

**Technical Annex of the Biennial Update Report**

**Lao People's Democratic Republic**

**Results achieved from Reducing Emissions  
from Deforestation and Forest Degradation,  
and Increasing Removals through  
Enhancement of Forest Carbon Stocks  
for  
REDD+ Results-Based Payments**

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**Department of Forestry**

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

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## Acronyms

AD	Activity Data
AGB	Above Ground Biomass
BGB	Below Ground Biomass
CF	Coniferous Forest
DBH	Diameter at Breast Height
DD	Dry Dipterocarp Forest
DOF	Department of Forestry
EG	Evergreen Forest
E/R factors	Emission and Removal Factor
FIPD	Forestry Inventory and Planning Division
FREL/FRL	Forest Reference Emission Level/Forest Reference Level
GHG	Greenhouse Gas
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
Lao PDR	Lao People's Democratic Republic
MAF	Ministry of Agriculture and Forestry
MCB	Mixed Coniferous Broadleaved Forest
MD	Mixed Deciduous Forest
NFI	National forest Inventory
NRTF	National REDD+ Taskforce
MRV	Measurement, Reporting and Verification
NFMS	National Forest Monitoring System
REDD+	Reducing Emissions from Deforestation and forest Degradation plus the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks
RV	Regenerating Vegetation
TWG	Technical Working Group
UNFCCC	United Nations Framework Convention on Climate Change

## 1. INTRODUCTION

Lao PDR presents this Technical Annex to obtain and receive results-based payments for reducing emissions from deforestation and forest degradation and increasing removals through enhancement of forest carbon stocks through REDD+ actions under the UNFCCC.

This Technical Annex was developed following the guidelines for elements to be included in the technical annex referred to in decision 14/COP19, paragraph 7 and other relevant decisions under the UNFCCC. It presents the **results of 12,805,253 tCO<sub>2</sub>e for reduced emissions and 1,873,301 tCO<sub>2</sub>e for increased removals for the period of 1<sup>st</sup> January 2015 to 31 December 2018 (4 years) estimated consistently against the FREL/FRL.**

The presentation of this Technical Annex does not modify, revise or adjust in any way the Nationally Determined Contribution of Lao PDR, or any national legal instruments or binding agreements under the UNFCCC.

## 2. SUMMARY OF INFORMATION ON THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

Lao PDR submitted its initial Forest Reference Emission Level/Forest Reference Level (FREL/FRL) on 8 January 2018, and the modified version was submitted in October 2018. The technical assessment was completed in January 2019 and published in the UNFCCC REDD+ web platform<sup>1</sup>.

### Elements for FREL/FRL

Table 1 below summarizes the main scope for the FREL/FRL.

**Table 1: Main scope for the FREL/FRL**

Scope	Contents
<b>Activities included</b>	Deforestation Forest degradation including from selective logging Forest enhancement (restoration) Forest enhancement (reforestation)
<b>Carbon Pools</b>	Included: AGB, BGB Not included: Deadwood, Litter, Soil – lack of data, insignificant
<b>Gases</b>	Only CO <sub>2</sub> included
<b>Scale</b>	National
<b>Reference period and validity</b>	2005-2014 (10 years) The validity of FREL/FRL is for the period 2015–2025 (11 years)
<b>Emission/Removal Factors</b>	Data source: 2nd NFI; country-specific allometric equation; IPCC default values; data of Vietnam. Then, stratified into five strata. Calculation: amount of changes in carbon stock of among the five strata.
<b>Activity Data</b>	Data source: national-scale forest type maps for year 2005, 2010 and 2015. Then, stratified in to five strata. Calculation: amount of changes in areas among the five strata. Estimated through reference sampling ('Design-Based Area Estimation')
<b>Model applied</b>	Historical average
<b>Adjustment</b>	No.

### Forest definition

According to the Land Law (2003) and Forestry Law (2019), forest and forest resources in Lao PDR occur in lands that are designated by the Government as forest lands, and in areas outside forest lands, and includes stocked and temporarily un-stocked forests.

Lao PDR has applied definitions for Current and Potential forests respectively, as national definitions of the forests, for which a summary is shown below.

<sup>1</sup> <https://redd.unfccc.int/submissions.html?country=lao>

- “Current Forest” consists of forest with trees with minimum DBH of 10cm forming minimum crown density of 20% and constituting a minimum area of 0.5ha. For forest plantations, tree plots satisfying a minimum area of 0.5ha are considered as Current Forest (DBH and crown density are not considered).
- “Potential Forest” is defined as Lands previously forested, but presently not meeting the definition of “Current Forest” due to various disturbances, and expected to be restored to “Current Forest” status if continuously left undisturbed, and not permanently being used for other purposes (i.e. residential, agriculture etc.).

This definition was used for the past two National Communications to the UNFCCC, and has been agreed to be used for the future national Greenhouse Gas (GHG) inventory starting with the Third National Communication and the 1st Biennial Update Report which the Lao government plans to submit both to the UNFCCC in 2020.

### **Land and forest classification**

The land and forest classification system of the country applies two levels of classification, namely, Level 1 consisting of seven classes including “Current Forest” and “Potential Forest” among others, and Level 2 which further classifies “Current forest” class under Level 1 into six natural and plantation forest classes. The land classification system is provided in Table 2 below, and a full description of the definition of each Level 2 class is available at the Department of Forestry (DOF)’s website<sup>2</sup>.

**Table 2: National level land and forest classification system of Lao PDR with IPCC definition on land use categories**

IPCC Definition	National level classification system		
	Level 1	Level 2	
Forest Land	Current Forest	Evergreen Forest	EG
		Mixed Deciduous Forest	MD
		Dry Dipterocarp Forest	DD
		Coniferous Forest	CF
		Mixed Coniferous and Broadleaved Forest	MCB
	Forest Plantation	P	
	Potential Forest	Bamboo	B
	Regenerating Vegetation	RV	
Grassland	Other Vegetated Areas	Savannah	SA
		Scrub	SR
		Grassland	G
Cropland	Cropland	Upland Crop	UC
		Rice Paddy	RP
		Other Agriculture	OA
		Agriculture Plantation	AP
Settlement	Settlement	Urban Areas	U
Other land	Other Land	Barren Land and Rock	BR
		Other Land	O

<sup>2</sup> <http://dof.maf.gov.la/en/home/>

Wetland	Above-ground Water Source	River (Water)	W
		Wetland (Swamp)	SW

### **Stratification**

For the purpose of the estimation of forest-related emissions and removals, the national land and forest classification explained above are condensed into five strata. Such simplified stratification will help reduce uncertainty of emissions and removals while balancing the accuracy of sampling and the cost/efforts required.

**Table 3: Stratified land/forest classification system and the five land/forest strata**

Land/forest classes			Strata
Level 1	Level 2		
Current Forest	Evergreen Forest	EG	1
	Mixed Deciduous Forest	MD	
	Coniferous Forest	CF	2
	Mixed Coniferous and Broadleaved Forest	MCB	
	Dry Dipterocarp Forest	DD	3
	Forest Plantation	P	
Potential Forest	Bamboo	B	4
	Regenerating Vegetation	RV	
Other Vegetated Areas	Savannah	SA	5
	Scrub	SR	
	Grassland	G	
Cropland	Upland Crop	UC	
	Rice Paddy	RP	
	Other Agriculture	OA	
	Agriculture Plantation	AP	
Settlement	Urban Areas	U	
Other Land	Barren Land and Rock	BR	
	Other Land	O	
Above-ground Water Source	Wetland (Swamp)	SW	
	River (Water)	W	

### **General methodologies used for the construction of FREL/FRL**

Reflecting the dynamic nature of land-use change in the country, and also to adequately monitor the future impacts of REDD+ implementation, Lao PDR considers it more appropriate to present historical emissions and removals separately per each source and sink activity. Accordingly, the four sources and sinks (i.e., emissions from deforestation and degradation, and removals from restoration and reforestation) are estimated by calculating the changes in biomass caused by the shift from one stratum to another. Due to the limitation in available data, emissions and removals occurring in forests remaining in the same category (i.e. strata 1, 2, 3 and 4) are not accounted for, except in the case of emissions estimated through measurement of tree stumps as proxy data for selective logging.



### **Historical data used**

Regarding the Activity Data (AD) and Emission/Removal factors (E/R factors):

- The AD is generated spatially using satellite-based analysis of land/forest cover for the two periods: 2005-2010 and 2010-2015. National-scale Forest Type Maps are used as the basis for estimating the AD. Changed areas are detected by change detection method, and then applied reference sampling ('Design-Based Area Estimation') with respect to generating statistically reliable estimates.
- E/R factors are basically generated using national-scale biomass data from the 2<sup>nd</sup> National Forest Inventory (NFI) combined with country-specific allometric equations, and an independent biomass measurement data for Regenerating Vegetation (RV) class<sup>3</sup>. IPCC default and data from neighbouring Vietnam are used for some land/forest classes where no country-specific data are available.

Apart from the above, Lao PDR estimates emissions from forest degradation by selective logging through proxy approach. The approach uses the tree stump records measured through the 2<sup>nd</sup> NFI to complement the impact of selective logging which was considered as under-represented in the estimation of emissions from forest degradation. The approach also complements quantifying forest degradation in stable forest classes where forest biomass change data is limited.

### **Emission and removals calculated based on changes among land/forest strata**

Based on the process and data explained above, average annual historical emissions and removals based on the changes among land/forest strata over the reference period of 2005-2014 are calculated.

Further, two adjustments were made with an aim to make the estimation as accurate as possible:

(i) Adjustment of removals (regrowth rate and reversals)

For land cover changes which result in emissions (i.e. 'Deforestation' and 'Forest Degradation'), the entire expected emission is assumed to occur (i.e. evenly distributed) over the time period in question. Meanwhile, for land/forest cover changes which result in removals (i.e. 'Restoration' and 'Reforestation') adjustments were applied as follows;

- a. Adjustments were made to 'Restoration' and 'Reforestation' by considering the types of changes and rate of tree growth. This recognizes that in forest ecosystems, forest biomass increase slowly over time to reach their full biomass (IPCC 2006).
- b. Reversals during the reference period (2005-2014) were identified through time-series analysis of polygons, in order to avoid double-counting. This is because due to the estimation method of generating AD for two independent periods (i.e. 2005-2010 and 2010-2015), there is a chance that the emissions from reversal events which have occurred during the reference period are unreported (in other words, removals are over-estimated).

(ii) Adjustment of emissions from deforestation and forest degradation

The resulting estimation based on above (i) presents the risk of overestimation of emissions from deforestation and degradation. This is because, the E/R factors are strata-specific and do not reflect

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<sup>3</sup> The reason for not using the 1<sup>st</sup> NFI data is explained in the Annex 10: Emission and Removal Factors Report.

the actual accumulated biomass which may be lower. Such change patterns were tracked through the time series-analysis of forest maps. The resulting over-estimation of emissions from deforestation and over-estimation of emissions from forest degradation were estimated and deducted, respectively.

**Emissions from selective logging (forest degradation)**

As explained already, the 2nd NFI recorded the tree stumps of the trees felled by human activities. The biomass of the felled trees were estimated from the measured size of each tree stump, aggregated for each of the five forest class (i.e. EG, MD, DD, CF, MCB) in order to estimate the average loss of carbon stock, and converted to tCO<sub>2</sub>e. Then, the results were multiplied with the area of each forest class calculated from the Forest Type Map 2015, to estimate the assumed emissions from such logging events. Possible double-counting between the calculation of emissions from selective logging and the calculation of degradation based on changes in forestland strata (i.e. strata 1, 2, 3 and 4) is avoided by deducting latter from the entire forest degradation emissions.

**Results of calculation and the proposed FREL/FRL**

From the above, the average value for each period was estimated in order to derive the annual historical emissions and removals. The results are shown in Table 4 below.

**Table 4: Annual historical emissions and removals by sources and sinks**

Unit: tCO<sub>2</sub>e

Year	Annual historical emissions and removals by sources and sinks				Reference level	
	Emissions: Deforestation	Emissions: Forest Degradation	Removals: Reforestation	Removals: Restoration	Emissions	Removals
	2005	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898
2006	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2007	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2008	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2009	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2010	9,602,777	25,572,121	-2,922,006	-3,039,488	35,174,898	-5,961,494
2011	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2012	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2013	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
2014	15,587,931	34,183,013	-3,739,205	-6,152,448	49,770,943	-9,891,653
				Average	41,013,316	-7,533,558

In conclusion, the FREL/FRL for Lao PDR is 41,013,316 tCO<sub>2</sub>e/year for emissions and 7,533,558 tCO<sub>2</sub>e/year for removals.

**Assessment of uncertainty**

Uncertainty associated with (a) emission and removals calculated based on changes among land/forest strata, and (b) emissions from selective logging, is quantified by applying 'propagation of

error approach' and by using the generic equations given in the IPCC Guidelines 2006 (Equation 3.1 and 3.2).

As the final result, the overall uncertainty of the proposed FREL/FRL is considered as 16.0% for emissions and 19.3% for removals.

**Table 5: Overall uncertainty of the proposed FREL/FRL**

Source/Sink	2005-2014		
	Amount (tCO <sub>2</sub> e/year)	Uncertainty range (tCO <sub>2</sub> e/year)	Uncertainty (%)
<b>Emission (5 strata and selective logging combined)</b>	41,013,316	6,562,648	16.0%
<b>Removal</b>	-7,533,558	-1,457,714	19.3%

### 3. RESULTS IN TONNES OF CO2 EQ PER YEAR, CONSISTENT WITH THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

The full description of the calculation is available in the “Lao People’s Democratic Republic: 1st National REDD+ Results Report for REDD+ Results-Based-Payment under the UNFCCC” and associated technical documents available from < <http://dof.maf.gov.la/en/publications/>>.

Lao PDR has measured the REDD+ results in full consistency with the FREL/FRL in methodology and scope, by using updated data. The results for the period 2015 - 2018 were calculated as the difference between the average annual emissions and removals of 2015-2018 and the FREL/FRL of 2005-2014.

First, the emissions and removals of 2015 -2018 period are summarized in Table 6. Note that the results are separated out into two time periods reflecting the difference in approaches applied for the emissions from selective logging per each time period (see footnote 4 for more explanation).

**Table 6: Average Annual Emissions and Removals over the 1st National REDD+ Results period**

Source/Sink	Emissions(+)/ Removals(-)		
	Total 2015-2018 (tCO2e)	Average annual 2015-2016 (tCO2e/year)	Average annual 2017-2018 (tCO2e/year)
Deforestation	44,974,274	11,243,569	11,243,569
Forest Degradation	106,273,739	27,088,804	26,048,065
Changes among land/forest strata	71,608,030	17,902,008	17,902,008
Selective logging <sup>4</sup>	34,665,708	9,186,797	8,146,058
Reforestation	-4,337,947	-1,084,487	-1,084,487
Restoration	-27,669,584	-6,917,396	-6,917,396
<b>Total Emission</b>	151,248,013	38,332,373	37,291,634
<b>Total Removals</b>	<b>-32,007,531</b>	<b>-8,001,883</b>	<b>-8,001,883</b>

Next, from the above, average value for each period was estimated in order to derive the annual historical emissions and removals. The results are shown in Table 7.

<sup>4</sup> As the 2<sup>nd</sup> NFI in fact includes tree stumps of 2015 and 2016, emissions from selective logging accounted in the FREL/FRL (i.e. 9,186,797 tCO2e/year) is also accounted as the emissions from selective logging for the 2015-2016 period. For the 2017-2018 period, tree stump data from the 3<sup>rd</sup> NFI is used to estimate the emissions from selective logging (i.e. 8,146,058 tCO2e/year).

**Table 7: 1<sup>st</sup> National REDD+ results – annualized\***

Unit: tCO<sub>2</sub>e/year

Year	Annual historical emissions and removals 2005-2014		Annual emissions and removals 2015-2018		1 <sup>st</sup> National REDD+ Results 2015-2018	
	Emissions: Deforestation and Forest Degradation	Removals: Reforestation and Restoration	Emissions: Deforestation and Forest Degradation	Removals: Reforestation and Restoration	Emissions reduction	Removals increase
2005	41,013,316	-7,533,558	/	/	/	/
2006	41,013,316	-7,533,558				
2007	41,013,316	-7,533,558				
2008	41,013,316	-7,533,558				
2009	41,013,316	-7,533,558				
2010	41,013,316	-7,533,558				
2011	41,013,316	-7,533,558				
2012	41,013,316	-7,533,558				
2013	41,013,316	-7,533,558				
2014	41,013,316	-7,533,558				
	Reference period					
2015	41,013,316	-7,533,558	38,332,373	-8,001,883	2,680,944	468,325
2016	41,013,316	-7,533,558	38,332,373	-8,001,883	2,680,944	468,325
2017	41,013,316	-7,533,558	37,291,634	-8,001,883	3,721,683	468,325
2018	41,013,316	-7,533,558	37,291,634	-8,001,883	3,721,683	468,325
Total					12,805,253	1,873,301

\*Figures have been rounded to the nearest whole number

In conclusion, the 1<sup>st</sup> National REDD+ Results for Lao PDR for the period of 2015-2016 and 2017-2018 is 2,680,944 tCO<sub>2</sub>e/year and 3,721,683 tCO<sub>2</sub>e/year respectively (12,805,253 tCO<sub>2</sub>e over 4 years) for emissions and 468,325 tCO<sub>2</sub>e/year (1,873,301 tCO<sub>2</sub>e over 4 years) for removals as shown in Table 8.

**Table 8: Proposed 1<sup>st</sup> National REDD+ Results for Lao PDR (2015-2018)**

Emissions/Removals	tCO <sub>2</sub> e/year	4 years total
<b>Emissions reduction 2015-2016</b>	2,680,944	12,805,253
<b>2017-2018</b>	3,721,683	
<b>Removals increase 2015-2016</b>	468,325	1,873,301
<b>2017-2018</b>	468,325	

The overall uncertainty of the proposed 1<sup>st</sup> National REDD+ Results is considered as 16.5% for emissions and 15.7% for removals for the 2015-2016 period, and 12.7% for emissions and 15.7% for removals for the 2017-2018 period.

**Table 9: Overall uncertainty of the proposed 1st National REDD+ Results (2015-2016)**

Source/Sink	2015-2016		
	Amount (tCO <sub>2</sub> e/year)	Uncertainty range (tCO <sub>2</sub> e/year)	Uncertainty (%)
<b>Emission</b>	2,680,944	442,697	16.5%
<b>Removal</b>	468,325	73,592	15.7%

**Table 10: Overall uncertainty of the proposed 1st National REDD+ Results (2017-2018)**

Source/Sink	2017-2018		
	Amount (tCO <sub>2</sub> e/year)	Uncertainty range (tCO <sub>2</sub> e/year)	Uncertainty (%)
<b>Emission</b>	3,721,683	470,809	12.7%
<b>Removal</b>	468,325	73,592	15.7%

#### 4. DEMONSTRATION THAT THE METHODOLOGIES USED TO PRODUCE THE RESULTS ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE ASSESSED FOREST REFERENCE EMISSION LEVEL AND FOREST REFERENCE LEVEL

As summarized in Table 11 below, the REDD+ results contained in this technical annex is produced in full consistency with the FREL/FRL by using updated data for some elements.

**Table 11: Comparison of the FREL/FRL and REDD+ results**

Scope	FREL/FRL	REDD+ results
<b>Forest definition</b>	<p>“Current Forest” with</p> <ul style="list-style-type: none"> <li>- Stand DBH: minimum of 10cm</li> <li>- Crown density: minimum of 20%</li> <li>- Minimum area of 0.5ha.</li> </ul> <p>and</p> <p>“Potential Forest” defined as lands previously forested, but presently not meeting the definition of “Current Forest” due to various disturbances, and expected to be restored to “Current Forest” status if continuously left undisturbed.</p>	Same.
<b>Land and forest classification system</b>	<p>National land and forest classification system with two levels of classification:</p> <ul style="list-style-type: none"> <li>- Level 1 consisting of seven classes including “Current Forest” and “Potential Forest”; and</li> <li>- Level 2 which further classifies “Current forest” class under Level 1 into six natural and plantation forest classes.</li> </ul>	Same.
<b>Stratification</b>	<p>For the purpose of the REDD+, the national land and forest classification explained above are condensed into five land/forest strata.</p>	Same.
<b>Activities included</b>	<p>Deforestation</p> <p>Forest degradation including selective logging</p> <p>Forest enhancement (restoration)</p> <p>Forest enhancement (reforestation)</p>	Same.
<b>Carbon Pools</b>	<p>Included: AGB, BGB</p> <p>Not included: Deadwood, Litter, Soil – lack of data, insignificant</p>	Same.

<b>Gases</b>	Only CO2 included.	Same.
<b>Scale</b>	National	Same.
<b>Reference period and validity</b>	2005-2014 (10 years) The validity of FREL/FRL is for the period 2015–2025 (11 years)	The proposed results period is 2015-2018 (4 years) and within the validity period of the FREL/FRL.
<b>Emission Factor</b>	Data source: 2nd NFI; country-specific allometric equation; IPCC default values; data of Vietnam. Then, stratified into five strata. Calculation: amount of changes in carbon stock of among the five strata.	Data source: 3rd NFI. Otherwise same.
<b>Activity Data</b>	Data source: national-scale forest type maps for year 2005, 2010 and 2015. Then, stratified in to five strata. Calculation: amount of changes in areas among the five strata. Estimated through reference sampling ('Design-Based Area Estimation')	Data source: national-scale forest type maps for year 2019. Otherwise same.
<b>Model applied</b>	Historical average	Same.
<b>Adjustment</b>	No.	Same.



## 5. DESCRIPTION OF THE NATIONAL FOREST MONITORING SYSTEM AND THE INSTITUTIONAL ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING THE RESULTS

### 5.1 Description of the National Forest Monitoring System

As evidenced by the submission of this REDD+ Technical Annex, Lao PDR is already implementing core parts of its National Forest Monitoring System (NFMS) which supports the country's REDD+ MRV. It should be noted that Lao PDR currently implements REDD+ MRV on two different scales; one for the national level (as reported herewith) and another for a sub-national level which is for the Emission Reduction Program (ER Program) for the Forest Carbon Partnership Facility's Carbon Fund<sup>5</sup>. The FREL/FRLs for the national and sub-national levels were constructed using same methodologies and datasets, therefore, considered as highly consistent.

The NFMS is being developed in step-wise fashion to support monitoring of the drivers and interventions (a conceptual picture show in Figure 1 below). There are several related initiatives progressing in parallel, and they will be coordinated under the National REDD+ Task Force (NRTF) and the REL/MRV Technical Working Group (TWG) so that the NFMS will contribute to the overall performance monitoring of the forestry sector.

Recognizing the importance of a robust and transparent NFMS, Lao PDR is currently developing its national approach to the NFMS through the development of Lao NFMS Roadmap with support from JICA. The Lao NFMS Roadmap, once complete, would provide a comprehensive overview and work plan for improvements, identified actions, institutional arrangements, and capacity building needs. Based on an assessment of its national circumstances, existing and emerging REDD+ investments, and broader climate finance opportunities the national approach to NFMS will ensure REDD+ MRV requirements are fully considered. The Lao NFMS Roadmap is expected to be complete by the 3<sup>rd</sup> Quarter of 2020.

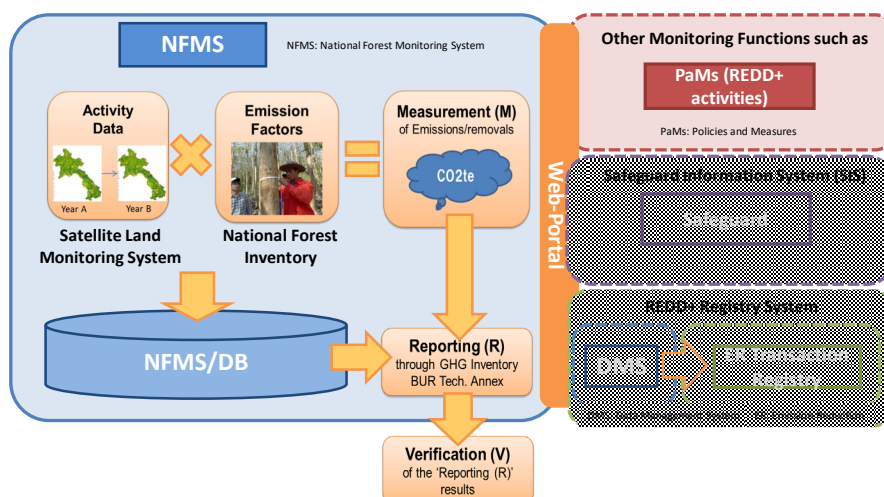


Figure 1: Conceptual diagram of Lao PDR's NFMS and its interactions with other REDD+ system

<sup>5</sup> <https://www.forestcarbonpartnership.org/country/lao-pdr>

## **5.2 Institutional roles and responsibilities for measuring, reporting and verifying the reported results**

### **Role and capacity of entities for conducting MRV**

#### **■ Department of Forestry (DOF)**

DOF, as the national entity responsible for forest management, will play the main role in the MRV. Forest Planning and Inventory Division (FIPD) of DOF will continue to be responsible for generating the AD and E/R factors, and applying other proxy-based methods as appropriate.

#### **■ REL/MRV Technical Working Group (TWG)**

The REL/MRV TWG will technically review the results of the MRV (and other technical areas related to NFMS, such as forest monitoring for law enforcement). The TWG consists of members from the four key government agencies (FIPD of DOF, REDD+ Division of DOF, Department of Agriculture Land Management of MAF, Department of Climate Change of MONRE) and one from academia (Faculty of Forestry, under the National University of Laos (NoUL)). The TWG is technically supported by international projects and advisors and is an open process. Although the MRV itself is under the responsibility of the REL/MRV TWG, members of other five TWGs<sup>6</sup> will be invited as appropriate, where there are links between the thematic areas. Having DDC of MONRE, who is the national focal point to the UNFCCC, and responsible for climate change related issues including GHG Inventory, as a member of the TWG will allow the coordination of the MRV process and results with other GHG mitigation initiatives in the country.

#### **■ National REDD+ Task Force (NRTF)**

The NRTF will be responsible for reviewing and politically endorsing the results of MRV. The NRTF consists of concerned government agencies, academia (NoUL) and business associations (Chamber of Commerce) who have stake in forestry, land-use, climate change, poverty reduction and other issues related to REDD+ in Lao PDR.

#### **■ Ministry of Agriculture and Forestry (MAF)**

MAF will be responsible for the overall governance and supervision of the REDD+ including the MRV, and will undertake the final responsibility to submit the MRV report (through MONRE who is the UNFCCC focal point).

#### **■ Private sector and local community**

The private sector and local community will be informed of the results to ensure transparency and accountability in MRV. Some of them, particularly the local communities, will continue to be involved in supporting the technical work, such as being local guides for the NFIs. Moreover, the information from their own activities are expected to be used as ancillary information to support and improve the MRV, particularly in forest mapping. This includes, for example, plantation management information of the forest companies to improve classification of plantations, and village-level forest

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<sup>6</sup> Benefit Sharing TWG, Land TWG, Legal TWG, Monitoring and Promoting REDD+ Strategy Implementation TWG and Social and Environmental Safeguards TWG.

monitoring activities based on the land-use plans to further understand the stages of shifting-cultivation and forest regeneration stages. Other potential means of engagement will be explored through the course of designing the future NFMS.

## 6. NECESSARY INFORMATION THAT ALLOWS FOR THE RECONSTRUCTION OF THE RESULTS

Lao PDR is in the process of developing its NFMS including the database system and web-based portal.

For the development of a database system which enables automated estimation of forest carbon stocks and its changes over time, this will be done through developing functions to:

1. Archive, calculate and output the AD
2. Archive, calculate and output the E/R factors
3. Calculate, evaluate and output the forest carbon stocks and its changes, and convert to tCO<sub>2</sub>e.

The advantage of such system is that it will unify all the existing official data used for the emissions and removals into one single database, reduce costs by means of automating, and facilitate transparency of the estimation methods and results. Moreover, overlaying such information with the administrative boundary data, forest category data, and other forestry-related data will allow the data users to analyse forests according to their interest.

**Table 12: Data to be presented in the NFMS web-portal**

Data related to AD	Data type
Forest Type Map 2000, 2005, 2010, 2015, 2019	Raster data
Forest cover change map 2000-2005, 2005-2010, 2010-2015, 2015-2019	Raster data (partly vector data)
Satellite imagery used for the development of Forest Type Maps Landsat (2000), SPOT4, 5 MS(2005), RapidEye (2010, 2015) (both false colour and true colour), Sentinel 2(2019)	Raster data
Data related to E/R factors	Data type
1 <sup>st</sup> NFI data	Tabular data
2 <sup>nd</sup> NFI data	Tabular data including GIS points
3 <sup>rd</sup> NFI data	Tabular data including GIS points
Other data	Data type
Administrative area: national, province, district	Vector data
Forest category: Production Forest, Protection Forest, Conservation Forest	Vector data
Reports	Data storage
FREL/FRL Report to the UNFCCC including annexes	Available in UNFCCC website
1 <sup>st</sup> National REDD+ Results to the UNFCCC including annexes	To be made available in UNFCCC website
1 <sup>st</sup> National Communication to the UNFCCC	Available in UNFCCC website
2 <sup>nd</sup> National Communication to the UNFCCC	
3 <sup>rd</sup> National Communication to the UNFCCC	To be made available in UNFCCC website
1 <sup>st</sup> Biennial Update Report to the UNFCCC	

The NFMS web-portal will enable access through internet<sup>7</sup>. The information to be presented in the NFMS web-portal will be further enhanced, although step-wise, to ensure transparency.

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<sup>7</sup> <<http://nfms.maf.gov.la:4242/nfms/>>. As the web-portal is currently inaccessible due to its system upgrading in progress (as of June 2020), the temporary back-up website can be accessed through <<http://nfms-lao.net/nfms/>>.

## **7. DESCRIPTION OF HOW THE ELEMENTS CONTAINED IN DECISION 4/CP.15, PARAGRAPH 1(C) AND (D), HAVE BEEN TAKEN INTO ACCOUNT**

### **7.1 To use of the most recent IPCC guidance and guidelines**

The Lao PDR used the methodologies and equations provided in the 2006 IPCC Guideline for the construction of the FREL/FRL. The REDD+ results presented herewith maintains overall consistency with the 2006 IPCC Guideline by applying methodologies consistent with the FREL/FRL as explained in Section 4.

Equations 2.15 and 2.16 from vol. 4, chapter 2) of the 2006 IPCC Guidelines are used for the estimation of carbon stock changes in land converted to other land-use categories. For lands remaining in the same land-use category, gain and loss method is partially used by considering only the losses in carbon stocks from selective logging.

A simplified approach for land representation is applied in which all non-forest land classes (cropland, grassland, wetlands, settlements and other land) are grouped into one non-forest class. Such approach was adopted in order to reduce the uncertainty associated with the land representation. Lao PDR acknowledges this approach is not consistent with the approaches for land representation provided in the IPCC 2016 Guidelines (vol. 4, chapter 3), however, the national data allows the application of approach 3 for land representation provided in the IPCC 2006 Guidelines.

The forest carbon stocks for the REDD+ results were derived using the data from the 3<sup>rd</sup> NFI conducted in 2019 together with the default parameters provided in the 2006 IPCC Guidelines and also some data from Vietnam. To calculate the above-ground biomass stocks of the five strata of land and forest classes, country-specific allometric equations are used. To calculate the below-ground biomass stocks, the root-to-shoot ratios provided in the 2006 IPCC Guidelines (vol. 4, chapter 4, Table 4.4) are used. Biomass stocks were converted into carbon stocks using the carbon fraction values (0.46 or 0.47 depending on the land class) provided in the 2006 IPCC Guidelines (vol. 4, chapter 4, Table 4.3).

Apart from the above, there are several areas for future technical improvement which will be addressed step-wise in the future in order to further improve conformity with the 2006 IPCC Guidelines.

### **7.2 To establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems that:**

As already described in Section 5 and Section 6, Lao PDR already has the initial phase of NFMS which supports the REDD+ MRVs, including the database system and web-based portal. The NFMS is also being developed step-wise to improve the quality of REDD+ MRVs as well as to support monitoring of the drivers and interventions. Lao PDR is currently developing its Lao NFMS Roadmap with target for completion by the 3<sup>rd</sup> Quarter of 2020.

Standard Operating Procedure (SOP) is developed for each of the components below, with aim to achieve efficiency and quality output in standardized manner, thereby make the NFMS robust and transparent:

- SOP for Forest Type Map development
- SOP for National Forest Inventory
- SOP for NFMS database and web-portal (user manual, data installation manual)
- SOP for estimation of emissions/removals, REDD+ results and uncertainty

**(i) Use a combination of remote sensing and ground-based forest carbon inventory approaches**

As explained in the FREL/FRL submission and also in the 1<sup>st</sup> National REDD+ results, the NFMS of Lao PDR uses a combination of remote sensing and ground-based forest carbon inventory approaches for consistently estimating the REDD+ results as summarized below (in fact the two approaches support each other in many ways). Uncertainty of each of the input data as well as the overall uncertainty are assessed.

- a. Measurement based on land/forest area changes
  - Use of AD estimated based on the stratified wall-to-wall mapping (remote sensing-based) and through reference sampling ('Design-Based Area Estimation'); and
  - Use of E/R factors based on the biomass data from the NFIs (ground-based survey);
- b. Proxy data (tree stumps observed and measured through the NFIs) to estimate emission from forest degradation by selective logging
- c. Uncertainty assessment by using propagation of error approach.

**(ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties**

The NFMS database stores national datasets used for generating AD and E/R factors and made accessible to everyone. Thus, the dataset used for the construction of FREL/FRL are made transparent through the NFMS database and other documentation (e.g. FREL/FRL report and other background documents being published). In a same way, the dataset used for the estimation of REDD+ results will be made transparent and allow reconstruction of the estimation.

The raw datasets are stored in a server system of DOF primarily to serve for the use of technical staff authorized by DOF staff, however, they can be shared to other users if the purposes are reasonably acceptable. DOF is planning to replace the server system managed by FIPD in order to strengthen its data management capacity and system security. The calculation spreadsheets and other data sources can be provided upon request. This Technical Annex will be made publicly accessible once the technical analysis is completed.

Institutionally, the NRTF established under the leadership of MAF vice minister serve as a venue to review and endorse the issues related to REDD+ including the REDD+ results. Under the NRTF, REL/MRV TWG operates as a venue to technically review and agree on the issues related to REL/MRV. The meetings of the REL/MRV TWG are generally open, to enhance partnership and transparency.

The estimation of REDD+ results are conducted in a consistent manner with the methods used for constructing the FREL/FRL as repeatedly explained elsewhere.

Lao PDR is committed to continuously improve the accuracy and reduce the uncertainty of the estimates as described in the related reports and technical documents associated to this Technical Annex. Through the exercise of developing the FREL/FRL and the REDD+ results, and also through

various interactions with external expertise such as the technical assessment process of FREL/FRL and FCPF Carbon Fund, Lao PDR already has acknowledged some areas that need improvement. As explained in Section 5, the Lao NFMS Roadmap being prepared will help to clarify how DOF seeks to improve the MRVs and other forest monitoring components. JICA has been leading in technical support to the NFMS in collaboration with other development partners, with prospect to continue its support for the coming years.

For asseing uncerainty, Lao PDR conducted uncertainty assessment of the FREL/FRL by using propagation of error approach. Same approach is applied in the estimation of the REDD+ results and the results are already presented in Section 3.

**(iii) Are transparent and their results are available and suitable for review**

Lao PDR recognizes the importance of building a truly functional institutional set-up, robust technical elements, data transparency, and a data management system to support a sustainable operation of the NFMS.

As explained in Section 6, the NFMS web-portal and other documentations are/will be made accessible for enhanced transparency. The Lao NFMS Roadmap will also enhance transparency and allow interested stakeholders to understand how Lao PDR aims to manage and develop its NFMS.