1057	DD	Savannakhet	105.66104	16.250538	45.42	21.35	8.37	3.93
1058	DD	Savannakhet	105.828533	16.25956	87.01	40.89	16.96	7.97
1059	DD	Savannakhet	105.747569	16.250517	126.71	59.55	29.04	13.65
1060	DD	Savannakhet	105.771204	16.242666	55.42	26.05	10.59	4.98
1061	DD	Savannakhet	105.966364	16.231927	55.65	26.16	10.78	5.07
1062	DD	Savannakhet	105.917729	16.206057	75.31	35.4	16.13	7.58
1063	DD	Savannakhet	105.465043	16.177195	97.77	45.95	21.67	10.18
1064	MDF	Savannakhet	105.823007	16.163619	136.37	64.1	29.34	13.79
1065	DD	Savannakhet	105.429921	16.143298	63.42	29.81	11.97	5.63
1066	DD	Savannakhet	105.48314	16.161195	78.4	36.85	14.98	7.04
1068	DD	Salavan	106.252344	16.05181	101.61	47.76	19.76	9.29
1069	DD	Savannakhet	105.917701	16.017968	92.43	43.44	18.04	8.48
1070	DD	Savannakhet	105.836041	15.9977	104.63	49.18	23.26	10.93
1071	DD	Salavan	105.462886	15.951427	91.96	43.22	17.74	8.34

1072	DD	Salavan	106.42269	15.950304	74.97	35.23	14.36	6.75
1073	DD	Salavan	105.56529	15.924968	28.55	13.42	5.15	2.42
1074	DD	Salavan	105.990572	15.931162	47.24	22.2	8.92	4.19
1075	DD	Salavan	106.281827	15.803093	82.47	38.76	15.76	7.41
1076	DD	Salavan	106.497648	15.727624	108.15	50.83	24.82	11.67
1077	DD	Salavan	106.224042	15.670159	107.77	50.65	23.41	11
1078	DD	Salavan	106.437978	15.693031	46.54	21.87	8.61	4.05
1079	DD	Salavan	106.510302	15.686945	46.58	21.89	8.67	4.08
1080	DD	Salavan	105.79401	15.646131	53.29	25.04	9.93	4.67
1081	DD	Salavan	106.434184	15.668522	58.24	27.37	11.25	5.29
1082	DD	Salavan	106.46982	15.665401	73.48	34.54	15.43	7.25
1083	DD	Salavan	106.121172	15.620215	170.16	79.97	39.54	18.58
1084	DD	Salavan	106.160132	15.598421	123.31	57.95	27.03	12.7
1085	DD	Salavan	106.603092	15.573755	90.33	42.46	19.71	9.27
1089	DD	Xekong	106.733295	15.454282	68.72	32.3	13.53	6.36
1090	MDF	Xekong	106.890392	15.344593	67.84	31.89	13.19	6.2
1092	DD	Xekong	106.77997	15.256799	106.81	50.2	22.37	10.51
1093	DD	Attapeu	106.783326	15.243	33.9	15.93	6.54	3.07
1094	DD	Attapeu	106.774824	15.222438	90.86	42.7	17.52	8.24
1095	DD	Attapeu	106.82749	15.170409	46.35	21.78	8.95	4.21
1098	DD	Attapeu	106.901822	15.067131	47.37	22.26	8.54	4.01
1099	DD	Attapeu	106.863443	14.992629	97.33	45.74	21.66	10.18
1102	DD	Champasak	105.615145	14.937732	39.83	18.72	7.16	3.37
1103	DD	Champasak	106.132949	14.929911	47.6	22.37	7.63	3.59
1106	DD	Attapeu	106.850127	14.901653	63.28	29.74	12.01	5.65
1109	DD	Champasak	106.126079	14.851103	83.53	39.26	18.1	8.51
1112	DD	Champasak	105.601525	14.815744	42.56	20	7.89	3.71
1113	DD	Champasak	105.645741	14.8285	44.66	20.99	8.18	3.84
1117	DD	Attapeu	106.350799	14.638119	65.55	30.81	12.55	5.9
1118	DD	Attapeu	106.426295	14.627253	59.4	27.92	11.35	5.33
1119	DD	Attapeu	106.405887	14.576591	47.89	22.51	8.81	4.14
1120	DD	Champasak	105.611726	14.555894	62.14	29.21	11.78	5.54
1121	DD	Champasak	105.590035	14.534359	62.21	29.24	11.81	5.55
1122	DD	Champasak	105.772004	14.518449	49.5	23.27	9.14	4.29
1123	DD	Champasak	105.605327	14.504341	55.94	26.29	10.55	4.96
1124	DD	Champasak	105.7069	14.486924	80.26	37.72	15.37	7.23
1125	DD	Champasak	105.896331	14.486383	54.53	25.63	10.51	4.94
1126	DD	Attapeu	106.38248	14.49525	115.88	54.46	25.44	11.96
1128	DD	Champasak	105.749947	14.302794	18.99	8.93	3.29	1.55
1129	DD	Champasak	105.338755	14.237426	60.21	28.3	11.35	5.33
1130	DD	Champasak	105.380145	14.223548	83.64	39.31	17.51	8.23
1131	DD	Champasak	106.000506	14.126098	99.58	46.8	20.9	9.82
1132	DD	Champasak	106.03795	14.080803	38.9	18.29	7.41	3.48
1133	MDF	Xaignabouly	101.483254	19.609111	167.23	78.6	39.09	18.37

1134	MDF	Xaignabouly	100.547147	19.591166	164.63	77.38	37.62	17.68
1136	MDF	Xaignabouly	101.427288	19.281388	163.49	76.84	37.73	17.73
1138	EF	Xiengkhouang	104.031949	19.203737	621.64	292.17	148.64	69.86
1139	MDF	Vientiane	102.015545	19.112891	156.75	73.67	35.98	16.91
1140	MDF	Xaignabouly	101.735412	18.973929	96.64	45.42	20.31	9.55
1141	MDF	Xaisomboun	102.795633	18.990984	86.64	40.72	16.38	7.7
1143	MDF	Xiengkhouang	104.207391	19.006559	170.64	80.2	38.43	18.06
1145	MDF	Vientiane	102.596778	18.924405	150.98	70.96	22.15	10.41
1146	MDF	Xaignabouly	101.33624	18.881851	160.59	75.48	35.03	16.46
1147	MDF	Vientiane	102.067945	18.900458	220.76	103.76	35.29	16.58
1149	MDF	Xaisomboun	102.807294	18.862251	108.15	50.83	20.01	9.4
1150	MDF	Bolikhamxay	103.837966	18.836523	178.64	83.96	41.51	19.51
1151	DD	Xaignabouly	101.425165	18.781267	253.14	118.98	59.75	28.08
1156	MDF	Bolikhamxay	103.944222	18.660989	246.98	116.08	58.83	27.65
1159	MDF	Bolikhamxay	104.050561	18.646196	193.47	90.93	43.06	20.24
1160	EF	Bolikhamxay	103.921415	18.549585	260.22	122.31	60.93	28.64
1161	EF	Bolikhamxay	104.770488	18.567517	355.28	166.98	84.87	39.89
1163	MDF	Bolikhamxay	103.166801	18.517008	161.24	75.78	36.11	16.97
1164	EF	Bolikhamxay	103.379985	18.531759	289.54	136.08	69.12	32.48
1165	EF	Bolikhamxay	104.094794	18.459323	302.02	141.95	72.08	33.88
1166	EF	Bolikhamxay	104.208753	18.464275	439.63	206.63	105.21	49.45
1167	MDF	Bolikhamxay	102.991901	18.271972	187.09	87.93	41.74	19.62
1169	MDF	Bolikhamxay	104.351644	18.148531	107.37	50.46	22.56	10.6
1170	EF	Bolikhamxay	104.862023	18.114405	408.14	191.83	97.55	45.85
1171	MDF	Bolikhamxay	104.978834	18.003651	195.21	91.75	46.23	21.73
1174	MDF	Khammouane	105.228048	17.909333	306.96	144.27	72.92	34.27
1175	MDF	Khammouane	105.324519	17.11139	191.53	90.02	42.9	20.16
1176	MDF	Khammouane	105.327575	17.112805	254.84	119.78	60.08	28.24
1177	MDF	Savannakhet	105.904396	17.035136	243	114.21	56.16	26.39
1178	MDF	Savannakhet	106.096338	16.924257	191.68	90.09	43.13	20.27
1180	MDF	Savannakhet	105.999223	16.602939	134.74	63.33	26.35	12.38
1181	MDF	Savannakhet	106.208124	16.521916	194.65	91.49	45.31	21.3
1182	MDF	Salavan	106.563141	16.133962	192.26	90.36	43.39	20.39
1183	MDF	Savannakhet	105.972055	16.102979	172.74	81.19	40.51	19.04
1184	MDF	Savannakhet	105.546765	16.073165	168.42	79.16	39.41	18.52
1185	MDF	Salavan	105.917637	15.820016	116.11	54.57	24.29	11.42
1189	MDF	Louangnamtha	101.387997	21.196884	165.21	77.65	38.67	18.17
1190	MDF	Louangnamtha	101.473964	21.218247	157.18	73.88	36.37	17.1
1191	MDF	Louangnamtha	101.52442	21.205782	169.3	79.57	38.92	18.29
1192	MDF	Louangnamtha	101.382756	21.17706	118.91	55.89	25.96	12.2
1193	MDF	Louangnamtha	101.516063	21.17921	141.85	66.67	32.65	15.35
1195	MDF	Louangnamtha	101.601856	21.13319	143.48	67.44	33.1	15.56
1196	MDF	Louangnamtha	101.141969	21.10734	248.17	116.64	58.14	27.33
1197	MDF	Oudomxai	101.800833	21.103877	124.37	58.45	26.42	12.42

1199	MDF	Louangnamtha	101.301684	21.04889	168.18	79.04	39.34	18.49
1200	MDF	Oudomxai	101.782095	21.038833	195.64	91.95	46.6	21.9
1201	MDF	Oudomxai	101.851678	21.051906	227.7	107.02	53.99	25.38
1202	MDF	Louangnamtha	101.565495	20.940487	179.91	84.56	42.73	20.08
1203	MDF	Louangnamtha	101.42708	20.805325	168.45	79.17	36.85	17.32
1204	MDF	Louangnamtha	101.168667	20.773179	230.65	108.41	55.04	25.87
1205	MDF	Louangnamtha	101.278562	20.789072	234.16	110.05	55.72	26.19
1206	MDF	Louangnamtha	101.27756	20.702904	201.39	94.65	46.45	21.83
1207	MDF	Bokeo	100.641774	20.632361	138.05	64.88	32.88	15.45
1208	MDF	Louangnamtha	100.909367	20.594611	173.29	81.45	37.27	17.52
1209	MDF	Bokeo	NA	NA	283.42	133.21	63.99	30.08
1210	MDF	Bokeo	100.711492	20.548843	164.26	77.2	36.54	17.17
1211	MDF	Bokeo	100.81146	20.557694	264.78	124.44	62.52	29.38
1212	MDF	Louangnamtha	101.080541	20.462055	194.89	91.6	46.3	21.76
1213	MDF	Louangnamtha	101.165374	20.467242	187.71	88.22	43.68	20.53
1215	EF	Houaphanh	104.323852	20.278423	235.87	110.86	56.2	26.41
1218	EF	Houaphanh	104.329941	20.111899	252.78	118.81	60.21	28.3
1219	MDF	Houaphanh	103.435475	20.025422	267.45	125.7	63.53	29.86
1220	MCB	Khammouane	105.172788	17.857024	198.77	93.42	47.49	22.32
1221	MCB	Khammouane	105.201193	17.830771	258.95	121.71	61.55	28.93
1222	MCB	Khammouane	105.243811	17.761611	272.23	127.95	65.01	30.56
1223	MDF	Khammouane	105.338543	17.718139	155.64	73.15	35.65	16.76
1224	MCB	Khammouane	105.358369	17.657128	284.52	133.72	67.68	31.81
1225	CF	Khammouane	105.434766	17.637088	89.47	42.05	28.17	13.24
1228	MCB	Xekong	107.167969	15.410287	170	79.9	39.81	18.71
1229	MDF	Champasak	105.392558	14.37611	36.91	17.35	6.72	3.16
1230	MDF	Champasak	NA	NA	51.83	24.36	9.93	4.67
1231	MCB	Xiengkhouang	103.091225	19.683629	49.88	23.44	9.23	4.34
1232	MCB	Xiengkhouang	103.124845	19.684794	83.45	39.22	15.97	7.5
1234	MCB	Xiengkhouang	103.00292	19.631112	88.76	41.72	16.91	7.95
1235	MCB	Xiengkhouang	103.035423	19.64508	125.52	58.99	28.31	13.31
1236	MCB	Xiengkhouang	103.062756	19.637288	74.6	35.06	14.18	6.66
1237	MCB	Xiengkhouang	102.880317	19.590796	93.25	43.83	18.14	8.52
1239	MDF	Xiengkhouang	102.819785	19.429896	165.04	77.57	36.98	17.38
1240	MCB	Xiengkhouang	103.038078	19.340413	125.77	59.11	28.68	13.48
1241	MCB	Xiengkhouang	103.184611	19.350885	105.33	49.51	23.53	11.06
1242	MDF	Vientiane	102.781011	18.402988	149.95	70.48	32.12	15.1
1243	MCB	Khammouane	105.15531	17.86151	239.57	112.6	56.65	26.63
1244	MCB	Khammouane	105.175939	17.836577	140.99	66.27	31.6	14.85
1245	MCB	Khammouane	105.313838	17.691004	268.88	126.37	64.17	30.16
1246	MCB	Khammouane	105.233339	17.634634	160.79	75.57	37.43	17.59
1247	MCB	Salavan	106.706312	15.924735	82.31	38.68	15.2	7.15
1250	CF	Xekong	107.076009	15.412495	93.72	44.05	29.67	13.94
1257	EF	Houaphanh	104.677685	20.139508	394.27	185.31	94.37	44.36

1258	MDF	Xaignabouly	101.195053	19.824752	216.32	101.67	50.76	23.86
1261	MDF	Louangphabang	102.372266	19.850181	174.92	82.21	34.51	16.22
1264	MDF	Xaignabouly	100.753295	19.774917	81.92	38.5	17.43	8.19
1266	MDF	Louangphabang	102.575504	19.782328	122.32	57.49	26.9	12.64
1267	MDF	Xaignabouly	101.2024	19.75482	143.55	67.47	29.28	13.76
1268	DD	Xaignabouly	100.46839	19.730798	52.93	24.88	9.62	4.52
1271	MDF	Xiengkhouang	102.881514	19.70604	246.26	115.74	58.73	27.6
1272	MDF	Xaignabouly	100.928349	19.665357	110.53	51.95	23.44	11.02
1273	MDF	Xaignabouly	101.052597	19.668283	134.55	63.24	28.47	13.38
1274	MDF	Xaignabouly	101.03674	19.628933	193.58	90.98	44.62	20.97
1275	MDF	Louangphabang	102.317722	19.631968	99.21	46.63	19.59	9.21
1277	MDF	Xaignabouly	101.141617	19.59762	143.72	67.55	32.89	15.46
1278	MDF	Xaignabouly	101.751313	19.580928	150.5	70.73	34.27	16.11
1279	MDF	Louangphabang	101.924442	19.601986	139.34	65.49	29.69	13.95
1283	MDF	Xaignabouly	NA	NA	169.63	79.73	29.19	13.72
1285	MDF	Xaignabouly	101.650167	19.511585	126.93	59.66	16.61	7.8
1286	MDF	Xaignabouly	101.711824	19.508657	86.17	40.5	16.82	7.91
1287	MDF	Xaignabouly	101.45497	19.464518	115.57	54.32	25.45	11.96
1289	MDF	Xaignabouly	101.739615	19.450533	194.05	91.2	34.42	16.18
1295	DD	Xaignabouly	101.670825	19.350137	109.41	51.42	21.87	10.28
1296	MDF	Xaignabouly	101.79662	19.324702	121.2	56.97	26.15	12.29
1298	DD	Xaignabouly	101.769606	19.306921	85.42	40.15	18.62	8.75
1303	DD	Xaignabouly	101.419494	19.202066	142.06	66.77	32.59	15.32
1305	DD	Xaignabouly	101.602615	19.120159	106.47	50.04	22.2	10.44
1306	DD	Xaignabouly	101.654992	19.117414	89.58	42.1	16.83	7.91
1308	MDF	Xaignabouly	101.592717	19.081139	123.07	57.84	21.3	10.01
1311	MDF	Xaisomboun	103.507085	19.080946	180.48	84.83	41.18	19.35
1312	DD	Xaignabouly	101.789739	18.975677	52.19	24.53	6.26	2.94
1314	MDF	Xaisomboun	NA	NA	101.59	47.75	20.07	9.43
1315	MDF	Xaisomboun	103.670499	18.974937	111.36	52.34	22.65	10.65
1319	MDF	Xaignabouly	101.651742	18.845377	156.06	73.35	36.06	16.95
1320	MDF	Xaignabouly	101.47554	18.743289	200.76	94.36	42.6	20.02
1322	MDF	Xaignabouly	101.532588	18.696529	169.33	79.58	36.6	17.2
1323	EF	Bolikhamxay	104.129135	18.727584	432.66	203.35	103.49	48.64
1325	MDF	Vientiane	102.489253	18.671343	169.61	79.72	31.26	14.69
1329	MDF	Bolikhamxay	104.778412	18.679988	177.51	83.43	40.67	19.11
1330	MDF	Bolikhamxay	104.821921	18.678192	173.58	81.58	39.19	18.42
1331	MDF	Vientiane	102.207054	18.629444	133.64	62.81	27.38	12.87
1336	MDF	Vientiane	102.083558	18.568245	101.19	47.56	17.89	8.41
1337	MDF	Xaignabouly	101.379051	18.501322	141.19	66.36	27.65	12.99
1342	EF	Bolikhamxay	104.1413	18.461799	422.07	198.37	100.75	47.35
1343	MDF	Xaignabouly	101.263588	18.339835	207.6	97.57	48.85	22.96
1345	MDF	Bolikhamxay	103.123254	18.335643	132.01	62.04	28.29	13.29
1346	MDF	Phongsaly	NA	NA	126.19	59.31	27.89	13.11

1353	MDF	Vientiane Capital	102.319683	18.103153	135.24	63.56	24.92	11.71
1354	MDF	Xaignabouly	101.091628	17.735138	229.41	107.82	37.55	17.65
1356	MDF	Xaignabouly	101.173218	17.600014	125.38	58.93	27.68	13.01
1357	MDF	Savannakhet	105.341274	17.055546	198.17	93.14	45.37	21.32
1362	DD	Savannakhet	105.312759	16.565511	61.33	28.82	11.55	5.43
1363	DD	Savannakhet	105.262529	16.447671	81.15	38.14	15.36	7.22
1364	MDF	Savannakhet	105.257108	16.424883	120.57	56.67	26.76	12.57
1366	DD	Savannakhet	105.821695	16.339014	45.62	21.44	8.29	3.89
1368	MDF	Savannakhet	105.587922	16.132234	106.72	50.16	20.39	9.58
1369	MDF	Salavan	106.496314	16.003064	136.59	64.2	21.5	10.11
1370	MDF	Salavan	105.656464	15.901519	146.47	68.84	31.73	14.91
1371	MDF	Salavan	106.548246	15.905007	136	63.92	11.3	5.31
1372	MDF	Salavan	106.608173	15.889448	199.42	93.73	33.66	15.82
1373	MDF	Salavan	106.591577	15.861685	109.11	51.28	21.06	9.9
1374	MDF	Salavan	106.612126	15.843008	182.64	85.84	30.99	14.56
1375	DD	Salavan	105.73411	15.702256	72.21	33.94	11.74	5.52
1376	MDF	Salavan	106.671238	15.65592	160.23	75.31	36.53	17.17
1377	MDF	Champasak	106.027941	15.344579	161.83	76.06	36.89	17.34
1378	MDF	Phongsaly	NA	NA	109.4	51.42	24.16	11.36
1383	MDF	Attapeu	106.975268	15.028344	134.21	63.08	28.89	13.58
1384	MDF	Champasak	106.041424	14.982391	72.17	33.92	13.93	6.55
1387	MDF	Attapeu	107.315577	14.809543	111.06	52.2	24.2	11.38
1388	MDF	Attapeu	107.195218	14.769506	46.87	22.03	6.96	3.27
1390	MDF	Attapeu	106.864079	14.57545	104.99	49.34	15.22	7.15
1391	MDF	Champasak	105.569864	14.540468	74.37	34.95	15.73	7.39
1392	MDF	Attapeu	106.88385	14.533315	84.7	39.81	16.32	7.67
1394	EF	Champasak	105.974781	14.366909	158.09	74.3	36.36	17.09
1397	MDF	Champasak	105.73055	14.225998	95.72	44.99	19.86	9.34
1398	DD	Champasak	105.483465	14.143479	48.66	22.87	9.27	4.36
1399	MDF	Louangnamtha	101.199216	21.507748	128.58	60.43	27.57	12.96
1402	MDF	Phongsaly	NA	NA	188.52	88.6	44.63	20.98
1403	MDF	Phongsaly	NA	NA	93.52	43.95	18.39	8.64
1405	MDF	Louangnamtha	101.376809	21.212317	195.8	92.03	46.55	21.88
1406	MDF	Phongsaly	NA	NA	80.2	37.69	15.79	7.42
1410	MDF	Phongsaly	NA	NA	116.35	54.68	24.5	11.51
1411	MDF	Louangnamtha	101.60363	20.960588	189.37	89	42.73	20.08
1416	MDF	Louangnamtha	101.620555	20.892823	200.23	94.11	45.95	21.6
1418	MDF	Louangnamtha	100.836495	20.801849	70.21	33	13	6.11
1424	MDF	Louangnamtha	100.845405	20.786642	118.84	55.86	19.07	8.96
1426	MDF	Bokeo	NA	NA	100.35	47.16	18.19	8.55
1428	MDF	Oudomxai	101.577101	20.723369	82.94	38.98	14.28	6.71
1433	MDF	Louangnamtha	100.902209	20.652739	247.17	116.17	57.65	27.1
1435	MDF	Louangnamtha	100.892352	20.606185	178.52	83.9	37.66	17.7
1438	MDF	Louangnamtha	101.400574	20.571857	169.72	79.77	35.93	16.89

1439	MDF	Louangnamtha	101.541308	20.549926	140.73	66.14	14.62	6.87
1441	MDF	Oudomxai	101.914825	20.541029	164.84	77.48	39.13	18.39
1443	MDF	Oudomxai	102.012696	20.526258	201.28	94.6	48.06	22.59
1444	MDF	Louangnamtha	101.045316	20.477798	74.6	35.06	14.3	6.72
1445	MDF	Louangnamtha	101.294528	20.477899	145.81	68.53	33.57	15.78
1446	MDF	Oudomxai	101.866421	20.460149	187.3	88.03	41.78	19.64
1447	MDF	Louangphabang	103.053296	20.469889	220.33	103.56	49.41	23.22
1449	MDF	Bokeo	100.972603	20.407691	226.6	106.5	53.95	25.35
1450	MDF	Louangphabang	102.636631	20.426864	150.32	70.65	29.47	13.85
1451	MDF	Oudomxai	101.765459	20.37661	167.51	78.73	36.56	17.18
1456	MDF	Louangphabang	102.52464	20.327727	155.58	73.12	35.45	16.66
1457	MDF	Bokeo	100.417036	20.294353	91.55	43.03	19.71	9.26
1459	MDF	Bokeo	100.945784	20.244902	104.09	48.92	21.86	10.28
1463	MDF	Bokeo	100.87622	20.219634	112.75	52.99	25.04	11.77
1464	MDF	Oudomxai	101.935304	20.245237	67.89	31.91	13.34	6.27
1465	MDF	Oudomxai	101.994089	20.234263	65.1	30.6	12.77	6
1466	MDF	Bokeo	100.896989	20.117019	78.37	36.84	13.81	6.49
1467	MDF	Bokeo	100.909508	20.093251	37.25	17.51	5.12	2.41
1469	MDF	Oudomxai	101.821066	20.089323	128.33	60.32	27.54	12.94
1471	MDF	Louangphabang	103.014223	20.096353	216.11	101.57	42.62	20.03
1472	MDF	Oudomxai	101.689503	20.044728	192.36	90.41	44.8	21.06
1473	MDF	Oudomxai	101.730356	20.037054	134.63	63.27	30.82	14.49
1474	MDF	Oudomxai	101.602915	19.948678	185.86	87.35	43.41	20.4
1475	DD	Louangphabang	102.116542	19.948462	149.61	70.32	34.83	16.37
1476	DD	Louangphabang	102.143983	19.950149	59.55	27.99	11.43	5.37
1477	MDF	Oudomxai	101.177632	19.894294	111.6	52.45	17.67	8.31
1478	MDF	Oudomxai	101.423788	19.920546	120.64	56.7	26.5	12.45

8.4 QC Survey Plot Information

			QC Sampling				Normal sampling				
Plot number	**Province Name**	**Forest type**	**C stock (t/ha)**	**S.D.**	**S.E.**	**CI (95%)**	**C stock (t/ha)**	**S.D.**	**S.E.**	**CI (95%)**	**p value**
1039	Savannakhet	DD	36.96	26.50	15.30	29.98	28.94	29.08	14.54	28.49	0.764
1042	Savannakhet	DD	39.17	11.86	5.93	11.62	33.20	10.61	5.30	10.40	0.446
1046	Savannakhet	DD	50.66	18.98	10.96	21.48	34.59	26.66	13.33	26.13	0.545
1053	Savannakhet	DD	54.28	25.96	12.98	25.44	50.84	18.49	9.25	18.12	1
1058	Savannakhet	DD	53.74	21.93	10.96	21.49	50.94	19.06	9.53	18.68	0.632
1062	Savannakhet	DD	36.49	37.01	18.51	36.27	41.67	38.22	19.11	37.45	1
1064	Savannakhet	MDF	80.01	31.49	18.18	35.63	57.75	51.26	25.63	50.24	0.538
1069	Savannakhet	DD	66.08	33.44	16.72	32.77	54.34	26.24	13.12	25.72	0.446
1070	Savannakhet	DD	58.05	27.52	13.76	26.97	62.83	31.15	15.58	30.53	0.8
1121	Champasak	DD	35.05	17.91	8.96	17.55	35.82	24.93	12.47	24.43	1
1124	Champasak	DD	48.42	27.07	13.54	26.53	44.00	30.22	15.11	29.62	0.632
1130	Champasak	DD	56.13	27.48	13.74	26.93	46.84	24.12	12.06	23.64	0.6
1140	Xaignabouly	MDF	62.86	24.29	12.15	23.81	57.18	15.01	7.50	14.71	0.816
1159	Bolikhamxay	MDF	87.57	60.49	30.24	59.28	120.71	101.26	50.63	99.23	0.6
1160	Bolikhamxay	EF	91.26	43.22	21.61	42.35	151.32	80.11	40.05	78.51	0.258
1164	Bolikhamxay	EF	129.76	35.34	17.67	34.63	169.55	22.72	11.36	22.26	0.187
1167	Bolikhamxay	MDF	109.08	39.30	19.65	38.52	109.68	40.47	20.23	39.66	1

1180	Savannakhet	MDF	45.34	11.46	5.73	11.23	74.49	36.78	18.39	36.04	0.187
1181	Savannakhet	MDF	102.32	21.15	10.57	20.72	117.45	29.34	14.67	28.75	0.632
1184	Savannakhet	MDF	98.66	37.27	18.64	36.53	98.45	27.24	13.62	26.70	0.816
1201	Oudomxai	MDF	139.17	40.89	20.45	40.08	135.58	45.32	22.66	44.42	1
1228	Xekong	MCB	114.36	49.50	28.58	56.01	98.59	13.35	7.71	15.10	0.644
1229	Champasak	MDF	52.82	24.86	12.43	24.36	9.83	10.92	5.46	10.70	0.073
1231	Xiengkhouang	MCB	17.60	13.77	6.89	13.50	20.83	16.64	8.32	16.31	0.694
1236	Xiengkhouang	MCB	36.49	9.15	4.58	8.97	41.26	10.37	5.18	10.16	0.446
1250	Xekong	CF	99.93	33.73	16.87	33.06	57.61	26.46	13.23	25.93	0.258
1283	Xaignabouly	MDF	96.14	69.72	34.86	68.33	83.67	47.99	24.00	47.03	0.8
1286	Xaignabouly	MDF	52.83	14.28	7.14	13.99	47.97	14.93	7.46	14.63	0.258
1308	Xaignabouly	MDF	0.02	0.04	0.02	0.04	63.68	37.65	21.74	42.60	0.973
1319	Xaignabouly	MDF	85.67	44.52	22.26	43.63	91.33	54.83	27.42	53.74	1
1320	Xaignabouly	MDF	85.58	52.87	26.43	51.81	108.53	81.28	40.64	79.65	0.6
1368	Savannakhet	MDF	58.11	8.30	4.15	8.14	60.32	5.30	2.65	5.20	0.8
1391	Champasak	MDF	52.76	36.31	18.15	35.58	41.14	33.77	16.89	33.09	0.6
1411	Louangnamtha	MDF	129.28	74.48	37.24	72.99	109.07	69.74	34.87	68.34	0.313
1428	Oudomxai	MDF	51.24	2.87	1.66	3.25	45.43	5.67	3.27	6.41	0.191