Ministry of Agriculture and Rural Development

Technical Annex on REDD+ according to Decision 14/CP.19

Results achieved by Vietnam from reducing emissions from deforestation, forest degradation and increasing removals from enhancement of forest carbon stock during 2014-2018

Hanoi, December 2020

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ACRONYMS AND ABBREVIATIONS

AGB	Above ground biomass
BGB	Below ground biomass
BUR	Biennial update report
COP	Conference of the Parties
DCU	Residential area
DKH	Other land
DTR	Bare land
EF/RF	Emission factor/removal factor
ER	Emission reduction
FAO	Food and Agriculture Organization of the United Nations
FIPI	Forest Inventory and Planning Institute
FREL/FRL	Forest reference emission level/forest reference level
HGGN	Mixed timber and bamboo forest
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
LRLK	Mixed broadleaf and coniferous forest
LULC	Land use and land cover
MNC	Water body
MRV	Measurement, reporting and verification
NDKC	Limestone without trees
NFIMAP	National Forest Inventory, Monitoring and Assessment Program
NFMS	National Forest Monitoring System
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
REDD+	Reducing emissions from deforestation and forest degradation, and the role of conservation of forest carbon stocks, sustainable management of forest resources, and enhancement of forest carbon stocks in developing countries
RLK	Coniferous forest
RND	Limestone forest

RNM	Mangrove forest
RRL	Deciduous forest
RTG	Planted forest
RTN	Bamboo forest
TXB	Evergreen broadleaf and semi-deciduous - medium forest
TXG	Evergreen broadleaf and semi-deciduous - rich forest
TXN	Evergreen broadleaf and semi-deciduous - poor forest
TXP	Evergreen broadleaf and semi-deciduous - regrowth forest
UNFCCC	United Nations Framework Convention on Climate Change

INTRODUCTION

This Technical Annex provides additional information to Vietnam's 3rd Biennial Update Report (BUR3) on the results of REDD+ implementation in Vietnam over the period 2010-2018. This annex has been developed in accordance with Decision 14/CP.19, which requires that developing country Parties that wish to receive REDD+ results-based payments should submit their estimated calculation of GHG emissions reduction and removal enhancements related to forests to the United Nations Framework Convention on Climate Change (UNFCCC) as a technical annex to the BURs. In order to implement REDD+, developing countries need to develop the following four pillars:

1) A national strategy or action plan on REDD+;
2) A national forest reference emission level and/or forest reference level, (or, as an interim measure, subnational forest reference emission levels and/or forest reference levels);
3) A national forest monitoring system for REDD+ measurement, reporting and verification;
4) A safeguard information system (SIS) for REDD+ implementation.

Vietnam has been involved in the REDD+ initiative since 2009 and has fulfilled the requirements for REDD+ implementation. The first National REDD+ Action Program for the period 2011-2020 was approved in 2012[1] before the revised National REDD+ Action Program was updated and revised for the period of 2017-2030[2]. Vietnam submitted its first national FREL/FRL at the beginning of 2016 and, in May 2017, the revised national FREL/FRL submission, supported by the Technical Evaluation Report, was published by on UNFCCC REDD+ website[3]. In November 2018, the Summary of Information (SOI) was developed and submitted to the UNFCCC[4].

In order to receive results-based payments for REDD+ implementation from the Green Climate Fund (GCF), this Technical Annex reports on the national performance of REDD+ in Vietnam over the period 2014-2018, compared with its published FREL/FRL. In addition to reporting and ensuring transparency in Vietnam's efforts to implement REDD+, this Technical Annex can also be used to develop strategies and action plans for emission reduction under the Paris Agreement in the field of Land use, land use change and forestry (LULUCF) in Vietnam.

This technical annex provides the information and data as requested in the Annex to Decision 14/CP.19 - Guidance on the elements to be included in the technical annex as per paragraph 7 of Decision 14/CP.19, including six following contents: (1) Overview of FREL/FRL, (2) GHG emission reduction results, (3) consistency in methodology between REDD+ results calculation and FREL/FRL construction, (4) National forest monitoring system and responsibilities of relevant authorities, (5) Necessary information to allow for the reconstruction of the results, and (6) Compliance with paragraphs 1 (c)[5] and 1 (d)[6] of Decision 4/CP.15.

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[1]Decision No. 799/QD-TTg dated June 27, 2012 of the Prime Minister approving the National REDD+ Action Program for the period 2011-2020.
[2]Decision No. 419/QD-TTg dated April 5, 2017 of the Prime Minister approving the National REDD+ Action Program to 2030.
[3] https://redd.unfccc.int/submissions.html?country=vnm
[4] https://redd.unfccc.int/files/4850_1_first_soi_viet_nam__28eng_29.pdf
[5]Paragraph 1(c) of Decision 4/CP.15 requires developing countries to use the most recent Intergovernmental Panel on Climate Change guidance and guidelines, as adopted or encouraged by the Conference of the Parties, as

1. OVERVIEW OF THE ASSESSED FREL/FRL

1.1. Background

Vietnam developed and submitted its first national FREL/FRL in January 2016 and the revised national FREL/FRL in July 2016. In May 2017, the Technical Assessment Report of Viet Nam FREL/FRL was completed and published by the UNFCCC Secretariat on its REDD+ website[7].

The development of national FREL/FRL in Viet Nam started since 2009 with the support from several international and domestic initiatives related to REDD+. Domestically, the construction was carried out at the national, regional and provincial levels. From 2009 to 2016, assistance from Finland (NORDECO project), JICA, FAO and the UNREDD Vietnam Program Phases 1 and 2 was provided to harmonize the forest types to 17 classes, develop national level allometric equations, review and improve the mapping and data analysis processes of NFIMAP. Vietnam's initial FREL/FRL report was submitted to UNFCCC in January 2016.

Vietnam's initial FREL/FRL proposal underwent a technical review following the procedures prescribed by the UNFCCC, the first step being a centralized review held in Bonn, Germany in March 2016. In preparation for the technical evaluation process, MARD established a FREL/FRL technical working group comprising experts from MARD and MONRE. Pursuant to feedback from the technical assessment team of UNFCCC, Vietnam revised its FREL/FRL report and submitted the revised FREL/FRL in July 2016.

Accordingly, this FREL/FRL was later clarified and improved through communications between the Technical assessment team of UNFCCC and the Technical Working Group on FREL/FRL of Vietnam. On 5 May 2017, the revised FREL/FRL with the accompanying Technical Assessment Report was published on the UNFCCC REDD+ website.

1.2. Information on the assessed FREL/FRL

Table 1 provides key information on the Vietnam's assessed FREL/FRL. FREL/FRL is national (covering a total forest area of 14 million ha) and includes four REDD+ activities: (1) Reducing emissions from deforestation; (2) Reducing emissions from forest degradation; (3) Enhancement of carbon stock from reforestation; (4) Enhancement of carbon stock from forest restoration. The Vietnam's FREL/FRL includes two carbon pools, above-ground biomass (AGB) and below-ground biomass (BGB). CO_2 emissions are taken into account while non-CO_2 gases

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appropriate, as a basis for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes.

[6]Paragraph 1(d) of Decision 4/CP.15 requires developing countries to establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that: (i) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes, (ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;; and (iii) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties.

[7] https://redd.unfccc.int/submissions.html?country=vnm

are not accounted for because their emissions are proved to be insignificant. The reference period is 1995-2010. The FREL/FRL are constructed by taking the averages of the entire reference period. The FRL was adjusted by removing the results achieved by Vietnam under the 5 Million Hectare Reforestation Program (Program 661).

Table 1: Key information of the assessed FREL/FRL

Contents	Description
Scale	Nationwide (excluding archipelagos and islands)
Forest area	About 14 million hectares
REDD+ activities[8]	Includes 4 activities: (1) Reducing emissions from deforestation; (2) Reducing emissions from forest degradation; (3) Enhancement of carbon stock from reforestation; (4) Enhancement of carbon stock from forest restoration.
Carbon pools included[9]	Above-ground biomass (AGB) and below-ground biomass (BGB)
Gases included	Only CO_2. Non-CO_2 gases (CH_4, N_2O, CO, etc.) are not accounted for because their emissions are proved to be insignificant.
Reference period	1995 -2010
Activity data	Using the IPCC Approach 3. Land use/land cover (LULC) maps were developed every 5 years during the reference period (1995, 2000, 2005 and 2010) and harmonized into 17 classes including 12 forest types. These maps were used to fill in land use/land cover change matrices reporting areas of change for 5 years periods (1995-2000, 2000-2005 and 2005-2010).
Emission factor/ removal factor	Using the IPCC Tier 2. National forest inventories were implemented on 5 years cycles for the period 1990-2010. The average carbon densities of forest types are calculated from sample plot data at five-year intervals (1995, 2000, 2005 and 2010) and then compared with one another to calculate the emission factors/removal factors for LULC conversion in each 5-year period. The carbon densities for non-forest land types and the post-deforestation carbon density are assumed to be zero. Country-specific allometric equations for timber and bamboo forests were used to estimate AGB for individual trees, sample plots and forest types in each eco-region. Default IPCC root-to-shoot ratios and carbon fraction (IPCC 2006) were applied to calculated BGB and carbon stocks.
Uncertainty	Activity data (AD): LULC maps have an uncertainty of 5% for the classification of forest and non-forest land, 20% for the classification of forest types and 26% for the classification of volume-based broadleaf evergreen forests. The uncertainty of the LULC change maps has not been estimated. Emission factor/removal factor (EF/RF): The uncertainty incurred in sampling error has been estimated for each average carbon stock density of forest types by eco-region. The uncertainties associated with field measurement errors, and the error of the biomass allometric equations have not been taken into account.

[8]Carbon stock conservation and Sustainable forest management are included under Reducing emissions from forest degradation if the carbon density measured at the second time point is less than the carbon density measured at the first time point, or included under Enhancement of carbon stock from forest restoration if the opposite is true.

[9]Carbon pools: Deadwood, litter and soil organic matters are not included due to lack of available data and in case of using IPCC default values, the uncertainty will be high.

Contents	Description
	Annual CO_2 emissions/removals: The uncertainties for annual emissions/removals are not estimated.
Model applied	Historical average. Reference emission level (FREL) and reference removal level were calculated separately.
Adjustment according to the national circumstances	An adjustment is proposed to FRL by removing the results achieved by Vietnam under the 5 Million Hectare Reforestation Program (Program 661).

1.3. Proposed FREL/FRL and adjustment

The FREL/FRL for Vietnam's REDD+ includes a Forest Reference Emission Level of **+59,960,827 tCO_2e/year** and a Forest Reference Level of **−39,602,735 tCO_2e/year**. The FRL for Vietnam was adjusted by removing the results achieved by Vietnam under the Program 661. Without adjustment to the national circumstances, the annual average removal is **−47,786,072 tCO_2e/year** (Figure 1).

Major government programs for reforestation/afforestation had been implemented since around the mid-1990s, most notably the Program 661 (1998-2010) and made considerable contributions to the increasing trend of national forest cover. The final report of Government of Vietnam (2016) concluded that the Program has met its targets. And independent studies estimated the success rate of this program between 41% in a few provinces with low access to markets and 87 % on average for most provinces.

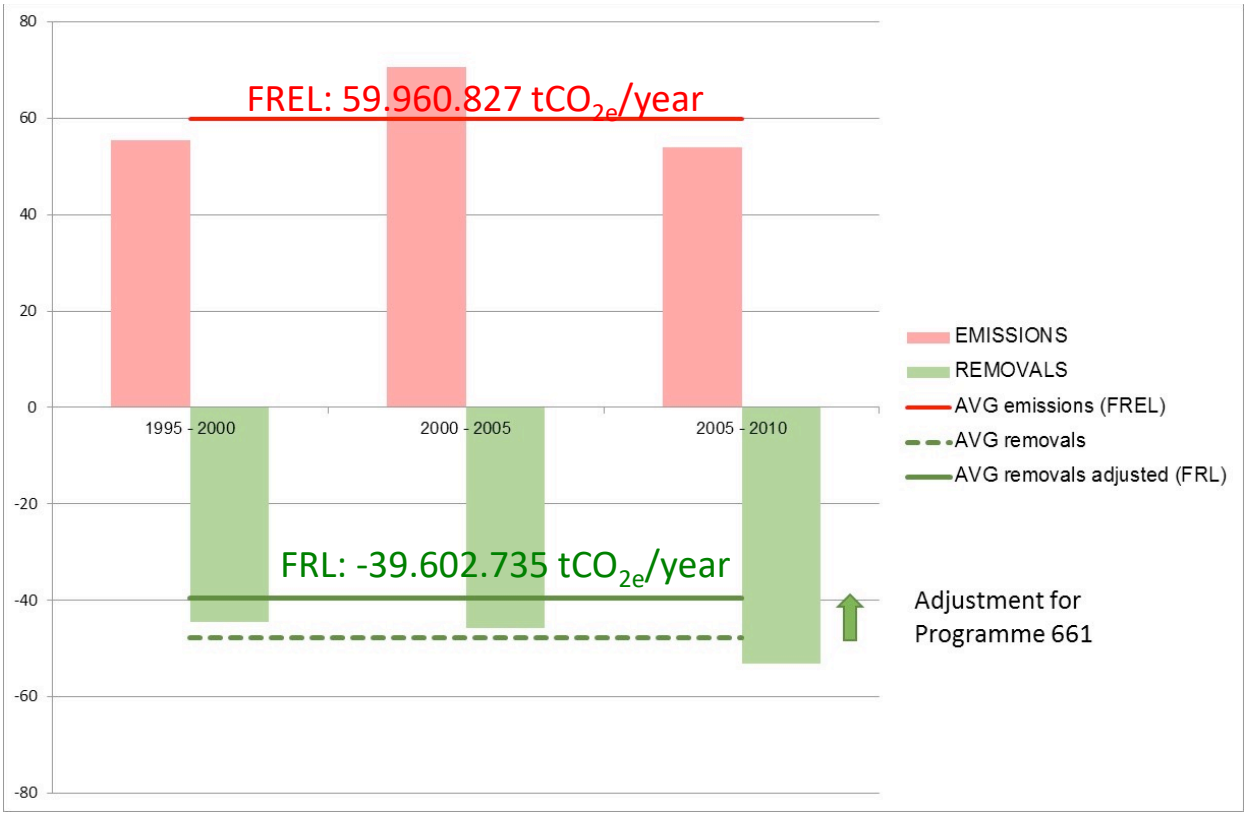

Figure 1: Forest Reference (Emission) Levels of Vietnam, period 1995-2010

The removals associated with the Program 661 come from the plantation activity and amount to 123 $MtCO_2e$. Viet Nam adjusted its FRL by removing (discounting) this amount, considering it would be difficult to implement such ambitious plantation programs in the future, for the reasons of reduced area for planting, and termination of funding for the said Program (financed partly by Official Development Assistance).

1.4. Technical assessment of FREL/FRL

The UNFCCC Technical Assessment Report of the proposed FREL/FRL recognized Vietnam's efforts to improve the transparency of the input data for FREL/FRL construction. The report also commends Viet Nam for showing a strong commitment to the continuous improvement of its FREL/FRL estimates in line with the stepwise approach. In general, the Vietnam's FREL/FRL complies with the UNFCCC's FREL/FRL reporting guidance. The Technical Assessment Report provides following recommendations to Vietnam for further FREL/FRL improvement:

- Use of a consistent approach to geospatial image interpretation across the time series
- Harmonization of the activity data and emission factors used between the GHG inventory and the FREL/FRL submission
- Provision of time-series information on forest and land-use transitions
- Use of time-series consistent data in the estimation of carbon stock densities
- Improvement of the definition of forest degradation to include thresholds like canopy cover or carbon stock decline and to exclude short-term loss of carbon stocks
- Inclusion in the FREL/FRL of non-biomass pools and non-CO_2 gases
- Assessment of the effect of forest fires on the resulting non-CO_2 emissions from deforestation and forest degradation

In addition, the revised FREL/FRL submission only estimated the uncertainty for the 2010 LULC map; the uncertainty of LULC change maps was not estimated. The reason is that the classification system used to construct the national FREL/FRL has totally 17 LULC categories. This means that there may be 17 x 17 = 289 LULC conversions, making it difficult to assess uncertainty. Therefore, there is a need to simplify the classification system to ease uncertainty assessment.

Following the recommendations in the Technical Assessment Report, Vietnam has made efforts to improve the national FREL/FRL, including:

- Using a consistent automatic change detection method to geospatial image interpretation across the time series
- Provision of time-series information on forest and land-use transitions
- Simplification of classification systems and conduction of uncertainty assessments of LULC change maps

However, results produced by these improvement efforts were not too different from the submitted FREL/FRL. Therefore, Vietnam decided that it was not necessary to submit the updated FREL/FRL.

2. RESULTS OF GHG EMISSION REDUCTIONS

2.1. Emission reductions/removal enhancements from 2014 to 2018

The total amount of CO_2 emission reductions and removal enhancements (hereinafter referred to as net emission reductions) for 5 years, from 2014 to 2018 is 283.996 $MtCO_2$ (91.466 $MtCO_2$ as emission reductions from deforestation and forest degradation; 192.530 $MtCO_2$ from removal enhancements from reforestation and forest restoration).

If FRL is not adjusted according to the results of Program 661, the net amount of emission reductions in the 5-year period from 2014 to 2018 is 243.080 $MtCO_2$ (91.466 $MtCO_2$ as emission reductions and 151.614 $MtCO_2$ as removal enhancements).

2.2. Annual emission reductions

Annual average emission in the period 2010-2018 is 41.668 $MtCO_2$/year and the annual average removal is −78.109 $MtCO_2$/year. The Central Highlands is the region with the largest emissions (16.4 $MtCO_2$/year), followed by North Central Coast (8.6 $MtCO_2$/year), South Central Coast (6.5 $MtCO_2$/year). The regions with the largest amount of carbon removals include the North East (-22.8 $MtCO_2$/year), South Central Coast (-16.5 $MtCO_2$/year), North Central Coast (-14.9 $MtCO_2$/year) (Table 2).

Table 2: Annual emissions and removals during 2010-2018

Eco-regions	Total emissions from deforestation ($MtCO_2$/year)	Total emissions from forest degradation ($MtCO_2$/year)	Total removals from reforestation ($MtCO_2$/year)	Total removals from forest restoration ($MtCO_2$/year)
Red river delta	0.175	0.104	-0.298	-0.522
North East	1.419	2.572	-6.746	-16.171
North West	1.081	1.404	-2.215	-5.652
North Central Coast	0.908	7.338	-5.314	-9.659
South Central Coast	2.583	4.015	-8.451	-8.157
Central Highlands	7.067	9.421	-0.765	-10.121
South East	1.120	0.730	-1.298	-1.410
Mekong River Delta	1.410	0.320	-0.502	-0.827
Total	**15.764**	**25.904**	**-25.590**	**-52.519**

Annual average emission reductions and removal enhancements are determined based on the annual average emissions and removals for the period 2010-2018 and the average emissions and removals for the reference period (1995-2010). It is found that the annual average emission reductions for the period 2010-2018 amount to 18.293 $MtCO_2$/year. For removal, the annual average removal enhancements for the period 2010-2018 (including the results of the program

661) amount to 38.506 $MtCO_2$/year. Annual net emission reductions for the period 2010-2018 amount to 56.799 $MtCO_2$ (Table 3).

Table 3: Annual net emission reductions during 2010-2018

Categories	Reference period[a] ($MtCO_2$/year)	2010-2018 period ($MtCO_2$/year)	Difference ($MtCO_2$/year)
Annual average emissions	59.961	41.668	18.293
Annual average removals	-39.603	-78.109	38.506
Annual average net emissions	20.358	-36.441	56.799

[a] For the reference period, the annual average removals and the annual net emissions have been adjusted according to the results of the Program 661.

If not adjusted according to the results of the 661 Program, the average removal enhancements in the period 2010-2018 will be 30.323 $MtCO_2$ and the annual net emission reductions will be 48.616 $MtCO_2$.

For the period 2010-2018, the uncertainties of annual average emissions from deforestation and forest degradation are 5.6% and 7.3% respectively; accordingly, the uncertainty of annual average emissions is 5.0%. The uncertainties of annual average removals from reforestation and forest restoration are 5.9% and 10.6% respectively; accordingly, the uncertainty of annual average removals is 7.4% (Table 4).

Table 4: Uncertainty of annual average emissions and removals for 2010-2018

Categories	Value ($MtCO_2$/year)	Uncertainty (%)
Annual average emissions from deforestation	15.764	5.6
Annual average emissions from forest degradation	25.904	7.3
Total annual emissions	**41.668**	**5.0**
Annual average removals from reforestation	-25.590	5.9
Annual average removals from forest restoration	-52.519	10.6
Total annual removals	**-78.109**	**7.4**

The revised FREL/FRL submission does not provide the combined uncertainty of the FREL/FRL but identifies this as an area for future improvement. To estimate the combined uncertainty of annual average net emission reductions in 2010-2018, the uncertainties of annual average emissions and removals in the reference period (i.e., FREL and FRL) are assumed to be equal to those for the period of 2010-2018 (i.e., 5.0% for FREL and 7.4% for FRL). With this assumption, the uncertainty of the annual average emission reductions in the period 2010-2018

is 20.0%; the uncertainty of the annual average removal enhancements in the period 2010-2018 is 16.8%; and the uncertainty of the annual average net emission reductions for the period 2010-2018 is 13.1% (Table 5).

Table 5: Uncertainty of annual average net emission reductions for period 2010-2018

Categories	Value (MtCO2/year)	Uncertainty (%)
Annual average emissions during reference period (FREL)	59.961	5.0
Annual average emissions during 2010-2018	41.668	5.0
Annual average emission reductions during 2010-2018	***18.293***	***20.0***
Annual average removals during reference period (FRL)	-39.603	7.4
Annual average removals during 2010-2018	-78.109	7.4
Annual average removal enhancements during 2010-2018	***38.506***	***16.8***
Annual average net emission reductions during 2010-2018	**56.799**	***13.1***

2.3. Emission reductions by REDD+ activities

The annual average emission reductions and removal enhancements over the period 2010-2018 by REDD+ activities are presented in Table 6. Emission reductions mainly come from the activity that reduce forest degradation (10.997 $MtCO_2$/year). Removal enhancements primarily come from the forest restoration activity (31.021 $MtCO_2$/year).

Table 6: Annual average emission reductions/removal enhancements for period 2010-2018

Categories	Reference period ($MtCO_2$/year)	2010-2018 period ($MtCO_2$/year)	Difference ($MtCO_2$/year)
1. Annual average emissions	**59.961**	**41.668**	**18.293**
Annual average emissions from deforestation	23.060	15.764	7.296
Average annual emissions from forest degradation	36.900	25.904	10.997
2. Average annual removals	**-39.603**	**-78.109**	**-38.506**
Annual average removals from reforestation	-18.105	-25.590	-7.485
Annual average removals from forest restoration	-21.498	-52.519	-31.021

2.4. Emission reductions by eco-regions

The North Central Coast region has the highest emission reductions (6.506 $MtCO_2$/year), followed by the North East region (6.142 $MtCO_2$/year) and the South Central Coast region (3.732 $MtCO_2$/year). The Central Highlands region does not produce emission reductions but instead increases its emissions by 3.167 $MtCO_2$/year (Table 7).

Table 7: Emission reductions/removal enhancements by ecoregion

Eco-regions	Emission reductions ($MtCO_2$/year)	Removal enhancements ($MtCO_2$/year)	Net emission reductions ($MtCO_2$/year)
Red river delta	0.154	0.673	0.827
North East	6.142	15.238	21.380
North West	2.514	2.922	5.436
North Central Coast	6.506	5.611	12.117
South Central Coast	3.732	11.432	15.164
Central Highlands	-3.167	2.615	-0.552
South East	2.113	0.224	2.337
Mekong River Delta	0.299	-0.208	0.091
Nationwide	**18.293**	**38.506**	**56.799**

In terms of removal enhancements, the North East region has the largest removal enhancements (15.238 MtCO2/year), followed by the South Central Coast region (11.432 MtCO2/year) and the North Central region (5.611 MtCO2/year). In terms of net emission reductions, the North East region has the largest amount (21.380 MtCO2/year), followed by respectively the South Central Coast region (15.164 MtCO2/year) and the North Central Coast region (12.117 MtCO2/year).

3. DEMONSTRATION OF METHODOLOGIES USED TO PRODUCE THE RESULTS THAT ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE FREL/FRL

The REDD+ results method is overall consistent with the FREL/FRL (Table 8). Both methods use the same forest definition and LULC classification, and share the same REDD+ activities, carbon pools, gases and scales. However, few minor differences can be found in the development of the AD and EF/RF:

- Change of remote sensing images from Landsat7/SPOT5 to Sentinel-2 for the 2018 LULC map,
- Adding uncertainty assessment for the LULC conversion areas,

- Improvement of the national forest inventory sample plot design for cost efficiency.
- The uncertainty of the emission and removal factors over the period 2010-2018 takes into account the uncertainty of the root-to-shoot ratios and that of the carbon fraction.

With the FREL/FRL established based on a variety of remote sensing imagery with spatial resolution ranging from 30 m (Landsat7) to 2.5 m (SPOT5), selection of Sentinel-2 images (spatial resolution of 10 m) for the development of the 2018 LULC map is considered consistent with the FREL/FRL construction.

While the uncertainties of LULC conversion areas was assessed when estimating the combined uncertainty of REDD+ results, the conversion areas were not adjusted based on this uncertainty assessment, thus the creation of activity data when calculating REDD+ results is still completely consistent with the FREL/FRL construction.

Similarly, the NFIMAP data used for the FREL/FRL construction followed the same sampling design (8 x 8 km sampling grid) and plot design. However, the number of plots visited changed between cycles depending on available funding, from 1,706 to 2,750, depending on the available budget.

The data of the fifth NFI cycle (2016-2020) used for calculating the REDD+ results was based on an optimized plot design that reduced the number of subplots measured but maintained the overall sampling design and intensity (systematic sampling with 8 x 8 km grid). However, the plot design has been optimized to reduce the number of subplots and trees that need to be measured while maintaining almost equal accuracy (and thus increasing cost efficiency).

Please refer to Section 5 *for more details on the construction of AD and EF/RF.*

Table 8: Comparison of the methodological steps taken for the FREL/FRL construction and calculation of REDD+ results

Methods	FREL/FRL construction	Calculation of REDD+ results
Forest definition	Based on Circular No. 34/2009/TT-BNNPTNT Minimum thresholds: 10% tree cover, height of 5 meters, block area of 0.5 ha. Minimum height for forest plantations: 1.5-meter height for slow growing plantations and 3 meter height for fast growing plantations and the density of at least 1,000 trees per ha. According to "Decision 2855 (2008) on Identification of Rubber as Multi-purpose Trees", rubber is defined as a multi-purpose tree and its plantations are accounted as planted forest.	Same definition.
Land and forest classification	17 LULC categories, including: 12 forest types (including 4 evergreen broadleaf volume-based categories) and 5 non-forest types.	Same
REDD+ activities	- Reducing emissions from deforestation - Reducing emissions from forest degradation - Enhancement of carbon stocks from reforestation - Enhancement of carbon stocks from forest	Same REDD+ activities.

	restoration	
Carbon pools	AGB and BGB	Same carbon pools.
Gases	CO_2 only.	Same.
Scale	Nationwide (excluding archipelagos and islands)	Same.
Accounting period	1995 -2010	2011 -2018
Activity data (AD)	Overlay of LULC maps harmonized to 17 LULC classes to generate LULC change matrices at regional level. The LULC maps are initially created from a range of remote sensing products from Landsat 7 to SPOT 5, etc.	Similar methodologies. The 2018 LULC map is developed based on Sentinel-2 images.
Emission factor/removal factor (EF/RF)	NFIMAP cycles are implemented every 5 years at country level. Country-specific allometric equations are used to calculate AGB of individual trees and bamboos. Plot data are aggregated by eco-region to overcome the inconsistencies in plot location and sampling intensity (that differed between inventory cycles based on available funding). Default IPCC root-to-shoot ratios and carbon fraction are applied to calculate BGB and convert biomass to carbon. Carbon stock densities at two time points of a period are compared to calculate EF/RF for the same period.	Similar methodologies. Data from NFIMAP Cycle 4 (2006-2010) and new NFIMAP Cycle 5 (2016-2020) are used to calculate EF/RF for the period 2011-2018.
Annual emissions and removals	The emissions and/or removals of a LULC conversion in a period are calculated by having activity data for such conversion multiplied by the corresponding EF/RF. Emissions/removals are then summed across all conversions for each 5-year period and the average emissions/removals for three 5-year periods are then divided by 5 to generate annual emissions/removals.	Similar methodologies. AD and EF/RF for the period 2011-2018 are used instead to calculate the average figures for the same period (8 years).
Uncertainty	AD: Uncertainty of the LULC maps included (based on the 2010 map). EF/RF: Uncertainty arose from the sampling included Emissions/removals: Uncertainty of emissions/removals are not evaluated.	AD: Improved method, with additional uncertainty assessment for LULC conversion maps EF/RF: Improved method, with additional uncertainty assessment for the root-to-shoot ratios and carbon fraction. Emissions/removals: IPCC error propagation formulas for sums and multiplications applied.

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

4.1. National Forest Monitoring System (NFMS)

Vietnam has two parallel systems in place for the monitoring of its forests, the Forest Resource Monitoring System (FRMS), led by the Forest Protection Department under the Vietnam Administration of Forestry (VNFOREST), MARD (since 2002), and the National Forest Inventory, Monitoring and Assessment Program (NFIMAP), conducted every five years and led by the Forest Inventory and Planning Institute (FIPI) since 1990.

NFIMAP is the main source of information to construct FREL/FRL and calculate REDD+ emission reductions. FRMS is not integrated yet to the MRV for REDD+ but contributes alongside NFIMAP to the monitoring of the National REDD+ Action Program, and its provincial plans (Figure 2).

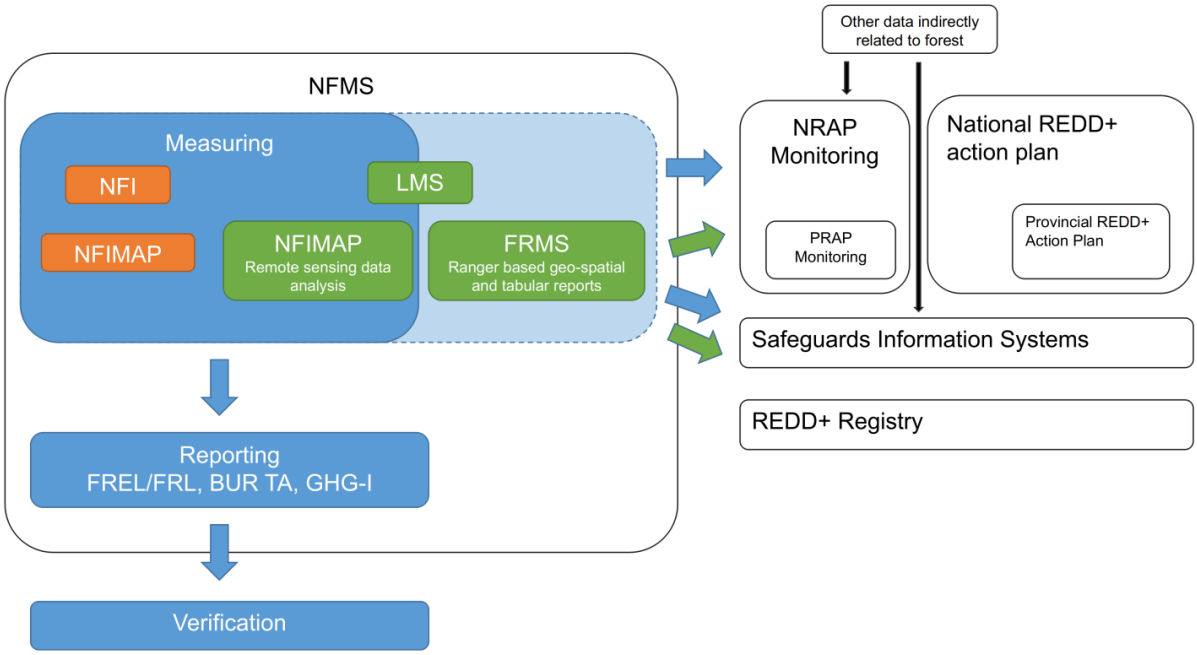

Figure 2: National Forest Monitoring System diagram

4.1.1. Forest Resource Monitoring System (FRMS)

The FRMS updates annual forest changes from forest rangers' offices at commune, district, provincial and national level. Traditionally, these reports were in tabular form, aggregated from the local level to the national level. Forests are categorized in three main functions (protection, production and special use) and 98 forest types. Since 2013, the Finland project FORMIS supported the development of a geospatial database to allow forest rangers and FPD staff to switch to spatial recording of forest area changes, leading to the FRMS. FRMS is updated on near real time whenever a change happens and validated annually.

The FRMS is the main data source for official forest area in Vietnam however it is not used for the REDD+ MRV for the following reasons:

- At the time of the first FREL/FRL development, the geo-spatial system was not in place.
- FRMS data was not used for the FREL/FRL construction. Therefore, it couldn't be used for the calculation of REDD+ results for the sake of consistency.
- FRMS mainly provides updates on deforestation and reforestation; it is challenging to obtain timely updates on changes in forest conditions using FRMS system (due to its forest stratification of 98 forest types). Therefore, this prevents calculating reduced emissions from forest degradation and enhanced removals from forest restoration based on FRMS data.
- FRMS doesn't include the measurement of forest plots for monitoring timber volumes and forest carbon stocks as a basis to update EF/RF.

However, FRMS contains invaluable information on forest ownership and especially on new forest plantations which cannot be easily interpreted using medium resolution satellite images. Thus, Vietnam is working on integrating this system into its MRV for REDD+.

4.1.2. National Forest Inventory and Monitoring Assessment Program (NFIMAP)

The NFIMAP was funded continuously by the government from 1990 to 2010 (Cycles 1 to 4). The program was not carried out for the period of 2011-2015 during which Vietnam delivered the National Forest Inventory Project, including some similar objectives with the NFIMAP program. The program was resumed in 2016 under the National Target Program for Sustainable Forest Development for period 2016-2020 to support management of national forest sector and serve as the main source of data for calculation of REDD+ results for the period 2016-2020 as well as updates of the national FREL/FRL. It includes the development of LULC maps for 2018 using Sentinel 2 images and creation of AD for the period 2010-2018.

In addition, NFIMAP Cycle 5 also included surveys of sample plots at the national level to calculate the emission/removal factors for the 2010-2018 period. These factors, together with the activity data for the 2010-2018 period, were used to calculate national REDD+ results for the 2014-2018 period as reported in Section 2 above.

4.1.3. Activity data

The AD is based on the national forest monitoring system, relying on Sentinel 2 images to produce LULC maps for different time points. The LULC maps are then overlaid to generate AD.

The AD is generated at the eco-region level, specifically for 8 eco-regions included in the construction of the national FREL/FRL (Table 9).

Table 9: Provinces/cities in 8 eco-regions in Vietnam

No.	Eco-regions	Provinces and cities
1	North West	Lai Chau, Dien Bien, Son La and Hoa Binh
2	North East	Cao Bang, Lang Son, Bac Kan, Thai Nguyen, Quang Ninh, Bac Giang, Lao Cai, Yen Bai, Ha Giang, Tuyen Quang and Phu Tho
3	Red river delta	Hai Phong, Hai Duong, Bac Ninh, Hung Yen, Hanoi, Thai Binh, Nam Dinh, Ha Nam, Ninh Binh and Vinh Phuc

4	North Central Coast	Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien - Hue
5	South Central Coast	Da Nang City, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan
6	Central Highlands	Gia Lai, Kon Tum, Dak Lak, Dak Nong and Lam Dong
7	South East	Dong Nai, Binh Duong, Binh Phuoc, Tay Ninh, Ho Chi Minh City, Ba Ria - Vung Tau
8	Mekong River Delta	Long An, Ben Tre, Dong Thap, Soc Trang, Vinh Long, Can Tho, Hau Giang, Tien Giang, Bac Lieu, Ca Mau, Kien Giang, An Giang and Tra Vinh

The land uses and land covers are categorized in 17 classes including 12 forest types, and 5 non-forest land uses (Table 10). EFs/RFs and AD are calculated based on this stratification system.

Table 10: Land uses and land covers stratification for FREL/FRL construction and calculation of emission reductions

No.	LULC codes	Forest / land use types	Forest/ non-forest	Remarks
1	TXG	Evergreen broadleaf - rich forest	Forest	Volume > 200 m^3/ha
2	TXB	Evergreen broadleaf - medium forest	Forest	Volume of 100-200 m^3/ha
3	TXN	Evergreen broadleaf - poor forest	Forest	Volume <100 m^3/ha
4	TXP	Evergreen broadleaf - regrowth forest	Forest	
5	RRL	Deciduous forest	Forest	
6	RTN	Bamboo forest	Forest	
7	HGGN	Mixed timber and bamboo forest	Forest	
8	RLK	Coniferous forest	Forest	
9	LRLK	Mixed broadleaf and coniferous forest	Forest	
10	RNM	Mangrove forest	Forest	
11	RND	Limestone forest	Forest	
12	RTG	Planted forest	Forest	
13	NDKC	Limestone without trees	Non forest	
14	DTR	Bare land (grass land, shrub land, land with scattered trees)	Non forest	
15	MNC	Water body	Non forest	
16	DCU	Residence	Non forest	
17	DKH	Other land	Non forest	

The creation of the activity data follows two main steps (**Error! Reference source not found.**):

- Step 1: Interpretation of satellite imagery to develop LULC maps for 2018. This step includes data preprocessing and development of LULC maps based on Sentinel-2 image classification, using object-oriented classification methodology and deploying with eCognition software.
- Step 2: Development of LULC change maps for 2010-2018 and REDD+ activity data for 2010-2018. This step includes: (1) Overlaying eco-region LULC maps for 2018 with the one for 2010 (which were originally generated by FIPI and subsequently upgraded for developing the FREL/FRL) to generate LULC change maps for each eco-region in the period 2010 - 2018, (2) Checking and evaluating unreasonable changes, then developing the rules for updating LULC change maps and AD and finalizing LULC change maps for the period 2010 - 2018, (3) Aggregation of the maps for REDD+ activities based on definition of the REDD+ activities and EFs/RFs, and (4) Assessment of accuracy and reliability of the AD: The Olofsson et al. (2013) methodology was applied to assess the accuracy and reliability of the estimation of area using information in the confusion matrix.

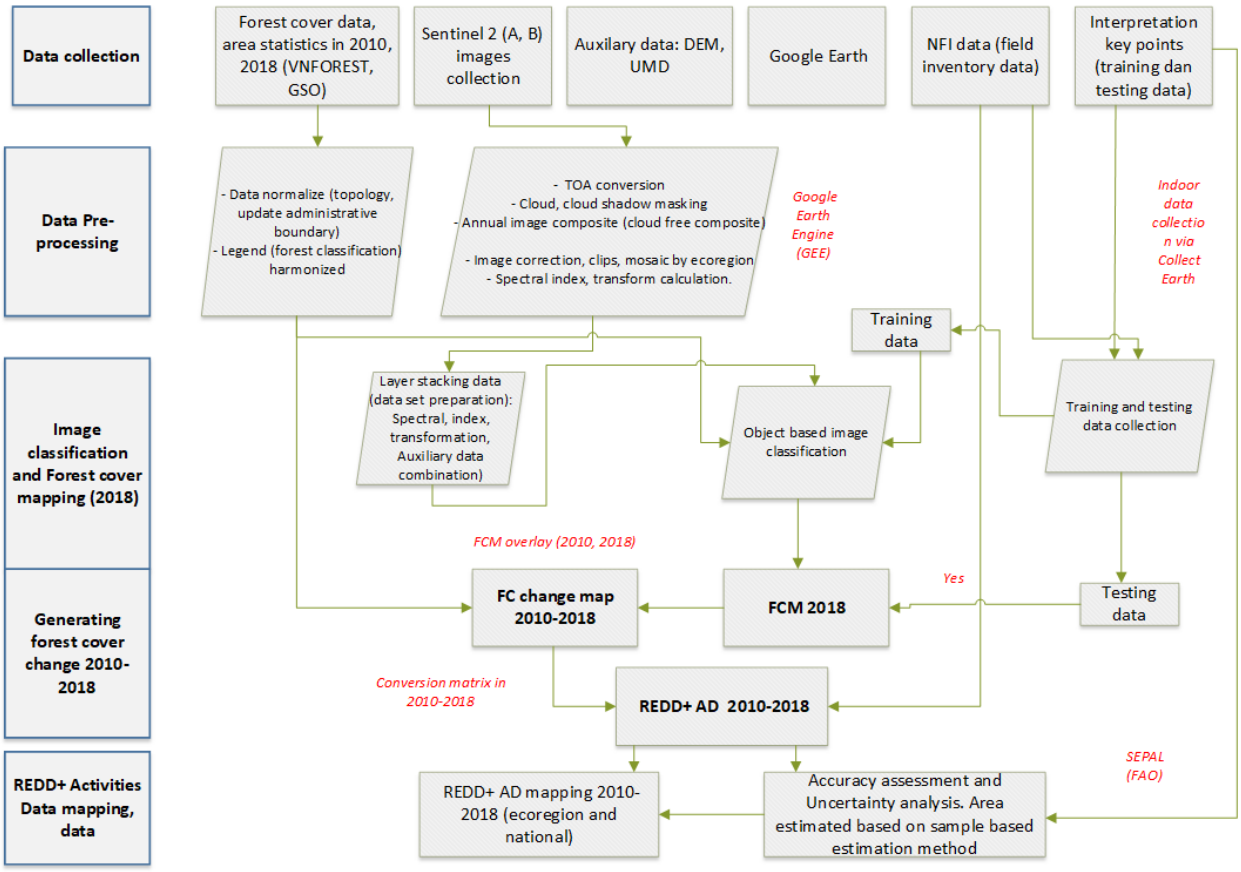

Figure 3: Steps to create activity data

The main data sources used to generate the AD are:

- Map data: The terrain map with VN2000 datum at scale of 1/250.000 and LULC map of 2010 which has been used to develop the national FREL/FRL, VNFOREST's FRMS annual forest monitoring data until 2018.
- Data of annual forest area changes in the period 2010 - 2018.
- Satellite imagery data: Sentinel 2 data covers the whole country. Sentinel 2 data comes from earth observation of Copernicus Program which belongs to European Space Agency (ESA). Available data are images processed at level 1C (Top of Atmospheric reflectance) and can be accessed freely via Google Earth Engine (GEE). All visible and near-infrared bands are used for analyzing and classifying the LULC classes. All Sentinel-2 scenes which cover the whole area of Vietnam territory in 2018 has been collected and processed.
- Field survey data of 1,380 clusters of sample plots within two years of 2017 and 2018. These data are important for confirmation of forest condition in the field in order to provide image interpretation keys and verification points to verify the classification results.
- Other data sources on terrain and topography, tree height and tree canopy of 2018 which have been derived from satellite imagery data by the University of Maryland, United States.

4.1.4. Development of Emission factors/removal factors (EFs/RFs)

The EFs/RFs are based on the national forest inventory cycles implemented before and after the monitoring period. For each NFIMAP cycle, the tree measurement data are aggregated to the plots level and then averaged per LULC type at the regional level, following the same LULC stratification as the AD.

For example, for the calculation of REDD+ results in the period 2010-2018, the NFIMAP cycle 4 (2005-2010) and cycle 5 (2016-2020) data are used. The EFs/RFs for the change between Evergreen broadleaf - rich forest (cat. 1) in 2010 to mixed timber and bamboo forest (cat. 7) in 2018 the carbon stock of cat. 1 in 2010 is taken from the NFIMAP cycle 4 and the carbon stock of cat. 7 in 2018 is taken from the NFIMAP cycle 5. The steps for calculating EFs/RFs are as follows:

- Forest measurements following the NFIMAP design: systematic sampling method (equally spaced grids with 8 km distance) with L-shaped primary sample plots (PSP) of 5 circular secondary sample plots (SSP) of 1000 m^2 for natural forest, and 500 m^2 for plantation and mangroves.
- Data collection and control with Open Foris Collect and an independent QA/QC of 15% of the total clusters, selected randomly.
- Assignment of forest types. Forest types are recorded at the SSP level; therefore, data are also analyzed at the SSP level.
- Calculation of the average AGB for each forest type, based on AGB calculated from country-specific allometric equations for trees and bamboos. For more details, please refer to the Technical Report "Calculation of emission factors/removal factors for the

period 2010-2018 for national FREL/FRL update and MRV implementation of REDD+" (Forest Inventory and Planning Institute, 2019).

- Calculation of BGB, total biomass and carbon stocks, using IPCC default values: *RS* ratio = 0.205 if AGB <125 tons/ha or *RS* = 0.235 otherwise, and the default carbon fraction is 0.47 (IPCC 2006).

- Calculation of EF/RF (tCO_2/ha) of the *ij* change (converted from type *i* in 2010 to type *j* in 2018) using the following formula:

$$EF/RF_{ij}(\text{tCO2/ha}) = \left(\overline{C\_ha}_i - \overline{C\_ha}_j\right) \times 44/12$$

where $\overline{C\_ha}_i$ and $\overline{C\_ha}_j$ are carbon stock densities of the *i* and *j* LULC categories in 2010 and 2018, respectively.

4.2. Roles and responsibilities

4.2.1. State Steering Committee for forest protection and development plans

According to Decision No. 419/QD-TTg dated April 5, 2017 of the Prime Minister, the State Steering Committee for forest protection and development plans directs the implementation of the REDD+ program in general, which includes also MRV implementation for REDD+.

4.2.2. Ministry of Agriculture and Rural Development

Responsibilities of the MARD in MRV implementation for REDD+ are stipulated in Decision No. 419/QD-TTg as follows:

- Takes the lead and coordinates with the relevant ministries and People's Committees of provinces and centrally-run cities in organizing the implementation of the Program as prescribed.

- Develops mid-term and annual implementation plans before submission to competent authorities for approval, or approval if authorized.

- Coordinates the implementation of the REDD+ Program, providing technical assistance, collecting and consolidating data from all the implementing agencies; including the means of implementation, progress and results; carries out assessment and analysis of performance.

- Annually coordinates with the MONRE and relevant ministries to consolidate and review the request for budget allocation and the list of REDD+ projects to integrate into implementation plans of the National Target Program on Climate Change and other related programs.

- Leads on formulating and guiding the application of the monitoring and evaluation process; publicizes and informs on the results of the REDD+ implementation to the MONRE focal point to coordinate and capture information.

- Advises the Prime Minister to assign specific duties; directs and enhances the coordination among the ministries and promotes the role of socio-political associations in implementation of the REDD+ Program.

4.2.3. Ministry of Natural Resources and Environment

The MONRE is the focal point for the implementation of the UNFCCC in Vietnam and takes charge of the submission of the Biennial Update Reports. Therefore, the MONRE shall perform the following:

- Takes the lead and coordinates with the MARD to integrate data on progress and results of REDD+ implementation into the National Communications and Biennial Update Reports and submit them to UNFCCC Secretariat.
- Coordinates with the MARD to develop the system of MRV, FREL/FRL, and evaluates the results in terms of emissions reductions by the REDD+ Program.
- Performs other tasks assigned by the Chairperson of the Steering Committee.

5. NECESSARY INFORMATION TO ALLOW FOR THE RECONSTRUCTION OF THE RESULTS

5.1. Data source

The detailed methodology for the calculation of the AD is available in the Technical Report entitled: “Generation of activity data for the period 2010-2018 for national FREL/FRL update and MRV implementation for REDD+" (FIPI, 2019).

The detailed methodology for the calculation of EFs/RFs is provided in the Technical Report entitled "Calculation of emission factors/removal factors for the period 2010-2018 for national FREL/FRL update and MRV implementation for REDD+" (FIPI, 2019).

The two technical reports, the MS Excel file where the elements have been combined to calculate the REDD+ results, LULC maps and LULC change maps of the NFIMAP are being filed at FIPI and can be made available upon request.

The following sections present (1) the LULC changes matrices for period 2010-2018 used for the AD, (2) the EFs/RFs in tCO_2e/ha for the period 2010-2018 and (3) the calculations steps for the emission reductions and removal enhancements.

5.2. Activity data

The LULC changes at the national level for the period of 2010-2018 are presented in Table 11. In the period 2010-2018, the total forested land increased by 0,801 million ha from 13.661 million ha to 14.462 million ha, of which planted forest area increased by 1.115 million ha and natural forest area decreased by 0.314 million ha. Areas of LULC types by eco-region are shown in Annex 1.

Table 11: National land cover area for the period 2010-2018

No.	Land use and land cover types	Area (ha)

		2010	2018	2010-2018 change	Annual average change
	Total	**33,016,827**	**33,016,827**	**0**	**0**
I	***Forested land***	***13,661,080***	***14,462,276***	***801,196***	***100,150***
1	Evergreen broadleaf forest - rich	680,968	542,034	-138,934	-17,367
2	Evergreen broadleaf forest - medium	1,674,100	1,600,149	-73,951	-9,244
3	Evergreen broadleaf forest - poor	1,581,286	1,453,829	-127,457	-15,932
4	Evergreen broadleaf forest - regrowth	3,653,656	3,511,740	-141,916	-17,740
5	Deciduous forest	645,592	582,682	-62,910	-7,864
6	Bamboo forest	440,682	256,656	-184,026	-23,003
7	Mixed timber and bamboo forest	748,141	1,168,083	419,942	52,493
8	Coniferous forest	162,427	124,342	-38,085	-4,761
9	Mixed broadleaf and coniferous	52,723	32,308	-20,415	-2,552
10	Mangrove forest	141,941	155,542	13,601	1,700
11	Limestone forest	757,312	797,711	40,399	5,050
12	Planted forest	3,122,254	4,237,200	1,114,946	139,368
II	***Bare land***	***4,892,711***	***3,721,614***	***-1,171,097***	***-146,387***
13	Limestone without trees	204,599	133,880	-191,211	-23,901
14	Bare land (grass land, shrub land, land with scattered trees)	4,688,112	3,587,734	-1,100,378	-137,547
III	***Agricultural land and others***	***14,463,036***	***14,832,937***	***369,901***	***46,238***
15	Water body	869,873	831,938	-37,935	-4,742
16	Residential area	1,797,651	2,289,760	492,109	61,514
17	Other land	11,795,512	11,711,240	-84,272	-10,534

The change areas by REDD+ activities during 2010-2018 by eco-region are given in Table 12.

Table 12: REDD+ activity area during 2010-2018 by eco-region

Eco-regions	REDD+ activity area (ha)			
	Deforestation[a]	Forest degradation	Reforestation	Forest restoration
Red River Delta	19,733	12,110	22,452	78,358
North East	168,954	328,643	523,431	3,001,352
North West	127,953	126,107	178,024	1,296,258

North Central Coast	79,634	528,121	402,451	2,172,605
South Central Coast	246,220	413,309	653,482	1,319,922
Central Highlands	362,532	789,720	48,424	1,711,501
South East	96,047	82,999	111,078	265,015
Mekong River Delta	83,871	14,652	29,689	172,258
Nationwide	**1,184,946**	**2,295,663**	**1,969,029**	**10,017,268**

[a] Deforestation here includes losses of natural forest and plantation forest.

The uncertainty of REDD+ activity area for the period 2010-2018 is assessed at regional level and the assessment results are presented in Table 13.

Table 13: Uncertainty of REDD+ activity area during 2010-2018 by eco-region

Eco-regions	Uncertainty of REDD+ activity area (%)			
	Deforestation	Forest degradation	Reforestation	Forest restoration
Red River Delta	16.08	87.41	62.48	101.92
North East	46.94	36.35	21.18	23.16
North West	26.73	14.65	9.15	12.95
North Central Coast	17.37	15.28	29.29	28.96
South Central Coast	21.95	21.10	10.79	15.36
Central Highlands	17.73	14.61	28.09	28.69
South East	13.10	39.76	43.16	50.21
Mekong River Delta	40.69	26.34	111.34	192.94

In general, forest degradation and restoration activities have higher levels of uncertainty than deforestation and reforestation activities.

The activity data matrices (LULC change area) were developed for each eco-region and showed the conversions of 17 LULC types in 2010 to 17 LULC types in 2018. Therefore, each matrix has 17 x 17 = 289 LULC conversions (details of the LULC change matrices are shown in Annex 2).

5.2. Emission factors/removal factors

The statistics on the number of clusters and sample plots, and the calculation of carbon stock densities by forest types nationwide for cycle 5 (calculated for 2019 - the last year of the field survey) are presented in Table 14.

Table 14: Forest carbon stock densities in 2019

Forest types	# clusters	# of sample plots	Carbon density (tC/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	430	992	143.33	5.28
Evergreen broadleaf forest - medium	516	819	69.94	4.82
Evergreen broadleaf forest - poor	443	629	31.95	5.58
Evergreen broadleaf forest - regrowth	732	1,317	30.63	5.65
Deciduous forest	76	215	38.08	17.76
Bamboo forest	216	335	23.44	13.09
Mixed timber and bamboo forest	638	1,286	50.85	6.63
Coniferous forest	13	29	111.70	25.81
Mixed broadleaf and coniferous	28	62	91.45	26.78
Limestone forest	118	224	39.50	13.77
Planted forest	592	1,382	27.29	8.00

[a] Cumulative uncertainty, which includes uncertainties raised from sampling error, uncertainties of root-to-shoot ratios and uncertainties of carbon fraction.

The statistics on the number of clusters and sample plots, and the calculation of carbon densities by forest types and eco-regions for cycle 5 (calculated for 2019 - the last year of the field survey) are presented in details in Annex 4.

Table 15: Average carbon stock densities (C) and uncertainties (U) by forest types at national level

Forest types	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	139.86	5.52	143.33	5.28	142.95	4.75
Evergreen broadleaf forest - medium	75.24	4.87	69.94	4.82	70.53	4.29
Evergreen broadleaf forest - poor	32.12	5.21	31.95	5.58	31.97	4.99
Evergreen broadleaf forest - regrowth	26.41	7.59	30.63	5.65	30.16	5.15
Deciduous forest	31.20	8.96	38.08	17.76	37.32	16.13
Bamboo forest	14.56	11.50	23.44	13.09	22.46	12.17
Mixed timber and bamboo forest	42.08	8.26	50.85	6.63	49.88	6.06
Coniferous forest	94.82	11.72	111.70	25.81	109.83	23.36
Mixed broadleaf and coniferous	66.64	44.96	91.45	26.78	88.70	24.83
Limestone forest	18.92	83.14	39.51	13.77	37.22	13.81
Planted forest	16.12	13.36	27.29	8.00	26.05	7.51

The average carbon stock densities by forest types in 2018 at national level and the associated uncertainties were interpolated from the 2010 and 2019 data, and are given in Table 15. It can be seen that, compared to cycle 4, the carbon stock densities of most forest types in cycle 5 have increased (except for evergreen broadleaf forest - medium, with lower carbon stock density and evergreen broadleaf forest - poor, with almost unchanged carbon stock density). This means that the quality of Vietnam's forests is improving in terms of carbon stocks.

The average carbon stock densities by forest types in 2018 for each eco-region and the associated uncertainties were interpolated from the 2010 and 2019 data, and given in Annex 3.

The emission factors/removal factors were calculated based on the average carbon stock densities of 12 forest types at two time points for each eco-region. Carbon stock densities calculated from NFIMAP cycle 4 data was assigned for 2010 (the last year of the field survey for cycle 4) and reported in the Vietnam FREL/FRL submission. The carbon stock densities from NFIMAP cycle 5 were assigned for 2019 (the last year of the field survey for cycle 5). Then, the carbon stock densities of 2018 were interpolated from those of 2010 and 2019 with the assumption that the carbon stock density of each forest type changes uniformly between 2010 and 2019. Finally, the average carbon stock densities of forest types in 2010 and 2018 were used to calculate the EFs/RFs according to the calculation method presented in Section 4.4.1.

Similar to the AD, the EFs/RFs are calculated at regional level. However, due to the small forest area and thus inadequate sample size, the Red River Delta region was grouped with the North East region and the Mekong River Delta region grouped with the South East region for calculation (Annex 5).

5.3. Calculation of emission reductions and removal enhancements

5.3.1. Calculation of annual average emission reductions

CO_2 emissions as a result of reduced carbon stock density due to a conversion from LULC category *i* in 2010 to LULC category *j* in 2018, E_{ij} (tCO_2) is calculated as follows:

$$E_{ij} = AD_{ij} \times EF_{ij} \quad (1)$$

where: where AD_{ij} (ha) is conversion area (or AD) from LULC category *i* in 2010 to LULC category *j* in 2018; EF_{ij} is the EF of the conversion from LULC category *i* in 2010 to LULC category *j* in 2018.

Total emissions of all conversions during the period 2010-2018, *E* (tCO_2), is calculated by summing up emissions from all types of LULC conversion as categorized in the stratification system of 17 LULC categories:

$$E = \sum_{i=1}^{17} \sum_{j=1}^{17} E_{ij} \quad (2)$$

Note: When applying the formula (2), if the conversion increases carbon stock density (or CO_2 removal), then $E_{ij} = 0$.

The annual average CO_2 emissions for the period 2010-2018 will be calculated by the following formula:

$$\bar{E} = \frac{E}{2018 - 2010} = \frac{E}{8} \quad (3)$$

Annual emissions reductions during the period 2010-2018,$\overline{ER}$, is calculated by subtracting the annual average emissions during the period 2010-2018 from the annual average emissions during the reference period of 1995-2010 (i.e., *FREL*):

$$\overline{ER} = FREL - \bar{E} \quad (4)$$

The amount of emission reductions during the period 2014-2018 (5 years), *ER*, is calculated as follows:

$$ER = 5 \times \overline{ER} \quad (5)$$

5.3.2. Calculation of annual removal enhancements

CO_2 removals as a result of enhanced carbon stock density due to a conversion from LULC category *i* in 2010 to LULC category *j* in 2018, R_{ij} (tCO_2), is calculated as follows:

$$R_{ij} = AD_{ij} \times RF_{ij} \quad (6)$$

where: AD_{ij} (ha) is conversion area (or AD) from LULC category *i* in 2010 to LULC category *j* in 2018; RF_{ij} is the RF of the conversion from LULC category *i* in 2010 to LULC category *j* in 2018.

Total removals of all conversions during the period 2010-2018, *R* (tCO_2), are calculated by summing up removals from all types of LULC conversion as categorized in the stratification system of 17 LULC categories:

$$R = \sum_{i=1}^{17} \sum_{j=1}^{17} R_{ij} \quad (7)$$

Note: when applying the formula (7), if the conversion reduces the carbon stock intensity (i.e., CO_2 emissions), then $R_{ij} = 0$.

Annual average removals during the period 2010-2018 are calculated as follows:

$$\bar{R} = \frac{R}{2018 - 2010} = \frac{R}{8} \quad (8)$$

Annual removal enhancements during the period 2010-2018, $\overline{RE}$, are calculated by subtracting the annual removal enhancements during the period 2010-2018 by the annual removal enhancements during the reference period of 1995-2010 (i.e., *FRL*):

$$\overline{RE} = FRL - \bar{R} \quad (9)$$

The amount of removal enhancements during the period 2014-2018 (5 years), *RE*, is calculated as follows:

$$RE = 5 \times \overline{RE} \quad (10)$$

5.4. Calculation of combined uncertainties

The NFIMAP sample plot system is based on systematic sampling of plot clusters. Therefore, the variance of the mean AGB is calculated using the following equation (derived from the equation 6.9, page 155 of Cochran (1977)):

$$Var_s(\overline{AGB_i}) = \frac{N_i}{(N_i - 1) \times \left(\sum_{j=1}^{N_i} a_{i,j}\right)^2} \times \sum_{j=1}^{N_i} \left(x_{i,j} - \overline{AGB_i} \times a_{i,j}\right)^2 \quad (11)$$

where:

$\overline{AGB_i}$ is the mean AGB of the forest type i.

N_i is the number of clusters having at least one sample plot of the forest type i;

$x_{i,j}$ is the AGB of all sample plots in the cluster *j* of forest type *i;*

$a_{i,j}$ is the total area of all sample plots in the cluster *j* of forest type i;

The 95% confidence interval of the mean AGB value, $CI_s(\overline{AGB_i})$, is calculated by the formula:

$$CI_s(\overline{AGB_i}) = t_{(1-0.05/2,N_i-1)} \times \sqrt{Var_s(\overline{AGB_i})} \quad (12)$$

where: $t_{(1-0.05/2,N_i-1)}$ is the value of the t distribution of $N_i - 1$ degrees of freedom with a confidence interval of 95 %.

The uncertainty of the mean AGB incurred from sampling error is calculated using the formula:

$$U_s(\overline{AGB_i})\% = \frac{CI_s(\overline{AGB_i})}{\overline{AGB_i}} \times 100 \quad (13)$$

Since *biomass* = *AGB* × (1+ *RS*), where *RS* is the root-to-shoot ratio, the uncertainty of the average biomass of forest types *i*, $U(\bar{B}_i)$, will include the uncertainty raised from the sampling error with $\overline{AGB_i}$ and the uncertainty of the coefficient (1 + *RS*), and is calculated using the following formula:

$$U(\bar{B}_i) = \sqrt{U(\overline{AGB_i})^2 + U(1 + RS)^2} \quad (14)$$

Where *U* (*1* + *RS*) is the uncertainty of the coefficient (1 + *RS*) and is calculated using the following formula:

$$U(1 + RS) = RS \times U(RS)/(1 + RS) \quad (15)$$

Where *U (RS)* is the uncertainty of the *RS* coefficient and has the value of 20% (IPCC, 2003); *RS* equals 0.205 if $\overline{AGB} < 125$ tonnes/ha; *RS* equals 0.235 otherwise.

Since *carbon* = *biomass* × *CF*, the uncertainty of the average carbon stock density of forest type *i*, $U(\bar{C}_i)$, is calculated using the following formula:

$$U(\bar{C}_i) = \sqrt{U(\bar{B}_i)^2 + U(CF)^2} \quad (16)$$

Where *U* (*CF*) is the uncertainty of the carbon fraction and has the value of 2.70% (IPCC, 2003).

The uncertainty of AD for the period 2010-2018 was evaluated based on Olofsson (2014) method. Details of the evaluation method are described in the Technical Report: "Generation of activity data for the period 2010-2018 for national FREL/FRL update and MRV implementation for REDD+" as indicated in Section 5.1 above.

The error propagation equation was applied to calculate uncertainties[10] of total net emission reductions; according to the error propagation method, the equation (17) is used to calculate the combined uncertainty when *n* uncertain quantities are to be combined by addition while the equation (18) is used when *n* uncertain quantities are to be combined by multiplication (IPCC, 2000).[11]

$$U_{total} = \frac{\sqrt{(U_1 \times X_1)^2 + (U_2 \times X_2)^2 + \cdots + (U_n \times X_n)^2}}{X_1 + X_2 + \cdots + X_n} \quad (17)$$

$$U_{total} = \sqrt{{U_1}^2 + {U_2}^2 + \cdots + {U_n}^2} \quad (18)$$

where: U_{total} is the percentage uncertainty in the addition or multiplication of the quantities; *Xi* (i = 1, 2, …, *n*) is the value of the *i*th quantity; *Ui* (*i* = 1, 2, …, n) is the percentage uncertainty associated with the i^{th} quantity.

6. DESCRIPTION OF HOW THE ELEMENTS IN DECISION 4/CP.15 PARAGRAPHS 1(C) AND (D) HAVE BEEN TAKEN INTO ACCOUNT

6.1. Use of the most recent IPCC Guidance and Guidelines

Vietnam employed the Stock-Difference Method (Equation 2.5, Chapter 2, Volume 4, 2006 IPCC Guidelines for National Greenhouse Gas Inventories) to calculate annual net changes in carbon stocks. However, these changes in carbon stocks are divided into two parts: (1) changes due to reduction of carbon stocks attributed to deforestation and forest degradation, and (2) changes due to enhancement of carbon stocks driven by reforestation and forest restoration.

In addition to using national sample plots data and country-specific allometric equations, Vietnam used the default values of root-to-shoot ratios and carbon fraction from 2006 IPCC

[10]According to IPCC (2000), uncertainty is defined as relative errors at the 95% confidence interval.

[11] IPCC (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

Guidelines for National Greenhouse Gas Inventories to calculate the average carbon stock densities for each forest type, based on which the EFs/RFs could be calculated for each LULC conversion.

6.2. Establish, according to national circumstances and capabilities, robust and transparent National Forest Monitoring System

6.2.1. Use a combination of remote sensing and ground-based forest carbon inventory

As described in Section 4 (Description of the National Forest Monitoring System and institutional roles and responsibilities for measuring, reporting and verifying the results), the NFMS is based on a combination of remote sensing images analysis for the generation of activity data and ground based national forest inventory for the calculation of the forest carbon stocks and resulting emission and removal factors.

6.2.2. Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties

The modalities for accessing information that would be sufficient for recalculating the REDD+ results are provided in Section 5 (Necessary information to allow for the reconstruction of the results), therefore the estimates provided in these documents are considered transparent. The Section 3 (Demonstration that the methodologies used to produce the results are consistent with those used to establish the FREL/FRL) provides details on how the REDD+ Results are consistent with the revised FREL/FRL submission of Vietnam.

To further reduce uncertainties, the uncertainty analysis of the LULC changes has been added to the activity data, which is an improvement to the method used for the FREL/FRL construction.

6.2.3. Transparent results are available and suitable for review

Section 5 (Necessary information to allow for the reconstruction of the results) presents the details of AD and EFs/RFs calculation, and describes how the necessary information to reconstruct the REDD+ results can be accessible.

7. CONCLUSIONS

This Technical Annex reports annual emission reductions and removal enhancements from REDD+ activities during the period of 2010-2018 compared with the reference period of 1995-2010. **Annual emission reductions for the period 2010-2018 amount to 18.3 $MtCO_2$/year. Annual removal enhancements for the period 2010-2018 amount to -38.5 $MtCO_2$/year.** As a result, the amount of net annual emission reductions is 56.8 $MtCO_2$/year for the period 2010-2018; or 283.9 $MtCO_2$ for five years of the period 2014-2018. The uncertainty of net emission reductions is 13.1%.

The results also show that, compared with the reference period, Vietnam's forests had been better protected (demonstrated in the annual emission reductions from deforestation and forest degradation of 18.3 $MtCO_2$/year) as well as better developed (demonstrated in the annual removal enhancements from reforestation and restoration of 38.5 $MtCO_2$/year) during the period of 2010-2018.

In terms of REDD+ activities, the removal enhancements from reforestation contribute 54.6% to the total net emission reductions, followed by the emission reductions from activities that address forest degradation (19.4 %).

Among eco-regions, the North East region has the largest amount of net emission reductions and removal enhancements (21.4 $MtCO_2$/year, accounting for 37.6%), followed by the South Central Coast region (15.2 $MtCO_2$/year, accounting for 26.7 %) and the North Central Coast region (12.1 $MtCO_2$/year or 21.3%).

This Technical Annex reports on the results of the MRV implementation for REDD+ at the national level for the period 2014-2018 compared with the assessed FREL/FRL so that Vietnam can access to REDD+ results-based payment from the Green Climate Fund (GCF). In addition, this Technical Annex can also be used to support state management, and develop strategies and plans in the Land Use, Land Use Change and Forestry sector in Vietnam.

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Annex 1: Forest and land uses area in 2018 by eco-region

Forest and land use types	Area (ha) by region								
	Red River Delta	North East	North West	North Central Coast	South Central Coast	Central Highlands	South East	Mekong River Delta	Total
I. Forested land	***119,197***	***3,871,596***	***1,680,022***	***3,104,384***	***2,386,713***	***2,549,645***	***486,863***	***263,855***	***14,462,276***
1.Evergreen broadleaf forest - rich	171	52,967	7,571	181,597	96,986	200,129	2,417	196	542,034
2.Evergreen broadleaf forest - medium	3,678	172,778	101,685	451,344	340,044	507,068	20,903	2,649	1,600,149
3. Evergreen broadleaf forest - poor	6,372	248,668	147,220	468,586	345,191	192,433	42,916	2,444	1,453,829
4. Evergreen broadleaf forest - regrowth	3,237	1,068,944	903,409	547,179	489,165	409,191	65,312	25,304	3,511,740
5. Deciduous forest	0	0	0	0	140,580	436,590	5,513	0	582,682
6. Bamboo forest	25	52,034	36,569	100,144	14,445	41,986	11,452	0	256,656
7. Mixed timber and bamboo forest	736	329,039	149,691	264,965	82,314	274,089	67,209	39	1,168,083
8. Coniferous forest	0	0	0	0	8,142	116,200	0	0	124,342
9. Mixed broadleaf and coniferous forest	0	0	0	0	11,261	21,046	0	0	32,308
10. Mangrove forest	12,816	29,416	0	1,866	279	0	42,879	68,285	155,542
11. Limestone forest	34,031	390,409	158,343	207,254	6,796	0	878	0	797,711
12.Plantation	58,132	1,527,341	175,534	881,450	851,508	350,914	227,384	164,938	4,237,200
II. Non-forested land	***1,368,286***	***2,549,514***	***2,050,308***	***2,013,123***	***2,025,818***	***2,923,644***	***1,854,831***	***3,769,027***	***18,554,551***
13. Limestone without trees	8,992	87,249	23,448	6,642	7,292	169	88	0	133,880
14. Bare land (grass land, shrub land, land with scattered trees)	12,554	825,807	1,106,474	416,776	541,595	443,176	207,662	33,690	3,587,734

15.Water body	68,358	127,387	50,950	112,760	103,041	67,820	126,767	174,853	831,938
16. Residence	432,891	249,469	117,550	228,722	326,985	165,918	287,298	508,073	2,316,907
17.Others	845,491	1,259,603	751,886	1,248,223	1,046,904	2,246,561	1,233,015	3,052,410	11,684,092
III. Total	**1,487,484**	**6,421,111**	**3,730,331**	**5,117,507**	**4,412,530**	**5,473,289**	**2,341,694**	**4,032,882**	**33,016,827**

Annex 2: LULC change matrices by eco-regions

2.1. North West *(Unit: ha)*

		2018																	
	LULC code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*Total*
2010	1	6,227	3,588	362	1,033	0	0	92	0	0	0	0	45	0	65	3	0	9	11,424
	2	1,344	76,153	22,571	23,945	0	0	7,305	0	0	0	0	389	0	3,226	16	43	351	135,344
	3	0	9,658	87,964	36,215	0	35	9,958	0	0	0	0	1,379	49	1,847	119	94	493	147,810
	4	0	11,755	25,514	756,517	0	4,740	54,562	0	0	0	0	6,159	607	40,058	1,437	1,704	11,402	914,455
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	27	240	4,931	0	24,678	16,282	0	0	0	0	3,041	39	4,376	77	512	10,900	65,102
	7	0	504	3,480	9,470	0	548	31,912	0	0	0	0	2,212	3	5,772	100	213	2,828	57,041
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	136,080	1,529	2,702	5,562	109	79	2,684	148,745
	12	0	0	543	11,640	0	1,983	1,024	0	0	0	0	104,368	975	12,079	491	3,926	13,001	150,031
	13	0	0	0	0	0	0	0	0	0	0	22,264	1,100	6,872	2,836	44	190	2,582	35,889
	14	0	0	6,546	46,641	0	4,585	21,373	0	0	0	0	49,008	6,451	921,402	6,098	11,396	216,783	1,290,284
	15	0	0	0	16	0	0	3	0	0	0	0	27	73	66	37,835	279	1,437	39,737
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	263	62,652	5,614	68,529

	17	0	0	0	13,002	0	0	7,179	0	0	0	0	6,279	5,675	109,182	4,359	36,462	485,548	667,687
	Total	7,571	101,685	147,220	903,409	0	36,569	149,691	0	0	0	158,343	175,534	23,448	1,106,474	50,950	117,550	753,632	3,732,078

2.2. North East *(Unit: ha)*

		2018																	
	LULC code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*Total*
2010	1	42,493	10,324	1,340	1,805	0	0	1,823	0	0	0	0	116	6	272	0	8	22	58,208
	2	10,474	121,064	27,064	21,519	0	35	24,230	0	0	0	0	1,647	177	3,084	35	36	820	210,185
	3	0	26,864	178,757	52,400	0	168	39,545	0	0	2	0	8,760	426	7,668	81	146	2,948	317,764
	4	0	12,916	32,897	921,147	0	5,781	93,695	0	0	96	0	55,145	919	16,094	466	763	12,702	1,152,620
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	163	470	2,606	0	37,865	6,929	0	0	0	0	8,903	20	3,583	7	120	2,340	63,005
	7	0	1,446	4,614	15,187	0	3,816	146,437	0	0	4	0	19,136	34	6,644	60	177	4,364	201,919
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	22	0	0	0	0	0	18,170	0	101	4	40	358	67	594	19,357
	11	0	0	0	0	0	0	0	0	0	0	325,157	1,992	14,638	7,164	42	79	4,417	353,489
	12	0	0	1,425	22,499	0	1,212	3,125	0	0	262	0	1,034,519	204	52,098	316	717	24,195	1,140,571
	13	0	0	0	0	0	0	0	0	0	0	65,252	645	54,937	5,405	46	27	7,904	134,216
	14	0	0	2,102	24,661	0	3,157	9,125	0	0	415	0	303,467	6,441	656,762	336	1,007	141,126	1,148,600
	15	0	0	0	4	0	0	0	0	0	799	0	67	5	364	123,774	97	15,176	140,286
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	242,749	1,471	244,233
	17	0	0	0	7,093	0	0	4,131	0	0	9,668	0	92,844	9,438	66,628	1,853	3,477	1,044,451	1,239,582
	Total	52,967	172,778	248,668	1,068,944	0	52,034	329,039	0	0	29,416	390,409	1,527,341	87,249	825,807	127,387	249,469	1,262,530	6,424,037

2.3. Red River Delta *(Unit: ha)*

		2018																	
	LULC code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	***Total***
2010	1	63	23	11	12	0	0	36	0	0	0	0	0	0	0	0	0	0	145
	2	108	2,626	1,035	333	0	0	563	0	0	0	0	188	0	149	1	5	6	5,014
	3	0	961	4,194	905	0	0	94	0	0	0	0	1,195	13	177	1	47	22	7,609
	4	0	68	860	1,853	0	0	13	0	0	0	0	932	0	152	5	154	134	4,171
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	25	0	0	0	0	0	0	0	1	0	0	0	26
	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	6,277	0	30	45	330	1,170	47	931	8,829
	11	0	0	0	0	0	0	0	0	0	0	34,031	5,127	3,884	2,334	388	516	669	46,948
	12	0	0	0	39	0	0	3	0	0	0	0	35,142	114	2,707	401	2,671	2,660	43,736
	13	0	0	0	0	0	0	0	0	0	0	0	3,260	2,671	206	178	484	1,616	8,416
	14	0	0	272	72	0	0	27	0	0	0	0	3,102	199	3,598	356	738	2,305	10,670
	15	0	0	0	0	0	0	0	0	0	609	0	808	296	203	35,938	15,860	35,592	89,308
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,996	236,339	106,750	351,084
	17	0	0	0	23	0	0	0	0	0	5,929	0	8,349	1,770	2,697	21,923	176,029	696,771	913,491
	Total	171	3,678	6,372	3,237	0	25	736	0	0	12,816	34,031	58,132	8,992	12,554	68,358	432,891	847,455	1,489,448

2.4. North Central Coast *(Unit: ha)*

		2018																	
	LULC code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*Total*
2010	1	140,578	62,399	13,690	3,486	0	0	5,997	0	0	0	0	201	0	213	15	10	149	226,740
	2	40,344	274,527	79,093	30,211	0	9	22,732	0	0	8	0	2,923	0	2,532	110	166	614	453,267
	3	0	82,737	246,415	79,771	0	984	45,769	0	0	0	2	12,894	0	1,469	94	706	1,830	472,671
	4	0	18,983	72,396	325,908	0	7,275	49,171	0	0	0	0	26,961	0	6,441	449	2,843	5,356	515,784
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	2,064	6,227	16,514	0	54,495	30,915	0	0	0	0	13,949	0	7,537	102	717	5,251	137,770
	7	0	5,025	7,924	12,416	0	6,088	78,333	0	0	0	0	5,418	0	3,779	39	319	2,597	121,939
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	1,207	0	9	0	3	190	8	120	1,537
	11	0	0	0	0	0	0	0	0	0	0	201,915	379	403	611	23	27	615	203,972
	12	0	0	1,091	5,916	0	254	336	0	0	68	0	605,926	5	24,783	135	1,620	7,754	647,887
	13	0	0	0	0	0	0	0	0	0	0	5,183	1,307	5,485	412	0	27	1,370	13,783
	14	675	5,609	41,750	65,845	0	31,040	27,469	0	0	18	144	152,896	550	326,791	2,589	23,561	79,244	758,179
	15	0	0	0	0	0	0	0	0	0	183	0	140	4	653	105,099	433	18,253	124,765
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	164,403	66,728	231,167
	17	0	0	0	7,112	0	0	4,243	0	0	382	11	58,445	196	41,553	3,879	33,883	1,061,243	1,210,946
	Total	181,597	451,344	468,586	547,179	0	100,144	264,965	0	0	1,866	207,254	881,450	6,642	416,776	112,760	228,722	1,251,123	5,120,408

2.5. South Central Coast *(Unit: ha)*

		2018																	
	LULC code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	***Total***
2010	**1**	68,666	17,347	6,890	4,065	0	0	431	0	0	0	0	810	0	1,339	43	3	237	99,831
	2	28,320	203,147	35,626	28,645	0	13	5,379	0	0	0	0	4,271	3	8,774	128	9	1,109	315,425
	3	0	70,624	186,200	50,135	0	340	8,473	0	0	0	0	12,808	34	14,392	484	38	3,321	346,848
	4	0	45,956	59,727	221,663	0	509	13,452	0	0	43	0	62,748	274	52,319	737	543	16,213	474,186
	5	0	0	0	0	109,726	0	12,336	0	0	0	0	3,026	12	10,064	102	312	8,661	144,239
	6	0	395	638	861	7	4,711	3,526	0	0	0	0	2,552	0	3,882	93	12	499	17,176
	7	0	1,600	1,389	8,860	2,772	1,499	23,355	0	0	0	0	2,302	0	3,678	34	0	905	46,394
	8	0	387	473	699	343	0	447	3,965	2,628	0	0	253	0	367	0	0	7	9,568
	9	0	588	481	1,027	855	0	131	3,392	7,845	0	0	8	0	706	0	0	30	15,062
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	2,712	150	294	260	0	1	58	3,474
	12	0	0	4,983	20,262	955	199	352	4	0	1	0	364,249	215	37,449	1,346	9,349	67,883	507,247
	13	0	0	0	0	0	0	0	0	0	0	4,084	452	4,541	2,065	5	157	799	12,102
	14	0	0	45,084	141,645	23,626	7,174	12,872	781	772	34	0	203,010	1,381	324,841	3,958	6,592	102,656	874,427
	15	0	0	0	0	0	0	0	0	0	160	0	936	0	291	91,004	770	16,997	110,158
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	204	189,251	14,957	204,413
	17	0	0	3,701	11,303	2,296	0	1,560	2	17	41	0	193,933	537	81,167	4,903	119,949	815,005	1,234,412
	Total	96,986	340,044	345,191	489,165	140,580	14,445	82,314	8,142	11,261	279	6,796	851,508	7,292	541,595	103,041	326,985	1,049,337	4,414,963

2.6. Central Highlands *(Unit: ha)*

		2018																	
	LULC code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	***Total***
2010	**1**	156,050	88,175	12,635	15,294	0	0	5,766	0	0	0	0	1,537	0	1,248	40	7	1,382	282,134
	2	44,080	321,849	42,161	61,744	0	107	25,349	0	0	0	0	11,439	0	9,612	275	40	10,736	527,392
	3	0	37,195	91,272	31,182	0	36	11,315	0	0	0	0	13,041	0	18,675	375	60	39,347	242,498
	4	0	43,434	33,946	266,357	0	1,419	25,701	0	0	0	0	19,093	2	47,557	1,483	130	47,987	487,109
	5	0	0	0	0	434,363	0	10,772	0	0	0	0	15,853	0	6,954	1,326	112	25,179	494,560
	6	0	1,515	1,457	11,003	170	36,167	38,081	0	0	0	0	25,832	0	15,664	2,429	74	10,284	142,677
	7	0	10,777	8,086	11,487	591	3,796	150,558	0	0	0	0	29,143	0	14,110	1,605	49	25,453	255,655
	8	0	2,618	929	3,208	312	0	3,325	101,727	7,349	0	0	13,872	0	5,458	131	317	13,659	152,903
	9	0	1,505	221	2,281	708	0	2,515	9,645	13,133	0	0	3,561	0	924	17	85	3,186	37,780
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	0	0	1,722	6,193	446	444	474	4,697	557	0	0	169,953	0	18,264	757	1,413	36,126	241,046
	13	0	0	0	0	0	0	0	0	0	0	0	9	167	100	0	0	33	308
	14	0	0	5	44	0	17	70	7	0	0	0	28,894	0	241,923	3,295	1,870	202,377	478,501
	15	0	0	0	0	0	0	0	0	0	0	0	89	0	515	52,985	54	11,324	64,967
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	125,244	24,858	150,135
	17	0	0	0	398	0	0	162	124	8	0	0	18,597	0	62,171	3,070	36,464	1,799,850	1,920,844
	Total	200,129	507,068	192,433	409,191	436,590	41,986	274,089	116,200	21,046	0	0	350,914	169	443,176	67,820	165,918	2,251,781	5,478,508

2.7. South East *(Unit: ha)*

		2018																	
	LULC code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	*Total*
2010	1	1,494	679	240	95	0	0	373	0	0	0	0	0	0	18	0	0	0	2,899
	2	923	13,379	5,301	3,826	0	0	5,733	0	0	0	0	321	0	694	6	0	86	30,268
	3	0	1,345	24,041	10,110	0	131	8,195	0	0	0	0	1,715	0	470	5	61	321	46,395
	4	0	2,956	9,704	49,470	0	110	4,832	0	0	4	0	4,875	0	4,321	35	187	3,406	79,901
	5	0	0	0	0	4,910	0	5	0	0	0	0	1,086	0	290	17	121	732	7,161
	6	0	461	401	93	12	7,469	1,156	0	0	0	0	1,142	0	2,270	32	0	1,927	14,963
	7	0	2,083	2,404	308	2	2,701	45,060	0	0	0	0	3,300	0	5,616	88	29	3,611	65,204
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	20,303	0	9	0	54	1,938	786	1,740	24,831
	11	0	0	0	0	0	0	0	0	0	0	859	29	62	15	0	0	4	970
	12	0	0	219	408	7	35	185	0	0	19,341	0	111,944	0	30,055	1,070	2,339	33,637	199,241
	13	0	0	0	0	0	0	0	0	0	0	19	0	4	0	0	0	0	23
	14	0	0	606	726	159	1,006	1,048	0	0	132	0	16,606	11	38,945	1,543	7,793	54,179	122,755
	15	0	0	0	27	0	0	24	0	0	1,409	0	137	0	777	113,092	1,695	10,151	127,311
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	183,754	14,181	198,105
	17	0	0	0	249	422	0	598	0	0	1,689	0	86,221	10	124,136	8,771	90,533	1,111,904	1,424,532
	Total	2,417	20,903	42,916	65,312	5,513	11,452	67,209	0	0	42,879	878	227,384	88	207,662	126,767	287,298	1,235,880	2,344,559

2.8. Mekong River Delta *(Unit: ha)*

		2018																	
	LULC code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	***Total***
2010	**1**	116	43	0	233	0	0	0	0	0	0	0	3	0	0	0	0	0	394
	2	80	1,217	617	1,726	0	0	0	0	0	0	0	31	0	27	8	0	54	3,758
	3	0	184	549	1,680	0	0	0	0	0	0	0	10	0	5	1	0	7	2,437
	4	0	1,206	1,271	21,232	0	0	0	0	0	0	0	907	0	2,398	6	5	3,489	30,514
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	47,256	0	7,931	0	5,462	8,588	1,369	16,781	87,388
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	0	0	0	79	0	0	39	0	0	11,509	0	136,249	0	8,809	2,530	1,193	33,140	193,547
	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	0	0	7	64	0	0	0	0	0	0	0	1,532	0	3,582	896	92	3,379	9,551
	15	0	0	0	0	0	0	0	0	0	640	0	165	0	2,287	153,449	966	15,685	173,191
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	534	328,042	22,255	350,830
	17	0	0	0	291	0	0	0	0	0	8,881	0	18,110	0	11,120	8,842	176,408	2,964,713	3,188,365
	Total	196	2,649	2,444	25,304	0	0	39	0	0	68,285	0	164,938	0	33,690	174,853	508,073	3,059,502	4,039,974

Annex 3: Forest carbon stock densities (tC/ha) in 2019 by ecoregion

3.1. North West

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	21	36	126.12	19.98
Evergreen broadleaf forest - medium	71	110	64.92	8.06
Evergreen broadleaf forest - poor	80	116	29.84	9.00
Evergreen broadleaf forest - regrowth	145	273	24.62	8.26
Bamboo forest	34	44	30.25	39.11
Mixed timber and bamboo forest	87	137	39.21	12.66
Limestone forest	28	47	37.68	22.63
Planted forest	23	39	21.83	26.31

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

3.2. North East and Red River Delta

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	31	44	131.16	13.18
Evergreen broadleaf forest - medium	78	117	61.52	7.42
Evergreen broadleaf forest - poor	80	100	24.87	9.67
Evergreen broadleaf forest - regrowth	209	363	23.54	7.12
Bamboo forest	61	84	26.66	19.81
Mixed timber and bamboo forest	206	459	44.49	8.62
Limestone forest	54	105	36.22	22.88
Planted forest	249	580	27.92	10.27

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

3.3. North Central Coast

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	85	161	123.60	6.80
Evergreen broadleaf forest - medium	123	238	70.78	6.00
Evergreen broadleaf forest - poor	141	227	32.94	7.02
Evergreen broadleaf forest - regrowth	132	231	27.95	10.46
Bamboo forest	63	123	24.60	20.31
Mixed timber and bamboo forest	135	295	50.13	9.95
Limestone forest	19	35	51.33	27.44
Planted forest	120	259	25.13	12.06

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

2.4. South Central Coast

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	104	237	141.72	6.75
Evergreen broadleaf forest - medium	121	184	72.67	6.13
Evergreen broadleaf forest - poor	70	101	34.11	9.35
Evergreen broadleaf forest - regrowth	128	260	35.65	8.96
Deciduous forest	17	56	36.76	49.48
Bamboo forest	9	14	17.16	36.05
Mixed timber and bamboo forest	67	130	61.85	13.38
Mixed broadleaf and coniferous	3	3	68.03	121.34
Limestone forest	17	37	39.69	33.08
Planted forest	104	267	24.75	10.92

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

2.5. Central Highlands

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	170	450	153.24	5.92
Evergreen broadleaf forest - medium	105	146	78.41	6.03
Evergreen broadleaf forest - poor	64	74	38.03	10.28
Evergreen broadleaf forest - regrowth	100	163	47.87	9.00
Deciduous forest	55	148	38.97	18.11
Bamboo forest	43	63	14.68	39.38
Mixed timber and bamboo forest	122	220	63.37	13.53
Coniferous forest	13	29	111.70	25.81
Mixed broadleaf and coniferous	25	59	92.73	27.62
Planted forest	67	150	35.37	28.48

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

2.6. South East and Mekong River Delta

Forest type	# of clusters	Number of sample plots	Carbon density (tons/ha)	Uncertainty[a] (%)
Evergreen broadleaf forest - rich	20	64	148.67	11.45
Evergreen broadleaf forest - medium	18	24	81.77	9.97
Evergreen broadleaf forest - poor	8	11	33.22	34.05
Evergreen broadleaf forest - regrowth	18	27	52.77	20.60
Deciduous forest	4	11	32.66	63.34
Bamboo forest	6	7	16.57	39.51
Mixed timber and bamboo forest	21	45	62.91	25.75
Planted forest	29	87	24.46	23.43

[a] Cumulative uncertainty, which includes uncertainties caused by sampling errors, uncertainties of BGB/AGB ratios and uncertainties of carbon fractions.

Annex 4: Carbon stock densities of forest types by eco-region in period 2010-2018

4.1. North West

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	145.01	47.35	126.12	19.98	128.22	18.45
Evergreen broadleaf forest - medium	64.63	9.15	64.92	8.06	64.89	7.24
Evergreen broadleaf forest - poor	28.19	24.76	29.84	9.00	29.66	8.46
Evergreen broadleaf forest - regrowth	17.28	14.31	24.62	8.26	23.80	7.68
Bamboo forest	15.67	31.45	30.25	39.11	28.63	36.78
Mixed timber and bamboo forest	29.64	21.21	39.21	12.66	38.15	11.71
Limestone forest	18.92	83.14	39.51	13.77	37.21	13.81
Planted forest	11.86	36.66	21.83	26.31	20.72	24.74

4.2. North East and Red River Delta

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	106.63	12.68	131.16	13.18	128.43	12.02
Evergreen broadleaf forest - medium	64.11	7.24	61.52	7.42	61.80	6.61
Evergreen broadleaf forest - poor	20.07	12.89	24.87	9.66	24.33	8.86
Evergreen broadleaf forest - regrowth	16.33	10.47	23.54	7.12	22.74	6.61
Bamboo forest	17.27	17.81	26.66	19.81	25.62	18.37
Mixed timber and bamboo forest	27.31	10.94	44.49	8.62	42.58	8.04
Limestone forest	18.92	83.14	39.51	13.77	37.22	13.81
Planted forest	14.40	16.09	27.92	10.27	26.42	9.70

4.3. North Central Coast

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	141.18	9.46	123.60	6.80	125.56	6.09
Evergreen broadleaf forest - medium	70.24	2.63	70.78	6.00	70.72	5.37
Evergreen broadleaf forest - poor	31.04	4.16	32.94	7.02	32.73	6.31
Evergreen broadleaf forest - regrowth	19.21	17.61	27.95	10.46	26.98	9.74
Bamboo forest	14.74	17.99	24.60	20.31	23.50	18.94

Mixed timber and bamboo forest	39.67	11.42	50.13	9.95	48.97	9.12
Limestone forest	18.92	83.14	39.51	13.77	37.22	13.81
Planted forest	22.14	29.89	25.13	12.06	24.80	11.27

4.4. South Central Coast

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	133.92	7.64	141.72	6.74	140.85	6.09
Evergreen broadleaf forest - medium	75.64	5.68	72.67	6.12	73.00	5.46
Evergreen broadleaf forest - poor	32.49	7.00	34.11	9.35	33.93	8.39
Evergreen broadleaf forest - regrowth	27.48	13.34	35.65	8.96	34.75	8.25
Deciduous forest	28.35	21.66	36.76	49.47	35.82	45.16
Bamboo forest	13.21	27.29	17.16	36.05	16.72	32.98
Mixed timber and bamboo forest	50.44	23.11	61.85	13.38	60.58	12.33
Coniferous forest	94.82	11.72	111.70	25.80	109.83	23.36
Mixed broadleaf and coniferous	66.64	44.96	91.45	26.78	88.70	24.83
Limestone forest	18.92	83.14	39.51	13.77	37.22	13.81
Planted forest	10.41	23.44	24.75	10.92	23.15	10.44

4.5. Central Highlands

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	141.26	5.52	153.24	5.92	151.91	5.33
Evergreen broadleaf forest - medium	79.39	4.94	78.41	6.03	78.52	5.38
Evergreen broadleaf forest - poor	37.67	5.67	38.03	10.28	37.99	9.16
Evergreen broadleaf forest - regrowth	43.21	9.09	47.87	9.00	47.35	8.14
Deciduous forest	32.22	9.08	38.97	18.11	38.22	16.44
Bamboo forest	11.72	27.49	14.68	39.38	14.35	35.90
Mixed timber and bamboo forest	50.82	11.97	63.37	13.53	61.98	12.35
Coniferous forest	94.82	12.63	111.70	25.81	109.79	23.37
Mixed broadleaf and coniferous	76.97	48.40	92.73	27.62	90.98	25.43
Planted forest	23.27	42.38	35.37	28.48	34.03	26.51

4.6. South East and Mekong River Delta

Forest type	2010		2019		2018	
	C (tC/ha)	U (%)	C (tC/ha)	U (%)	C (tC/ha)	U (%)
Evergreen broadleaf forest - rich	161.44	16.29	148.67	11.45	150.09	10.28
Evergreen broadleaf forest - medium	82.38	8.08	81.77	9.97	81.84	8.91
Evergreen broadleaf forest - poor	34.16	17.30	33.22	34.05	33.33	30.24
Evergreen broadleaf forest - regrowth	51.91	18.59	52.77	20.60	52.68	18.46
Deciduous forest	31.20	7.84	32.66	63.34	32.50	56.60
Bamboo forest	16.32	81.17	16.57	39.51	16.54	36.29
Mixed timber and bamboo forest	56.11	26.79	62.91	25.75	62.16	23.33
Limestone forest	18.92	83.02	24.46	23.43	37.22	13.81
Planted forest	15.09	28.57	148.67	11.45	23.42	21.85

Annex 5: Emission and removal factors by eco-region for period 2010-2018

5.1. North West

Emission/removal factors (tCO_2/ha)		LULC types 2018								
		TXG	TXB	TXN	TXP	RTN	HGGN	RND	RTG	DKR
LULC types 2010	TXG	61.6	293.8	423.0	444.4	426.7	391.8	395.3	531.7	531.7
	TXB	-233.2	-1.0	128.2	149.7	132.0	97.1	100.5	237.0	237.0
	TXN	-366.7	-134.5	-5.4	16.1	-1.6	-36.5	-33.1	103.4	103.4
	TXP	-406.8	-174.6	-45.4	-23.9	-41.6	-76.5	-73.1	63.4	63.4
	RTN	-412.7	-180.5	-51.3	-29.8	-47.5	-82.4	-79.0	57.5	57.5
	HGGN	-361.4	-129.2	-0.1	21.4	3.7	-31.2	-27.8	108.7	108.7
	RND	-400.7	-168.5	-39.4	-17.9	-35.6	-70.5	-67.1	69.4	69.4
	RTG	-426.7	-194.5	-65.3	-43.8	-61.5	-96.4	-93.0	-32.5	43.5
	DKR	-470.1	-237.9	-108.7	-87.3	-105.0	-139.9	-136.4	-76.0	0.0

5.2. North East and Red River Delta

Emission/removal factors (tCO_2/ha)		LULC types 2018									
		TXG	TXB	TXN	TXP	RTN	HGGN	RNM	RND	RTG	DKR
/LULC types 2010	TXG	-79.9	164.4	301.8	307.6	297.1	234.9	261.9	254.5	391.0	391.0
	TXB	-235.9	8.4	145.8	151.7	141.1	78.9	106.0	98.6	235.1	235.1
	TXN	-397.3	-153.0	-15.6	-9.8	-20.4	-82.5	-55.5	-62.9	73.6	73.6
	TXP	-411.0	-166.7	-29.3	-23.5	-34.1	-96.2	-69.2	-76.6	59.9	59.9
	RTN	-407.6	-163.3	-25.9	-20.0	-30.6	-92.8	-65.7	-73.1	63.3	63.3
	HGGN	-370.8	-126.5	10.9	16.8	6.2	-56.0	-28.9	-36.3	100.1	100.1
	RNM	-341.8	-97.6	39.8	45.7	35.1	-27.1	0.0	-7.4	129.1	129.1
	RND	-401.5	-157.2	-19.8	-14.0	-24.6	-86.7	-59.7	-67.1	69.4	69.4
	RTG	-418.1	-173.8	-36.4	-30.6	-41.2	-103.3	-76.3	-83.7	-44.1	52.8
	DKR	-470.9	-226.6	-89.2	-83.4	-93.9	-156.1	-129.1	-136.5	-96.9	0.0

5.3. North Central Coast

Emission/removal factors (tCO_2/ha)		LULC types 2018									
		TXG	TXB	TXN	TXP	RTN	HGGN	RNM	RND	RTG	DKR
LULC types	TXG	57.3	258.3	397.7	418.7	431.5	338.1	388.6	381.2	517.7	517.7
	TXB	-202.8	-1.8	137.5	158.6	171.4	78.0	128.5	121.1	257.5	257.5

2010	**TXN**	-346.6	-145.5	-6.2	14.9	27.6	-65.7	-15.3	-22.7	113.8	113.8
	TXP	-389.9	-188.9	-49.6	-28.5	-15.7	-109.1	-58.6	-66.0	70.4	70.4
	RTN	-406.3	-205.3	-66.0	-44.9	-32.1	-125.5	-75.0	-82.4	54.0	54.0
	HGGN	-314.9	-113.9	25.5	46.5	59.3	-34.1	16.4	9.0	145.5	145.5
	RNM	-331.3	-130.2	9.1	30.2	42.9	-50.5	0.0	-7.4	129.1	129.1
	RND	-391.0	-189.9	-50.6	-29.5	-16.8	-110.2	-59.7	-67.1	69.4	69.4
	RTG	-379.2	-178.1	-38.8	-17.7	-5.0	-98.4	-47.9	-55.3	-9.8	81.2
	DKR	-460.4	-259.3	-120.0	-98.9	-86.2	-179.6	-129.1	-136.5	-90.9	0.0

5.4. South Central Coast

Emission/ removal factors (tCO_2/ha)		**LULC types 2018**											
		TXG	**TXB**	**TXN**	**TXP**	**RRL**	**RTN**	**HGGN**	**RLK**	**LRLK**	**RNM**	**RND**	**RTG**	**DKR**
LULC types 2010	**TXG**	-25.4	223.4	366.6	363.7	359.7	429.7	268.9	88.3	165.8	254.9	354.6	491.1	491.1
	TXB	-239.1	9.7	152.9	149.9	146.0	216.0	55.2	-125.4	-47.9	41.2	140.9	277.3	277.3
	TXN	-397.3	-148.6	-5.3	-8.3	-12.2	57.8	-103.0	-283.6	-206.1	-117.0	-17.4	119.1	119.1
	TXP	-415.7	-166.9	-23.6	-26.6	-30.6	39.5	-121.4	-301.9	-224.5	-135.4	-35.7	100.8	100.8
	RRL	-412.5	-163.7	-20.5	-23.5	-27.4	42.6	-118.2	-298.8	-221.3	-132.2	-32.5	103.9	103.9
	RTN	-468.0	-219.2	-76.0	-79.0	-82.9	-12.9	-173.7	-354.3	-276.8	-187.7	-88.0	48.4	48.4
	HGGN	-331.5	-82.7	60.5	57.5	53.6	123.6	-37.2	-217.8	-140.3	-51.2	48.5	184.9	184.9
	RLK	-168.8	80.0	223.3	220.3	216.3	286.4	125.5	-55.0	22.5	111.5	211.2	347.7	347.7
	LRLK	-272.1	-23.3	119.9	116.9	113.0	183.0	22.2	-158.4	-80.9	8.2	107.9	244.3	244.3
	RNM	-280.3	-31.5	111.7	108.7	104.8	174.8	14.0	-166.6	-89.1	0.0	99.7	236.1	236.1
	RND	-447.1	-198.3	-55.0	-58.0	-62.0	8.1	-152.8	-333.3	-255.8	-166.8	-67.1	69.4	69.4
	RTG	-478.3	-229.5	-86.2	-89.2	-93.2	-23.1	-184.0	-364.5	-287.0	-198.0	-98.3	-46.7	38.2
	DKR	-516.5	-267.7	-124.4	-127.4	-131.3	-61.3	-222.1	-402.7	-325.2	-236.1	-136.5	-84.9	0.0

5.5. Central Highlands

Emission/removal factors (tCO_2/ha)		**LULC types 2018**										
		TXG	**TXB**	**TXN**	**TXP**	**RRL**	**RTN**	**HGGN**	**RLK**	**LRLK**	**RTG**	**DKR**
LULC types 2010	**TXG**	-39.0	230.0	378.6	344.3	377.8	465.3	290.7	115.4	184.4	517.9	517.9
	TXB	-265.9	3.2	151.8	117.5	151.0	238.5	63.9	-111.5	-42.5	291.1	291.1
	TXN	-418.8	-149.8	-1.2	-35.5	-2.0	85.5	-89.1	-264.4	-195.4	138.1	138.1
	TXP	-398.5	-129.5	19.1	-15.2	18.3	105.8	-68.8	-244.1	-175.1	158.4	158.4

	RRL	-438.9	-169.8	-21.2	-55.5	-22.0	65.5	-109.1	-284.4	-215.5	118.1	118.1
	RTN	-514.0	-244.9	-96.3	-130.7	-97.2	-9.7	-184.3	-359.6	-290.6	43.0	43.0
	HGGN	-370.7	-101.6	47.0	12.7	46.2	133.7	-40.9	-216.2	-147.3	186.3	186.3
	RLK	-210.5	58.6	207.2	172.9	206.4	293.9	119.3	-56.1	12.9	346.5	346.5
	LRLK	-274.8	-5.7	142.9	108.6	142.1	229.6	54.9	-120.4	-51.4	282.2	282.2
	RTG	-471.7	-202.6	-54.0	-88.3	-54.8	32.7	-141.9	-317.3	-248.3	-39.5	85.3
	DKR	-557.0	-287.9	-139.3	-173.6	-140.1	-52.6	-227.3	-402.6	-333.6	-124.8	0.0

5.6. South East and Mekong River Delta

Emission/removal factors (tCO_2/ha)		**LULC types 2018**										
		TXG	**TXB**	**TXN**	**TXP**	**RRL**	**RTN**	**HGGN**	**RNM**	**RND**	**RTG**	**DKR**
LULC types 2010	**TXG**	41.6	291.9	469.7	398.8	472.8	531.3	364.0	355.8	455.5	591.9	591.9
	TXB	-248.3	2.0	179.9	108.9	182.9	241.4	74.1	65.9	165.6	302.0	302.0
	TXN	-425.1	-174.8	3.0	-67.9	6.1	64.6	-102.7	-110.9	-11.2	125.2	125.2
	TXP	-360.0	-109.7	68.1	-2.8	71.2	129.7	-37.6	-45.8	53.8	190.3	190.3
	RRL	-435.9	-185.7	-7.8	-78.8	-4.8	53.7	-113.5	-121.7	-22.1	114.4	114.4
	RTN	-490.5	-240.2	-62.3	-133.3	-59.3	-0.8	-168.1	-176.3	-76.6	59.9	59.9
	HGGN	-344.6	-94.3	83.6	12.6	86.6	145.1	-22.2	-30.4	69.3	205.7	205.7
	RNM	-314.2	-63.9	113.9	43.0	117.0	175.5	8.2	0.0	99.7	236.1	236.1
	RND	-480.9	-230.7	-52.8	-123.8	-49.8	8.7	-158.5	-166.8	-67.1	69.4	69.4
	RTG	-495.0	-244.7	-66.9	-137.8	-63.8	-5.3	-172.6	-180.8	-81.1	-30.5	55.3
	DKR	-550.3	-300.1	-122.2	-193.2	-119.2	-60.7	-227.9	-236.1	-136.5	-85.9	0.0