Joint Crediting Mechanism Approved Methodology LA_AM004
"Reducing GHG emissions from deforestation and forest degradation through controlling shifting cultivation in Phonxay District, Luang Prabang Province of Lao PDR"

A. Title of the methodology

Reducing GHG emissions from deforestation and forest degradation through controlling shifting cultivation in Phonxay District, Luang Prabang Province of Lao PDR, Version 1.0

B. Terms and definitions

Terms	Definitions
Lao People's Democratic Republic Forest Reference Emission Level and Forest Reference Level for REDD+ Results Payment under the UNFCCC (national FREL/FRL (2018))	The national FREL/FRL is defined as the forest reference emission level/forest reference level of Lao People's Democratic Republic (May 2018), which was submitted by the Government of Lao PDR to the UNFCCC secretariat through the official process of the technical assessment. The reference period of the national FREL/FRL is from 2005 to 2014.
Forest Type Map	The forest type map is an official land cover/use map of the Lao PDR which is used for establishing the national FREL/FRL (2018) and is provided by the national forest monitoring system.
Peat land	Peat land is an area with an accumulation of partly decomposed organic matter, with ash content equal to or less than 35%, peat depth equal to deeper than 50 cm, and organic carbon content (by weight) of at least 12% (Osaki et al. 2016[1]).

C. Summary of the methodology

Items	Summary
Project activities (emission	Activities for reducing shifting cultivation pressures on forest

[1] Osaki, M., Hirose, K., Segah, H., & Helmy, F. (2016). Tropical peat and peatland definition in Indonesia. In Tropical Peatland Ecosystems (pp. 137-147). Springer, Tokyo.

reduction /removal enhancement measures)	resources by introducing alternative and suitable livelihoods based on rural people's capability.
Establishment of project reference level	- The project reference level is calculated on the basis of the average net GHG emissions in the project area from 2005 to 2014. - The net GHG emission from carbon stock change in project area is calculated from the annual average of CO_2 emissions and removals to be provided by the Government of Lao PDR. These values are consistent with the national FREL/FRL. - Non-CO_2 GHG emissions from biomass burning in project area is considered following the 2006 IPCC Guidelines although the source is not included in the national FREL/FRL.
Calculation of project net emissions/removals	Project net emissions are calculated by using 2 types of data; 1) CO_2 emissions and removals from carbon stock change during the monitoring period which will be provided by the Government of Lao PDR based on the national forest monitoring system. 2) GHG emissions from biomass burning, rice paddy cultivation and fossil fuel consumption associated with the project during the monitoring period are estimated by methods following the 2006 IPCC Guidelines.
Monitoring parameters and methods	- The national forest monitoring system monitors the land use/cover change. The analyzed data during the monitoring period is provided by the Government of Lao PDR, in the form of CO_2 emissions and removals from carbon stock change. - Area of rice paddy (wet rice paddy) is calculated based on the land cover/use maps (the Forest Type Maps) analyzed and provided by the Government of Lao PDR. - Quantity of fuel consumptions by agricultural heavy machines newly introduced by the project is collected from business records in oil shop(s) in the project area and information from villagers using the participatory rural appraisal (PRA).
Calculation of project	The default discount factor of 30%, as defined in the Joint

emission reductions or removals to be credited	Crediting Mechanism Guidelines for Developing Proposed Methodology for Reducing Emissions from Deforestation and Forest Degradation, and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries (REDD-plus) (hereinafter referred to as "the methodology guidelines"), is applied to project emissions reductions to account for the risk of reversal.

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	Project participants receive official data from the Government of Lao PDR, such as the Forest Type Maps and carbon stock change emissions and removals in the project area which are consistent with the national FREL/FRL and the national forest monitoring system.
Criterion 2	The project is to reduce deforestation and forest degradation in Project activity in taking place within Phonxay District, Luang Prabang Province, Lao PDR, where major drivers of deforestation and forest degradation are shifting cultivation (i.e. slash-and-burn agriculture).
Criterion 3	There is no peat land in the project area.
Criterion 4	Project activities are implemented by collaboration among rural people and project participant(s) who have been trained for alternative livelihood, which is evidenced by participants list or activity records.
Criterion 5	Project activities do not include activities which directly increase the number of livestock.
Criterion 6	Project activities do not include any activities which cause displacement of deforestation and/or forest degradation outside of the project area. That is to be confirmed during the monitoring period by the PRA.

E. Geographical Boundaries

Essential

Geographical boundary	Requirements
Project area	No requirements in addition to those described in paragraphs 16 to 21 of the methodology guidelines ver01.0 (JCM_LA_GL_PM_REDD+_ver01.0.pdf).
Reference area	The reference area is the same to the project area.

Optional boundaries

Geographical boundary	Required (Y/N/TBD)	Additional requirements
Activity area	N	None
Displacement belt	N	None

TBD: to be decided by the project participant

F. Carbon pools and GHG sources

The net emission sources to be considered include all the following Carbon pools and GHG sources.

Project reference level			
Carbon pools and GHG sources		Included (Y/N)	Explanation
Carbon pools	Above ground biomass	Y	This pool is expected to contribute significantly to emissions and emission reductions and is therefore included.
	Below ground biomass	Y	This pool is expected to contribute significantly to emissions and emission reductions and is therefore included.
	Dead wood	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
	Litter	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
	Soil organic carbon	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
GHG sources	CH_4 in biomass burning		GHG emission from this source is to be estimated.
	N_2O in biomass burning		GHG emission from this source is to be estimated.

Project net emissions/removals			
Carbon pools and GHG sources		Included (Y/N)	Explanation
Carbon pools	Above ground biomass	Y	This pool is expected to contribute significantly to emissions and emission reductions and is therefore included.
	Below ground biomass	Y	This pool is expected to contribute significantly to emissions and emission reductions and is therefore included.
	Dead wood	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
	Litter	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
	Soil organic carbon	N	It is expected that this pool would have decreased in the absence of the project and, therefore, it is conservatively excluded.
GHG sources	CH_4 in biomass burning		GHG emission from this source is to be estimated.
	N_2O in biomass burning		GHG emission from this source is to be estimated.
	CH_4 from paddy (wet paddy) area expanded during the monitoring period.		GHG emission from this source is to be estimated.
	CO_2 emissions from energy use for agricultural heavy machines newly introduced by the project		GHG emission from this source is to be estimated.

G. Establishment and calculation of project reference level

G.1. Establishment of project reference level

Approach for estimating project reference level	The reference level is established based on carbon stock change data to be provided by the Government of Lao PDR and other GHG emissions in the project area.

The Government of Lao PDR submitted its proposed forest reference emission level/forest reference level (national FREL/FRL) on 5 January 2018 to the UNFCCC secretariat. The technical assessment on the proposed FREL/FRL was conducted by the experts and the Government of Lao PDR provided a modified version of its FREL/FRL submission on 28 May 2018, considering the technical inputs of the technical assessment. The national FREL/FRL for the reference period 2005–2014 was emissions of 41,013,316 t CO_2/year and removals of 7,533,558 t CO_2/year in line with the modified submission and it is assumed to be valid for the next 11 years (i.e. 2015–2025).

The methodology guidelines require to respect the national reference level or forest monitoring system developed by the Government of Lao PDR, to apply the approach and procedures used for the national reference level when developing the project reference level and to consider the approach and procedures used in national forest monitoring system when establishing the monitoring system for the project. This methodology fully respects the national reference level and forest monitoring system based on the consultations with the technical contact person for REDD-plus under the JCM.

The project reference level is calculated from the CO_2 emissions and removals by carbon stock change ($CS_{emission\ ref}$ and $CS_{removal\ ref}$, respectively) and Non-CO_2 GHG emissions (CH_4 and N_2O) from biomass burning in the project reference area (= project area) during the reference period.

The $CS_{emission\ ref}$ and $CS_{removal\ ref}$ are to be provided by the Government of Lao PDR, and estimated from activity data and emission factors used in the development of national FREL/FRL.

The activity data (area changed) in the project reference area during the project reference period and the monitoring period are derived from the Forest Type Maps in the project reference area/project area developed with 5-year intervals (e.g., 2005, 2010, 2015). The land-use and land cover were classified into 20 classes including 8 forest types and grouped into five strata as below.

- Stratum 1: evergreen forest
- Stratum 2: mixed deciduous forest, conifer forest, and mixed coniferous and broadleaved forest
- Stratum 3: dry dipterocarp forest

- Stratum 4: plantation, bamboo and regenerating vegetation
- Stratum 5: 12 non-forest classes, including grasslands, rice paddies, urban areas, and barren land and rock.

The activity data in a form of land transition matrix of the five strata in the reference area/project area for the periods are to be developed by the Government of Lao PDR.

The emission factors are presented in the Table 4-2 of the national FREL/FRL. The emission (and removal) factors corresponding to transitions between two strata were difference in the carbon stocks between the two strata. The forest carbon stocks were derived using the data from the second National Forest Inventory (NFI) conducted during the period 2015–2017 together with the default parameters provided in the 2006 IPCC Guidelines. To calculate the above-ground biomass stocks of the five strata of land classes, country-specific allometric equations were applied, while the root-to-shoot ratios provided in the 2006 IPCC Guidelines (vol. 4, chapter 4, table 4.4) were applied to calculate the below-ground biomass stocks. 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).

To estimate Non-CO_2 GHG emissions (CH_4 and N_2O) from biomass burning in the project reference area (= project area) during the reference period in a conservative manner, the minimum area of upland crop (UC) in all Forest Type Maps during the reference period is applied as average burnt area during the reference period, and all the burnt area is assumed to have been regenerating vegetation before being burned as the mass of fuel available for combustion in regenerating vegetation is the smallest among all strata.

G.2. Calculation of project reference level

1. The project reference level is calculated as follows;

$$RL_y = CS_{net\ ref,y} + Fire_{ref,y} \quad \text{(Equation 1)}$$

Where:

RL_y	Project reference level in year y [tCO_2e/yr]
$CS_{net\ ref,y}$	Net emissions/removals from carbon stock changes in above- and below-ground biomass in project reference area in year y [tCO_2e/yr]
$Fire_{ref,y}$	Amount of non-CO_2 GHG emissions from forest fires (i.e. biomass burning) in project reference area in year y [tCO_2e/yr]

2. Calculation of $CS_{net\ ref,y}$ is as follows;

$$CS_{net\ ref,y} = CS_{emission\ ref,y} + CS_{removal\ ref,y} - \quad \text{(Equation 2)}$$

Where:

$CS_{emission\ ref,y}$ Amount of CO_2 emissions from carbon pools (above- and below-ground biomass) in project reference area in year y during the reference periods [tCO_2e/yr], provided by the Government of Lao PDR.

$CS_{removal\ ref,y}$ Amount of CO_2 removals into carbon pools (above- and below-ground biomass) in project reference area in year *y* during the reference periods [tCO_2e/yr], provided by the Government of Lao PDR.

3. Calculation of $Fire_{ref,y}$ is as follows (CH_4 and N_2O emissions from biomass burning are calculated although they are not considered in the national FREL/FRL);

$$Fire_{ref,y} = \Sigma_{i,k} (A\text{-}burn_{ref\,i} \times MB_{ref,rv} \times Cf_i \times G_{ef,k} \times 10^{-3} \times GWP_k) \quad \text{(Equation 3)}$$

Where:

$Fire_{ref,y}$ Amount of non-CO_2 GHG (i.e. CH_4 and N_2O) emissions from forest fires in project reference area in year *y* [tCO_2e/yr]

$A\text{-}burn_{ref\,i}$ Annual burnt area in stratum *i* during the reference period in project reference area [ha/yr]

The minimum area of upland crop (UC) in all Forest Type Maps during the reference period is applied as the burnt area

$MB_{ref,rv}$ Mass of fuel available for combustion in regenerating vegetation in project reference area during the reference period [t/ha]

Cf_i Combustion factor (identified as secondary tropical forests in line with 2006 IPCC Guidelines) [dimensionless]

$G_{ef,k}$ Emission factor of GHG_k in forest fire in the project reference area [g/kg-d.m. burnt]

GWP_k Global Warming Potential of GHG_k [25 for CH_4 or 298 for N_2O]

i Stratum type. Regenerating vegetation is to be applied for all burnt area [dimensionless]

k Type of GHG [dimensionless]

$$MB_{ref,rv} = C_{ref,rv} / (44/12 \times CF_i) \quad \text{(Equation 4)}$$

$MB_{ref\,rv}$ Mass of fuel available for combustion in regenerating vegetation in project reference area during the reference period [t/ha]

$C_{ref,rv}$ Carbon Stock in regenerating vegetation to be applied for the reference period [tCO_2/ha]

CF_i Carbon fraction of dry matter in stratum *i* [dimensionless]

H. Calculation of project net emissions/removals

1. Project net emissions in year *y* during the monitoring period are calculated as follows;

$PE_y = CS_{net\ pro,y} + Fire_{pro,y} + Paddy_{pro,y} + E_{pro,y}$ (Equation 5)

Where:

PE_y Project net emissions in year *y* [tCO_2e/yr]

$CS_{net\ pro,y}$ Net emissions/removals from carbon stock changes in above- and below-ground biomass during the monitoring period in year *y* [tCO_2e/yr]

$Fire_{pro,y}$ Amount of non-CO_2 GHG emissions from forest fires during the monitoring period in the project area in year *y* [tCO_2e/yr]

$Paddy_{pro,y}$ Amount of GHG emissions from rice paddy area expanded during the monitoring period in the project area in year *y* [tCO_2e /yr]

$E_{pro,y}$ Amount of CO_2 emissions from energy use for agricultural heavy machine for the project activities during the monitoring period in the project area in year *y* [tCO_2e/yr]

2. Calculation of $CS_{net\ pro,y}$ is as follows;

$CS_{net\ pro,y} = CS_{emission\ pro,y} + CS_{removal\ pro,y}$ - (Equation 6)

Where:

$CS_{emission\ pro,y}$ Amount of CO_2 emissions from carbon pools (above- and below-ground biomass) during the monitoring period in the project area [tCO_2e/yr], provided by the Government of Lao PDR.

$CS_{removal\ pro,y}$ Amount of CO_2 removals into carbon pools (above- and below-ground biomass) during the monitoring period in the project area [tCO_2e/yr], provided by the Government of Lao PDR..

3. Calculation of $Fire_{pro,y}$ is as follows (CH_4 and N_2O emissions from biomass burning are calculated although they are not considered in the national FREL/FRL);

$Fire_{pro,y} = \Sigma_{i,k} (A\text{-}burn_{pro,i} \times MB_{pro,\ i} \times Cf_i \times G_{ef,\ k} \times 10^{-3} \times GWP_k)$ (Equation 7)

Where:

$Fire_{pro,y}$ Amount of non-CO_2 GHG (i.e. CH_4 and N_2O) emissions from forest fires during the monitoring period in the project area in year *y* [tCO_2e/yr]

$A\text{-}burn_{pro,i}$ Maximum annual burnt area in stratum *i* during the monitoring period in the project area [ha/yr]

$MB_{pro\ i}$ Mass of fuel available for combustion in stratum *i* during the monitoring period in the project area [t/ha]

Cf_i Combustion factor [dimensionless]

$G_{ef,k}$	Emission factor of GHG *k* in forest fire during the monitoring period in the project area [g/kg-dm burnt]
GWP_k	Global Warming Potential of GHG *k* [25 for CH_4 or 298 for N_2O]
i	Stratum type [dimensionless]
k	Type of GHG [dimensionless]

$$MB_{pro\ i} = C_{pro,i} \times (1 - R_{ratio,\ i}) / (44/12 \times CF_i) \quad \text{(Equation 8)}$$

Where:

$MB_{pro\ i}$	Mass of fuel available for combustion in stratum *i* during the monitoring period in the project area [t/ha]
$C_{pro\ i}$	Above-ground and below-ground carbon stock in stratum *i* during the monitoring period in the project area [tCO_2/ha]
$R_{ratio,\ i}$	Ratio of below-ground biomass to above-ground biomass in stratum *i* in the project area [dimensionless]
CF_i	Carbon fraction of dry matter in stratum *i* [dimensionless]
i	Stratum type [dimensionless]

4. Calculation of $Paddy_{pro,y}$ is as follows;

$$Paddy_{pro,y} = EF_{pro} \times A\text{-}p_{pro,y} \times t_{pro} \times 10^{-3} \times GWP_k \quad \text{(Equation 9)}$$

Where:

$Paddy_{pro,y}$	Amount of GHG emissions from rice paddy area expanded during the monitoring period in the project area in year *y* [tCO_2e /yr]
EF_{pro}	A daily emission factor from rice paddy cultivation during the monitoring period in the project area [kg CH_4/ha/day]
$A\text{-}p_{pro,y}$	Area of rice paddy expanded during the monitoring period in the project area in year *y* [ha/yr]
t_{pro}	Maximum cultivation period of rice paddy during the monitoring period in the project area in year *y* [day]
GWP_k	Global Warming Potential of GHG k [25 for CH_4]
k	Type of GHG [dimensionless]

$$EF_{pro} = EF_c \times SF_w \times SF_p \quad \text{(Equation 10)}$$

Where:

EF_{pro}	A daily emission factor from rice paddy cultivation during the monitoring period in the project area [kg CH_4/ha/day]
EF_c	Baseline emission factor for continuously flooded fields without organic amendments [kg CH_4/ha/day]

SF_w Scaling factor to account for the differences in water regime during the cultivation period [dimensionless]

SF_p Scaling factor to account for the differences in water regime in the pre-season before the cultivation period [dimensionless]

5. Calculation of $E_{pro,y}$ is as follows;

$$E_{pro,y} = FC_{MG,y} \times NCV_{MG} \times E_{fuel,MG} \quad \text{(Equation 11)}$$

Where:

$E_{pro,y}$ Amount of CO_2 emissions from energy use for agricultural heavy machineries for project activities during the monitoring period in the project area in year y [tCO_2e/yr]

$FC_{MG,y}$ Maximum consumption of motor gasoline during the monitoring period in the project area in year y [kg/yr]

NCV_{MG} Net calorific value of motor gasoline [GJ/kg]

$EF_{fuel,MG}$ CO_2 emission factor of motor gasoline combusted [tCO_2/GJ]

I. Calculation of project emissions reductions or removals to be credited

1. Project emission reductions are calculated as the difference between the project reference level and project net emissions/removals, as follows;

$$ER_y = (RL_y - PE_y) \quad \text{(Equation 12)}$$

Where:

ER_y Net GHG emission reductions in year y [tCO_2e]

RL_y Project reference level in year y [tCO_2e]

PE_y Project net emissions/removals in year y [tCO_2e]

2. Annual project emission reductions to be credited are calculated considering the discount for the risk of reversals. The default value of 30% is applied for the discount factor.

$$ER_{credt,y} = ER_y \times (1 - DF) \quad \text{(Equation 13)}$$

Where:

$ER_{credt,y}$ Project emission reductions to be credited in year y [tCO_2e]

ER_y Project emission reductions in year y [tCO_2e]

DF Discount factor, the default value specified in the methodology guidelines as 0.3

3. Project emission reductions to be credited during a monitoring period p are calculated as follows;

$ER_{credt,p} = \Sigma_y ER_{credt,y}$ (Equation 14)

Where:

$ER_{credt,p}$	Project emission reductions to be credited during a monitoring period p [tCO_2e]
$ER_{credt,y}$	Project emission reductions to be credited in year y [tCO_2e]

J. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* [2] is listed as below.

Parameter	Description of data	Source
$CS^{emission}_{ref,y}$	Amount of CO_2 emission from carbon pools (above- and below-ground biomass) in project reference area in year y	The data is to be provided by the Government of Lao PDR and consistent with national FREL/FRL.
$CS^{removal}_{ref,y}$	Amount of CO_2 emission from carbon pools (above- and below-ground biomass) in project reference area in year y	The data is to be provided by the Government of Lao PDR and consistent with national FREL/FRL.
$A\text{-}burn_{ref.i}$	Annual burnt area in stratum i in project reference area during the reference period [ha/yr]	The data is to be provided from the Government of Lao PDR. As upland crop field is generally used just for one year after burning and turned into regenerating vegetation the next year, area of Upland Crop (UC) in a Forest Type Map of a year is applied as average burnt area in the previous year. The minimum area of UC in all Forest Type Maps during reference period is considered as burnt area during the reference period. Regenerating vegetation is applied for stratum i for all burnt area.
Cf_i	Combustion factor [dimensionless] - All secondary tropical forests: 0.55	Table 2.6 of Chapter 2 Volume 4 of 2006 IPCC Guidelines
$G_{ef,k}$	Emission factor of GHG k in forest fire	Table 2.5 of Chapter 2 Volume 4 of

[2] This includes including the data to be provided by the Government of Lao PDR and consistent with national FREL/FRL as criterion 1 of the eligibility criteria.

	[g/kg-d.m. burnt] - Tropical forest: CH_4 6.8, N_2O 0.20	2006 IPCC Guidelines
GWP_k	Global Warming Potential of GHG *k* - CH_4: 25 - N_2O: 298	Table 2.14 in Chapter 2 of Contribution of Working Group I to the Fourth Assessment Report of the IPCC
$C_{ref,rv}$	Carbon Stock in regenerating vegetation to be applied for the reference period [tCO_2/ha] - 65.8	The data is to be provided from the Government of Lao PDR and consistent with national FREL/FRL
CF_i	Carbon fraction of dry matter in stratum *i* [dimensionless] - Current Forest: 0.47	Annex 2 of national FREL/FRL
$R_{ratio,i}$	Ratio of below-ground biomass to above-ground biomass [dimensionless]; if above-ground biomass is under 125 t/ha: 0.2 if above-ground biomass is over 125 t/ha: 0.24	Table 4.4 of Chapter 4 Volume 4 of 2006 IPCC Guidelines
EF_c	Baseline emission factor for continuously flooded fields without organic amendments [kg CH_4/ha/day] - CH_4 emission as IPCC default: 1.30	Table 5.11 of Chapter 5 Volume 4 of 2006 IPCC Guidelines
SF_w	Scaling factor to account for the differences in water regime during the cultivation period [dimensionless] - Rainfed and deep water (Regular rainfed): 0.27	Table 5.12 of Chapter 5 Volume 4 of 2006 IPCC Guidelines
SF_p	Scaling factor to account for the differences in water regime in the pre-season before the cultivation period [dimensionless] - Non flooded preseason >180 day: 1.22	Table 5.13 of Chapter 5 Volume 4 of 2006 IPCC Guidelines
NCV_{MG}	Net calorific value of motor gasoline [GJ/kg] - Motor Gasoline: 44.3 TJ/Gg	Table 1.2 of Chapter 1 Volume 2 of 2006 IPCC Guidelines

$EF_{fuel,MG}$	CO_2 emission factor of the motor gasoline combusted [tCO_2/GJ] - Motor Gasoline: 69,300 kg CO_2/TJ	Table 3.2.1 of Chapter 3 and Table 2.5 of Chapter 2 Volume 2 of 2006 IPCC Guidelines
DF	A default discount factor of 30% as defined in the guideline is applied (*see* right) automatically	Joint Crediting Mechanism Guidelines for Developing Proposed Methodology for Reducing Emissions from Deforestation and Forest Degradation, and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries (REDD-plus) for Lao PDR. (JCM_LA_GL_PM_REDD+_ver01.0)

History of the document

Version	Date	Contents revised
01.0	23 March 2022	Electronic decision by the Joint Committee Initial approval.