



Forest Carbon Partnership Facility (FCPF) Carbon Fund ER Monitoring Report (ER-MR)	
ER Program Name and Country:	Mai-Ndombe ER-Program, Democratic Republic of Congo
Reporting Period covered in this report:	1-January-2019 to 31-December-2020
Number of FCPF ERs:	5,565,432
Quantity of ERs allocated to the Uncertainty Buffer:	948,652
Quantity of ERs to allocated to the Reversal Pooled Reversal buffer:	1,391,356
Number of FCPF ERs from enhanced removals through afforestation/ reforestation	N/A
Number of FCPF ER from High Forest Low Deforestation (HFLD)	2,205,863
Date of Submission:	4-4-2025
Version	3.2

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The Facility Management Team and the REDD Country Participant shall make this document publicly available, in accordance with the World Bank Access to Information Policy and the FCPF Disclosure Guidance.

General guidelines on completing the ER-MR. Guidance text within the ER Monitoring template shall be considered as requirements and shall be met by the ER Program.

ER Programs shall comply with the requirements of the FCPF Methodological Framework's version available at the time of ERPA signature and the latest version of other FCPF requirements such as the Buffer Guidelines, Process Guidelines, Validation and Verification Guidelines, and the Guidelines on the application of the Methodological Framework. These versions may be found in here: <https://www.forestcarbonpartnership.org/requirements-and-templates>

Purpose of the ER-MR

ER Programs that have been included in the portfolio of the FCPF Carbon Fund shall implement the ER Program and report on performance, in particular ERs generated. By completing and submitting the ER Monitoring Report, a REDD Country Participant or its authorized entity officially reports on its performance to the Carbon Fund.

The FCPF Glossary of Terms provides definitions of specific terms used in the Methodological Framework, Buffer Guidelines and other requirements. Unless otherwise defined in this ER-MR template, any capitalized term used in this ER-MR template shall have the same meaning ascribed to such term in the FCPF Glossary of Terms.

Guidance on completing the ER-MR

All sections of the ER-MR shall be completed. If sections of the ER-MR are not applicable, explicitly state that the section is "Intentionally left blank" and provide an explanation why this section is not applicable. All instructions, including this section, should be deleted when submitting the ER-MR to the Facility Management Team of the FCPF.

Font of the body text shall be Calibri 10 black font.

Provide definitions of key terms that are used and use these key terms, as well as variables etc, consistently using the same abbreviations, formats, subscripts, etc. If the ER –MR contains equations, please number all equations and define all variables used in these equations, with units indicated.

The presentation of values in the ER-MR, including those used for the calculation of emission reductions, should be in international standard format e.g 1,000 representing one thousand and 1.0 representing one. Please use International System Units (SI units – refer to http://www.bipm.fr/enus/3_SI/si.html) unless the MF or the IPCC Guidelines indicate otherwise (e.g. tonnes vs Mg).

REDD Country Participants should note that if the Reporting Period does not coincide with the beginning and end of a natural year it shall apply the Guidelines on the application of the MF Number 3 on reporting periods. In this case, net ERs shall be estimated for the Monitoring Period and they shall be allocated to the Reporting Period pro-rata on the number of months. In the template Monitoring Report refers to the period used for monitoring ERs, while Reporting period refers to the period defined in the ERPA and for which ERs are paid for.

REDD Country Participants should also note that if Technical Corrections to the Reference Level have been applied in accordance with the Guidelines on the application of the methodological framework number 2 on technical corrections, then the technically corrected RL shall be reported in Annex 4 and will be subject to Validation by the Validation and Verification Body.

Acronym List

AD	: <i>Activity Data</i>
AGB	: <i>Above Ground Biomass</i> – Biomasse épigée
AOI	: <i>Area of Interest</i>
AT	: Autres Terres
BGB	: <i>Below Ground Biomass</i> – Biomasse souterraine
BSP	: Benefit Sharing Plan
CAFI	: Central African Forest Initiative
CFCL	: Concession des Forêts des Communautés Locales / Concession of Forests to Local Communities
CAFI	: <i>Central Africa Forest Initiative</i> – Initiative pour la Forêt d’Afrique Centrale
CCNUCC	: Convention-Cadre des Nations Unies sur le Changement Climatique
CIF	: <i>Climate Investment Fund</i> – Fonds d’Investissement Climat
CM&M	: <i>Carbon Map and Model</i> – Carte de Carbone et Modèle
CN-REDD	: Coordination Nationale REDD / National REDD Coordination
CARG	: Conseil Agricole Rural de Gestion / Rural Agricultural Management Advisory
COCOSI	: Comité de Coordination des Sites / Site Coordination Committee
COLO	: Communauté Locale / Local Community
COPIL	: Comité de Pilotage / Steering Committee
COS	: Carbone Organique du Sol
CRCA	: Culture et Régénération de Culture Abandonnée
CTPM-PF	: Comité Technique Permanent Multisectoriel de la Planification Familiale / Permanent Multisectoral Technical Committee for Family Planning
Cu	: Culture
DBH	: Diameter at Breast Height
DHS	: Forêt dense Humide Sempervirente de basse et moyenne altitude
DIAF	: Direction des Inventaires et Aménagements Forestiers / Forest Inventory and Management Directorate
DS	: Forêt dense Sèche de basse et moyenne altitude
RDC	: Democratic Republic of the Congo
EF	: Emission Factors
ER	: Emission Reductions
ER-MR	: Emissions Reductions-Monitoring Report
ERPA	: Emission Reductions Payment Agreement
ERP	: Emission Reductions Program
ER-PD	: Emission Reduction Program Document
FAO	: <i>Food and Agriculture Organization</i> – Organisation des Nations Unies pour l’Alimentation et l’Agriculture
FC	: Fraction de carbone ou Forêt Claire
FCPF	: <i>Forest Carbon Partnership Facility</i> – Facilitation du partenariat pour le carbone forestier
FDH	: Forêt Dense Humide / Dense wet forest
FDHSH	: Forêt Dense Humide sur Sol Hydromorphe / Dense humid wetland forest
FDHTF	: Forêt Dense Humide sur Terre Ferme / Dense wet forest on dry land

FE	: Facteur d'Émission
FONAREDD	: Fonds National REDD / National REDD Fund
FREL	: Forest Reference Emission Level
FSc	: Forêt Secondaire
FSFC	: Forêt Sèche ou Forêt Claire
GES	: Gaz à Effet de Serre
GFOI	: <i>Global Forest Observation Initiative</i> – Initiative Globale pour l'Observation de la Forêt
GIEC	: Groupe Intergouvernemental d'Experts sur l'Évolution du Climat
HFLD	: High Forest, Low Deforestation
ICRAF	: <i>World Agroforestry Centre</i>
IFLMP	: <i>Improved Forest Landscape Management Project</i>
IFN	: <i>National Forest Inventory</i>
IPCC	: Intergovernmental Panel on Climate Change
IPs	: Indigenous Peoples
JAFTA	: <i>Japanese Forest Technology Association</i> – Association Japonaise pour la Technologie Forestière
JICA	: <i>Japanese International Cooperation Agency</i> – Agence Japonaise de Coopération Internationale
LCC	: Land Cover Change
LDC	: Local Development Committee
LIDAR	: <i>Light Detection And Ranging</i>
LU/LC	: <i>Land Cover / Land USE</i>
MEDD	: Ministry of Environment and Sustainable Development
MF	: Methodological Framework
MGD	: Methods Guidance Document
MMR	: Measuring, Monitoring and Reporting
NRMP	: Natural Resource Management Plan
OPERPA	: <i>Operationalization of the Emissions Reduction Payment Agreement</i>
OSFAC	: Observatoire Satellital des Forêts d'Afrique Centrale / Central African Forest Satellite Observatory
OGF	: Observatoire de la Gouvernance Forestière
PES	: Payment for Environmental Services
PI	: Plan d'Investissement
PIF	: Forest Investment Program
PMU	: Program Management Unit
PRE	: Programme de Réduction des Émissions
PRE-IFN	: Pré-Inventaire Forestier National / Pre-National Forest Inventory
PTC	: Plateforme Technique de Concertation
QA/QC	: Quality Assurance/Quality Control
RAC	: Rural Agricultural Committee
REDD	: Reducing Emissions from Deforestation and Forest Degradation
RE	: Reduction Emission
RNTL	: Réserve Nationale de Tumba Lediima / Tumba Lediima National Reserve
R-PP	: <i>Readiness Preparation Plan</i>
SA	: Forêt Secondaire Adulte
SEPAL	: <i>System for Earth Observation Data Access, Processing and Analysis for Land Monitoring</i>

SJ : Forêt Secondaire Jeune
SMC : *Southern Mapping Company*
TH : Terres Humides

Table of Contents

1	Implementation and operation of the ER Program during the Reporting Period	9
1.1	Implementation status of the ER Program and changes compared to the ER-PD	9
1.2	Update on major drivers and lessons learned	14
2	System for measurement, monitoring and reporting emissions and removals occurring within the monitoring period.....	14
2.1	Forest Monitoring System	14
2.2	Updates to the monitoring approach	19
2.3	Measurement, monitoring and reporting approach	19
3	Data and parameters.....	27
3.1	Fixed Data and Parameters	27
3.2	Monitored Data and Parameters.....	37
4	Quantification of emission reductions	42
4.1	ER Program Reference level for the Monitoring / Reporting Period covered in this report	42
4.2	Estimation of emissions by sources and removals by sinks included in the ER Program's scope	43
4.3	Calculation of emission reductions	45
5	Uncertainty of the estimate of Emission Reductions	46
5.1	Identification, assessment and addressing sources of uncertainty	46
5.2	Uncertainty of the estimate of Emission Reductions	49
5.3	Sensitivity analysis and identification of areas of improvement of MRV system	50
6	Transfer of Title to ERs	52
6.1	Ability to transfer title	52
6.2	Implementation and operation of Program and Projects Data Management System	53
6.3	Implementation and operation of ER transaction registry	53
6.4	ERs transferred to other entities or other schemes	54
7	Reversals	54
7.1	Occurrence of major events or changes in ER Program circumstances that might have led to the Reversals during the Reporting Period compared to the previous Reporting Period(s)	54
7.2	Quantification of Reversals during the	54
7.3	Quantification of pooled reversal buffer replenishments	56
7.4	Reversal risk assessment.....	56
8	Emission Reductions available for transfer to the Carbon Fund	60
	Annex 1: Information on the implementation of the Safeguards Plans	62
	Annex 2: Information on the implementation of the Benefit-Sharing Plan.....	78
	Annex 3: Information on the generation and/or enhancement of priority Non-Carbon Benefits.....	85
	Annex 4: CARBON ACCOUNTING - Addendum to the ERPD.....	93
	Technical corrections	93
	Start Date of the Crediting Period	94

7.	Carbon pools, sources and sinks	95
7.1	Description of Sources and Sinks selected	95
7.2	Description of carbon pools and greenhouse gases selected	95
8	Reference Level	97
8.1	Reference Period	97
8.2	Forest definition used in the construction of the Reference Level	98
8.3	Average annual historical emissions over the Reference Period	100
8.4	Estimated Reference Level	115
8.5	Upward or downward adjustments to the average annual historical emissions over the Reference Period (if applicable)	116
8.6	Relation between the Reference Level, the development of a FREL/FRL for the UNFCCC and the country's existing or emerging greenhouse gas inventory	122
9	approach for Measurement, Monitoring and reporting	123
9.1	Measurement, monitoring and reporting approach for estimating emissions occurring under the ER Program within the Accounting Area	124
	<i>Parameters to be monitored</i>	128
9.2	Organizational structure for measurement, monitoring and reporting	130
9.3	Relation and consistency with the National Forest Monitoring System	132
12	Uncertainties of the calculation of emission reductions	132
12.1	Identification and assessment of sources of uncertainty	132
12.2	Quantification of uncertainty in Reference Level Setting	134

1 IMPLEMENTATION AND OPERATION OF THE ER PROGRAM DURING THE REPORTING PERIOD

1.1 Implementation status of the ER Program and changes compared to the ER-PD

1.1.1 Update on ERP activities implementation

The Emission Reduction Program (ERPA) between the Democratic Republic of Congo (DRC) and the World Bank was signed on September 21, 2018. Following the completion of the conditions for the effectiveness of the ERPA it became effective on July 21, 2022. The Government of DRC has specifically worked to complete the following activities:

1. Submission of the letter of approval in October 2019.
2. Finalization and validation of the Benefit Sharing Plan which was developed with stakeholder inputs in 2019 and 2020 (see section 1.1.3) and presented to stakeholders at the meeting of the Provincial Steering Committee of the ER Program held on April 21, 2022 in Inongo. It was then approved in a national workshop held in Kinshasa on May 6, 2022.
3. A revised reference level was submitted to improve the accuracy of the activity data on deforestation, forest degradation and enhancement of forest carbon stocks in the reference period. The work began in 2019 with consultation workshops with stakeholders followed in 2020 by meetings to discuss the methodology for the revision. The revised reference level was developed by the University of Maryland, with the contribution of the Unit for Forests Inventory and Management Foresters of Ministry of Environment and Sustainable Development, and the first results were published in October 2020. After and then on the results (January 2021).
4. The current management unit of the Forest Investment Program (UC-PIF) was selected as the ER Program Management Unit.
5. An Action Plan that described the steps and timelines for the Ministry of Environment and Sustainable Development to demonstrate its ability to transfer Title to ERs has been established.
6. Ministry of Environment and Sustainable Development has secured funding of at least 2.2 million USD to operationalize and improve the components and sub-components required for ER Program implementation.

In terms of implemented activities contributing to emissions reduction, the ERP is based on a comprehensive approach that recognizes the link between sustainable forest management and use, community agricultural development, and governance. For the current reporting period, the ERP emission reduction results are based on activities implemented by:

- [Improved Forest Landscape Management Project](#) (IFLMP, P128887):
 - Forest Investment Program - Component 1 Integrated REDD+ Project in the Plateaux (PIREDD Plateaux)
 - Additional funding for the [Mai-Ndombe Integrated REDD+ project](#) (P162837, PIREDD Mai-Ndombe) from CAFI
 - Additional funding for the [Mai-Ndombe Integrated REDD+ project](#) (P160182) from the GEF
- Dedicated Grant Mechanism: [Support to Forest Dependent Communities Project](#) (P149049), complemented by additional funding from CAFI to support to Indigenous Peoples.
- The [Mai Ndombe REDD+ project](#) implemented by Wildlife Works

Table 1-1. Projects supporting the implementation of the ERP activities.

Project	Amount	Period	Status update
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Improved Forest Landscape Management Project (IFLMP, P128887), Component 1, Integrated Project REDD+ Plateau (PIREDD Plateau)	14,2 million USD (PIREDD Plateau)	April 2015 - June 2020	The following results have been achieved: • 4070 hectares of agroforestry have been established out of the 5,000 hectares planned, and 13,994 hectares of savannahs have been protected (8,750 hectares have been well preserved) • 329 PES contracts signed with 155 LDCs out of the 215 that have been created/revitalized • Rural Agricultural Management Committees (CARG) supported at the rate of 1 CARG per Territory • 360,472.75 were paid to communities in the form of PES for community use (schools, wells, etc....) • 11,573 beneficiary households (of which 8002 male-headed households, 3551 female-headed households, 20 concessionaires/small farmers (of which 1 is female)
Improved Forest Landscape Management Project (IFLMP, P128887), Additional funding for Maï-Ndombe REDD+ project (P162837, PIREDD Maï-Ndombe)	18,22 million USD	May 2018 – Dec 2022	The following results were achieved in the first phase of the project. These include: • 480 Natural Resource Management Plans (NRMPs) validated • 19 Rural Agricultural Management Committees (RACs) including 4 Territories and 15 Sectors revitalized • 1,690 ha of oil palm and 1,800 ha of acacia put in place, 835 ha of perennial crops put in place, 9,936 ha of savannah put in conservation, • 2,194 ha of conservation and/or sustainable forest put in place, • 1,697. 986.39 USD paid to communities in the form of payment for environmental services (About 33% of this amount was received by women beneficiaries of project activities), 20 bridges and 8 culverts built, 4 office buildings built, • 231 km of rural roads maintained, • 1 mini-oil mill installed and operational

			• 1 cocoa processing center installed and operational • 6 micro-projects for indigenous populations • 1 Permanent Multisectoral Technical Committee on Family Planning (CTMP-PF) set up • 4 administrative buildings constructed, • 9,608 farmers (including 3,205 women and 497 IPs) and 76 concessionaires/farmers (including 9 women and 2 IPs) direct beneficiaries of the project's interventions, 130,562 people were sensitized, including 99,093 men (76%), 31,469 women (24%), 10,774 indigenous people (8%) and 119,788 Bantu (92%).
Improved Forest Landscape Management Project (IFLMP, P128887), Additional funding for Mai-Ndombe REDD+ project (P160182)	6,2 million USD	June 2019 – July 2021	• Launching of awareness-raising activities for local communities and Indigenous Peoples on the sustainable management of biodiversity in 19 of the 75 Terroirs selected as having a high biodiversity value potential. • Carry out biodiversity inventories in the 19 Terroirs. • 4 local community forest concessions (CFCL) are being established. These are: Djoko (47,496 ha) and Losomba/Bakonda (42,884 ha) in Kiri Territory, Nkalontulu/Bolendo (48,209 ha) in Oshwe Territory, and Boototango/Mpenge (44,027 ha) in Inongo Territory. • Socio-economic surveys and multi-resource inventories conducted in the 4 CFCLs. • Community sensitization, completion of socio-economic surveys and identification of sites for the implementation of community REDD+ sub-projects (Mpenge with 14 terroirs in the Inongo Territory and Mbantin with 10 Terroirs in the Kutu Territory) • 10 new potential microprojects in favor of IPs identified, • Deployment of the Complaint Management Mechanism in the area in the Tumba Lediima National Reserve (RNTL),

			establishment of the Site Coordination Committee (COCOSI) in the RNTL, (viii) 2 sub-microprojects on bioprospecting developed.
DGM : Support to forest dependent communities (P149049)	6 million USD, Maï Ndombe is one of the provinces where the project is implemented	April 2016 - July2021	- Drafting of the roadmap containing the priority actions to be carried out in order to integrate the concerns of IPs in the reform being developed in the areas of land use planning, land tenure and community forestry, - Accompanying the communities of Bakwangombe - Tshiefu in the villages of Bondon, Mitsha, Kombe and Tongonuena to obtain the titles of four Forest Concessions of Local Communities (CFCL), - Validation of 3 microprojects in favor of IPs and COLOs of the territories of Kabinda, Lubao and Lubefu validated and ready for financing, - Elaboration of 5 microprojects in favor of IPs of the territories of Yahuma, Opala, Banalia, Bafwasende and Mambasa
Wildlife Works Maï Ndombe project		Since 2011	- Halting planned legal and unplanned illegal logging, charcoal production and slash and burn agriculture. - School construction, repair and supply - Community engagement – Local Development Committees (CLDs) - Health care improvements - Mobile Medical Clinic and Emergency Response System; - Agroforestry and demonstration gardens - Participatory mapping, with workshops planned for Lobeke and Mbale - Bridge repair and road clearing was performed along two main routes in the Project Area; Improved lake transportation for local communities. Full report for the 2017-2020 monitoring period is available here.

1.1.2 Updated strategy to mitigate and/or minimize potential displacement

The drivers of deforestation and forest degradation under the ER program remain the same, namely slash-and-burn agriculture, wood energy production, uncontrolled bush fires, mining and oil exploitation, artisanal logging, and industrial logging. All strategies described in the emissions reduction program are being implemented to avoid displacement of emissions. The risk of displacement is always assessed and classified as medium for slash-and-burn agriculture, medium for fuelwood production, high for artisanal logging and low for industrial logging. The emissions reduction program has made every effort to minimize displacement of emissions to an area outside the program boundaries and, if it exists, it will be minimal, as most of the measures proposed to address drivers of deforestation and forest degradation are primarily based on incentives and valuation of non-carbon benefits rather than coercive measures that will result in displacement of drivers of deforestation. Some of these elements have been implemented by projects under the Emissions Reduction Program (ERP), notably the *Projet de Gestion Améliorée des Paysages Forestiers (PGAPF)* and the *Projet Intégré REDD+ dans le Mai-Ndombe*, as detailed in the *Rapport 2022 du Programme d'Investissement pour la Forêt de la RDC* (pages 14-20).

1.1.3 Effectiveness of organizational arrangements and involvement of partner agencies

The successful implementation of an ER program depends on stakeholder engagement. The following activities were used to promote stakeholder engagement during the current reporting period:

- Following the signing of the ERPA of the Mai-Ndombe Emissions Reduction Program (ERP) between the Democratic Republic of the Congo and the World Bank on September 21, 2018, six prerequisites for its implementation were retained, including the finalization of the BSP by all stakeholders. To this end, the BSP Working Group (WG) established on November 12, 2018 drafted a work plan, which was reviewed on February 26, 2019 and provided for a concept note designed to facilitate discussions for the finalization of the advanced version of the BSP. This concept note was made available to the WG on April 5, 2019. A second BSP WG meeting was held on April 11 2019, to bring all WG members up to speed on the concept note (PCN). A third meeting was held on May 15, 2019, during which the Working Group approved the options in the concept note, which added further details to the BSP. The Working Group met 10 times in total until February 2022 to work on BSP finalization, analyze methodological aspects, and review the results of various activities, including those related to LCIP consultation and revisions to the ERP baseline (which impacts the BSP).
- The revision of the reference level also provided an opportunity for stakeholder engagement as described in section 1.1.1.

Under the IFLMP, governance structures have been strengthened which benefit the implementation of the ER Program activities:

- The FONAREDD Steering Committee (COFIL) , presided by the Minister of Finance and on which the Minister of Environment and Sustainable Development serves as vice president, is was established. The COFIL is the policy- and decision-making body responsible for ensuring the ERP's operation. Thus, it approves the ERPA Monitoring Report, authorizes disbursements, and validates ERP programming. It is composed of members of government respectively responsible for finance, environment, agriculture, energy, land affairs and land use, as well as representatives of civil society, the private sector and donors.
- The Provincial Steering Committee is presided by the Governor of Mai-Ndombe. It was established in 2016 and comprises representatives of the pertinent provincial ministries (Agriculture, Environment, Energy, Health, Land Use, Land Affairs), territorial administration, decentralized agencies, provincial REDD+ focal point and representatives from the private sector, civil society and Local Communities and Pygmy Indigenous Peoples. The Provincial Committee steers the ERP's implementation in the field and works closely with the PMU. It acts in a steering capacity and is in charge of political coordination at the Provincial level. It approves the Annual Work Plan and Budget (AWPB) of the Local Implementation Agencies that implement enabling and investment activities. The Provincial COFIL met three times in 2019-2020.

- At the local level, Local Development Committees (LDCs) were established during the current reporting period to improve the management of natural resources. LDCs solid foundation for the stakeholder participation and investments necessary to reach the ERP objectives. 215 Local Development Committees were established or the Plateau PI-REDD and 480 LDCs were established under the Mai Ndombe PI-REDD.

The DRC Forest Investment Program Coordination Unit (CU-FIP) within the Ministry of the Environment and Sustainable Development (MEDD) serves as the IFLMP as well as the ERP project management unit. As such, it already benefits from the CU-FIP's: i) considerable sectoral expertise; ii) established project infrastructure, notably its Local Implementation Agencies (LIA); iii) solid references and qualifications in financial management and the implementation of environmental and social protection instruments; iv) synergies with other Mai-Ndombe ERP financing implemented by the CU-FIP (notably the Mai-Ndombe PIREDD and OPERPA project), which permit the efficient management of operating costs and the rapid implementation of ERPA-funded activities; v) and programmatic coherence for all of activities financed in Mai-Ndombe. The CU-FIP also has long-established connections with DRC REDD+ institutions (FONAREDD, CN-REDD, DIAF, etc.) as well as the environmental civil society while ensuring its independence in carrying out its duties and responsibilities. Finally, the CU-FIP receives regular and continued supervision from the World Bank. Once the OPERPA project starts, the CU-FIP will count with the hiring of an MRV expert and will be further strengthened once the ERPA payments are disbursed.

1.2 Update on major drivers and lessons learned

The main drivers of forest degradation and deforestation remain the same as those described in the ERPD. Slash-and-burn agriculture, wood energy production, uncontrolled bushfires, mining and oil exploitation, artisanal logging, and industrial logging are identified as the primary direct drivers of deforestation. Indirect factors or underlying causes identified include: poverty, lack of economic and technical alternatives, poor natural resource management, unregulated land tenure, population growth, and increased demand for agricultural products, charcoal, and land. For more information on the drivers of deforestation and forest degradation in the context of the ER program, please refer to the Democratic Republic of Congo's ERPD. In order to support the generation of ERs in the program area and to minimize the risk of displacement, MEDD will continue to monitor the dynamics of emissions from deforestation and forest degradation and invest in sustainable practices in agriculture, forestry, and land.

Slash-and-burn agriculture and charcoal production pose a medium risk for potential leakage and displacement of the activity to the districts outside of the ER Program. However, no harmful activities were prohibited inside of the ER Program as part of the strategies to minimize potential displacement. Improvements on practices are based on incentives for agricultural intensification through the activities of the PI-REDD Plateaux and Mai-Ndombe limiting the risk of leakage through displacement of slash-and-burn agriculture to new areas. Conversely, charcoal production is typically a by-product of shifting cultivation, i.e. the wood which is cut to clear areas for agricultural production, is used for charcoal production. Considering the linkage between clearing land for agricultural activities and charcoal production and the activities implemented to intensify agriculture production, it is not the risk of shifting charcoal production to areas outside of the ER Program area has been mitigated. In addition, the PI-REDD supported the development of simple land management plans ('PSAT') at terroir level that contribute to structure charcoal production in sustainable rotation cycles establishing the basis for sustainable charcoal production. Finally, leakage due to displacement artisanal logging has been considered low and has been addressed through the creation of community led concession which helped to structure the logging activities conducted by communities.

2 SYSTEM FOR MEASUREMENT, MONITORING AND REPORTING EMISSIONS AND REMOVALS OCCURRING WITHIN THE MONITORING PERIOD

2.1 Forest Monitoring System

The monitoring system uses the same methods for quantifying emissions and removals as the REL to produce fully consistent results as a basis for quantifying emission reductions. Activity Data is estimated using the same Approach 3 method (i.e. sampling using the same methodology). Monitoring of Activity Data (AD) will be done with a probability-based sample of time-series imagery. Emission Factors will be equivalent to those used in the REL (See Annex 4 CARBON ACCOUNTING - ADDENDUM TO THE ERPD), therefore being consistent with Indicators 14.1 - 14.3 of the MF. Uncertainty related to the quantity of emission reductions will quantify using Monte Carlo methods. Underlying sources of error in data and methods for integrated measurements of deforestation, forest degradation and enhancements (e.g. as in a national forest inventory) will be combined into a single combined uncertainty estimate and will be reported at the two-tailed 90% confidence level.

Monitoring occurs at different levels and for different purposes. Hence monitoring can be differentiated as follows:

- **The carbon accounting monitoring system** that is used to report emissions and removals (based on measured activity data) to third parties (i.e. Carbon fund) during the program period is operated by the Program Management Unit (PMU). The PMU will carry out QA/QC measures – either itself or through third parties – to ensure a high quality of monitoring results prior to verification. (The present section describe this monitoring level).
- **Performance monitoring of different emission reduction activities** will be carried out by operators and executing agencies. Here, the PMU will take a verifying role. The monitoring of performance of activities is the basis to implement the benefit-sharing plan.

Measuring, Monitoring and Reporting (MMR) observe the following objectives:

- The primary objective is to monitor land cover change that occurs during the implementation of the ER Program. This system will allow for the subsequent comparison between program emissions and the reference level, leading to the quantification of emission reductions (ERs) which may in turn be sold and generate carbon revenues for ER Program stakeholders.
- The MMR system shall quantify deforestation and degradation in a spatially explicit manner, thereby facilitating the just sharing of financial benefits, based on performance.
- Finally, the MMR system will assess individual activities and provide valuable feedback to the ER Program that could in turn refine ER Program investment strategy and planning. The ER Program plans to integrate the MMR system into its overall adaptive management strategy: MMR results will lead to re-investment of carbon revenues in the ER Program for various high-performing emission reduction activities.

The MMR for the ER Program (sub-national MMR design) was designed to be harmonized with the ER Program's reference level design. As such, the MMR system will employ a sampling approach that utilizes identical manual/visual classification rules used for calculation of the ER Program REL. This will allow full consistency with the methods used to estimate the Activity Data for the REL.

Table 2-12-1: ER Measurement, Monitoring and Reporting System Attributes

Attribute	Advantage
Sampling approach design	Harmonization with reference level model, allowing for accurate calculation of ERs. Primary advantage of sample alignment is the availability of historical land cover information for each sample, allowing for the application of amelioration model.
Flexible sample design	Adaptive management allowing for high sample density in AOIs. This leads to greater precision and accuracy of these areas. The different sampling intensity per AOIs will be considered using a stratified estimator.
Use of various spatial-resolution remote sensing imagery.	Adaptive management / utilization of high-resolution imagery in different areas throughout the ER Program area, allowing for greater precision of ER estimates in AOIs.

Organizational Structure for Measurement, Monitoring and Reporting

The Program Management Unit (PMU) will assume the overall responsibility for conducting the MRV function. The PMU will implement the monitoring and relevant Standard Operating Procedures and QA/QC procedures (see table 2-2) with a mixed team composed of local expert involved in Reference Level measurement (Observatoire Satellitale des Forêts d' Afrique Centrale -OSFAC) and of administration agents from both national and provincial level (Direction Inventaire et Aménagement Forestiers -DIAF). This will ensure capacity building and facilitate the link with the National Forest Monitoring System. The PMU will consolidate a carbon monitoring report that will be endorsed by the Provincial REDD+ Steering Committee and then transferred to the Carbon Fund by the central government. (See figure below). This monitoring report will serve as a basis for the ERPA payments.

The monitoring system will also provide information for the benefit-sharing mechanism. The spatial information generated by sampling analysis will be crosschecked with field information reported by operators and executing agencies. For example:

- Forest companies engaged in Reduced-Impact logging will report on specific indicators (to be defined in sub-contracts). The PMU will conduct independent field verification that will be crosschecked with remote-sensing information.
- Communities or local organizations involved in reforestation or assisted natural regeneration activities will report on area reforested. The PMU will verify occurrence of fire based on FIRMs requests.

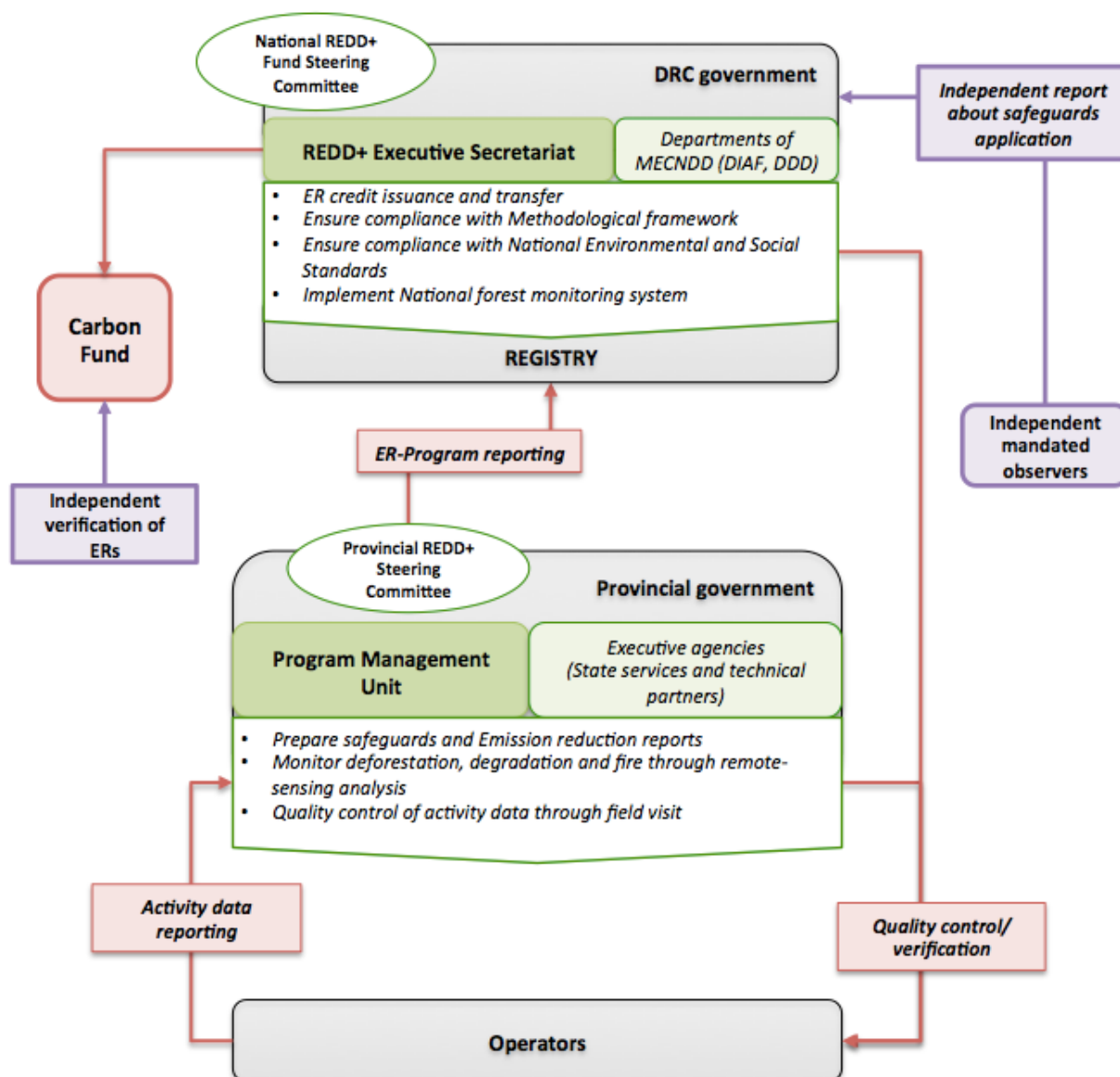


Figure 2-1: Role and responsibilities for monitoring and reporting of carbon and non-carbon performance.

Table 2-22-2: Relevant Standard Operating Procedures (SOP) and QA/QC procedures

Parameter	Document	Changes introduced in the SOP compared to the description that was provided in the ER-PD.
Activity data	Appendix 1 of Final Report "Quantifying the forest Reference Level of the emissions reduction program of Maï-Ndombe Province, Democratic Republic of Congo -	The sample-based area estimation of activity data has been updated. Initial FREL was estimated using systematic grids (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are

	University of Maryland / GLAD Lab ¹	calculated using pixel-based stratified random sampling with 2,000 sampling points. We estimate activity data using pixel-based stratified random sampling.
Emission Factor	DRC FREL Modified Submission ² includes a description of methods and procedures applied during data collection: Annex 7 - WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 - Methodology of the National Forest Pre-Inventory.	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). The mean total biomass per stratum has been updated with a new dataset. AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF). Different methods were used to estimate updated values of mean total biomass per stratum (i.e., Root-shoot ratio).

Community engagement

The participation of local communities in Mai Ndombe has been effective during all phases of development of the present program, notably through consultations launched the Environmental Civil Society (GTCR) under the operational lead of the NGO Ocean, which deployed its teams in the 8 territories of Mai Ndombe province in 2015

These consultations resulted in the appointment of three delegates per territory, made up of two members of local communities and/or indigenous peoples as well as a territory CARG coordinator.

In all, 24 people were designated to participate directly their representatives by the delegates.

Since then, these delegates have participated as stakeholders in ERP activities, including in the process of finalizing the Benefit Sharing Plan (BSP). To this end, consultations were held at all levels: national, provincial and local. Prior to the signing of the ERPA, there were several consultations, notably in the context of the BPP between 2014 and 2016, with a consultation workshop on the principles of the BPP in 2017. After the ERPA was signed, 13 consultation workshops with colos and PAs between September and November 2019 were conducted by REPALEF, GTCR R and GTCR.

(See the report on the consultations held with indigenous peoples and local communities in the jurisdictional area of the emission reduction program in the Maindombe in the Democratic Republic of Congo on key aspects of the benefit-sharing plan as part of its finalization, April 2020).

The BSP was presented to the COPIL on April 21, 2022. It is also important to note that the ERP is part of the capitalization of the achievements of the PIREDD, which succeeded in setting up a CLD at the level of each terroir.

As far as the monitoring report itself is concerned, it is important to stress that local communities were not directly involved in the process of drawing it up. However, they did take part in the last meeting of the PIREDD Mai Ndombe Steering Committee (COPIL) held in Nioki, where the first draft was presented.

¹ Final report for **Quantifying the forest Reference Level of the emissions reduction program of Mai-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab** -can be accessed at the following link:

[https://www.dropbox.com/scl/fo/fnfqubpc5cvm07ksyoezp/h?dl=0&preview=rdc_documentnerf_soumissionfinale_29112018+\(1\).pdf&rlkey=0cb794w54jout87exbraba8f8](https://www.dropbox.com/scl/fo/fnfqubpc5cvm07ksyoezp/h?dl=0&preview=rdc_documentnerf_soumissionfinale_29112018+(1).pdf&rlkey=0cb794w54jout87exbraba8f8)

² https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

2.2 Updates to the monitoring approach

The monitoring approach has not been updated, Therefore this section is not applicable.

2.3 Measurement, monitoring and reporting approach

Table 2.1 describes the set of tools developed by the Democratic Republic of Congo to estimate emissions and removal from deforestation, degradation, and forest regeneration. Also is provided a step-by-step description of the monitoring parameters used to establish the Reference Level and estimate Emissions and Emissions reductions during the Monitoring Period for the Carbon Pools and greenhouse gases selected in the ER-PD. The set of tools for emission and removal estimation can be accessed at the following link:

<https://www.dropbox.com/scl/fo/fnfgupbc5cvm07ksyoezp/h?rlkey=0cb794w54jout87exbraba8f8&e=1&dl=0>

Table 2-32-3: Step-by-step description of the monitoring parameter and data integration tools to establish the Reference Level and estimate Emissions and Emissions reductions during the Monitoring Period for the Carbon Pools and greenhouse gases selected in the ER-PD.

Monitoring parameters and Data Integration tools	Step	Description of the measurement and monitoring approach
Land use carbon density calculation and uncertainty analysis See tdm/ha values in Monitoring Parameters Table in "ER_Calculation" sheet of DRC_ER_Calculations rev3.xlsx.	1	The carbon density used to estimate net emissions for the reference and monitoring period is based on a Data compilation of three datasets. In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them. Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/).
Activity Data estimate and associated uncertainty <i>AD_calculationTool_RP rev.xlsx</i> ³	2	The visual interpretation of land use for the Reference and Monitoring periods is included in both tools' spreadsheet "LU_interpretation."

³ Activity data estimate tool for the Reference Period can be accessed at the following link:
https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0

<i>AD_calculationTool_MP rev.xlsx⁴</i>		Activity Data calculation and associated uncertainty for Reference and Monitoring Periods are included in the "AreaCalculation" spreadsheet.
Calculation of emissions and removals <i>DRC_ER_Calculations rev3. xlsx⁵</i>	3, 4 and 5	Emissions from deforestation and degradation, and new forest removals is calculated with DRC_ER_Calculation tool.
Emission reduction calculation <i>DRC_ER_Calculations rev3.xlsx</i>	6	Emission Reductions are calculated with DRC_ER_Calculation tool.
Emission reduction uncertainty estimate and sensitivity analysis <i>DRC ER MC Analysis Rev3.xlsx⁶</i> <i>DRC_ER_SensitivityAnalysis Rev2.xlsx⁷</i>	7	The Monte Carlo analysis to estimate the global uncertainty of Emission Reduction is made using the DRC ER MC Analysis tool. The Sensitivity Analysis was prepared with the DRC_ER_SensitivityAnalysisRev2.xlsx.

2.3.1 Line Diagram

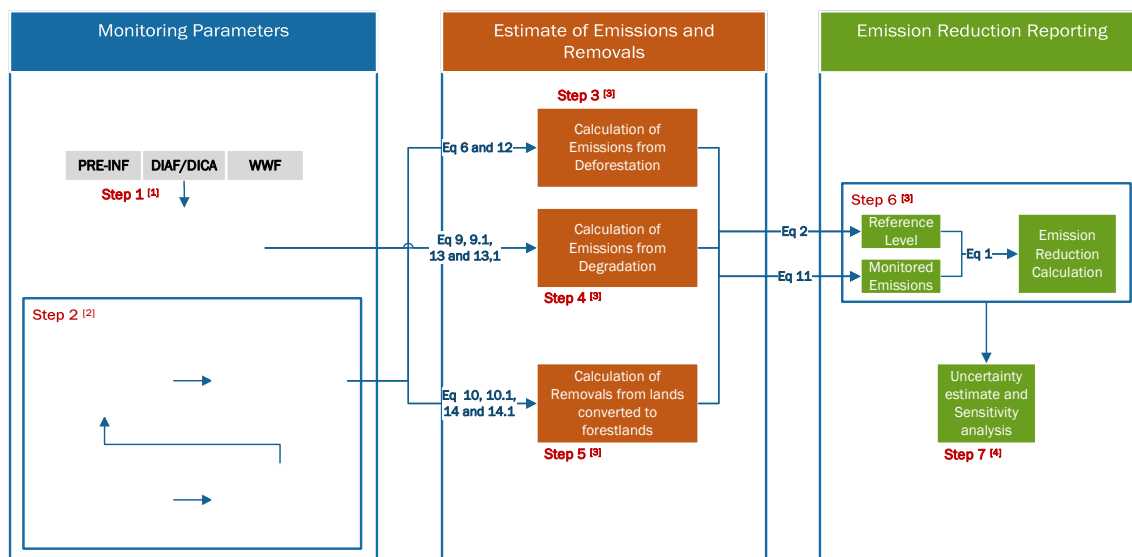
Figure 2.1 shows a line diagram with relevant monitoring points, parameters, and data integration until reporting.

⁴ Activity data estimate tool for the Monitoring Period can be accessed at the following link:
https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0

⁵ Calculation of emission and removal tool can be accessed at the following link:
https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0

⁶ Emission Reduction Uncertainty Estimate tool can be accessed at the following link:
https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0

⁷ Emission Reduction Sensitivity Analysis tool can be accessed at the following link:
https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0



- [1] See tdm/ha values in Monitoring Parameters table in "ER_Calculation" sheet of "DRC_ER_Calculation.xlsx"
- [2] See activity data estimate for Reference and Monitoring period in "AD_calculationTool_RP.xlsx" and "AD_calculationTool_MP.xlsx".
- [3] Emission from deforestation and degradation, new forest removals and Emission Reductions are calculated with "DRC_ER_Calculations.xlsx" tool.
- [4] The Monte Carlo analysis to estimate global uncertainty of Ers is made with DRC_ER MC Analysis tool. The Sensitivity Analysis is prepared with the "DRC_ER_SensitivityAnalysis.xlsx".

Figure 2-2: Line diagram with monitoring parameters, equations, and the integration of data until reporting.

2.3.2 Calculation

Equations and parameters used to calculate GHG emissions and removals are listed below. These equations show the steps from the measured input to the aggregation into final reported values. Changes to the original calculation described in the ER-PD have been highlighted. Description of the parameters may be found in Annex 4 – Section 8.3

Emission reduction calculation

$$ER_{ERP,t} = RL_t - GHG_t \quad \text{Equation 1}$$

Where:

- ER_{ERP} = Emission Reductions under the ER Program in year t; $tCO_2e \cdot year^{-1}$.
- RL_{RP} = Gross emissions of the RL over the Reference Period; $tCO_2e \cdot year^{-1}$. This is sourced from Annex 4 to the ER Monitoring Report and equations are provided below.
- GHG_t = Monitored gross emissions from deforestation at year t; $tCO_2e \cdot year^{-1}$;
- T = Number of years during the monitoring period; dimensionless.

Reference Level (RL_t)

The RL estimation may be found in Annex 4, yet a description of the equations is provided below.

Net emissions of the RL over the Reference Period (RL_{RP}) are estimated as the sum of annual change in total biomass carbon stocks (ΔC_{B_t}) during the reference period.

$$RL_{RP} = \frac{\sum_t^{RP} \Delta C_{B_t}}{RP} + AE \quad \text{Equation 2}$$

Where:

- RP = Reference period; years.
- AE = Upward adjustment of emissions $tCO_2 \cdot year^{-1}$. For further details on the quantification of the upward adjustment to the average annual historical emission over the reference period, see Annex 4, section 8.4.
- ΔC_{B_t} = Annual change in total biomass carbon stocks at year t; $tCO_2 \cdot year^{-1}$; The annual changes in carbon stocks over the reference period in the Accounting Area are equal to the sum of annual change in

carbon stocks for each of the i REDD+ activities (ΔC_{LU_i}). Following the IPCC notation, the sum of annual change in carbon stocks for each of the i REDD+ activities (ΔC_{LU_i}) would be equal to the annual change in carbon stocks in the aboveground biomass carbon pool (ΔC_{AB}) and the annual change in carbon stocks in belowground biomass carbon pool (ΔC_{BB}) accounted.

$$\Delta C_{LU} = \sum_i \Delta C_{LU_i} \quad \text{Equation 3 (Equation 2.2, 2006 IPCC GL)}$$

$$\Delta C_{LU_i} = \Delta C_{AB} + \Delta C_{BB} = \Delta C_B \quad \text{Equation 4 (Equation 2.3, 2006 IPCC GL)}$$

Annual change in total biomass carbon stocks forest land converted to another land-use category (ΔC_{B_t})

Following the 2006 IPCC Guidelines, the annual change in total biomass carbon stocks forest land converted to other land-use category (ΔC_{B_t}) would be estimated through the following equation:

$$\Delta C_{B_t} = \Delta C_G + \Delta C_{CONVERSION} - \Delta C_L \quad \text{Equation 5 (Equation 2.15, 2006 IPCC GL)}$$

Where:

- ΔC_{B_t} = Annual change in carbon stocks in biomass on land converted to other land-use category, in tones C yr⁻¹;
- ΔC_G = Annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tones C yr⁻¹;
- $\Delta C_{CONVERSION}$ = Initial change in carbon stocks in biomass on land converted to other land-use category, in tones C yr⁻¹; and
- ΔC_L = Annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tones C yr⁻¹.

Following the recommendations set in chapter 2.2.1 of the GFOI Methods Guidance Document⁸ for applying IPCC Guidelines and guidance in the context of REDD+, the above equation will be simplified and it will be assumed that: a) the annual change in carbon stocks in biomass (ΔC_B) is equal to the initial change in carbon stocks ($\Delta C_{CONVERSION}$); b) it is assumed that the biomass stocks immediately after conversion is the biomass stocks of the resulting land-use. Therefore, the annual change in carbon stocks would be estimated as follows:

$$\Delta C_B = \Delta C_{CONVERSION}$$

$$\Delta C_{B_t} = \sum_{j,i} (B_{Before,j} - B_{After,i}) \times CF \times \frac{44}{12} \times A(j,i)_{RP} \quad \text{Equation 6 (Equation 2.16, 2006 IPCC GL)}$$

Where:

- $A(j,i)_{RP}$ = Area converted/transited from forest type j to non-forest type i during the Reference Period, in hectares per year. In this case, two forest land conversions are possible:
 - Primary forest terra firme to non-forest type i ; and
 - Secondary forest to non-forest type i
- One type of non-forest land is considered:
 - Crops and regeneration of abandoned crops (CRCA-Culture et Régénération de Culture Abandonnée).

Technical corrections: The sample-based area estimation of activity data has been updated. Initial FREL was estimated using **systematic grids** (37,184 samples) with variable spacing

⁸Page 44, GFOI (2013) Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative: Pub: Group on Earth Observations, Geneva, Switzerland, 2014.

between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using **pixel-based stratified random** sampling with 2,000 sampling points⁹.

The description of this parameter may be found in **Annex 4**.

$B_{Before,j}$ = Total biomass of forest type j before conversion/transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{Before,j}$) and belowground biomass ($BGB_{Before,j}$) and it is defined for each forest type.

$B_{After,i}$ = Total biomass of non-forest type i after conversion, in tons dry matter per ha. This is equal to the sum of aboveground ($AGB_{After,i}$) and belowground biomass ($BGB_{After,i}$) and it is defined for each of the non-forest IPCC Land Use categories.

Technical corrections: $B_{Before,j}$ and $B_{After,i}$ were technically corrected. Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

Description of these parameter may be found in **Annex 4**.

CF = Carbon fraction of dry matter in tC per ton dry matter. The value used is:

- **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3.

44/12 = Conversion of C to CO₂

Annual change in carbon stocks in biomass on forestland remaining forestland (ΔC_{BDEG})

Following the 2006 IPCC Guidelines the annual change in carbon stocks in biomass on forestland remaining forestland (ΔC_{BDEG}) could be estimated through the Gain-Loss Method or the Stock-Difference Method as described in Chapter 2.3.1.1 of Volume 4 of the 2006 IPCC Guidelines.

$$\Delta C_B = \Delta C_G - \Delta C_L \quad \text{Equation 7 (Equation 2.7, 2006 IPCC GL)}$$

$$\Delta C_B = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)} \quad \text{Equation 8 (Equation 2.8 (a), 2006 IPCC GL)}$$

Where:

ΔC_B = Annual change in carbon stocks in biomass for each land sub-category, in tonnes C yr⁻¹

ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr⁻¹

ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr⁻¹

C_{t_2} = total carbon in biomass for each land sub-category at time t_2 , tonnes C

C_{t_1} = total carbon in biomass for each land sub-category at time t_1 , tonnes C

Following the recommendations set in chapter 2.2.2 of the GFOI Methods Guidance Document¹⁰ for applying IPCC Guidelines and guidance in the context of REDD+, the above equation will be simplified, and it will be assumed that: a) the annual change in carbon stocks in biomass (ΔC_B) due to degradation is equal to the annual decrease in carbon stocks (b) the decrease in carbon stocks occurs the year of conversion. The long-term decrease in carbon stocks indicated in equation (1) of the GFOI MGD is assumed here to be zero. Therefore, considering the GFOI MGD the IPCC equation for forest degradation could be expressed as an Emission Factor time activity data as follows:

⁹ The file with 2,000 sampling points location can be accessed at the following link (UMD-WB_final_2000_samples.kml): https://www.dropbox.com/scl/fo/fnfgupbc5cvm07ksyoezp/h?dl=0&preview=UMD-WB_final_2000_samples.kml&rlkey=0cb794w54jout87exbraba8f8

¹⁰Page 48, GFOI (2013) Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative: Pub: Group on Earth Observations, Geneva, Switzerland, 2014.

$$\Delta C_{B_{DEG}} = \sum_j \{EF_{DEG} \times A(a, b)_{RP}\} \quad \text{Equation 9}$$

EF_{DEG} = Emission factor for degradation of forest type a to forest type b, tones CO₂ ha⁻¹. The Emission Factor is calculated with the equation 9.1 where B_{Before,a} is total biomass of forest type **a** before transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{Before,a}) and belowground biomass (BGB_{Before,a}) and B_{After,b} is total biomass of forest type **b** after transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{after,b}) and belowground biomass (BGB_{after,b}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

$$EF_{DEG} = (B_{Before,a} - B_{After,b}) \times CF \times \frac{44}{12} \quad \text{Equation 9.1}$$

A(a, b)_{RP} = Area of forest type a converted to forest type b (transition denoted by a,b) during the Reference Period, ha yr⁻¹.

Technical corrections: Calculation of annual change of carbon stocks on forestland remaining forestland has been technical corrected. Enhancement of carbon stocks in existing forest is not included in the updated FREL (See the Technical Corrections section in Annex 4: Carbon accounting – addendum to the ERPD)

Annual change in carbon stocks in biomass on non-forestland converted in forestland ($\Delta C_{B_{SREG}}$)

Land converted to forest land CO₂ removals has been estimated following the recommendations set in the Guidance Note for accounting of legacy emissions/removals of the FCPF (version 1). Since the FCPF Methodological Framework requires IPCC Tier 2 or higher method, the net annual CO₂ removals are calculated using equations 2.15 and 2.16 from the 2006 IPCC Guidelines, Volume 4, Chapter 2. These equations were simplified by assuming that the conversion from non-forest to forest occurs during a period from average carbon stocks in non-forest to average carbon stocks in forests. A conservative default period of 20 years is assumed for the forest to grow from the carbon stock levels of non-forest to the level of biomass in the average forest. The removal estimate considers changes in carbon stocks in above- and below-ground biomass. Using the outcome of equation 2.15 and 2.16, it was determined the changes in the total carbon stocks in biomass (removals) during the reference period as the sum of the total carbon stocks in biomass of all land units. From the point of view of notations, the emission factors in equation EQ5 above would be replaced by **RF_{SREG}** in enhancement of carbon stocks in new forests.

$$\Delta C_{B_{SREG}} = \sum_{LU=1}^n \{RF_{SREG} \times A(i, j)_{RP}\} \quad \text{Equation 10}$$

Where:

RF_{SREG} = enhancement of carbon stocks in new forests [tCO₂*ha*year⁻¹]. The Removal Factor is calculated with the equation 10.1 where B_{CRCA} is total biomass of crops and regeneration of abandoned crops, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{CRCA}) and belowground biomass (BGB_{CRCA}) and B_{SecondaryForest} is total biomass of Secondary Forests, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{SecondaryForest}) and belowground biomass (BGB_{SecondaryForest}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

According to the FCPF guidance note for accounting of legacy emissions/removals¹¹ and the IPCC guidelines, after a change in land use, it is good practice to assume that the

¹¹ FCPF guidance note for accounting of legacy emissions/removals can be accessed at the following link: https://www.forestcarbonpartnership.org/system/files/documents/fmt_note_2020-5_application_of_ipcc_guidelines_v2_.pdf

carbon stocks in the relevant area change from one steady value (associated with the land use before the land use change) to another steady value (associated with the land use after the land use change) over at least 20 years with the emissions and removals being spread over the whole transition period. Therefore, the total biomass gained from abandoned crops to secondary forests was divided by 20 years to estimate the removal factor.

$$RF_{SREG} = \frac{(B_{CRCA} - B_{SecondaryForest}) \times CF \times \frac{44}{12}}{20} \quad \text{Equation 10.1}$$

$A(i, j)_{RP}$ = Area of non-forestland i converted to forestland j (transition denoted by i, j) in the reference period, ha yr⁻¹.
 LU = Land unit.

Monitored emissions (GHG_t)

Annual gross GHG emissions over the monitoring period in the Accounting Area (GHG_t) are estimated as the sum of annual change in total biomass carbon stocks (ΔC_{B_t}).

$$GHG_t = \frac{\sum_t \Delta C_{B_t}}{T} \quad \text{Equation 11}$$

Where:

ΔC_{B_t} = Annual change in total biomass carbon stocks at year t ; tC*year⁻¹
 T = Number of years during the monitoring period; dimensionless.

Annual change in total biomass carbon stocks forest land converted to another land-use category (ΔC_{B_t})

Following the 2006 IPCC Guidelines, the annual change in total biomass carbon stocks forest land converted to other land-use category (ΔC_B) would be estimated through **Equation 5** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_B = \sum_{j,i} (B_{Before,j} - B_{After,i}) \times CF \times \frac{44}{12} \times A(j, i)_{MP} \quad \text{Equation 11}$$

Where:

$A(j, i)_{MP}$ = Area converted/transited from forest type j to non-forest type i during the Monitoring Period, in hectare per year. In this case, two forest land conversions are possible:

- Primary forest terra firme to non-forest type i ; and
- Secondary forest to non-forest type i

One type of non-forest land is considered:

- Crops and regeneration of abandoned crops (CRCA-Culture et Régénération de Culture Abandonnée).

$B_{Before,j}$ = Total biomass of forest type j before conversion/transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{Before,j}$) and belowground biomass ($BGB_{Before,j}$) and it is defined for each forest type.

$B_{After,i}$ = Total biomass of non-forest type i after conversion, in tons dry matter per ha. This is equal to the sum of aboveground ($AGB_{After,i}$) and belowground biomass ($BGB_{After,i}$) and it is defined for each of the five non-forest IPCC Land Use categories.

CF = Carbon fraction of dry matter in tC per ton dry matter. The value used is:

- **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3.

$44/12$ = Conversion of C to CO₂

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta C_{B_{DEG}}$)

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta C_{B_{DEG}}$) would be estimated through **Equations 7 and 8** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_{B_{DEG}} = \sum_j \{EF_{DEG} \times A(a, b)_{MP}\} \quad \text{Equation 12}$$

Where:

EF_{DEG} = Emission factor for degradation of forest type a to forest type b, tones CO₂ ha⁻¹. The Emission Factor is calculated with the equation 13.1 where B_{Before,a} is total biomass of forest type **a** before transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{Before,a}) and belowground biomass (BGB_{Before,a}) and B_{After,b} is total biomass of forest type **b** after transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{after,b}) and belowground biomass (BGB_{after,b}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

$$EF_{DEG} = (B_{Before,a} - B_{After,b}) \times CF \times \frac{44}{12} \quad \text{Equation 13.1}$$

A(a, b)_{MP} = Area of forest type a converted to forest type b (transition denoted by a,b) during the Monitoring Period, ha yr⁻¹.

Annual change in carbon stocks in biomass on non-forestland converted in forestland ($\Delta C_{B_{SREG}}$)

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta C_{B_{DEG}}$) would be estimated through **Equations 7 and 8** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_{B_{SREG}} = \sum_{LU=1}^n \{RF_{SREG} \times A(i, j)_{MP}\} \quad \text{Equation 13}$$

Where:

RF_{SREG} = enhancement of carbon stocks in new forests [tCO₂*ha*year⁻¹]. The Removal Factor is calculated with the equation 10.1 where B_{CRCA} is total biomass of crops and regeneration of abandoned crops, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{CRCA}) and belowground biomass (BGB_{CRCA}) and B_{SecondaryForest} is total biomass of Secondary Forests, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{SecondaryForest}) and belowground biomass (BGB_{SecondaryForest}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

According to the FCPF guidance note for accounting of legacy emissions/removals¹² and the IPCC guidelines, after a change in land use, it is good practice to assume that the carbon stocks in the relevant area change from one steady value (associated with the land use before the land use change) to another steady value (associated with the land use after the land use change) over at least 20 years with the emissions and removals being spread over the whole transition period. Therefore, the total biomass gained from abandoned crops to secondary forests was divided by 20 years to estimate the removal factor.

$$RF_{SREG} = \frac{(B_{CRCA} - B_{SecondaryForest}) \times CF \times \frac{44}{12}}{20} \quad \text{Equation 14.1}$$

A(j, i)_{MP} = Area of non-forest land *i* converted to forestland *j* (transition denoted by *i,j*) in the monitoring period, ha yr⁻¹.

LU = Land unit.

¹² FCPF guidance note for accounting of legacy emissions/removals can be accessed at the following link: https://www.forestcarbonpartnership.org/system/files/documents/fmt_note_2020-5_application_of_ipcc_guidelines_v2_.pdf

3 DATA AND PARAMETERS

3.1 Fixed Data and Parameters

Below is an overview of the measured or estimated parameters that will not be updated during the Crediting Period. These parameters are linked to the equations provided in section 2.2.2.

Activity data

Parameter:	$A(j, i)_{RP}$ Equation 6 $A(a, b)_{RP}$ Equation 9 $A(i, j)_{RP}$ Equation 10					
Description:	$A(j, i)_{RP}$: Area converted/transited from forest type j to non-forest type i during the Reference Period (Deforestation transition denoted by j, i) $A(a, b)_{RP}$: Area of forest type a converted to forest type b during the Reference Period (Degradation transition denoted by a, b). $A(i, j)_{RP}$: Area of non-forestland i converted to forestland j during the Reference Period (Regeneration transition denoted by i, j)					
Data unit:	hectare.					
Value monitored during this Monitoring / Reporting Period:	Table 3-13-1: Value monitored during the Reference Period					
	Code	Land cover transition	Land cover transition 2005-2009 (ha)	CI 2005-2009 (ha)	Land cover transition 2010-2014 (ha)	CI 2010-2014 (ha)
	AUTRE_AUTRE	Stable non-forest	3,543,685	108,864	3,583,473	109,271
	AUTRE_FS	Secondary Forest regeneration (forest gain / non-forest to Secondary Forest)	112,734	21,780	126,499	22,330
	FDHSH_FDHSH	Stable Dense humid Wetland Forest	2,392,511	289,802	2,392,511	289,802
	FHTF_AUTRE	Dense humid terra firma deforestation (DH terra firma to non-forest)	58,501	11,907	96,142	15,014
	FHTF_FHTF	Stable Dense humid (DH) Terra firma Forest	5,813,199	299,055	5,625,863	298,453
	FHTF_FS	Dense humid terra firma degradation (DH terra firma to secondary forest)	53,562	13,453	91,194	19,227
	FS_AUTRE	Secondary Forest deforestation (Secondary Forest to non-forest)	107,786	21,105	273,558	43,992
	FS_FS	Stable Secondary Forest	766,342	108,697	659,081	103,217
Source of data and description of measurement / calculation methods and procedures applied¹³:	A probability-based sample of time-series imagery was used as reference data in estimating activity data for the province of Maï-Ndombe, DRC, from 2005 to 2014 for the reference period (including two sub-periods for the 2005-2009, and 2010-2014 intervals), and for the performance period. We employed an approach with a goal of delivering a method that can readily be applied to all provinces in the DRC. <u>Sampling design</u>: A stratified random sampling design based on mapped classes closely aligned with activity data definitions was employed to maximize the efficiency of the sample allocation. An initial sample of 100 samples per stratum was drawn for each of the following classes in Maï-Ndombe					

¹³ Further details on source data and methods to estimate activity data can be found in the final report for **Quantifying the forest Reference Level of the emissions reduction program of Maï-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab** - https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0. Please take note that the UMD report is not the official data source for monitoring period activity data estimate, and it's just a preliminary estimate of emission reduction

province. Based on the target class proportions identified in each stratum from the interpretation of the initial sample, we calculated the number of sampling units per stratum required to reach the target 90% confidence interval of $\pm 20\%$ of the estimated area for the reporting classes. The required sample size for a given target variance for each target class can be found using Equation 5.66 from Cochran (page 110) for the optimal allocation with fixed n . Optimal sample allocation among strata (minimized variance for fixed n) was achieved using Equation 5.60 from Cochran (page 108) and replacing the true population class proportion for each stratum with the one estimated from the initial sample. Final sample allocation totaling 2000 sampling units.

Response design: The Response design included defining the assessment unit as 30m pixels from the mapped strata population, source reference data in the form of 16-day Landsat composite time-series data from 2000 through 2019, supplemented by Google Earth imagery. A detailed labeling protocol is described exhaustively in Standard Operating Procedures and includes decision trees and LULC classification systems in order to allow the unambiguous classification of the sample units. The sample-based analysis consisted of stratified randomly selected pixels across the area of Mai-Ndombe province. While the sampling unit was a pixel, and each pixel was examined at annual timescales, assessment was also facilitated by spatiotemporal context. Each sampling unit was interpreted using time-series Landsat and Google Earth imagery and time-series of individual spectral measures. Expert image interpreters analyzed the reference sampling units and labeled them at annual intervals as either primary forest, secondary forest, and non-forest, as well as transitions, type of change (loss or gain), driver, and the year of change. For pixels that were not interpreted consistently between the analysts, an additional analyst was engaged, and all analysts worked together to reach a consensus in making final assignments. The interpretation team included participants from the project consortium of DIAF/OSFAC/UMD.

Sampling unit interpretation protocol: Interpretations of each sampling unit selected for analysis began with a decision tree that provided a dichotomous rule set for assigning labels. The decision tree for assigning land cover is based on physiognomic-structural attributes of vegetation, specifically height and cover. Vegetation cover and height are used to differentiate forests from savanna and non-forest categories, with 30% cover and >3m height defining forests. For tree canopy cover $\geq 60\%$, we separate dense tree cover into dense humid (primary) terra firma and wetland forests and secondary (regrown) forests. Dense humid forest is differentiated from secondary humid forest by the spectral signature from greater vertical variation and texture associated with old growth forests compared to the more uniform canopies associated with colonizing tree species.

Area estimation for activity data: Area estimates were made for three scenarios: 1) consensus labels of all sampling units, 2) only samples where all interpretations agreed, and 3) subsets of sampling units with the same average annual number of observations per epoch, for example where we have at least 5 good annual Landsat observations per sample for all samples. Scenarios 2) and 3) served to evaluate the sensitivity the final consensus estimates to removing samples lacking interpreter consensus or removing samples with few quality image observations.

For a stratified random sample of pixels within nine strata, annual binary labels of yes/no for each stable land cover and transition class were assigned. Areas for each class were calculated per the following calculations, given the mean proportion of class i in stratum h :

$$\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h} \quad \text{Where: } p_{iu} = 1 \text{ if pixel } u \text{ is identified as class } i, \text{ and } 0 \text{ otherwise}$$

n_h – number of samples in stratum h

Estimated area of class i :

for 2018-2019. The ER-Program process is a lengthy one, and earlier decisions on data and periods were later revised, but such revisions are not reflected in the referenced document. The initial reporting period was set from 21.09.2018 to 31.07.2019 (see schedule 2 on page 15 of the [ERPA](#)). However, the reporting period was later changed from 01.01.2019 to 31.12.2020, as described in the MR. The ER-MR document references the UMD report to provide additional information on the methods used to estimate Activity Data.

	$\hat{A}_i = \sum_{h=1}^H A_h \bar{p}_{ih}$ Where: A_h – total area of stratum h H – number of strata ($H = 9$) Standard error of the estimated area of class i: $SE(\hat{A}_i) = \sqrt{\sum_{h=1}^H A_h^2 \frac{\bar{p}_{ih}(1 - \bar{p}_{ih})}{n_h - 1}}$
QA/QC procedures applied:	QA/QC procedures included the definition of clear roles and responsibilities in terms of QA/QC, the definition SOPs, training on the defined SOPs, multiple interpreters per sample unit, and a final quality assurance check in order to ensure the quality of the data. All sample pixels were initially interpreted by at least two independent experts. Each analyst assigned to each sample pixel the following labels: loss month and year, pre- and post-disturbance land cover type, land cover proportion, availability of high-resolution image, and forest disturbance driver, and expert's confidence (high/medium/low) separately for all labels. After the initial interpretation, a consensus exercise was performed for all sampled pixels featuring disagreement between interpreters or with low confidence for any interpreter. An additional expert joined the exercise, and a group discussion was undertaken to make the final assignment of land cover extent and change dynamics. Given the final interpretations, we assessed the sensitivity of the method as a function of interpreter agreement and data richness. Interpretations of 2005-2014 for all samples versus the subset of 1405 samples for which the two expert interpreters agreed resulted in similar area estimates with overlapping uncertainties. Area estimates for individual forest dynamics derived from the subset are within 11% of the estimate made using all 2000 samples. Results based on data richness show that restricting sampling units by annual minimum number of observations to 2, 3 and 4 images also produced similar estimates. There were 1,914 samples having at least two observations per year and area estimates of all forest change categories were less than 6% different across categories. For the 1,426 samples with at least three observations per year, all forest area change estimates differed by less than 9%. For the 584 samples with at least 4 observations per year, secondary regrowth differed by 22% and dense humid forest degradation by 14%, and others by less than 9%. The results indicate a robust method not biased by variation in measurements related to interpreter or observation richness. Importantly, all results from all scenarios document the within reference period increase in forest loss.
Uncertainty for this parameter:	Uncertainty stems primarily from: - Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. - The sampling errors. The presented work sought to improve the accuracy of the existing reference emissions level calculations through a more robust methodology to estimate activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Maï-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as a function of interpreter agreement and data richness. The principal improvement was derived from the stratification that enabled the efficient allocation and interpretation of reference data. Our goal of <20% uncertainty at the 90th percentile confidence interval for activity data from 2005-2014 was achieved using 2,000 samples. The initial FREL had higher uncertainties derived using over 30,000 samples. The methodological efficiency points to the possible extension of the approach to the national scale. Concerning the differences in areas, we believe that fewer samples interpreted by a small team of experts following a strict protocol of signal-based identification of forest loss and gain is a more robust approach.

Any comment:	Initial FREL was estimated using <i>systematic grids</i> (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using <i>pixel-based stratified random</i> sampling with 2,000 sampling points.
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Emission Factors

Parameter:	$B_{Before,j}$; Equations 6 and 12 $B_{After,i}$; Equations 6 and 12 CF; Equation 6																																																					
Description:	$B_{Before,j}$: Total biomass of forest type j before conversion/transition. This is equal to the sum of aboveground ($AGB_{Before,j}$) and belowground biomass ($BGB_{Before,j}$) and it is defined for each forest type. $B_{After,i}$: Total biomass of non-forest type i after conversion. This carbon content is equal to the sum of aboveground ($AGB_{After,i}$) and belowground biomass ($BGB_{After,i}$), and it is defined for each of the non-forest IPCC Land Use categories. CF: Carbon fraction of dry matter in tC per ton dry matter. The value used is: 0.47 is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3																																																					
Data unit:	Carbon content: tones of dry matter per ha ($tCO_2\ ha^{-1}$).																																																					
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Spatial Level: National Source of Data¹⁴: The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. Table 3-23-2: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops). <table><tr><th rowspan="2">Land cover class</th><th rowspan="2">Inventoried area (ha)</th><th colspan="4">SU type</th><th rowspan="2">Total</th></tr><tr><th>WWF (square cluster)</th><th>PRE-IFN (square plot)</th><th>DIAF-JICA (square cluster)</th><th>PRE-IFN & DIAF-JICA (circular cluster)</th></tr><tr><td>FDHTF</td><td>46.1</td><td>7</td><td>13</td><td>13</td><td>15</td><td>48</td></tr><tr><td>FDHSH</td><td>7.56</td><td></td><td></td><td>6</td><td></td><td>6</td></tr><tr><td>FSFC</td><td>6.29</td><td></td><td></td><td></td><td>11</td><td>11</td></tr><tr><td>FSc</td><td>3.32</td><td></td><td></td><td></td><td>14</td><td>14</td></tr><tr><td>Savannah</td><td>8.48</td><td></td><td></td><td></td><td>29</td><td>29</td></tr><tr><td>CRCA</td><td>3.46</td><td></td><td></td><td></td><td>14</td><td>14</td></tr></table> Methods for developing the data: After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them. <u>Wood Density</u>: The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the “Global Wood Density database” (Chave et al., 2005; Chave et al ., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database.	Land cover class	Inventoried area (ha)	SU type				Total	WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	FDHTF	46.1	7	13	13	15	48	FDHSH	7.56			6		6	FSFC	6.29				11	11	FSc	3.32				14	14	Savannah	8.48				29	29	CRCA	3.46				14	14
Land cover class	Inventoried area (ha)			SU type					Total																																													
		WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)																																																	
FDHTF	46.1	7	13	13	15	48																																																
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FSFC	6.29				11	11																																																
FSc	3.32				14	14																																																
Savannah	8.48				29	29																																																
CRCA	3.46				14	14																																																

¹⁴ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

	Estimation of tree heights: For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012). AGB estimation: Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/).The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used – $AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$ Mean AGB by Land-use type: The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i, obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000): $AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$ The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., DBH < 10 cm), a correction factor was applied to $AGB \geq 10$ cm according to the formula below: $AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$ Belowground Biomass Estimation: Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.																				
Value applied:	Table 3-33-3: Estimation of biomass values by forest type and non-forest land use. <table><tr><th>Land use</th><th>Label</th><th>Value (tdm/ha)</th><th>IC (tdm/ha)</th></tr><tr><td>FSc</td><td>Secondary Forest</td><td>236.71</td><td>58.30</td></tr><tr><td>FDHTF</td><td>Primary forest terra firme</td><td>432.30</td><td>20.00</td></tr><tr><td>FDHSH</td><td>Dense humid wetland forest</td><td>415.48</td><td>44.45</td></tr><tr><td>CRCA</td><td>Culture et Régénération de Culture Abandonnée).</td><td>32.90</td><td>5.61</td></tr></table>	Land use	Label	Value (tdm/ha)	IC (tdm/ha)	FSc	Secondary Forest	236.71	58.30	FDHTF	Primary forest terra firme	432.30	20.00	FDHSH	Dense humid wetland forest	415.48	44.45	CRCA	Culture et Régénération de Culture Abandonnée).	32.90	5.61
Land use	Label	Value (tdm/ha)	IC (tdm/ha)																		
FSc	Secondary Forest	236.71	58.30																		
FDHTF	Primary forest terra firme	432.30	20.00																		
FDHSH	Dense humid wetland forest	415.48	44.45																		
CRCA	Culture et Régénération de Culture Abandonnée).	32.90	5.61																		
QA/QC procedures applied	DRC FREL Modified Submission¹⁵ includes a description of methods and procedures applied during data collection: Annex 7 – WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 – Methodology of the National Forest Pre-Inventory.																				
Uncertainty associated	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB10cm. Nevertheless, to																				

¹⁵ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

with this parameter:	reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The Sus retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of Sus come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017). -For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$ Where E_B is the Total Biomass error (in tms*ha⁻¹), E_{AGB_{1cm}} is the error on the quantity AGB_{1cm} (in tms*ha⁻¹), and E_{BGB} the error on the quantity of BGB (in tms*ha⁻¹). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

Parameter:	EF_{DEG} Equations 9 and 13
Description:	EF_{DEG} : Emission factor for degradation of forest type a to forest type b, tones CO ₂ ha ⁻¹ .
Data unit:	Emission Factor : tones of dry matter per ha (tCO ₂ ha ⁻¹).
Source of data or description of the method for developing the data	Spatial Level: National Source of Data¹⁶: The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-INF), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework

¹⁶ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

including the spatial level of the data (local, regional, national, international):

of the DIAF-JICA Forests project (**DIAF-JICA data**) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (**WWF data**) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi.

Table 3-43-4: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops).

Land cover class	Inventoried area (ha)	SU type				Total
		WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	
FDHTF	46.1	7	13	13	15	48
FDHSH	7.56			6		6
FSFC	6.29				11	11
FSc	3.32				14	14
Savannah	8.48				29	29
CRCA	3.46				14	14

Methods for developing the data:

After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them.

Wood Density: The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the “Global Wood Density database” (Chave et al., 2005; Chave et al., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database.

Estimation of tree heights: For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012).

AGB estimation: Biomass estimates were carried out using the **BIOMASS package** (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, <https://cran.r-project.org/>). The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used –

$$AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$$

Mean AGB by Land-use type: The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i , obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000):

$$AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$$

The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., DBH < 10 cm), a correction factor was applied to $AGB \geq 10$ cm according to the formula below:

$$AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$$

Belowground Biomass Estimation: Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii)

	dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.								
Value applied:	Table 33-5: Estimation of Degradation Emission Factor. <table><tr><th>Emission Factor</th><th>Label</th><th>Value [tCO2/ha]</th><th>IC^[1]</th></tr><tr><td>EF Degradation</td><td>Transition from primary terra firme forest to secondary forest)</td><td>337.07</td><td>106.22</td></tr></table> [1] For illustrative purposes, Eq 3.2 Vol 1, Chapter 3 IPCC 2006 Guidelines were used to calculate IC. Uncertainty propagation in Monte Carlo analyses is based on carbon densities' uncertainties.	Emission Factor	Label	Value [tCO2/ha]	IC ^[1]	EF Degradation	Transition from primary terra firme forest to secondary forest)	337.07	106.22
Emission Factor	Label	Value [tCO2/ha]	IC ^[1]						
EF Degradation	Transition from primary terra firme forest to secondary forest)	337.07	106.22						
QA/QC procedures applied	DRC FREL Modified Submission¹⁷ includes a description of methods and procedures applied during data collection: Annex 7 – WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 – Methodology of the National Forest Pre-Inventory.								
Uncertainty associated with this parameter:	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB_{10cm}. Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The Sus retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of Sus come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017). -For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals ained (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$								

¹⁷ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

	Where E_B is the Total Biomass error (in $\text{tms} \cdot \text{ha}^{-1}$), $E_{AGB_{1cm}}$ is the error on the quantity AGB_{1cm} (in $\text{tms} \cdot \text{ha}^{-1}$), and E_{BGB} the error on the quantity of BGB (in $\text{tms} \cdot \text{ha}^{-1}$). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

Parameter:	RF _{SREG} Equations 10 and 14																																																					
Description:	RF _{SREG} : Enhancement of carbon stocks in new forests. The removal factor is estimated by dividing the Emission Factor of Secondary Forest by 20 years.																																																					
Data unit:	Removal Factor: tCO2 ha year ⁻¹ .																																																					
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Spatial Level: National Source of Data¹⁸: The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. Table 3-63-5: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops). <table><tr><th rowspan="2">Land cover class</th><th rowspan="2">Inventoried area (ha)</th><th colspan="4">SU type</th><th rowspan="2">Total</th></tr><tr><th>WWF (square cluster)</th><th>PRE-IFN (square plot)</th><th>DIAF-JICA (square cluster)</th><th>PRE-IFN & DIAF-JICA (circular cluster)</th></tr><tr><td>FDHTF</td><td>46.1</td><td>7</td><td>13</td><td>13</td><td>15</td><td>48</td></tr><tr><td>FDHSH</td><td>7.56</td><td></td><td></td><td>6</td><td></td><td>6</td></tr><tr><td>FSFC</td><td>6.29</td><td></td><td></td><td></td><td>11</td><td>11</td></tr><tr><td>FSc</td><td>3.32</td><td></td><td></td><td></td><td>14</td><td>14</td></tr><tr><td>Savannah</td><td>8.48</td><td></td><td></td><td></td><td>29</td><td>29</td></tr><tr><td>CRCA</td><td>3.46</td><td></td><td></td><td></td><td>14</td><td>14</td></tr></table> Methods for developing the data: After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them. Wood Density: The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the “Global Wood Density database” (Chave et al., 2005; Chave et al ., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database.	Land cover class	Inventoried area (ha)	SU type				Total	WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	FDHTF	46.1	7	13	13	15	48	FDHSH	7.56			6		6	FSFC	6.29				11	11	FSc	3.32				14	14	Savannah	8.48				29	29	CRCA	3.46				14	14
Land cover class	Inventoried area (ha)			SU type					Total																																													
		WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)																																																	
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FDHSH	7.56			6		6																																																
FSFC	6.29				11	11																																																
FSc	3.32				14	14																																																
Savannah	8.48				29	29																																																
CRCA	3.46				14	14																																																

¹⁸ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

	Estimation of tree heights: For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012). AGB estimation: Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/).The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used – $AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$ Mean AGB by Land-use type: The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i, obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000): $AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$ The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., DBH < 10 cm), a correction factor was applied to $AGB \geq 10$ cm according to the formula below: $AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$ Belowground Biomass Estimation: Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.						
Value applied:	Table 3-73: Estimation of removal rate. <table><tr><th>FSc Biomass $\pm$ 90% IC (tmd*ha⁻¹)</th><th>Total CRCA Biomass $\pm$ 90% IC (tmd*ha⁻¹)</th><th>Removal Factor (tCO²/ha/year)^[1]</th></tr><tr><td>236,71$\pm$58,3</td><td>32.90$\pm$56.1</td><td>-17.56</td></tr></table> ^[1] Uncertainty of the removal factor is propagated in the Monte Carlo Analysis based on carbon densities' uncertainties of Secondary Forest and CRCA.	FSc Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Total CRCA Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Removal Factor (tCO ² /ha/year) ^[1]	236,71 $\pm$ 58,3	32.90 $\pm$ 56.1	-17.56
FSc Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Total CRCA Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Removal Factor (tCO ² /ha/year) ^[1]					
236,71 $\pm$ 58,3	32.90 $\pm$ 56.1	-17.56					
QA/QC procedures applied	DRC FREL Modified Submission¹⁹ includes a description of methods and procedures applied during data collection: Annex 7 – WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 – Methodology of the National Forest Pre-Inventory.						
Uncertainty associated with this parameter:	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB10cm. Nevertheless, to						

¹⁹ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

	reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The Sus retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of Sus come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017). -For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals aimed (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$ Where E_B is the Total Biomass error (in tms*ha⁻¹), E_{AGB_{1cm}} is the error on the quantity AGB_{1cm} (in tms*ha⁻¹), and E_{BGB} the error on the quantity of BGB (in tms*ha⁻¹). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

3.2 Monitored Data and Parameters

Parameter:	A(j, i) _{MP} Equation 12 A(a, b) _{MP} Equation 13 A(i, j) _{MP} Equation 14
Description:	A(j, i) _{MP} : Area converted/transited from forest type j to non-forest type i during the Monitoring Period (Deforestation transition denoted by j, i) A(a, b) _{MP} : Area of forest type a converted to forest type b during the Monitoring Period (Degradation transition denoted by a, b). A(i, j) _{MP} : Area of non-forestland i converted to forestland j during the Monitoring Period (Regeneration transition denoted by i, j)
Data unit:	hectare.
Value monitored	

during this Monitoring / Reporting Period:

Table 3-83-6: Value monitored during 2019-2020 Monitoring Period

Parameter	Land cover transition	Land cover transition 2019-2020 (ha)	CI
A(i, j) _{MP} :	Secondary regeneration-2019-2020	138,070	35,773
A(j, i) _{MP} :	Dense humid Wetland Forest deforestation 2019-2020	759	919
	Dense humid Terra firma deforestation 2019-2020	23,736	3,686
	Secondary Forest deforestation 2019-2020	96,651	19,003
A(a, b) _{MP} :	Dense humid terra firme degradation 2019-2020	13,808	3,612

Source of data and description of measurement /calculation methods and procedures applied²⁰:

The methods to estimate activity data are the same for the reference period and the 1st monitoring period, following methods described in the UMD report²¹. As such, all information provided on methods used to estimate the activity data for the reference period are also applicable to the monitoring period.

A probability-based sample of time-series imagery was used as reference data in estimating activity data for the province of Maï-Ndombe , DRC, for the performance period of 2019-2020. We employed an approach with a goal of delivering a method that can readily be applied to all provinces in the DRC.

Sampling design: A stratified random sampling design based on mapped classes closely aligned with activity data definitions was employed to maximize the efficiency of the sample allocation. Note that there are different number of sampling strata between the monitoring period (8 strata) and the reference level period (9 strata). The table in the "AreaCalculation" sheet (cells L27..P37) of the AD_calculationTool_MP_rev workbook shows the difference in the number of sampling strata between the monitoring and reference periods. The reference period includes buffered change (strata 4-8) to minimize the uncertainty associated with omission errors, as suggested by Olofsson et al. in 2020²². However, for the monitoring period, including the buffered change strata was unnecessary because the uncertainty was already at the desired levels.

Label	Id Monitoring Period dataset	Id Reference Period dataset	2005-2015 (ha)	2019-2020 (ha)
Dense humid forest to non-forest	1	1	181,658	56,099
Dense humid forest to forest loss/gain	2	2	190,596	60,652
Secondary forest to non-forest	3	3	246,865	841,483
Secondary forest to forest loss/gain	4	4	291,862	128,959
Non-forest to secondary forest	5	5	28,164	241,195
Buffered change (strata 4-8)		6	761,287	
Stable dense humid forest	6	7	7,886,443	8,114,314

²¹ Final report for **Quantifying the forest Reference Level of the emissions reduction program of Mai-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab** -can be accessed at the following link: https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0. Please take note that the UMD report is not the official data source for monitoring period activity data estimate, and it's just a preliminary estimate of emission reduction for 2018-2019. The ER-Program process is a lengthy one, and earlier decisions on data and periods were later revised, but such revisions are not reflected in the referenced document. The initial reporting period was set from 21.09.2018 to 31.07.2019 (see schedule 2 on page 15 of the ERPA). However, the reporting period was later changed from 01.01.2019 to 31.12.2020, as described in the MR. The ER-MR document references the UMD report to provide additional information on the methods used to estimate Activity Data.

²² Pontus Olofsson, Paulo Arévalo, Andres B. Espejo, Carly Green, Erik Lindquist, Ronald E. McRoberts, María J. Sanz. Mitigating the effects of omission errors on area and area change estimates. Remote Sensing of Environment. Volume 236. 2020, 111492. ISSN 0034-4257. <https://doi.org/10.1016/j.rse.2019.111492> .

	Stable secondary forest	7	8	361,430	595,593
	Stable non-forest	8	9	2,900,017	2,810,027
	Accounting Area			12,848,321	12,848,321
	Also note that an independent sample was determined for the first Monitoring Period. An initial sample of 100 samples per stratum was drawn for each of the following classes in Mai-Ndombe province: 1) Dense humid forest to non-forest, 2) Dense humid forest to forest loss/gain, 3) Secondary forest to non-forest, 4) Secondary forest to forest loss/gain, 5) Non-forest to secondary forest, 6) Stable dense humid forest, 7) Stable secondary forest, 8) Stable non-forest. Based on the target class proportions identified in each stratum from the interpretation of the initial sample, we calculated the number of sampling units per stratum required to reach the target 90% confidence interval of $\pm 20\%$ of the estimated area for the reporting classes. The required sample size for a given target variance for each target class can be found using Equation 5.66 from Cochran (page 110)²³ for the optimal allocation with fixed n. Optimal sample allocation among strata (minimized variance for fixed n) was achieved using Equation 5.60 from Cochran (page 108) and replacing the true population class proportion for each stratum with the one estimated from the initial sample. Final sample allocation totaling 1169 sampling units²⁴. <u>Response design:</u> The Response design included defining the assessment unit as 30m pixels from the mapped strata population, source reference data in the form of 16-day Landsat composite time-series data from 2014 through 2020, supplemented by Google Earth imagery²⁵. In Appendix 1 of Final Report “Quantifying the forest Reference Level of the emissions reduction program of Mai-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab” a detailed labeling protocol is described exhaustively in Standard Operating Procedures and includes decision trees and LULC classification systems in order to allow the unambiguous classification of the sample units. The sample-based analysis consisted of stratified randomly selected pixels across the area of Mai-Ndombe province. While the sampling unit was a pixel, and each pixel was examined at annual timescales, assessment was also facilitated by spatiotemporal context. Each sampling unit was interpreted using time-series Landsat and Google Earth imagery and time-series of individual spectral measures. Expert image interpreters analyzed the reference sampling units and labeled them at annual intervals as either primary forest, secondary forest, and non-forest, as well as transitions, type of change (loss or gain), driver, and the year of change. For pixels that were not interpreted consistently between the analysts, an additional analyst was engaged, and all analysts worked together to reach a consensus in making final assignments. The interpretation team included participants from the project consortium of DIAF/OSFAC/UMD. <u>Sampling unit interpretation protocol:</u> Interpretations of each sampling unit selected for analysis began with a decision tree that provided a dichotomous rule set for assigning labels. The decision tree for assigning land cover is based on physiognomic-structural attributes of vegetation, specifically height and cover. Vegetation cover and height are used to differentiate forests from savanna and non-forest categories, with 30% cover and >3m height defining forests. For tree canopy cover $\geq 60\%$, we separate dense tree cover into dense humid (primary) terra firma and wetland forests and secondary (regrown) forests. Dense humid forest is differentiated from secondary humid forest by the spectral signature from greater vertical variation and texture associated with old growth forests compared to the more uniform canopies associated with colonizing tree species. <u>Area estimation for activity data:</u> Area estimates were made for three scenarios: 1) consensus labels of all sampling units, 2) only samples where all interpretations agreed, and 3) subsets of sampling units with the same average annual number of observations per epoch, for example where we have				

²³ Cochran, W.G. (1977) Sampling Techniques (3rd edition).

²⁴ Reference data with 1169 sample point can be accessed at following link https://indus.umd.edu/mndb_2020_wb/index.php . Websites is accessible using the same following credentials: username: svalidation, pwd: gladvalid400.

²⁵ Landsat imagery is available in the NASA repository (<https://landsat.visibleearth.nasa.gov/>), and Google Earth imagery is accessed with Google Earth PRO APP (<https://www.google.com/intl/es/earth/versions/>).

	at least 5 good annual Landsat observations per sample for all samples. Scenarios 2) and 3) served to evaluate the sensitivity the final consensus estimates to removing samples lacking interpreter consensus or removing samples with few quality image observations. For a stratified random sample of pixels within nine strata, annual binary labels of yes/no for each stable land cover and transition class were assigned. Areas for each class were calculated per the following calculations, given the mean proportion of class i in stratum h: $\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h} \quad \text{where} \quad p_{iu} = 1 \text{ if pixel } u \text{ is identified as class } i, \text{ and } 0 \text{ otherwise}$ n_h – number of samples in stratum h Estimated area of class i: $\hat{A}_i = \sum_{h=1}^H A_h \bar{p}_{ih} \quad \text{where} \quad A_h - \text{total area of stratum } h$ H – number of strata ($H = 9$) Standard error of the estimated area of class i: $SE(\hat{A}_i) = \sqrt{\sum_{h=1}^H A_h^2 \frac{\bar{p}_{ih}(1 - \bar{p}_{ih})}{n_h - 1}}$
QA/QC procedures applied:	QA/QC procedures for the AD estimate of the monitoring period were the same applied for the Reference Period. That included the definition of clear roles and responsibilities in QA/QC, the definition of SOPs, training on the defined SOPs, multiple interpreters per sample unit, and final quality assurance check to ensure the data quality. All sample pixels were initially interpreted by at least two independent experts. Each analyst assigned to each sample pixel the following labels: loss month and year, pre- and post-disturbance land cover type, land cover proportion, availability of high-resolution image, and forest disturbance driver, and expert's confidence (high/medium/low) separately for all labels. After the initial interpretation, a consensus exercise was performed for all sampled pixels featuring disagreement between interpreters or with low confidence for any interpreter. An additional expert joined the exercise, and a group discussion was undertaken to make the final assignment of land cover extent and change dynamics. Given the final interpretations, we assessed the sensitivity of the method as a function of interpreter agreement and data richness.
Uncertainty for this parameter:	Uncertainty stems primarily from: - Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. - The sampling errors. The presented work sought to improve the accuracy of the existing reference emissions level calculations through a more robust methodology to estimate activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Mai-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as a function of interpreter agreement and data richness. The principal improvement was derived from the stratification that enabled the efficient allocation and interpretation of reference data. Our goal of <20% uncertainty at the 90th percentile confidence interval for activity data from 2009-2020 was achieved using 1,169 samples. The initial FREL had higher uncertainties derived using over 30,000 samples. The methodological efficiency points to the possible extension of the approach to the national scale. Concerning the differences in areas, we believe that fewer samples interpreted by a small team of experts following a strict protocol of signal-based identification of forest loss and gain is a more robust approach.
Any comment:	

4 QUANTIFICATION OF EMISSION REDUCTIONS

4.1 ER Program Reference level for the Monitoring / Reporting Period covered in this report

The following table shows the Reference Level for the ER Program for the Reporting Period covered in this report. This Reference level was technically corrected.

Year of Monitoring	Average annual historical emissions from deforestation over the Reference Period (tCO _{2-e} /yr)	Annual historical emissions from forest degradation over the Reference Period (tCO _{2-e} /yr)	Average annual historical removals by sinks over the Reference Period (tCO _{2-e} /yr)	Adjustment, if applicable (tCO _{2-e} /yr)	Reference level (tCO _{2-e} /yr)
2019	24,038,150	4,879,243	-420,133	5,788,887	34,286,146
2020	24,038,150	4,879,242	-840,267	5,788,886	33,866,012
Total	48,076,300	9,758,485	-1,260,400	11,577,773	68,152,158

Year of Monitoring	Average annual historical emissions from deforestation over the Reference Period (tCO _{2-e} /yr)	Annual historical emissions from forest degradation over the Reference Period (tCO _{2-e} /yr)	Average annual historical removals by sinks over the Reference Period (tCO _{2-e} /yr)	Adjustment, if applicable (tCO _{2-e} /yr)	Reference level with adjustment (tCO _{2-e} /yr)	Reference level without adjustment (tCO _{2-e} /yr)
2019	24,038,150	4,879,243	-420,133	5,788,887	34,286,146	28,497,260
2020	24,038,150	4,879,242	-840,267	5,788,886	33,866,012	28,077,126
Total	48,076,300	9,758,485	-1,260,400	11,577,773	68,152,158	56,574,386

Technical Corrections applied to the Reference Level

The technical corrections applied to the original Reference Level have been made. All the technical modifications are in line with paragraph 2 of the "Guideline on the application of the methodological framework Number 2: Technical corrections to GHG emissions and removals reported in the reference period". Technical corrections do not compromise the consistency of GHG emissions and removals estimates between the Reference Period and monitoring periods, as both calculations apply the improvements. None of the improvements relate to a change in policy and design decisions affecting the Reference Level. Carbon pools and gases, GHG sources, reference period, forest definition, REDD+ activities, Accounting Areas, and forest types remain unchanged. Changes in data sources, methods, and the re-estimation of activity data and emission factors have been made in calculating the FREL/FRL of DRC. The changes made are detailed below.

- Removals from enhancement of carbon stocks:** Initial FREL included regrowth of forestland remaining forestlands. Updated FREL considers only removals from the conversion of non-forest lands to forest land. A conservative default period of 20 years is assumed for the forest to grow from the carbon stock levels of non-forest to the level of biomass in the average forest instead of the ten years used for the initial FREL. Carbon enhancement in transitions from secondary to primary forest has been excluded.

- **Mean AGB AND BGB by stratum:** The mean total biomass per stratum has been updated with a new dataset (see table below). AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF). Different methods were used to estimate updated values of mean total biomass per stratum (i.e., Root-shoot ratio). Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014).

Table 4-14-1: Mean total biomass per stratum comparison, initial vs. updated FREL calculation.

Land-use type	Total Biomass	
	Initial FREL	Updated FREL
Dense Forest [tdm/ha]	376.88	432.30 ^[1] ; 415.48 ^[2]
Secondary Forest [tdm/ha]	192.9	236.71
Non-Forest [tdm/ha]	25.2	32.90
Removal Factor [tCO ₂ /ha/yr.]	-15.9	NA
Secondary Regrowth [tCO ₂ /ha/yr.]	-14.4	-17.56

^[1] Primary Forest terra firma; ^[2] Dense Humid Wetland Forest.

- **Activity data estimate:** The sample-based area estimation of activity data has been updated. Initial FREL was estimated using **systematic grids** (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using **pixel-based stratified random** sampling with 2,000 sampling points. We estimate activity data using **pixel-based stratified random sampling**. Stratified random sampling is a method meant to increase sampling efficiencies by targeting homogeneous populations with regards to the categories of interest. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes. The new methodological approach sought to produce activity data estimates with low uncertainties using a method that may be readily extended to all provinces in implementing a national monitoring system. In this way, the method aimed to reduce errors associated with the estimates of forest extent and change, but also the time, human resource and effort invested, while maintaining the scientific rigor of and compliance with IPCC requirements.

Table 4-24-2: Activity data per transition, initial vs. updated FREL calculation.

REDD+ Activity	Transition	Activity data [ha/yr.]	
		Initial FREL	Updated FREL
Deforestation	Primary forest to non-forest	21,838	15,464
	Secondary forest to non-forest	44,226	38,134
Degradation	Primary to Secondary Forest	64,536	14,475
Removals from enhancement of carbon stocks	Non-forest to Secondary Forest	15,040	23,923
	Secondary Forest to Primary Forest	4,318	NA

4.2 Estimation of emissions by sources and removals by sinks included in the ER Program's scope

Quantifying emissions by sources and removals by sinks from the ER Program during the Monitoring Period is shown below. Emission Reductions calculation tool (DRC_ER_Calculations rev3.xlsx) can be accessed at the following link: https://www.dropbox.com/scl/fi/4m6grsbh36xo1ngdmw34b/DRC_ER_Calculations-rev3-3.xlsx?rlkey=8x46s4okj6u2ej8sopuskmuqd&st=n9u5l4aj&dl=0

. ER estimate tool provides sample calculations using the actual values from section 3 above. This tool also includes all formulas used for the ER estimate.

Year of Monitoring Period	Emissions from deforestation (tCO _{2-e} /yr)	If applicable, emissions from forest degradation (tCO _{2-e} /yr)*	If applicable, removals by sinks (tCO _{2-e} /yr)	Net emissions and removals (tCO _{2-e} /yr)
2019	25,392,536	2,327,159	-1,212,372	26,507,323
2020	25,392,535	2,327,158	-2,424,742	25,294,951
Total	50,785,071	4,654,317	-3,637,114	51,802,274

4.3 Calculation of emission reductions

	Deforestation	If applicable, forest degradation	If applicable, enhanced removals from afforestation/ reforestation (A/R)	If applicable, enhanced removals from other activities besides A/R*	Total (tCO ₂ -e)
Emission or removals in the Reference Level (tCO ₂ -e)	48,076,300	9,758,485	-1,260,400	N/A	68,152,158*
Emission or removals under the ER Program during the Reporting Period (Tco ₂ -e)	50,785,071	4,654,317	-3,637,114	N/A	51,802,274
Emission Reductions during the Reporting Period (Tco ₂ -e)	-2,708,771	5,104,168	2,376,714	N/A	16,349,884

* Including the adjustment as per section 4.1

	Total (tCO ₂ -e) with adjustment	Total (tCO ₂ -e) without adjustment
Emission or removals in the Reference Level (tCO ₂ -e)	68,152,158**	56,574,385
Emission or removals under the ER Program during the Reporting Period (Tco ₂ -e)	51,802,274	51,802,274
ERs sold, assigned or otherwise used by any other entity for sale, public relations, compliance or any other purpose including ERs accounted separately under other GHG accounting schemes or ERs that have been set-aside to meet Reversal management requirements under other GHG accounting schemes	8,444,444***	0
Total ER (Tco ₂ -e) available (Colum F table section 8)	7,905,440	4,772,111

***Emission reductions from the nested project are fully generated through an adjustment over their historical emissions and therefore labeled as HFLD. As such these are only subtracted from the adjusted performance.

Emission reductions from HFLD as a percentage of FCPF ERs –(K in table section 8)	39.635094575%
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5 UNCERTAINTY OF THE ESTIMATE OF EMISSION REDUCTIONS

5.1 Identification, assessment and addressing sources of uncertainty

In the following table the country identifies and discuss in qualitative terms the main sources of uncertainty and its contribution to total uncertainty of Emission Reductions. The measures that have been implemented to address these sources of uncertainty as part of the Monitoring Cycle are also discussed.

Source of uncertainty	Systematic	Random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimate
Activity Data						
Measurement	✓	✓	Land-use photo-interpretation: Land-use visual assessment uncertainty is associated with the photo-interpretation consistency. Bias in the photo-interpretation of land use was mitigated by: - For the purposes of per pixel interpretation forest was assigned only if the physiognomic/structural tree cover criteria were met for the sampling unit being analyzed, and if the pixel was part of a 0.5ha or larger contiguous patch of tree cover, which equated to a group of greater than 5 pixels (5 pixels x 30m x 30m / 10000 m2/ha = 0.45ha). - While labels were assigned to pixels at an annual scale, sampling unit assessments employed bi-monthly composites of ~1km² false color Landsat subsets as well as graphs of radiometrically normalized 16-day composite spectral data, both covering the entire study period. Such contextual spatial and temporal data facilitated per pixel labeling. - Each sampling unit was also uploaded into Google Earth in kml format which allowed for greater landscape context and possible very high spatial resolution imagery to further assist interpretations. - The QA/QC portion of our work consisted primarily of the inter-comparison of sampling unit interpretations as well as the data richness per sampling unit. Specifically, individual assessments of sampling units were compared and separated into pools of all interpreted sampling units (pixels) and all sampling units less those of initial disagreement. A multi-interpreter consensus assessment was used to resolve disagreements in making final labels. We then compared the two pools of data in assessing the difference in area estimates between the consensus interpretation of the full sample and the initial (default) agreement sample subset. - We also thresholded the populations based upon minimum annual Landsat observation counts and performed a similar comparison of all data versus a presumably higher confidence subset of data rich samples across all years. - The difference in area estimates of all samples versus comparatively data rich samples was examined. In both assessments, if the estimates based on 'default agreement' and 'data rich' sample subsets are within the uncertainty of the estimates based on the entire sample, it may serve as evidence of the robustness of the final results.	Low	Yes	No
Representativeness	✓	✓	Time-series Landsat data were used to map the activity in building strata for targeting the themes of interest for sample-based area estimation. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes.	Low	Yes	No
Sampling		✓	We estimate activity data using <i>pixel-based stratified random sampling</i> with 2,000 plots. Stratified random sampling is a method meant to increase sampling efficiencies by targeting homogeneous populations with regards to the categories of interest. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes. The new methodological approach sought to produce activity data estimates with low uncertainties using a method that may be readily extended to all provinces in implementing a national monitoring system. In this way, the method aimed to reduce errors associated with the estimates of forest extent and change, but also the time, human resource and effort invested, while maintaining the scientific rigor of and compliance with IPCC requirements.	High	Yes	Yes
Extrapolation	✓		No extrapolation of the Activity Data estimate was necessary. Activity Data were estimated with no stratification. Mapped strata were used to increase sampling efficiencies by targeting homogeneous populations concerning interest categories.	NA	NA	NA
Approach 3	✓		Permanent Sample Units (PSU) of one pixel (30 x 30 meters) were used to ensure the temporal tracking of land use for each period. However, the ER Program conducted two independent surveys to estimate activity data in the Reference Period (2005-2014) and Monitoring Period (2019 – 2020).	High	Yes	No
Emission Factors						
DBH measurement	✓	✓		Low	Yes	No

Source of uncertainty	Systematic	Random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimate
H measurement	✓	✓	The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB _{10cm} . Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed). The H: DBH model error to which tree height predictions are subject was considered in the estimation of the error on the average AGB _{10cm} .	High	Yes	Yes
Plot delineation	✓	✓	The bias of using an average wood density for several species was considered in the estimation of the error on the average AGB _{10cm} .	Low	Yes	No
Wood density estimation	✓	✓	In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used. The AGB model error to which tree AGB predictions are subject was considered in estimating the error on the average AGB _{10cm} .	High	No	Yes
Biomass allometric model	✓	✓	Average AGB _{10cm} estimates based on different inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB _{10cm} .	High	Yes	Yes
Sampling		✓	Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB _{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.	High	Yes	No
Other parameters (e.g. Carbon Fraction, root- to-shoot ratios)			Average AGB _{10cm} estimates based on different inventory plots are subject to a potentially significant representativeness bias. The SUs retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of SUs come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC.	High	Yes	No
Representativeness	✓					
Integration						
Model	✓		Control Mechanisms of material errors have been included in emission and removal calculations tools, i.e., sums of sampling points by forest type coincide with sample size ensuring no double counting in the sample-based activity data estimate.	Low	Yes	No
Integration	✓		Activity Data and Emission Factors are comparable. Carbon densities have been estimated according to the forest types (permanent and secondary), and non-forest land uses interpreted in the visual assessment of Landsat imagery.	Low	Yes	No

5.2 Uncertainty of the estimate of Emission Reductions

Parameters and assumptions used in the Monte Carlo method

Monte Carlo methods (IPCC Approach 2) were applied to quantify the Uncertainty of the Emission Reductions. The parameters subject to the Monte Carlo simulation and the Probability Distribution Function (PDF) type are shown in the table below. CI90%

Parameter included in the model	Parameter values Value $\pm$ CI90%	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Assumptions
Activity Data				
Secondary regeneration-2005-2009 [ha]	112,734 $\pm$ 21,780	Source of uncertainty: <i>Measurement, Type of error: Systematic and random</i> Activity data quantified sampling errors only. Updated AD estimates improved the accuracy of the existing reference emissions level calculations through a more robust methodology for estimating activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Mai-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as a function of interpreter agreement and data richness. The principal improvement was derived from the stratification that enabled the efficient allocation and interpretation of reference data.	Normal truncated, positive values	PDF function assumed normal
Secondary regeneration-2010-2014 [ha]	126,499 $\pm$ 22,330		Normal truncated, positive values	PDF function assumed normal
Secondary regeneration-2019-2020 [ha]	138,070 $\pm$ 35,773		Normal truncated, positive values	PDF function assumed normal
Dense Humid Def. 2005-2009 [ha]	58,501 $\pm$ 11,907		Normal truncated, positive values	PDF function assumed normal
Forest degradation 2005-2009 [ha]	53,562 $\pm$ 13,453		Normal truncated, positive values	PDF function assumed normal
Secondary Def. 2005-2009 [ha]	107,786 $\pm$ 21,105		Normal truncated, positive values	PDF function assumed normal
Dense Humid Def. 2010-2014 [ha]	96,142 $\pm$ 15,014		Normal truncated, positive values	PDF function assumed normal
Forest degradation 2010-2014 [ha]	91,194 $\pm$ 19,227		Normal truncated, positive values	PDF function assumed normal
Secondary Def. 2010-2014 [ha]	273,558 $\pm$ 43,992		Normal truncated, positive values	PDF function assumed normal
Dense Humid Def. Terra firma 2019-2020 [ha]	23,736 $\pm$ 3,686		Normal truncated, positive values	PDF function assumed normal
Dense Humid Wetland Def. 2019-2020 [ha]	759 $\pm$ 919		Normal truncated, positive values	PDF function assumed normal
Forest degradation 2019-2020 [ha]	13,808 $\pm$ 3,612		Normal truncated, positive values	PDF function assumed normal
Secondary Def. 2019-2020 [ha]	96,651 $\pm$ 19,003		Normal truncated, positive values	PDF function assumed normal
Primary terra firma forest 2005-2009 [ha]	5,813,199 $\pm$ 299,055		Normal truncated, positive values	PDF function assumed normal
Primary terra firma forest 2010-2014 [ha]	5,625,863 $\pm$ 298,453		Normal truncated, positive values	PDF function assumed normal
Dense Humid Wetland forest 2005-2009 [ha]	2,392,511 $\pm$ 289,802		Normal truncated, positive values	PDF function assumed normal
Dense Humid Wetland forest 2010-2014 [ha]	2,392,511 $\pm$ 289,802		Normal truncated, positive values	PDF function assumed normal

Parameter included in the model	Parameter values Value ± CI90%	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Assumptions
Secondary forest 2005-2009 [ha]	766,342 ± 108,697		Normal truncated, positive values	PDF function assumed normal
Secondary forest 2010-2014 [ha]	659,081 ± 103,217		Normal truncated, positive values	PDF function assumed normal
Carbon densities				
FSc (secondary forest) [tdm/ha]	237 ± 58	Sources of uncertainty: <i>DBH and H measurement, Plot delineation, Wood density estimation, Biomass allometric model.</i> Type of error: <i>Systematic and random.</i> The following error sources were quantified for the estimation of the error on the total biomass per stratum: -The bias of using an average wood density for several species. -The H: DBH model error to which tree height predictions are subject. -The AGB model error. -Sampling error of the estimate of the average Total Biomass per stratum.	Normal truncated, positive values	PDF function assumed normal
CRCA (non-forest) [tdm/ha]	33 ± 6		Normal truncated, positive values	PDF function assumed normal
FDHTF (primary forest terra firma) [tdm/ha]	432 ± 20		Normal truncated, positive values	PDF function assumed normal
FDHSH (dense humid wetland forest) [tdm/ha]	415 ± 44		Normal truncated, positive values	PDF function assumed normal

Quantification of the uncertainty of the estimate of Emission Reductions

The table below shows the uncertainty of aggregated Emission Reductions at the 90% confidence level. Uncertainty is reported for both the Reporting Period and for the period since the Crediting Period Start date. Uncertainty discount applicable is based on the highest of both uncertainties. Monte Carlo Analysis tool can be accessed at the following link: <https://www.dropbox.com/scl/fi/myoh98k7y7z0o6z3bdc40/DRC-ER-MC-Analysis-Rev2.xlsx?rlkey=8ifprt508uaddrt0qo0pu9ih&dl=0>

		Reporting Period	Crediting Period
		Total Emission Reductions*	Total Emission Reductions*
A	Median	16,486,913	16,486,913
B	Upper bound 90% CI (Percentile 0.95)	30,940,643	30,940,643
C	Lower bound 90% CI (Percentile 0.05)	-469,123	-469,123
D	Half Width Confidence Interval at 90% (B – C / 2)	15,704,883	15,704,883
E	Relative margin (D / A)	95%	95%
F	Uncertainty discount	12%	12%

*Forest degradation has not been estimated with proxy data; therefore, Degradation columns were removed.

5.3 Sensitivity analysis and identification of areas of improvement of MRV system

Activity Data used with the deforestation model contributes 83% of Emission Reductions variability. Secondary and Primary Forest deforestation for the periods 2010-2014 and 2019-2020 are the primary sources of variability of the ER estimate (64%). Secondary Forest carbon density contributes 9% of ER uncertainty. Technical and financial support is required to identify options to reduce the uncertainty in estimating deforestation in primary

and secondary forests. Sensitivity Analysis tool can be accessed at the following link:
https://www.dropbox.com/scl/fi/4ty77mzopcm43nxhq1309/DRC_ER_SensitivityAnalysisRev2.xlsx?rlkey=qbsho189ggyapbjf7bs7c8cn&dl=0

Table 5-15-1: Sensitivity analysis of Emission Reductions estimates for the Reporting Period.

Input Variable	Low Output	Base Case	High Output	Percent
Secondary Def. 2019-2020 [ha]	115,654	96,651	77,649	52.9%
Secondary Def. 2010-2014 [ha]	229,566	273,558	317,550	11.3%
FSc (secondary forest) [tdm/ha]	295.01	236.71	178.41	9.1%
Dense Humid Def. Terra firma 2019-2020 [ha]	27,422	23,736	20,051	7.6%
Dense Humid Def. 2010-2014 [ha]	81,128	96,142	111,156	5.1%
Dense Humid Def. 2005-2009 [ha]	46,594	58,501	70,409	3.2%
Secondary Def. 2005-2009 [ha]	86,682	107,786	128,891	2.6%
Forest degradation 2010-2014 [ha]	71,966	91,194	110,421	2.0%
Forest degradation 2019-2020 [ha]	17,420	13,808	10,196	1.8%
FDHTF (primary forest terra firme) [tdm/ha]	412.30	432.30	452.30	1.6%
Secondary regeneration-2019-2020 [ha]	102,297	138,070	173,843	1.1%
Forest degradation 2005-2009 [ha]	40,109	53,562	67,015	1.0%
Dense Humid Wetland Def 2019-2020 (ha)	1,678	759	0	0.4%
FDHSH (Dense humid wetland forest) [tdm/ha]	371.03	415.48	459.93	0.1%
Primary terra firme forest 2005-2009 [ha]	5,514,144	5,813,199	6,112,254	0.1%
Primary terra firme forest 2010-2014 [ha]	5,327,410	5,625,863	5,924,316	0.1%
Dense humid wetland forest 2005-2009 [ha]	2,102,708	2,392,511	2,682,313	0.0%
Dense humid wetland forest 2010-2014 [ha]	2,102,708	2,392,511	2,682,313	0.0%
Secondary regeneration-2010-2014 [ha]	148,830	126,499	104,169	0.0%
Secondary regeneration-2005-2009 [ha]	134,515	112,734	90,954	0.0%
CRCA (non-forest) [tdm/ha]	38.51	32.90	27.29	0.0%
Secondary forest 2005-2009 [ha]	657,645	766,342	875,040	0.0%
Secondary forest 2010-2014 [ha]	555,864	659,081	762,298	0.0%
Dense humid degradation 2010-2014 [ha]	71,966	91,194	110,421	0.0%
Dense humid degradation 2005-2009 [ha]	40,109	53,562	67,015	0.0%
Dense Humid Wetland Def. 2005-2009 [ha]				0.0%
Dense Humid Wetland Def. 2010-2014 [ha]				0.0%
				100.00%

6 TRANSFER OF TITLE TO ERS

6.1 Ability to transfer title

The homologation decree set out in Order n°047/CAB/MIN/EDD/AAN/MML/05/2018 of May 9, 2018 determines the procedure that enables DRC to transfer carbon titles. The decree sets out the following four steps to register projects:

- i. **A certificate of registration.** This is the document that attests to the registration of the project holder in the register, issued by the national REDD+ register keeper (CNREDD, Art. 2, point 28), after having checked the admissibility of the file and the good repute of its holder. As a result, a register must have been established. And this register is defined as a public directory, constituting the electronic database, intended to receive online all information on REDD+ investments (Art. 2, point 22).
- ii. **A favorable opinion:** This opinion is issued by the competent structure (Scientific Committee, Art. 2, point 27), following a new verification of the requirements and related documents, which led to the issuance of the registration certificate (Art. 17). It is signed by all the members of the Scientific Committee (Art. 18).
- iii. **The decision to approve the REDD+ investment.** This is made by the Regulator (Minister in charge of forests, Art. 2, point 23), by ministerial order, following the transmission of the favorable opinion by the competent structure (Art. 19).

The national approval certificate. This is the final title that confers the right of ownership on the forest carbon and the emission reduction units generated or to be generated for the benefit of the REDD+ investment holder.

In accordance with the action plan proposed in the ERPA implementation requirements, work is underway to revise and operationalize the 'homologation' decree with the objective of resolving all outstanding issues that prevent the country from authorizing the transfer of emission reduction securities in full compliance. The action plan is under implementation to finalize this process and enable the effectiveness of the ERPA through the following steps:

Revision of the decree and finalization of the procedure manual to align with the decree.

1. Organization of the Ministry's services for the implementation of the decree.
2. Approval of the ERP
3. Obtaining release of credits issued by The MaiNdombe REDD+ Project managed by WWC releasing its credits (no longer not required due to subtraction of WWC project reduced emissions from ERP emission reductions)
4. Issuance of a letter from the Ministry of Environment to the FCPF confirming the capacity of the DRC to transfer the titles.

As a first step, the Government, through the Ministry of Environment and Sustainable Development (MEDD), has initiated a process of reform of the legal framework in place to provide a comfortable legal and institutional basis for the valuation of emission reductions generated in the DRC. The option taken by the Government, through the MEDD, is to proceed to the modification of the law n° 11/009 of July 09, 2011 on the fundamental principles related to the environmental protection. The bill to amend the latter law was introduced by the MEDD to the Government was adopted on February 3rd 2023. The revised law established the Carbon Market Regulatory Authority, whose organization and operation shall be determined by decree of the Prime Minister and provides a legal basis for the definition of a certification procedure for carbon projects and related transactions.

The revision of the Environmental Law enables the implementation of the following steps set out in the action plan:

- Preparation and approval of the decree establishing the Authority with its role and responsibilities
- Preparation and approval of the revised homologation decree including the 'procedural manual' establishing the process and responsibilities for registration of projects under the ERP

The preparation and approval of these decrees are supported by the World Bank through the 'SUPPORT TO THE EFFECTIVENESS AND OPERATIONALIZATION OF THE EMISSION REDUCTIONS PAYMENT AGREEMENT UNDER THE

MAÏ-NDOMBE ER PROGRAMME' (OPERPA) as well as through the Budget Support for 2023 that includes support to the implementation of the institutional and technical framework for carbon markets and project registration.

6.2 Implementation and operation of Program and Projects Data Management System

The implementation and operation of the program and project data management system are essential elements of the OPERPA project. This project aims to support institutions involved in REDD+ MRV in the DRC, in particular the DIAF, in the production of robust biennial reports on estimated carbon emissions from Mai-Ndombe. This technical assistance will include partnerships with institutions such as the University of Maryland, which has already produced the 2019-2020 Mai-Ndombe ERP monitoring report. In addition, field missions and the provision of the necessary hardware will be ensured to operationalize the MRV systems for the Mai-Ndombe jurisdiction.

To ensure stakeholder consultation, the project will also support the organization of workshops for the DRC's Plateforme Technique de Consultation (PTC), dedicated to the development and operation of the Mai-Ndombe ERP. This activity will also support the FIP coordination unit's Geographic Information System (GIS) expert, who will be responsible for quality control and training.

Currently, all data is accessible to the general public in the DIAF Dropbox (<https://www.dropbox.com/scl/fo/fnfgupbc5cvm07ksyoezp/h?rlkey=0cb794w54jout87exbraba8f8&dl=0>).

However, this information will be transferred to the new National Forest Monitoring System portal as soon as hosting is renewed, and to the National REDD+ Register once it has been deployed. The developing version of the register can be accessed at <https://imags-group.com/rdc/>. At that point, all data will be made transparently available.

The Ministry's current web platform is the main tool used for monitoring activities in the field. It will be accessible to the public and will comprise several systems, including the National Forest Monitoring System, the Forest Atlas, the Safeguards Information System and the National REDD+ Register. These systems will make it possible to map the project's achievements, to geographically locate actors and beneficiaries in the project zones, to evaluate, analyze, correct and validate geographical data generated by the implementation of project activities, and to produce maps and cartographic works as required.

The DRC National REDD Register will play a crucial role as a centralized database of all relevant information and data from emission reduction programs, projects and initiatives. It will make it possible to register and approve projects, avoid double registration of territories and double accounting of carbon performance and transactions.

In summary, the DRC National REDD Registry has two main objectives: to centralize information on the implementation of REDD+ interventions in the DRC, and to ensure transparency in the monitoring of public and private REDD+ funding and results.

6.3 Implementation and operation of ER transaction registry

As mentioned in point 6.2, the revision and operationalization of the registry will be carried out with the support of the OPERPA project. The revision of the registry system will demonstrate that Emission Reduction will be issued exclusively through the National REDD+ Registry. Registry accounts will be created for all authorized project holders and the government (with specific sub-accounts for regional/jurisdictional programs). Once the Emission Reductions have been reported and verified, the respective ERs will be issued directly to the relevant accounts, with a separate allowance paid to one or more relevant (government) buffer accounts (so as to account for uncertainties and reversals). The issuance of ERs is subject to verification of carbon and other relevant social and environmental thresholds, which are defined in national standards. Project owners are free to transfer their issued ERs through sales contracts, conversion (from national ERs to Verified Carbon Units (VCUs)) or any other means. Thus, the DRC government has decided to use a centralized registry of ER transactions (CATS) managed by the FCPF until the operationalization of its own registry.

6.4 ERs transferred to other entities or other schemes

The MaiNdombe REDD+ project managed by Wildlife Works (WWC) is a VCS-VERRA registered project actively issuing VCUs. So far, the project has issued a total of 7,600,000 tCO₂eq VCUs under the VCS-VERRA Standard, out of a total ERs of 14,755,149** tCO₂eq ER reported under VERRA for 2019-2021. These 7.6 million ER, are the net ER after applying a buffer discount of 10% corresponding to 844,444 tCO₂eq* ER. This makes it so The MaiNdombe REDD+ project has transferred a total of 8,444,444 tCO₂eq Vintage ER (=7,600,000 tCO₂eq VCU + 844,444 tCO₂eq buffer discount ER) to the VCS-VERRA Scheme***. This volume has been discounted from the ERP performance reported in the monitoring report (see section 8) to comply with requirements under Criteria 23 and 38 and avoid double counting and double issuance. The MaiNdombe REDD+ Project has, according to [the project description](#), a baseline of 8,524,210 tCO₂eq for 2019 and of 9,642,568 tCO₂eq for 2020. The verification for the period 2017-2020 was conducted in March 2022 and the implementation report is available [here](#), as well as [all the project relevant information under that standard](#). The MaiNdombe REDD+ project reported 1,248,955 tCO₂eq for 2019 and 1,778,581 tCO₂eq 2020 emissions for a total of tCO₂eq 3,027,536 emissions for the reporting period 2019-2020.

As part of the [benefit sharing plan](#), The MaiNdombe REDD+ project, the government of DRC and the FCPF have agreed to apply to The MaiNdombe REDD+ project, a baseline of 3,800,000 tCO₂eq for the project for the duration of the ERPA.

*This number had to be estimated using: $Buffer\ discount = VCU / (1 - \%)$. Therefore Buffer ER=7,600,000/(1-10)=844,444 ER.

** This number is the performance recognized by VERRA for this period. The project and DRC agreed no additional VCUs will be issued from this performance.

*** VERRA has agreed to correct the buffer ER value in their registry to this updated number. They have also committed to cancel all remaining ERs a per their performance baseline.

7 REVERSALS

7.1 Occurrence of major events or changes in ER Program circumstances that might have led to the Reversals during the Reporting Period compared to the previous Reporting Period(s)

Intentionally left blank. No reversals occurred during the reporting period.

7.2 Quantification of Reversals during the

Intentionally left blank. No reversals occurred during the reporting period.

A.	ER Program Reference level for this Reporting Period (tCO₂-e)	<i>from section 4.1</i>	
B.	ER Program Reference level for all previous Reporting Periods in the ERPA (tCO₂-e).	<i>from section 4.1 of previous ER Monitoring Reports</i>	
			+
C.	Cumulative Reference Level Emissions for all Reporting Periods [A + B]		

D.	Estimation of emissions by sources and removals by sinks for this Reporting Period (tCO ₂ -e)	from section 4.2		
E.	Estimation of emissions by sources and removals by sinks for all previous Reporting Periods in the ERPA (tCO ₂ -e)	From section 4.2 of previous ER Monitoring Reports		
F.	Cumulative emissions by sources and removals by sinks including the current reporting period (as an aggregate accumulated since the Crediting Period Start Date) [D + E]			—
G.	Cumulative quantity of Total ERs estimated including the current reporting period (as an aggregate of ERs accumulated since the Crediting Period Start Date) [C – F]			
H.	Cumulative quantity of Total ERs estimated for prior reporting periods (as an aggregate of ERs accumulated since the Crediting Period Start Date)	from previous ER Monitoring Reports		—
I.	[G – H], negative number indicates Reversals			
If I. above is negative and reversals have occurred complete the following:				
J.	Cumulative quantity FCPF ERs (as an aggregate of FCPF ERs accumulated since the Crediting Period Start Date)	from previous ER monitoring reports, section 8		
K.	Cumulative ER Program's Pooled Reversal Buffer contributions (as an aggregate of Pooled Reversal Buffer ERs accumulated since the Crediting Period Start Date)	from previous ER monitoring reports, section 8		
L.	Cumulative ER Program's Uncertainty Buffer contributions (as an aggregate of Uncertainty Buffer ERs accumulated since the Crediting Period Start Date)	from previous ER monitoring reports, section 8		

M.	Cumulative ER Program's Pooled Reversal Buffer replenishments (as an aggregate of Reversal Buffer ERs replenished since the Crediting Period Start Date)	<i>from previous ER monitoring reports, section 7.3</i>	
N.	Cumulative amount of FCPF ERs , Uncertainty and Pooled Reversal Buffer contributions and replenishments (as an aggregate since the Crediting Period Start Date) [J + K + L + M]		
O.	Quantity of Buffer ERs to be canceled from the Pooled Reversal Buffer account [If I < N, report the value of I; if I > N, report the value of N]		

7.3 Quantification of pooled reversal buffer replenishments

This section is not applicable because this is the first reporting period.

7.4 Reversal risk assessment

Risk Factor	Risk indicators	Default Reversal Risk Set-Aside Percentage	Discount	Resulting reversal risk set-aside percentage
Default risk	<i>N/A</i>	10%	<i>N/A</i>	10%
Lack of broad and sustained stakeholder support	Different mechanisms will be implemented to address governance issues as (i) a multi-stakeholder steering committee in charge of the validation of the work prepared by the Implementation body, (ii) a transparent grievance and redress mechanism (Please refer to Section 14.3), and (iii) independent observers as OGF and the MOABI Platform. The ER program is designed to ensure excellent participation of agents (e.g. participatory land use planning and related design of mitigation activities). There are several best practice standards for stakeholder involvement in place: - DRC established an Environmental and Social Management Framework, which was funded by the FCPF and validated by the World Bank; - With support from UN REDD, a Safeguard Information System was put in place (UN REDD); and Also, the ER program incorporates a set of measures that maintain the subsistence of local communities. The ER Program will support the development of agroforestry systems. This activity will support local communities in creating agricultural products with a monetary volume that is above current HH income levels. The break-even is estimated for year 4. In addition, the ER program is developing conservation strategies in consultation with agents of deforestation and degradation: - Groupe de Travail Climat REDD+ (GTCR) is a coordination agency for the participation of the civil society in the program. GTCR is inherently involved in the program design and acts as one of four program partners. - Conservation and agroforestry activities are based signing proxy based payment contracts with local communities, which ensures excellent community involvement.	10%	5%	5%

	Many consultations have been done in DRC relative to REDD+ strategy and it will continue at a more local level in implementation phase (Please refer to Section 5).			
Lack of institutional capacities and/or ineffective vertical/cross sectorial coordination	The ER program is embedded in the National REDD+ Strategies, supported by the FCPF Readiness program, UN-REDD, and DRC submitted his National REDD+ investment plan for funding by CAFI. From a national perspective, the ER program is considered as the first application and test pilot of the National REDD+ Strategies. The National REDD+ Strategy is a multi-sectoral initiative approved and supported by the Council of Ministers aiming at the realization of the national vision for green development (Please refer to ERPD Section 2 and National REDD+ Strategy, Section 4.3). The sub-national jurisdictional program is being coordinated directly by the provincial government and benefits from strong institutional support of the federal government. An implementation body will assume the management of the program for the first years of the program (please refer to ER-PD Section 6.1, 'Institutional Arrangements'). The National REDD+ Fund governance structure is currently under operationalization (See ER-PD Annex 9) and will be managed by UNDP, which will ensure transparent accounting and disbursement of funds. It will allow some time to set transparent and clear scheme under the ER-Program that the provincial government will be able to manage at a medium term. The Provincial REDD+ steering committee has adopted terms of reference and will become operational.	10%	5%	5%
Lack of long term effectiveness in addressing underlying drivers	The program is based on agreements between the DRC and the World Bank's Forest Climate Partnership Facility (FCPF). Clear legal links have been designed between the national government as the guardian in respect of national REDD+ standards, the provincial government as guardian of good implementation and performance of the program, and the signatory of the ERPA. Individual mitigation activities were designed to ensure avoidance of reversal, e.g., reforestation of cash crops will ensure that local communities will have higher household income levels in the mid to long term (i.e., without further REDD+ payments) to ensure the long-term sustainability of mitigation measures. Mitigation: The Government of DRC and the provincial Government of Mai Ndombe are committed to improving governance issues within the framework of REDD+ readiness. - A study led to assessing timber companies in the ER Program area on their legality of operations to provide clear and transparent cooperation between companies and the ER Program. This will result in a simple and robust monitoring system of timber operations' legality and strengthen the administration's engagement. - An activity to reinforce on-site control and checkpoint will be implemented to limit and reduce illegal logging and poaching, often linked to corruption. - As part of DRC's national REDD+ readiness achievements, DRC included REDD+ issues (e.g., land use planning policies, and land tenure) in the country's Economic Governance Matrix. This matrix is a key Government planning instrument and is monitored on monthly basis by the Technical Committee for Reform Monitoring (please refer to ER-PD Section 2.3) The ER Program incorporates a set of measures that maintain the production levels of significant commodities driving deforestation and degradation. Key commodities and related practices are: - Shifting cultivation leads to the production of manioc, corn, and charcoal, which is partially sold to generate cash income, partially used for domestic purposes. - Industrial timber companies log trees to supply timber to domestic and international markets. The following measures are incorporated in the ER Program to mitigate risk of reversals (cp. Investment Plan): - As general principle, mitigation measures to address shifting cultivation are designed in a way that shifting cultivation is not constrained. The number of shifting cultivation fields so that communities can proceed with their current livelihoods. However, if needs for additional fields arise, the communities will create these fields in the Savannah, i.e. without new deforestation (cp. Draft conservation and reforestation contracts).	5%	5%	0%

	- The support of agroforestry systems (funding: 12.43 million USD) is envisaged to create additional 120.28 million USD income for local communities over ten years. - Rehabilitation of cocoa, café, palm oil and rubber plantations (funding: 11.98 million USD) is envisaged to create additional revenues/ products in the amount of 29.11 million USD over 10 years). - The strategy for addressing emissions from charcoal does not aim at reducing the charcoal production volumes (which seems impossible considering Kinshasa's demand). The rationale is merely to provide incentives for replacing unsustainable- by sustainable charcoal production (Please refer to activities ES1 (Sectoral activity Assisted natural regeneration for charcoal production) , ES2 (Sectoral activity Afforestation/Reforestation for charcoal production) and EH1 (Enabling activity Formalization and strengthening of the wood-energy sector), Section 4.3)) while reinforcing governmental control on compliance with the national forest regulation. - Supported natural regeneration for charcoal production (funding: 3.39 million USD) is expected to produce additional 400,659 t of sustainable charcoal with a value of 9.08 million USD over ten years. This production of sustainable charcoal will complement traditional and currently unsustainable charcoal production, which is envisaged to phase out over time, so that the overall productivity remains at the same level. - Artisanal logging: The ER Program aims to reduce illegal logging in the program area by the establishment and reinforcement of logging checkpoints and on-site control. - Conservation concessions will stop timber operations and hence will reduce to a reduction of timber supply. The expected reduction amounts to 1,44 million m3 over five years. - Reduced Impact Logging is designed in a way to reduce the residual damage of logging operations and reduce road width and length but does not significantly reduce logging volumes. - The mitigation activity FS4 (Activité Afforestation / Reforestation pour la production de bois d'œuvre) aims at increasing timber supply on 6,000 ha over five years. The expected timber supply over the first five years amounts to 882,000 m3 that partially compensates for the reductions of conservation concession activities.			
Exposure and vulnerability to natural disturbances	The jurisdictional program does not perceive any large natural risks due to fire, pests, extreme weather events or any other natural risks. The forest areas are humid also during the dry periods and hence feature a low risk of burning. To substantiate this opinion, an analysis of the spatial distribution of fire incidents in the Mai Ndombe Province was conducted based on fire events recorded by the MODIS sensor aboard the Terra and Aqua satellites. Fire events from January 2002 to December 2014 were considered. Over these 13 years, a total of 138,174 fire events were recorded. Of these, 136,414 could be attributed to have occurred in either forest land or savannah / shrubland (based on a 2014 land cover map by Saatchi et al. 2015). From these total fire incidents, only 16.9% are in forest areas. Considering that a MODIS pixel features a length of 250m, a pixel represents 6.25ha. Assuming that the pixel was completely burnt (which is conservative), the (maximum) areas burnt represent 143,981.7ha. However, according to the results of the REL, the total areas that underwent forest cover change (i.e. primary deforestation, secondary deforestation and degradation) are estimated to 2,7 million ha over the period 2004 to 2014.²⁶ It is concluded that the existing fire detections do not sufficiently explain the measured forest area changes. The results of the analysis provide a strong indication that while fire is used by farmers to clear forests, these fires do not lead to larger scale forest fires as is e.g. the case in Indonesia and other Southeast Asian countries. The figure below shows a part of the Main Ndombe Province, South East of the Mai Ndombe lake. The figure illustrates that the large majority of fire incidents is located in Savannah and shrubland, where as fires in forested areas do not occur at large extent.	5%	5%	0%

²⁶ However, the results of the analysis may be biased insofar, as each MODIS fire location represents the center of a 1km pixel that is flagged by the algorithm as containing one or more fires within the pixel. As such, if the center of the fire location is at the edge of forest / non-forest patch, the fire may have occurred in either or both forest and non-forest. Further, it is important to note, that MODIS fire data does not allow assessing the total area burnt.

	Finally, an accurate LiDAR forest carbon stock map was developed. The map indicates density (in tons dry matter), which is converted to carbon stocks. If large loss events had occurred decades ago, the map would indicate large patches of young forests having low biomass/carbon stock volumes. However, such incidents were not identified			
		Total reversal risk set-aside percentage		20%
		Total reversal risk set-aside percentage from ER-PD or previous monitoring report (whichever is more recent)		20%

8 EMISSION REDUCTIONS AVAILABLE FOR TRANSFER TO THE CARBON FUND

		2019	2020	TOTAL
A.	Emission Reductions during the Reporting period (tCO ₂ -e)	7,778,823	8,571,061	16,349,884
	<i>from section 4.3</i>			
B.	If applicable, number of Emission Reductions from reducing forest degradation that have been estimated using proxy-based estimation approaches (use zero if not applicable)	0	0	0
C.	Number of Emission Reductions estimated using measurement approaches (A-B)	7,778,823	8,571,061	16,349,884
D.	Percentage of ERs (A) for which the ability to transfer Title to ERs is clear or uncontested	100%	100%	
	<i>from section 6.1</i>			
E.	ERs sold, assigned or otherwise used by any other entity for sale, public relations, compliance or any other purpose including ERs accounted separately under other GHG accounting schemes or ERs that have been set-aside to meet Reversal management requirements under other GHG accounting schemes	4,222,222	4,222,222	8,444,444*
	<i>from section 6.4</i>			
	If applicable, any buffer replenishments			
	<i>section 7.3 P</i>			
F.	Total ERs [(B+C)*D-E] minus, if applicable, any replenishments as per section 7.3, Q	3,556,601	4,348,839	7,905,440

G.	Conservativeness Factor to reflect the level of uncertainty from non-proxy based approaches associated with the estimation of ERs during the Crediting Period	from section 5.2	12%	12%	
H.	Quantity of ERs to be allocated to the Uncertainty Reversal Buffer ($0.15 * B / A * F$) + ($G * C / A * F$)		426,792	521,860	948,652
I.	Total reversal risk set-aside percentage applied to the ER program	from section 7.4	20%	20%	
J.	Quantity of ERs to be allocated to the Pooled Reversal Buffer (F-H)*I		625,961	765,395	1,391,356
K.	Number of FCPF ERs (F- H – J)		2,503,848	3,061,584	5,565,432
L.	Percentage of Emission reductions from enhanced removals from afforestation/reforestation as a percentage of the total removals [Optional if the country wishes to label these]	From section 4.3	0%	0%	
M	Number of FCPF ERs from enhanced removals from afforestation/reforestation (L * K) [Optional if the country wishes to generate enhanced removals]				
N	Percentage of Emission reductions from HFLD [Optional if the country wishes to label HFLD units]	From section 4.3	39.635094575%	39.635094575%	
O	Number of FCPF ERs from HFLD (N * K) [Optional if the country wishes to label HFLD units]		992,402	1,213,461	2,205,863

ANNEX 1: INFORMATION ON THE IMPLEMENTATION OF THE SAFEGUARDS PLANS

I. Requirements of FCPF on Managing the Environmental and Social Aspects of ER Programs

Implementation of safeguard measures

Following the Strategic Environmental and Social Assessment (SESA) process, the DRC has adopted an Environmental and Social Management Framework (ESMF) for REDD+ activities thanks to funding from the FCPF and other instruments, as well as the following five specific frameworks that address the particular risks of REDD+ investments. These included a Resettlement Policy Framework (RPF), a Process Framework (PF), an Indigenous Peoples Plan (IPP), an Environmental and Social Management Framework (ESMF), a Cultural Heritage Protection Framework (CHPF), and an Integrated Pest Management Framework (IPMF). They were closely based on the national REDD+ frameworks of the same names, produced earlier as part of the FCPF-funded REDD+ readiness activities in the DRC. In addition, the DRC has drawn up guidelines for a national framework on Free, Prior and Informed Consent (FPIC), in the context of REDD+.

The DRC has also developed its country [Safeguards Information System \(SIS\)](#)²⁷ or REDD+ as a comprehensive framework to ensure the effective implementation of environmental and social safeguards in the context of REDD+ activities. The development of the SIS involved a collaborative effort between the DRC government, international partners (UNEP, LEAF Coalition), and relevant stakeholders. The SIS was designed to address key elements of REDD+ safeguards, including the protection of biodiversity, respect for the rights of indigenous peoples and local communities, and the promotion of transparent and accountable governance. It provides a mechanism to monitor and evaluate the social and environmental impacts of REDD+ initiatives, ensuring that they adhere to the DRC's national standards and international commitments.

Functionally, the SIS serves as a centralized platform to collect, manage, and disseminate relevant information related to safeguards. It facilitates data gathering, analysis, and reporting, enabling stakeholders to monitor the implementation of REDD+ projects and programs and assess their compliance with safeguards. The SIS incorporates various components, including data management, indicators, monitoring frameworks, and reporting mechanisms. In addition, the DRC prepared and published its [First Summary of Information on Safeguards to the UNFCCC in 2022](#). To ensure the effective functioning of the SIS, capacity building initiatives will continue to be conducted to enhance the technical expertise of relevant stakeholders in data collection, analysis, and interpretation.

Participatory process for developing the ERP

Consultations with stakeholders on the safeguard documents and on the overall ER REDD+ program have been extensive. The CN-REDD established a constructive dialogue with civil society and Indigenous Peoples' organizations over a long period. All major REDD+ documents were subject to multiple consultations with hundreds of stakeholders as documented in the Readiness Package. The various stakeholders involved in the development of the ERP were organized in working groups around the main ERP themes, in which the national civil society platform (Working Group on Climate and REDD+ known as GTCR-R) and IP network (Network of Indigenous and Local populations for the Sustainable Management of Forest Ecosystems – REPALEF) participated on a regular basis. In addition, significant efforts were undertaken over three years to inform and consult with local stakeholders in the Mai-Ndombe province. The Congolese Organization of Ecologists and Friends of Nature (OCEAN), a Non-Governmental Organization (NGO), was contracted by CN-REDD to lead consultations with local communities and IPs, who mandated representatives from the 19 sectors in the eight territories to participate. The consultation process is fully documented in the [ERP](#) and in the [BSP](#).

II. Monitoring and Reporting Requirements

²⁷ DRC Safeguard Information System is not currently online. Efforts are underway with CN-REDD (with OPERPA support) to update the report and publish the SIS online by October 2025.

1. Entities that are responsible for implementing the Safeguards Plans are adequately resourced to carry out their assigned duties and responsibilities as defined in the Safeguards Plans.

1.1 Summarize the key institutional arrangements, such as decision procedures, institutional responsibilities, budgets, and monitoring arrangements that are required under the Safeguards Plans.

The implementation of environmental and social measures is subject to monitoring in order to ensure that all the mitigation measures provided for in the safeguard plans are implemented in the [Improved Forested Landscape Management Project \(IFLMP\)](#) that contributed to emissions reductions through the Integrated REDD+ project (PI-REDD) in the Plateau district (Component 1 of the IFLMP) and PI-REDD in Mai Ndombe ([Additional Funding](#)). During the implementation of the IFLMP project, a Gender-Based Violence (GBV) action plan was developed. In 2020, a study was conducted to map first response services for GBV and multi-sectoral support services for survivors in the province of Mai Ndombe. Community focal points have been designated to enhance the functionality of the SEA/SH sensitive management and GRM.

The Forest Investment Program Coordination unit (FIP-CU) is in charge of implementing both PI-REDD Plateau and PI-REDD Mai Ndombe and has dedicated safeguards staff. FIP-CU contracted two delegated Implementation Agencies (DIA). Each DIA has a dedicated specialist based in the field and assigned in the management of environmental and social safeguards. They were receiving an oversight from the FIP-CU safeguard specialist. At the field level, each agency had a base manager in each territory who relays the monitoring of environmental and social measures, including the Grievance Redress Mechanism (GRM), under the supervision of the specialist in E&S safeguards at the field level. To operationalize the GRM at the territorial level, two individuals have been designated as focal points within the Management Committee of the established Local Development Committee (LDC). One focal point handles general complaints at the LDC level, while the other, preferably a woman, serves as contact for sensitive complaints related to Gender-Based Violence (GBV). A budget of approximately US\$750,000 has been allocated for the implementation of Environmental and Social (E&S) safeguards.

During FIP-CU joint monitoring missions with DIA, the safeguard specialist conducts refresher sessions with the field-based safeguards specialists. The field-based specialists in turn replicates the refresher sessions with the stakeholders as needed. These refresher training sessions focused on i) monitoring the implementation of the grievance and redress mechanism, ii) monitoring the implementation of environmental and social management instruments, iii) monitoring incidents and accidents, iv) monitoring the process of obtaining FPICs from communities, v) monitoring E&S with recommendations etc. The stakeholders trained include the staff of the delegated implementing agencies and members of the local development committees. The Table 1 below summarizes the organized trainings.

Table 1. Summary of organized trainings

N°	Date	Place / Provincial territories	Male	Female	Total	Topic	Domain
1	May 2019	Inongo, Oswhe, Kutu, Kiri	119	85	204	Procedure to raise and lodge grievances	Grievance redressal mechanism (GRM)
2	May 2019	Inongo, Oswhe, Kutu, Kiri	381	125	506	Application of FPIC in participatory land allocation procedures	FPIC Land use planning
3	July 2019	Inongo, Oswhe, Kutu, Kiri	36	9	45	Training on social and environmental screening	Environmental and Social Safeguards
4	August 2019	KIRI	10	4	14	Strengthening capacities of LDCs Board members and Conservation Committees	Governance

5	July to September 2019	Inongo, Oswhe, Kutu, Kiri	1479	372	1851	Training on GRM, LDCs, participatory diagnosis and participatory mapping	Land use planning, agriculture and GRM
6	January to March 2020	Inongo, Oswhe, Kutu, Kiri	512	95	607	Training of tree nurseries managers on plastic waste and monitoring of nurseries activities	Forestry and Waste Management
7	April to June 2019	Inongo, Oswhe	22	4	26	Training of tree nurseries managers on plastic waste and monitoring of nurseries activities	Forestry and Waste Management
8	April to June 2020	Inongo, Oswhe, Kutu, Kiri	228	35	263	Provision of potting soil and waste management for seedlings production	Forestry and Waste Management
TOTAL			2787	729	3516		

1.2 Confirm whether the institutional arrangements summarized above have been put in place.

The certification of routine data generated by the monitoring-evaluation system occurs at both the Local Implementing Agencies (LIA) and the FIP-CU levels. Regular validation meetings were held between the monitoring-evaluation experts of the FIP-CU and those of the Local Implementing Agencies to verify and validate the data before transmitting the report to the World Bank.

Additionally, during joint monitoring and evaluation missions, as well as georeferencing (GIS - Geographic Information System) of activities and environmental and social safeguards missions, teams from the FIP-CU and the agencies implementing field activities conducted quality assurance exercises on the data reported in various reports. These reports included E&S screening missions, E&S instrument implementation missions, and missions to prepare and validate disputed Natural Resource Management Plans (NRMPs), among others. The mission summary reports are provided below.

- i. For the mission on socio-environmental screening and information on safeguard policies in Inongo-Mai Ndombe, carried out from June 01 to 05, 2019, the aim was to assess socio-environmental concerns in connection with the construction of the project office building, and also to train staff (in particular PIREDD Mai-Ndombe field staff) on the World Bank's operational E&S policies and best practices relating to the environmental and social assessment process.
- ii. The joint monitoring-evaluation, socio-environmental safeguards and GIS mission organized from September 03 to 24, 2020 aimed to i) assess the operationalization of the Grievance Redress Mechanism, including GBV issues, ii) assess the progress made in implementing safeguard tools, iii) to assess the implementation of specific safeguard instruments, in particular the ESMP for the office and roads infrastructure, iv) to take stock of the implementation of the Plan for Indigenous Peoples (IPs) and launch of micro-projects for IPs v) to assess incidents/accidents recorded during the implementation of activities, vi) to assess the beneficiary consultation process and their participation mechanism, and to build the capacity of PIREDD/Mai-Ndombe teams in socio-environmental safeguards.
- iii. The mission to process and prepare for the validation of four disputed natural resource management plans (NRMPs) in the Bolobo territory, was carried out from November 25 to December 03, 2019. This mission team comprising representatives of FIP-CU, civil society and the Project Implementation Agency, was carried to examine and assess the reasons for the suspension of the validation process of the four NRMPs in order to provide guidelines for the continuation of the validation process. These are the NRMPs of the Kemvuma territory (Groupement Bwema) and the Nkometo, Bonkwi and Nkuru territories (Groupement Mbee Nkuru). During the mission, the following activities were carried out i) raising community awareness of PIREDD Plateaux activities and the land-use planning and development approach linked to the preparation of the NRMPs, ii) identifying the various problems blocking the validation of PGRNs in the four Bolobo territories, iii) reconciling of the different points of view and reaching

a consensus among all parties, obtaining FPIC for the validation of the four disputed NRMPs and iv) formulating recommendations for a consensual resolution of disputes concerning four local NRMPs.

These missions aimed to ensure that activities were implemented in accordance with the project document's guidelines. The outcome of these missions was a set of recommendations designed to enhance activity implementation in the field. In practice, before the implementation of activities, the project actively organized community consultations and awareness-raising efforts through Free, Prior, and Informed Consultation (FPIC) to ensure that the communities' views are considered. The various consultations and information sessions were organized in the territories of the two districts (Plateau and Mai Ndombe) within the framework of the PIREDD Mai-Ndombe, with a view to facilitating land use planning activities and participatory mapping with the communities. These various awareness-raising activities and consultations enabled the communities to better understand the project, to freely accept the implementation of activities within their territories, to accept the structuring of communities into CLDs and to agree to carry out and produce Simple Land Use Management Plans (SMP) for their territories.

The figures below illustrate the spatial distribution of the 480 established Local Development Committees (CLD) in Mai-Ndombe and the 215 in the Plateau following FPIC:

Figure 1: Established Local Development Committee (CLD) in the territories following Free, Prior and Informed Consultation (FPIC) in the Mai-Ndombe district

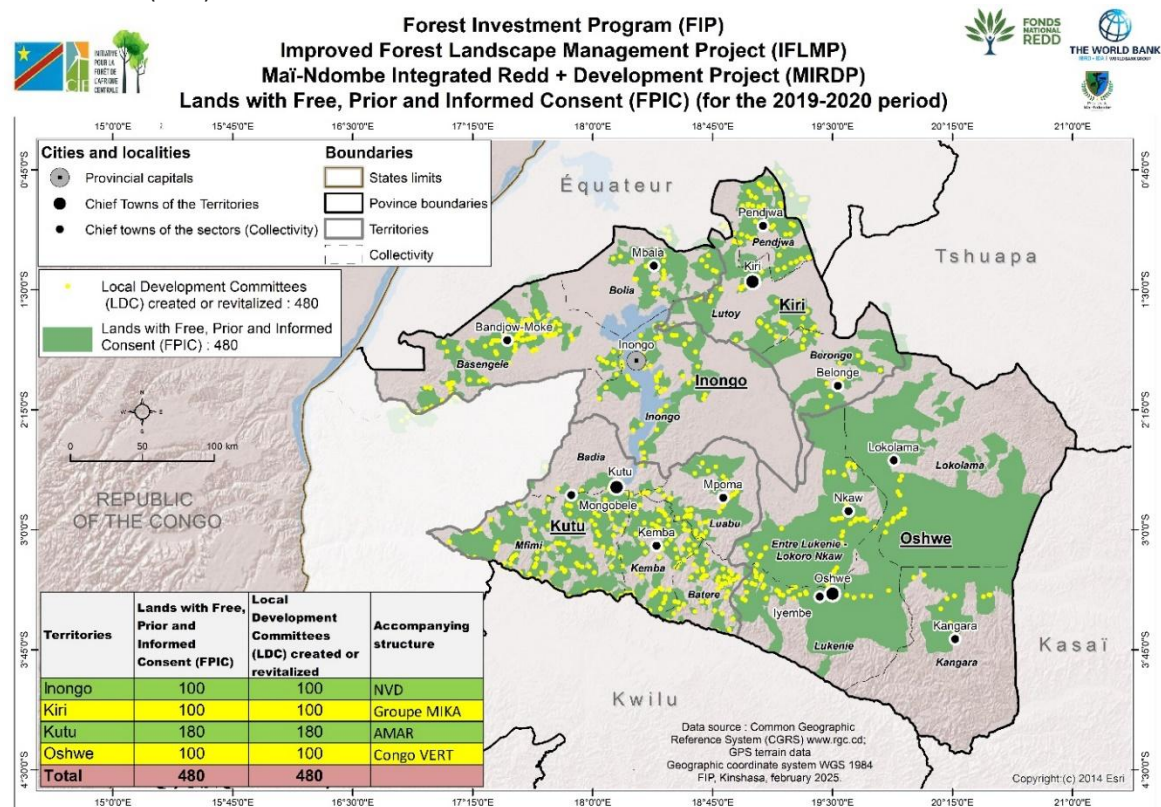
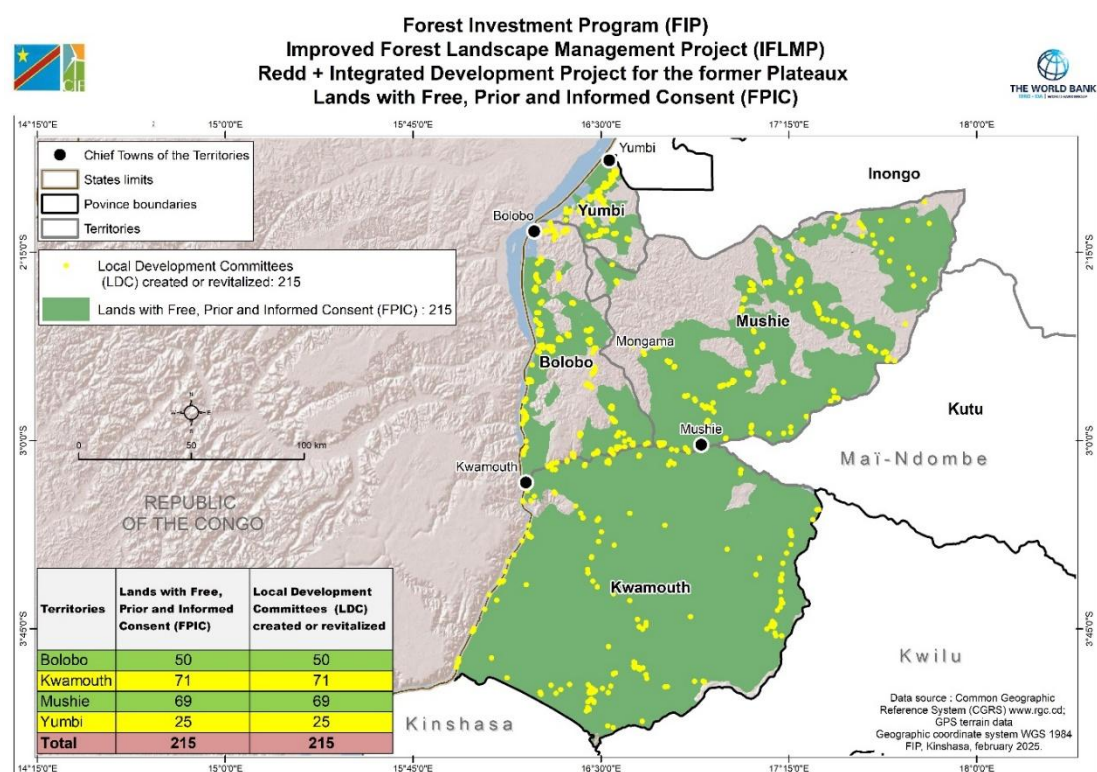


Figure 2: Established Local Development Committee (CLD) in the territories following Free, Prior and Informed Consultation (FPIC) in the Plateau District



1.3 Confirm that the implementing entities and stakeholders understand their respective roles; have the technical capacity to execute their responsibilities; and have adequate human and financial resources.

Environmental and Social Management Framework (ESMF) clearly indicates the roles and responsibilities for implementation and monitoring. With regards to the ERPA, the institutional arrangements will follow the provisions of the BSP. At the national level, the FONAREDD Steering Committee of (COPIL) is established and has an oversight function for the project. Regarding ERP payments, a designated account for the funds is opened in a commercial bank and the FIP-CU will be responsible for channelling ERP payments to beneficiaries, in accordance with the BSP. Fiduciary risk mitigation measures are in place (notably the continuous assessment of the FIP-CU by the World Bank) and the specific needs of the ERP will be the subject of detailed procedures in the ERP Procedures Manual. In addition, the project will coordinate closely with the FONAREDD Executive Secretariat with the view to ensuring a continuous improvement of the national REDD+ tools. Furthermore, the FIP-CU, which acts as the Program Management Unit, is responsible for guiding and ensuring compliance with safeguards requirements for the ER-Program. The FIP-CU, through its Social and Environmental Risks Management team, will be therefore responsible for helping beneficiaries, to ensure that all activities comply with the social and environmental safeguard plans of the ERP.

1.4 Where specific capacity building measures (e.g., training and professional development) have been required by the ER Program or Safeguards Plans, describe the extent to which these measures have been carried out.

As described in the section 1.1, during the implementation of the activities and during the supervision missions, cascade training was deployed to give as many as possible hands-on experience on environmental and social issues.

2. ER Program activities are implemented in accordance with management and mitigation measures specified in the Safeguards Plans.

2.1 Confirm that environmental and social documents prepared during Program implementation are based on the Safeguards Plans. Provide information on their scope, main mitigation measures specified in the plans, whether the plans are prepared in a timely manner, and whether disclosure and consultation on the plans are carried out in accordance with agreed measures.

In accordance with environmental and social safeguard instruments, plans for indigenous peoples, pesticide management plans, environmental and social management plans and complaints management mechanisms have been developed by the IFLMP financed by the World Bank and located in the ERP area. Several measures have been taken to mitigate and optimize environmental and social impacts. These measures were applied as appropriate, at project and component level, after disclosure of plans to stakeholders.

Table 2. Overview on mitigation measures, associated activities and outcomes

E&S Measurement	Activities	Period	Outcomes
Environmental and Social Screening	Selection and Implementation of Activities (Nursery site selection and establishment, Planting site selection, enclosure site selection)	Continued	Reduced Risk of Land Conflict, Involuntary Displacement, and Loss of Biodiversity
Utilizing the Activity Exclusion List: Ensure the selected site is not located close to Key Biodiversity Areas, protected areas under the	Delineation of enclosures, Establishment of agroforestry plantations	Every year prior to the start of the plantation activities	- Risks to biodiversity and protected areas Mitigated and Compliance with National and International Requirements: - environmentally friendly agroforestry practices adopted and plantations established

E&S Measurement	Activities	Period	Outcomes
Convention on Biological Diversity. - Confirm that the project does not have a high environmental impact. - Avoid the use of prohibited agrochemicals."			
Community sensitization and mobilization	Training on agroforestry and sustainable land management practices	All year round	Community Engagement and Best Practices adopted
Community awareness on Grievance Redress Mechanism (GRM)	All project activities	Continued	Grievances from Communities and Stakeholders documented and resolved
Provision and training on the use of Personal Protective Equipment (PPE)	Nursery Preparation, Ground Preparation, and Plantation Establishment	Continued	Occupational Accidents and Injuries Prevented and reduced
Community consultations through Free, Prior and Informed Consultations (FPIC)	- Beneficiary Community Identification - Participatory mapping of resource - Development of Simple Land Use Planning (SLUP)	Continued	Communities are fully aware, adequately informed, and their views are actively considered in decision-making processes.
Selection of adapted species, agroecological practices and degraded savannah zone	- Species choice and Species-sites matching - Types of reforestations (monoculture, mixed plantation) activities - Tree seed management	Quarterly	Forest cover and agricultural productivity improved
- Training courses on waste management, waste management safety, sustainable materials management and Waste Sorting - Preventing scattering and leakage in temporary storage and vehicle parking - Benefits of Biodegradable Plastic Bags	- Plastic waste from plantations - Vehicle maintenance waste - Storage of fuels (for motorbike, vehicle, tractor, power generator)	Continuous: nursery preparation period, during vehicle parking and maintenance, during fuel stock renewal	- Amount of waste that goes into landfill significantly reduced - Harmful effects of waste on the environment and human health significantly reduced
Food seeds and planting material quality verification	Purchase of food seeds and planting material for associations in agroforestry activities	Before each rainy season	Agricultural enhanced productivity thanks to readily available climate-resilient seeds and planting materials

E&S Measurement	Activities	Period	Outcomes
• Signing of code of conduct • Ensuring ethical and socially responsible production	All project activities	Continued	• Local community and worker rights effectively protected and upheld • Stakeholders demonstrate strong commitment to complying with measures addressing GBV/SEA/SH
Standards on good agricultural and environmental conditions of land	• Risk of introduction of unauthorized GMOs • Risk of excessive use of chemical fertilizers • Ban on burning on arable land • Tillage management and other appropriate techniques to reduce risk of soil degradation	Continued	• Environmentally friendly agricultural practices widely promoted and adopted. • Procedures outlined in the Pest and Pesticide Management Plan are fully complied with
• Facilitation of the recruitment of local implementing agencies • Good representation of local community during recruitment • Training in agroforestry techniques and sustainable management • Dissemination via local authorities, community radio	• Recruitment of structures to implement activities • Implementation of project activities in selected areas • Advertise jobs at local level	Continued	• Inclusion fostered, and new opportunities created for local communities. • Technical and professional capacities significantly strengthened • Local economy stimulated, and project ownership effectively built among stakeholders.
Representation of minorities and vulnerable groups in the board of the Local Development Committee (LDC)	• Activity of structuring the communities and organizing community initiatives to achieve shared goals • Establishment and creation of an LDC management committee	Continued	• Minorities and vulnerable groups actively participate in relevant initiatives and decision-making processes. • Social inclusion achieved, and respect fostered within the community
• Production of Plan for indigenous people development • Consultation and prioritization of IP activities	Implementation of the planning framework for the indigenous peoples	Prior to the implementation of activities in areas inhabited by indigenous peoples	Engagement with indigenous people thoughtfully considered and integrated into relevant processes and initiatives.

2.2 Confirm if entities responsible for implementing the Safeguards Plans maintain consistent and comprehensive records of ER Program activities such as records of administrative approvals, licenses, permits, documentation of public consultation, documentation of agreements reached with communities, records of screening process, due diligence assessments, and records of handling complaints and feedback under the Feedback and Grievance Redress Mechanism (FGRM).

Routine data verification is done at the delegated Implementation Agencies level and/or Local Execution Agencies (ALEs) and at the PMU level through the management system of the program's monitoring and evaluation mechanism. Regular validation meetings were organized between monitoring and evaluation experts from the PMU and those from the implementing agencies to verify and validate the data prior to the transmission of the report. The FIP-CU submits quarterly reports to the Bank. The online complaints register is also regularly updated (<https://shorturl.at/cVYi6> and <https://shorturl.at/FJGjD>)

2.3 Summarize the extent to which environmental and social management measures set out in the Safeguards Plans and any subsequent plans prepared during Program implementation are implemented in practice, the quality of stakeholder engagement, as well as whether field monitoring and supervision arrangements are in place.

All activities, including those related to FPIC consultations, underwent Environmental and Social (E&S) screening based on the Environmental and Social Safeguards to ensure the proper implementation of measures addressing E&S concerns before any activity commenced. Additionally, the [Project Implementation Manual \(PIM\)](#), in its chapter on E&S management, provides comprehensive guidelines for the effective implementation of the measures outlined in the instruments.

Review of E&S risks table including mitigation measures

Social and Environmental Risks	Completeness	Measures
Land Conflicts: Issues Related to Access and Land Rights	Yes	▪ Securing land tenure before site selection: ensure that selected sites have established land tenure security through participatory land mapping and contractual agreements with communities facilitated by Local Development Committees (LDCs). ▪ Utilization of local dispute resolution mechanisms: employ local mechanisms for managing and resolving land disputes to maintain harmony and fairness. ▪ Engagement of traditional chiefs and local authorities: involve traditional chiefs and local authorities in the site selection process and in providing land for project activities to ensure cultural and administrative alignment. ▪ Development and strengthening of land mediation bodies: establish or enhance local land mediation bodies, such as village reconciliation commissions, to clarify land rights and resolve disputes. ▪ Regular intercommunity meetings: organize regular meetings among communities to ensure transparency and fairness in the allocation of land for agroforestry projects
Risk of Water-Induced Soil Erosion and Land Degradation	Yes	▪ Reduce mechanization on slopes: to prevent soil erosion and land degradation. ▪ Contour line tree planting: promote the planting of trees along contour lines to enhance soil stability. ▪ Community awareness on land management: conduct sensitization campaigns to educate communities about effective land management practices and the risks associated with erosion
Chemical Pollution from Agricultural Inputs: Soil and Water Contamination Due to Pesticides, Herbicides, and Chemical Fertilizers	Yes	▪ Encourage organic pest control and fertilization: advocate for the use of organic inputs for pest control and fertilization to promote environmentally friendly agricultural practices. ▪ Utilize approved products: ensure that only products approved by the FAO/WHO are used, accompanied by comprehensive safety instructions to protect users and the environment. ▪ User training on safe product application: provide training to users on the safe application of products, emphasizing best practices and safety measures. ▪ Ensure Availability of Personal Protective Equipment (PPE): guarantee the availability of essential PPE, including masks, gloves, and boots, to safeguard users during product application. ▪ Develop and execute a management plan for leftover inputs, including consignment and controlled disposal, as part of the Pesticide Management Plan to minimize environmental impact.
Plastic Waste Management: Challenges with Uncollected, Dispersed, or Incinerated Nursery Bags	Yes	▪ Utilization of Biodegradable Bags in Nurseries: implement the use of biodegradable bags for nursery establishment to reduce environmental impact and promote sustainability. ▪ Training on Bag Management and Reuse: provide training to nursery staff and community members on the effective management and systematic collection of biodegradable plastic bags for reuse. ▪ Creation of Fixed Collection Points: establish fixed collection points at each site to facilitate the organized collection and recycling of biodegradable bags. ▪ Awareness Campaign on Plastic Sorting and Impact: conduct awareness campaigns to educate communities about the importance of sorting plastics and understanding their environmental impact.

Occupational Health and Safety: worksite and transport accidents involving machinery and vehicles, alongside the risk of communicable diseases such as HIV/AIDS and malaria among workers and communities	Yes	▪ Routine Vehicle Inspections: Conduct regular maintenance and technical inspections of vehicles, and maintain detailed logbooks to ensure operational safety and efficiency. ▪ Ensure Comprehensive Insurance Coverage: guarantee that vehicles are insured and that workers have access to health insurance to protect against unforeseen events. ▪ Risk Awareness and Prevention: Raise awareness about work-related risks and implement preventive measures to enhance workplace safety. ▪ Security and Safety Training: Provide training sessions focused on security and safety to equip workers with the knowledge and skills needed to handle potential hazards. ▪ Health Awareness Campaigns: Organize health awareness campaigns addressing communicable diseases, STIs/HIV, and malaria to promote community health and well-being. ▪ Availability of Medical First Aid Kits: Ensure that medical first aid kits are readily available to address any immediate health needs or emergencies.
Inequitable Access to Project Resources: Elite or Privileged Group Domination	Yes	▪ Formation of Local Development Committees (LDCs): establish LDCs to facilitate participatory land use planning and ensure equitable distribution of benefits from project activities. ▪ Transparent Benefit Sharing: implement a transparent benefit sharing across different geographical areas, including area quotas and equipment allocation, to ensure fairness and inclusivity. ▪ Community-Driven Project Activities: engage community members in activities such as nurseries and plantations, organized around the LDCs, to collectively harness the incentives and investments provided by the project.
Persistent Land and Community Conflicts: Tensions Over Land Access and Land Use	Yes	▪ Development and enhancement of local land mediation bodies: establish or strengthen village conciliation commissions to facilitate effective land dispute resolution and mediation. ▪ Facilitation of regular intercommunity meetings: organize regular meetings among communities to foster dialogue, cooperation, and mutual understanding. ▪ Ensuring transparency in land allocation: implement transparent processes for land allocation to build trust and accountability among stakeholders. ▪ Participatory community mapping: Engage communities in participatory mapping exercises, involving customary authorities throughout the process to ensure cultural relevance and inclusivity.
Fire hazard risk	Yes	▪ Procurement and installation of fire extinguishers: acquire and install fire extinguishers in office spaces to enhance safety and preparedness. ▪ Deployment of sandboxes: set up sandboxes as an additional fire safety measure. ▪ Creation of firebreaks and use of prescribed burns: Establish firebreaks and conduct prescribed burns when necessary to prevent and manage potential fire hazards effectively.
Non-Participation of local communities: challenges in engagement, including low involvement in planning and implementation, lack of interest in agroforestry activities,	Yes	▪ Securing Free, Prior, and Informed Consent (FPIC): Engage beneficiaries through consultations and information sessions to obtain FPIC, ensuring their informed agreement and participation. ▪ Community Awareness and Sensitization Campaigns: organize regular campaigns and continuous and tailored communication using community radios, local posters, and village meetings to educate communities on the project's objectives, benefits, and their roles.

perceptions of exclusion, and weak ownership of outcomes		▪ Inclusive Planning and Participation: Involve communities actively from the planning stage, ensuring their engagement in site identification, species selection, and the adoption of suitable agroforestry approaches. Utilize participatory tools like community maps, suggestion boxes, and focus groups to capture community priorities. ▪ Development and implementation of a GRM to address concerns and complaints ▪ Formalizing Partnerships: Sign collaboration protocols with relevant partners to strengthen cooperation and support project objectives.
Harassment and Sexual Exploitation and Abuse (SEA/SH) at Worksites, Particularly at Mobilization Sites and Plantations	Yes	▪ Awareness and Commitment to the Code of Conduct: Conduct sensitization sessions and ensure all individuals sign the code of conduct to affirm their understanding and commitment. ▪ Visibility of Regulations: Prominently display rules and guidelines on-site. ▪ Enforcement of Immediate Sanctions: Implement prompt disciplinary actions in the event of any violations to uphold standards and deter misconduct. ▪ Staff Training on Prevention: Provide comprehensive training for staff focused on preventing sexual harassment and exploitation, fostering a safe and respectful work environment.
Unresolved community grievances: issues with benefit sharing, working conditions	Yes	▪ Establishment of Focal Points in LDCs: Ensure dedicated representatives are present to address local needs and facilitate communication. ▪ Comprehensive complaint management: Implement a system for the registration and ongoing monitoring of all complaints to ensure timely resolution
Social Exclusion and Inequality: Marginalization of Women, Youth, and Minorities in Project Governance	Yes	▪ Implementation of Social Inclusion Strategies: ensure participation quotas for women and young people are met during information sessions, training programs, and awareness-raising activities. ▪ Gender Representation in Management: mandate the inclusion of women on management committees at the Community Governance Development (CGD) level. ▪ Inclusive decision-making on incentives: require women's participation in household-level decisions regarding the allocation of project incentives. ▪ Community engagement in site selection: Obligate the involvement of women and young people in selecting community sites for plantation development.

In addition, the World Bank conducted a gender-based violence (GBV) Risk Assessment Portfolio Review in 2018 in the DRC which led to the following project-specific recommendations that were implemented for the IFLMP and its Additional Financing during the current reporting period:

- Integrate gender discussion groups for women, especially those participating in the village savings and credit initiatives, including sharing of household decision-making and financial management (women being able to safely discuss strategies of how to manage the money they earn). If possible, include discussion group activities with husbands/male family members, with the objective of making positive changes to the status of women within the household and contributing to the reduction of the risk of intimate partner violence related to changing gender dynamics by providing men and women with skills in non-violent conflict resolution.
- Increase target from 30 percent to 50 percent female participants in consultation activities during project implementation, to align with the objective of fair representation and full participation of women.
- Include assessment of project-related impacts that reflect gender-differentiated outcomes, including unintended exacerbation of risk of GBV. For example, if cook stoves save time in cooking, understand how women spend that time instead.

2.4 Confirm that the FGRM is functional, supported with evidence that the FGRM tracks and documents grievances, is responsive to concerns, complaints or grievances.

The IFLMP has implemented an FGRM in Mai-Ndombe. This FGRM was developed in alignment with the national REDD+ process and became fully operational after a year-long implementation phase that began in July 2017. To facilitate the launch, a total of six workshops were organized through the Rural Agricultural Management Councils (CARGs). These workshops saw the participation of over 300 individuals from local structures, Local Development Committees (CLDs), decentralized technical services, land chiefs, and civil society. At the conclusion of the workshops, participants were provided with pre-established grievances registration, and appeal forms available in both French and local languages. Additionally, several radio and TV broadcasts were organized featuring local political and administrative authorities, opinion leaders, and technical departments (Environment, Rural Development, Agriculture) to enhance public awareness about the FGRM. The Grievance Redress Mechanism (GRM) is fully functional, with the registry made public. All complaints are documented, and all concerns raised have been resolved.

Grievances can be submitted to:

- plaintesrecours.pif@gmail.com
- FIP-CU
- LIAs
- Local Development Committees (LDC) or Agricultural and Rural Management Councils at local level.

The table below gives an illustration by project of the number of complaints received.

Period	Number of grievance per project		
	PIREDD PLATEAUX	PIREDD Mai-Ndombe	Total
Q1, 2019	7	4	11
Q 2, 2019	1	0	1
Q 3, 2019	0	4	4
Q 4, 2019	6	2	8
Q 1, 2020	*	6	6
Q 2, 2020	*	6	6
Q 3, 2020	*	3	3
Q 4, 2020	*	16	16
Total	14	41	55

* Closure of the component

During the years (2019-2020) of PIREDD plateaux and "PIREDD Mai-Ndombe, a total of 55 complaints had been received at the various contact points set up by the project. Of these, 51 were handled satisfactorily. The various complaints received related to delays in payment for environmental services by certain beneficiaries, claims by certain structures on the shortlists of local agencies published for the implementation of the Simple Land Use Plan in the Mai Ndombe district, the low transport rate for workshop participants, non-validation of the NRMPs for political, administrative and succession conflict reasons, destruction of plantations by stray animals, claims for support not provided for in the contract. It should be noted that the 4 unprocessed complaints were linked

to the refusal to validate the Natural Resource Management Plan (NRMPs) in the Bolobo territory²⁸. A joint FIP-CU, LIA and civil society mission had been dispatched to Bolobo to understand the reasons for the communities' refusal to validate the said NRMPs. The mission recommended suspending the validation process and referring the matter to the Provincial Steering Committee for a ruling.

The FGRM was updated in June 2021 in response to a review and feedback from the World Bank that aimed to enable it to cover the whole Mai-Ndombe ER Program zone. In the context of ERPA activities, the FGRM has been updated to: i) integrate specific FGRMs in all projects nested in the ER Program; and ii) register and document grievances and response measures at national REDD+ FGRM level once the National REDD+ Registry is online. FGRM operationalization and implementation at national level will also be supported by the [Support to the operationalization of the Emission Reductions Payment Agreement under the Mai-Ndombe ER Programme](#) (OPERPA) project. FIP-CU will be responsible for the daily monitoring of ER Program implementation.

3. The objectives and expected outcomes in the Safeguards Plans have been achieved

3.1 Assess the overall effectiveness of the management and mitigation measures set out in the Safeguards Plans.

Most monitoring missions conducted by the World Bank's Project Coordination and Supervision Units have reported that the emission reduction activities implemented in the program area through the PI-REDD Plateau and PI-REDD Mai Ndombe projects have adhered to environmental and social safeguards. No major outstanding issues were reported.

3.2 Are the arrangements for quality assurance, monitoring, and supervision effective at identifying and correcting shortcomings in cases when ER Program activities are not implemented in accordance with the Safeguards Plans?

The following quality assurance mechanism was in place under the IFLMP:

- **Monitoring system:** As part of the implementation of activities under the Forest Investment Program, a monitoring and evaluation manual for the project has been drafted and validated. This manual describes: (i) how results will be measured, (ii) how monitoring reports are drawn up and (iii) how evaluations are carried out. The guidelines contained in the manual are more strategic than operational. To consolidate the achievements of the various initiatives, it was decided to produce a manual of operational procedures for monitoring and evaluation, with a view to informing and guiding the various stakeholders involved at grassroots level in the production of strategic information, on the operational procedures to be observed in carrying out their tasks. The operational procedures contained in this manual can be adapted to the different types of projects to be implemented by FIP-CU.

3.3 Describe the supervision and oversight arrangements to ensure that the Safeguards Plans and, if any, subsequent environmental and social documents prepared during Program implementation are implemented. Are these supervision and oversight arrangements effective (e.g., provide meaningful feedback mechanism to implementing entities to allow for corrective actions)?

- **Quality assurance:** Certification of routine data generated by the M&E system is carried out at both LIA and FIP-CU levels. Validation meetings were held regularly between the experts in charge of monitoring-evaluation at FIP-CU and those at the LRAs, to validate the data prior to transmission of the report.
- **Field visits:** In addition to the FIP-CU reviewing the reports produced by the LIAs, combined monitoring-evaluation, GIS and Safeguarding missions were carried out to ensure that activities were being implemented according to the approaches set out in the project document. These missions resulted in

²⁸ Bolobo Territory is an administrative region of Mai-Ndombe Province of the Democratic Republic of the Congo. The headquarters is the town of Bolobo. The territory lies on the east side of the Congo River, opposite the Republic of the Congo.

a matrix of recommendations to be observed to improve the implementation of activities in the field. FIP-CU experts also capitalized on these moments to gather the opinions of project beneficiaries on the way in which activities were being carried out, as well as to exchange views with local authorities.

4 Program activities present emerging environmental and social risks and impacts not identified or anticipated in the Safeguard Plans prepared prior to ERPA signature.

4.1 Is the scope of potential risks and impacts identified during the SESA process continue to be relevant to ER Program activities?

The risks and impacts identified by the SESA for the period corresponding to the retroactive period are those previously identified in the Safeguard Plans. With the exception of risks related to contamination from the Covid-19 pandemic, which was not identified during the development of the safeguard instruments.

4.2 During implementation, has any ER Program activities led to risks or impacts that were not previously identified in those Safeguard Plans prepared prior to ERPA signature? If so, what are the proposed actions to manage such risks and impacts that were not anticipated previously?

The IFMLP safeguards instruments were established in 2014 and revised in 2017. A further updating of all the frameworks has been done, to reflect the additional financing for the PI-REDD Maï Ndombe. Additional consultations were carried out in Kinshasa at a workshop in November 2018 with major stakeholders. Further local-level consultations were carried out throughout project implementation. Two of the social frameworks were substantively updated. The Process Framework was adapted to address issues specific to Tumba Lediima Natural Reserve. The [Indigenous Peoples Plan](#) (IPP) was similarly updated to reflect the additional financing directed to benefit indigenous peoples. However, because of the additional activities under the additional funding for the PI-REDD Maï Ndombe, the existing safeguard documents ([ESMF](#), [RPF](#), [PF](#), [IPP](#) and [IPMF](#)) have been updated and re-disclosed both in-country and by the World Bank (in January and February, 2019). A consultant was recruited to update the various instruments. REPALF was responsible for carrying out consultations in the field and assisting in the production of the updated BSP. The consultations were carried out in the PIREDD Mai-Ndombe territories. To describe these changes, the integrated safeguards datasheet (ISDS) was also updated and re-disclosed.

5. Corrective actions and improvements needed to enhance the effectiveness of the Safeguards Plans.

5.1 Provide a self-assessment of the overall implementation of the Safeguards Plans

In general, the safeguards plans were implemented during the reporting period as 'Satisfactory' and no significant concerns have arisen either for social or environmental issues (see detail in Annex 1, Table 2). The basic elements were related to the availability of instrument implementation reports at Delegated Implementing Agency level, the number of complaints received and dealt with, major incidents/accidents noted during the implementation of activities, the availability of the specialist within the Delegated Implementing Agency, the E&S provisions in the signed contract (these provisions typically include details on environmental assessments, stakeholder engagement, mitigation measures, compliance with relevant laws, and reporting requirements to monitor E&S performance), etc.

5.2 List any corrective actions and areas for improvements. Take care to distinguish between: (i) corrective actions to ensure compliance with the Safeguards Plans; and (ii) improvements needed in response to unanticipated risks and impacts

The safeguards plan implementation during the reporting period was "satisfactory". Some minor issues were noticed and were related to the availability of reports on the implementation of the instruments at the delegated implementing agencies level, the number of complaints received and addressed on time. All weaknesses identified during 2019-2020 were corrected by:

- Raising awareness and establishing a training program stakeholder on environmental and social management.

- Strengthening the capacities of stakeholders in environmental and social assessment, environmental and social monitoring;
- Re-engaging the ERP management bodies for the REDD+ process;
- Follow up of the operationalization of the FRGM to meet the ERP needs
- Follow-up of the awareness raising on the ERP specific safeguard instruments (ESMF, RPF, PF, IPP and IPMF)

5.3 *Describe the timeline to carry out the corrective actions and improves identified above.*

These corrective measures will be carried out throughout the duration of the ERP. The government has formally sent a request of extension till June 30, 2027.

ANNEX 2: INFORMATION ON THE IMPLEMENTATION OF THE BENEFIT-SHARING PLAN

I. Requirements of FCPF on Benefit Sharing Plan

The development of the [Benefit Sharing Plan](#) (BSP) of the ER-Programme Mai Ndombe followed the guidelines defined by the Carbon Fund of the FCPF. The BSP is the result of a process of stakeholder participation and was conceived to meet the criteria set out in the Methodological Framework of the FCPF Carbon Fund (Criteria 29 to 33).

1.1 Confirm that the BSP has been completed and endorsed by all relevant parties. Are there any aspects of the BSP which remain unclear or require further review of endorsement by beneficiaries or other stakeholders? Has the BSP been made publicly available?

After a first draft was submitted in 2015, a Working Group (WG) was set up in 2018 to review and finalize the BSP. The WG prepared a final version of the BSP to ensure it included feedback from the FCPF Carbon Fund and reflected the views of civil society and Local Communities and Indigenous Peoples (LCIPs). Note that in-depth consultations were held during BSP finalization with LCIPs in various locations in Mai-Ndombe province between September and November 2019 to gather the views of LCIPs on key aspects of the BSP and to update the finalization process. Consultations directly involved approximately 2,500 people. Feedback and suggestions from consultations with LCIPs were discussed by the WG and integrated into the BSP. The document was made public after validation and is now available on the Ministry of Environment and Sustainable Development website²⁹ and on the FCPF website.

1.2 In cases where capacity building initiatives have been included as part of the BSP, confirm whether the Program Entity has completed required capacity building measures to ensure system effectiveness. What other measures are still outstanding?

No capacity building initiatives have been conducted.

II. Monitoring and Reporting Requirements

1. Overall fund disbursement

None to date.

2. BSP Revision

Were there any changes made to the BSP during the Reporting Period (as specified above in section II): ☒ Yes
☐ No

The BSP was revised in December 2024 to i) Update of results of the PI-REDD Plateau and PI-REDD Mai-Ndombe to reflect the latest achievement as of May 2024 when the projects closed, ii) Update of the arrangements for the flow of funds between the FCPF and the PIU through a commercial bank instead of the MPTFO, iii) Update on funding available for the PIU to operate beyond 2025. The government will enter in a subsidiary agreement with the commercial bank, to set out the responsibilities and institutional arrangement for the receipt and use of Payments received under the ERPA. The role of the Commercial Bank under the Subsidiary Agreement shall be limited to receiving ERPA Payments on behalf of the government, holding all ERPA Payments in the Dedicated Account, and releasing funds from the Dedicated Account on behalf of the government for sharing Monetary and Non-Monetary Benefits to eligible Beneficiaries under the instruction of the ER Program Management Unit, and in accordance with the Benefit Sharing Plan, the Program Implementation Manual and the Subsidiary Agreement.

3. Overall summary of the BSP implementation during the reporting period.

²⁹ https://medd.gouv.cd/wp-content/uploads/2022/07/final_benefit_sharing_plan-june_2022-drc.pdf

Following the signing of the ERPA of the Mai-Ndombe Emissions Reduction Program (ERP) between the Democratic Republic of the Congo and the World Bank on September 21, 2018, six prerequisites for its implementation were retained: (i) Submission of the Program's Letter of Approval, (ii) Completion of the Action Plan on Reversal Management Mechanism, (iii) Establishment of the Terms of Reference for the ER Program Management Unit, (iv) Development of the Action Plan for the Transfer of Title to ERs, (v) Provision of evidence that the Client has secured funding of USD 2,200,000 to operationalize instruments for ER Program implementation, (vi) Finalization of the Benefit Sharing Plan (BSP). To meet the last condition, the BSP Working Group (WG) established on November 12, 2018, drafted a work plan, which was reviewed on February 26, 2019, and provided for a concept note designed to facilitate discussions for the finalization of the advanced version of the BSP. This concept note was made available to the WG on April 5, 2019. A second BSP WG meeting was held on April 11, 2019, to bring all WG members up to speed on the concept note. A third meeting was held on May 15, 2019, during which the Working Group approved the options in the concept note, which added further details to the BSP. The Working Group met 10 times until February 2022 to work on BSP finalization, analyze methodological aspects, and review the results of various activities, including those related to Local Communities and Indigenous Peoples (LCIP) consultation and revisions to the ERP baseline (which impacted the BSP).

As agreed with the FCPF when signing the ERPA, a broad consultation with LCIPs took place in Mai-Ndombe in 2019. The consultations were conducted in the jurisdictional area by a consortium of three major environmental civil society platforms operating in the DRC: the Network of Indigenous and Local Peoples for the Sustainable Management of Forest Ecosystems (REPALEF), the Renovated Working Group on Climate and REDD+ known as GTCR-R, and the REDD Climate Working Group (GTCR). Two other civil society networks were involved, namely the Young People's Movement for the Environment and Sustainable Development (DYJEDD) and the Coalition of Women Leaders for the Environment and Sustainable Development (CFLEDD).

The consultations were conducted during the process of finalizing the BSP to reflect communities' interest in participating in the ERP and to inquire about what measures they intend to put in place to ensure ERP performance according to the BSP. A total of 2,497 people participated in the consultations in 13 workshops, 8 of which were at village level, 4 at regional level, and 1 at provincial level to confirm the results. Among the 2,497 participants in these workshops were 1,206 Bantu men, 383 non-Indigenous rural women, 639 indigenous men, and 269 indigenous women. The consultations were documented using the lists of participants broken down by relevant groups (gender, indigenous peoples), and photographs and videos attesting to the proceedings and validating the reported information. The [consultations report](#) was approved by the World Bank. Annex 4 of the BSP also provides a summary of the issues raised and preferences expressed by the local communities and indigenous peoples during the consultation process.

The BSP was presented to stakeholders at the IFMLP/ERP Provincial Steering Committee held in Inongo on April 21, 2022. It was subsequently validated at a national workshop held in Kinshasa on May 6, 2022. The BSP is currently acceptable to all and enforceable against all. It will be implemented after receipt of the first ERPA payment and may be revised as necessary. The document was made public after validation and is now available on the Ministry of Environment and Sustainable Development website³⁰ and on the FCPF website. The BSP document has been made public and validated by all parties concerned, which means that there is an internal consensus.

At the request of the DRC government, the BSP was updated in 2024 along with the amendment of the ERPAs. Following the update of the BSP, a workshop with stakeholders was held in December 2024 in Mai Ndombe provincial capital and was attended by about 100 participants (local governor and members of his provincial government, provincial elected officials, territorial administrators and civil society). The main objective of this workshop was to revive understanding of the ERPA, get Free, Prior and Informed Consent (FPIC) of stakeholders and sensitize on the BSP. The specific aim was to: (1) recall the main lines of the ERPA and the stakeholder consultation processes on the BSP; (2) present the updated BSP; (3) present activities that can be financed by the ERP and to collect the opinions and considerations of stakeholders. Overall, stakeholders are supportive of the BSP as revised to date and the programmatic activities ([Workshop Report-ERPA Sensitization and Revised BSP presentation](#)).

³⁰ https://medd.gouv.cd/wp-content/uploads/2022/07/final_benefit_sharing_plan-june_2022-drc.pdf

In addition, a [High-level Stakeholder Information and Exchange Workshop on the Benefit Sharing Plan \(BSP\) and the status of the ERPA](#) was held at the national level in Kinshasa on January 23, 2025. It was attended by 50 participants including the MEDD represented by its Secretary General and Directors and Heads of Divisions, FONAREDD, CN-REDD, DIAF, UC-FIP, Ministry of Finance, the National Forest Fund, the World Bank and various other stakeholders to explain what is the ERPA, its relevance, how it works, as well as the remaining prerequisite for the first disbursement. This workshop was timely as it provided an opportunity to share the updated BSP and to unfold the actions and responsibilities incumbent on the actors and on which the DRC will have to align itself in order to achieve payments. The main outcomes of this high-level meeting include: the sharing of information and the common understanding of the BSP and commitment to follow the roadmap and to work towards the first disbursement.

For the time being, FIP-CU, as the program's management unit, is responsible for planning the program's capacity-building activities. The capacity building will focus on developing the skills and knowledge of stakeholders involved in the project to effectively manage and distribute benefits, ensuring equitable participation and transparent implementation, including training on project management, financial literacy, community engagement, and monitoring and evaluation techniques to ensure the benefits reach the intended recipient. The FIP-CU is also recruiting a technical person to be based in the Mai-Ndombe to serve a direct contact on the BSP that will oversee its implementation and monitoring. A provincial Steering Committee is also being established and will provide an oversight on the implementation of the BSP.

4. Status of Benefit Distribution

No benefit has been distributed for the reporting period.

The following sections detail the updates and arrangements to the BSP.

4.1 Institutional arrangements

The institutional arrangements for the implementation of the Emission Reduction Program in Maï Ndombe build on existing mechanisms of the IFMLP (PI-REDD Plateau and PI-REDD Maï Ndombe) and the role and function of all institutions involved in REDD+. The overall governance of the Benefit Sharing Plan includes:

- **Commercial bank:** An account dedicated to ERPA funds will be opened in a commercial bank. The government will enter in a subsidiary agreement with the commercial bank, to set out the responsibilities and institutional arrangement for the receipt and use of Payments received under the ERPA. The role of the Commercial Bank under the Subsidiary Agreement shall be limited to receiving ERPA Payments on behalf of the government, holding all ERPA Payments in the Dedicated Account, and releasing funds from the Dedicated Account on behalf of the government. The MoF transmits to the World Bank the list of authorized representatives of FIP-CU for the requesting disbursement. The World Bank transfers ERPA funds at the request of authorized representatives of FIP-CU.
- **PMU:** the FIP-CU acts as the PMU.
 - PMU instructs the commercial bank to disburse to: i) owner(s) of private projects whose payment amounts are defined in the BSP; and ii) take responsibility for distributing among the other beneficiaries according to the BSP. PMU (FIP-CU) disburses to match the Annual Work Plan and Budget (AWPB) approved by the Steering Committee (COFIL) led by FONAREDD. The annual work plan and budget has been prepared during different working sessions with key stakeholders (FIP-CU, provincial representatives, civil society, technical department from the ministry of environment) and presented during the workshop held in December 2024 at the provincial level. It was pre-approved with some recommendation. The revised version is awaiting approval by the FONAREDD COFIL session scheduled for March 21, 2025.
 - Overall, stakeholders are supportive of the BSP as revised to date and the programmatic activities.
 - Payments to the Provincial Government are regulated by a Memorandum of Understanding (MoU) defining activities eligible for financing as well as an annual work plan (AWPB).
 - Payments for LCIPs (4% which includes 2% for Indigenous Peoples and 2% for Local Communities) are regulated by contracts with national NGOs. These contracts are signed based on terms of reference (ToR) defining activities, implementation methods, and required technical expertise.
 - Payments to rural areas follow the same implementation methods as that of PIREDD. FIP-CU signs a delegated implementation contract with the Local Implementation Agencies (LIA) that carry out

- activities and investments in rural areas. CU-FIP is also responsible for monitoring LIA implementation activities and use of funds.
- FIP-CU distributes payments to community-driven sub-projects, as stipulated in the Monitoring Report.
- **Provincial Government:** The Provincial Government signs a MoU with FIP-CU for implementing the activities in its AWPB. FIP-CU is responsible for monitoring activity implementation and use of funds.

The FONAREDD, CN-REDD, FIP-CU and other stakeholders will receive support from the [Emissions Reductions Payment Agreement Operationalization Support Project](#) (OPERPA) in 2024 to ensure the effective implementation of the ERP and ERPA. OPERPA has initiated implementation of a series of enabling activities that will contribute to the operationalization and continued improvement of national REDD+ tools, including the BSP, and their application at provincial level, notably:

- **Technical framework:** Operationalization of REDD+ tools and infrastructure for the Mai-Ndombe ERP (MRV, National REDD+ Registry, methodological framework for the nesting of REDD+ sub-projects, mechanism for BSP monitoring and assessment, environmental and social safeguards and GRM). It is important to note that the DRC SIS report currently lacks mention of Gender-Based Violence (GBV), despite its high prevalence in the Democratic Republic of Congo (DRC). GBV in the DRC is closely linked to underlying social and cultural norms that perpetuate power imbalances between men and women. This omission is particularly significant for Indigenous Peoples (IPs). Efforts are underway with CN-REDD to update the report to address this issue, including the incorporation of service provision and incident management for future occurrences.
- **Legal and regulatory framework:** Strengthening the legal and governance bases of the Mai-Ndombe ERP (development support for the homologation decree and any other national certification process for REDD+ projects and programs, transparency and integrity of national REDD+ infrastructures, political developments, and carbon finance regulatory framework)
- **Institutional framework:** Capacity-building for Mai-Ndombe ERP institutions and stakeholders (national level, provincial level, stakeholder involvement)

In addition to the Capacity-Building Program financed by the FCPF it will further strengthen the BSP's socialization aspects by providing targeted and complementary support to LCIPs. Activities will focus on filling underlying gaps in key aspects of the investments financed by ERPA as part of the ERP, particularly land tenure, natural resource management, and gender issues. These activities will be implemented in 2025 via civil society platforms and local NGOs operating in Mai-Ndombe.

4.2 Legal approval

No legal approval is required for the implementation of the BSP. The FONAREDD Steering Committee (COPIL), chaired by the Minister of Finance and with the Minister of the Environment and Sustainable Development as Vice-Chairman, is the decision-making and steering body responsible for ensuring the operationalization of the ERP. As such, it approves the ERPA Monitoring Report and validates ERP programming. It is made up of members of the government responsible for finance, the environment, agriculture, energy, land affairs and regional planning, as well as representatives of civil society, the private sector and donors.

At the Council of Ministers meeting in March 2023, the DRC government adopted a draft decree (Decree of 14 June 2023 n°23/22) on the creation, organization and operation of a public institution called the Carbon Market Regulation Authority (Autorité de Régulation du Marché de Carbone en République Démocratique du Congo (ARMCA)).

According to the Minister of the Environment and Sustainable Development, who submitted this draft law, the creation of this establishment is aimed at making the DRC's efforts to preserve its forests, strengthen its carbon stocks and contribute to regulating the global climate more profitable, thereby improving the population's living conditions. ARMCA will be responsible for organizing, regulating and monitoring the purchase and sale of carbon credits in the Democratic Republic of Congo.

As such, it will organize the regulation, control, monitoring and evaluation of activities involving the generation, purchase and sale of carbon credits. It will also be responsible for implementing the Carbon Tax, in conjunction with the authorized government sectors and departments. ARMCA has in principle will have its own assets and enjoys autonomous management, under the supervision of the Minister for the Environment and Sustainable Development. The timeline for the operationalization of the ARMCA is still to be determined.

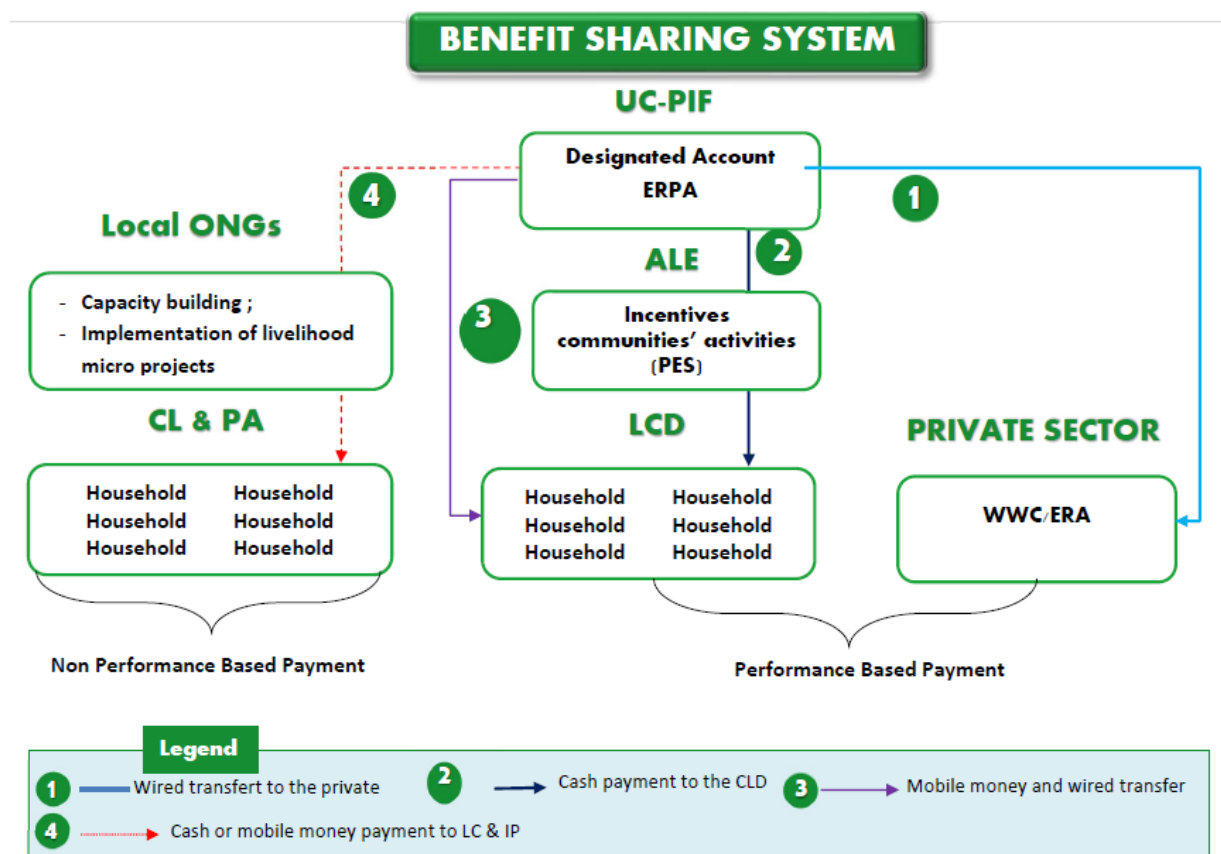
4.3 Roles and responsibilities

The BSP governance structure builds on existing mechanisms of the IFLMP (PI-REDD Plateau and PI-REDD Maï-Ndombe). The institutions and bodies (FONAREDD, FIP-UC, COPIL) involved in the implementation of the IFLMP have demonstrated understanding of their roles and responsibilities throughout the implementation of activities through decision-making processes and daily operations. These institutions and bodies have been closely involved in the development of the BSP. Similarly, consultations that were conducted during the process of finalizing the BSP also provided the opportunity to build the capacity of LCIPs on the BSP arrangements. Additional capacity building will be provided to all stakeholders through the OPERPA Project to ensure that all stakeholders on their roles in the implementation of the benefit sharing system.

4.4 Benefit sharing system

For the current reporting period, the benefits will be channeled to beneficiaries according to the arrangements defined by the IFMLP. The FIP-CU makes sub-grants to beneficiaries in accordance with eligibility criteria and procedures acceptable to the World Bank described in the Project Implementation Manual (PIM). The sub-grants include a contribution from the beneficiary, obligations to respect the project's environmental and social safeguards frameworks, anti-corruption measures, procurement and financial management provisions, and reporting requirements. Part of the proceeds of the sub-grants available to communities are provided under Agreements for Performance-Based Incentives, as are already indicated in the PIM (Agreements for performance-Based Incentives and Investments").

Benefits will be shared both monetarily and non-monetarily (see Figure below). Benefits will be distributed both in monetary (e.g., direct deposits into digital bank accounts for private sector and the provincial government and digital cash payments to reduce disbursement errors and increases access to benefits among eligible beneficiaries) and non-monetary form. These may be made as payments for environmental services (PES), goods and services financed by PES which have been piloted in the IFLMP. The OPERPA project is supporting the FONAREDD and the FIP-CU to finalize by March 31st, 2025, a Monitoring, Evaluation, and Learning manual for the BSP including the payment registry systems and related procedures. Once finalized the manual will be available at FIP-CU website.



UC-PIF: FIP-CU

ALE: Local Implementation Agency

LDC: Local Development Committee

- Payment to the private sector will be made directly into an account opened in a commercial bank;
- Payment of incentives for community activities will be made in cash through ALEs for households located in areas not covered by banks and the telephone network, and via mobile money and bank transfers in areas covered;
- PAs and CLs will be paid in cash or via mobile money.

4.5 Accountability systems

The accountability systems for reporting under the IFLMP were successfully implemented as described in Annex 1. Mai Ndombe Provincial Steering Committee (COPIL) was responsible for steering, monitoring and evaluating the Mai Ndombe PIREDD. It is chaired by the provincial Minister of the Environment. The ERP will build on the existing accounting accountability mechanisms, both for daily operations within the FIP-CU as for the overall governance of the program with the Steering Committees at national and provincial levels. The OPERPA project will support the FONAREDD and the FIP-CU to set up the accountability systems according to the BSP.

4.6 FRGM

As mentioned in Annex 1, the ERPA under Mai Ndombe ER Program uses the existing GRM of the Improved Forested Landscape Management Project which is operation in the whole area of the ER Program (Mai-Ndombe Province). The FRGM was updated in June 2021 following the Bank's review and feedback. However, it is important to note that as per the PAD of the ERPA, the FRGM of the Mai-Ndombe Program needs to be connected to a national-level REDD+ FRGM (coordinated by the relevant REDD+ institutions) which has yet to be established by DRC. The US\$ 5 million OPERPA project, which became effective in February 2024, has been designed to support also this aspect, and is expected to be setting up and maintaining such national level REDD+ FRGM, which will be effective independently from the Improved Forested Landscape Management Project that

closed on May 31, 2024. To date, it's the same FGRM that is operational and no complaints about ERPA have been registered.

4.7 Human resources

The PMU team (ERP Manager, Safeguards and monitoring, evaluation expert, procurement expert, financial expert, carbon & MRV expert and communication expert) are responsible for the implementation of the ERP and the BSP. The safeguards and monitoring & evaluation expert will be responsible for the support to implementing entities and oversight of safeguards implementation. A dedicated budget of USD 350,000 for the duration of the ERPA has been allocated for safeguards supervision, including FGRM revision.

In addition, the OPERPA project (USD 5M) will support additional support for mechanism for BSP monitoring and assessment, environmental and social safeguards and GRM as mentioned in section 2.1.

5. Status of Benefit Distribution

The Benefit Sharing Plan will be implemented upon receipt of funds for the current reporting period. As this is the first monitoring report, no payments have been received yet. Updates and information regarding these aspects will be provided once the Benefit Sharing Plan is in effect.

6. Implementation of the Environmental and Social Management Measures for the BSP

In general, the safeguards plans were implemented during the reporting period as 'Satisfactory' (see detail in Annex 1, Table 2). Further, the environmental and social management measures of the Benefit Sharing Plan will be implemented upon receipt of funds for the reference period of this report. This is the first monitoring report and payments have not yet been received. Information or updates on these aspects will be provided once the benefit-sharing plan has been implemented. The Programme Implementation Unit (PIU) is finalizing a Monitoring, Evaluation, and Learning manual for the BSP. This manual describes: (i) how results will be measured, (ii) how monitoring reports are drawn up and (iii) how evaluations are carried out. Overall, it will enable the tracking of implementation progress, facilitate adaptive management, and support lesson learning throughout the process.

7. Recommendations for BSP Improvement or Modifications

Recommendations will be made following the implementation of the Benefit Sharing Plan upon receipt of funds for the reference period of this report. This is the first monitoring report and payments have not yet been received. Information or updates on these aspects will be provided once the benefit-sharing plan has been implemented.

ANNEX 3: INFORMATION ON THE GENERATION AND/OR ENHANCEMENT OF PRIORITY NON-CARBON BENEFITS

1. Priority of non-carbon benefits

Priority non-carbon benefits have been identified during the feasibility studies to prepare the sub-investments program as the PIREDD Plateau (FIP) and PIREDD Mai-Ndombe (CAFI). From the consultation with stakeholders, 4 main categories of non-carbon benefits have been identified as priorities and condition for the program to succeed in engaging and maintaining stakeholders in implementation of mitigation activities. This identification has been materialized in the ER-Program main objectives defined at the ER-PIN stage: 1. Climate, 2. Biodiversity, 3. Rights, 4. Livelihoods and 5. Finance and Governance.

Table 1: Achievement of objectives for generating non-carbon benefits

Priority non-carbon benefits identified in the program area	Details on generation and improvement activities / Achievement of objectives
Biodiversity: Biodiversity is maintained and ecosystems services are improved	The following indicators have been identified in the ERPD : • Surface of community forests under conservation (ha) • Surface of natural regeneration and reforestation in savannah (ha) • Surface of conservation concession (ha) • Change in abundance and distribution of targeted species For the present reporting period, the following indicators are available: • Surface of community forests under conservation (ha) 136 045 ha of primary forest conserved • Surface of natural regeneration 13 994 ha (of which 9 669 ha are well preserved and the rest was disturbed by uncontrolled fire) • Surface of reforestation in savannah (ha) 5 233 ha • Surface of conservation concession (ha) 1 131 726 ha • Change in abundance and distribution of targeted species: no data
Rights: The legal and customary and users' rights of local communities and Indigenous Pygmy Peoples over land, territories and resources are recognized, respected and strengthened	• Number of territories mapped by participatory mapping clarifying allocations: 695 (215 PIREDD/Plateau, 480 PIREDD Mai-Ndombe); • Number of Land Use Plan validated for sustainable natural resource management: 590 (PIREDD/Plateau 110, PIREDD Mai-Ndombe 480). • Number of validated community forest concessions: 0 for PI-REDD Mai Ndombe
Livelihoods: REDD+ benefits are shared equitably; improve local livelihoods in the long-term and the well-being of stakeholders, with a focus on the most vulnerable groups	• Average revenues per household (USD/year) To capture the project's impact on changes in the monetary situation of beneficiaries/persons affected by the PGAPF activities, baseline studies had been carried out in 2015 including for the PIREDD Plateau. Based on a sample of 1,650 households, the MULTIMA study carried out in the first half of 2018 shows that almost 15,700 households, or nearly 110,000 people, including 58,400 women, have seen their living conditions improve. Overall household income (monetary and non-monetary) rose from an annual average of USD 2,507.3 to USD 2,876.8, an increase of 14.7%. • Average revenues per farmer (USD/year): not available • Socio-economic investments ○ PIREDD Mai Ndombe: USD 1,096,575.81 paid to communities in the form of payment for environmental services (About 33% of this amount was received by women beneficiaries of project activities), 20 bridges and 8 culverts built, 4 office buildings built ○ PIREDD Plateau: USD 1,360,472.75 were paid to communities in the form of PES for community use (schools, wells, etc....)

	○ Increase productive employment linked to REDD+, including potentially vulnerable and marginalized persons: no update
Finance and governance: Immediate, sufficient and predictable resources are mobilized to reward performance in the priority forest areas in an equitable, transparent, participatory and coordinated manner	• Number of Rural Agricultural Management Committees established or restructured and operational ○ PIREDD Maï Ndombe: 19 Rural Agricultural Management Committees including 4 Territories and 15 Sectors revitalized ○ PIREDD Plateau: 10 Rural Agricultural Management Committee per Territory • Number of Provincial REDD+ Steering Committee meetings: 2 • Number of complaints received, handled and successfully redressed: 55 complaints, 51 resolved – for details please see FRGM section above (see <i>Annex 1, section 2.4</i>). • Number of independent observation reports: not applicable • Funds received and used by the ER Program, including transfers of funds from emission reductions, performance-based payments and reinvestments: not applicable

2. Other non-carbon benefits and additional information related to the Monitoring and Evaluation Framework

Livelihood improvement and sustainability

2.1 *Is your CF program testing ways to sustain and enhance livelihoods (e.g. one of your program objective/s is explicitly targeted at livelihoods; your approach to non-carbon benefits explicitly incorporates livelihoods)? Please provide detailed information to justify.*

To understand the project's impact on changes in the monetary situation of beneficiaries/persons affected by IFLMP activities, baseline studies had been carried out in 2015 including for the Plateau PIREDD. Based on a sample of 1,650 households, the MULTIMA study carried out in the first half of 2018 shows that nearly 15,700 households, or almost 110,000 people including 58,400 women, have seen their living conditions improve. Overall household income (monetary and non-monetary) rose from an annual average of USD 2,507.3 to USD 2,876.8, an increase of 14.7%. The project successfully tested new approaches to improve community livelihoods. Most notably, the project introduced an approach combining community-level territorial development planning with implementation incentives through PES. The PIREDDs established PES contracts in the territories, rewarding communities and households for the deployment of sustainable agroforestry activities. Beyond this, the PIREDDs promoted the production of non-timber forest products and supported microprojects for IPs. The PES resources have enabled the various communities to finance, according to their choice, activities at the household level (payment of school fees, acquisition of certain goods, development of income generating activities etc.) but also infrastructure for community use (schools, wells, etc.).

Biodiversity

2.2 *Is your CF program testing ways to conserve biodiversity (e.g. one of your program objective/s is explicitly targeted at biodiversity conservation; your approach to non-carbon benefits explicitly incorporates biodiversity conservation)? Please provide detailed information to justify.*

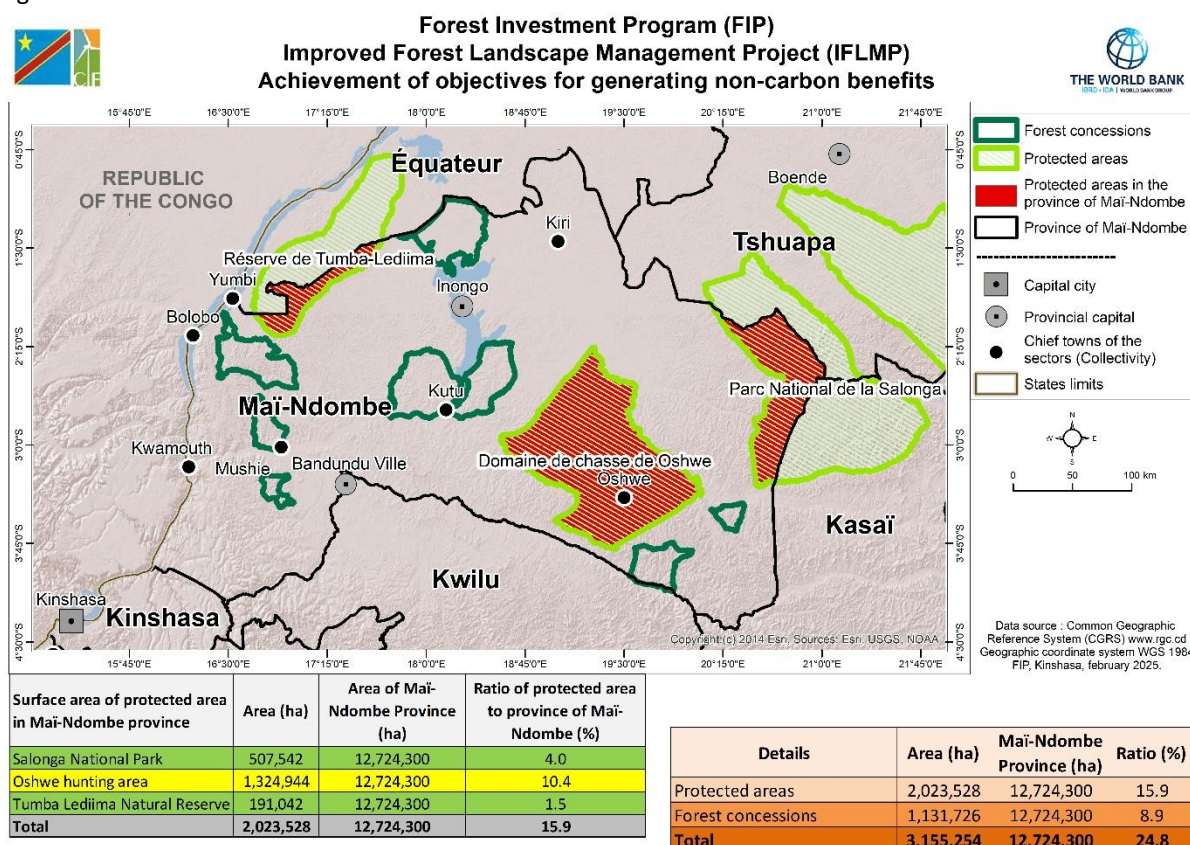
Mai-Ndombe province encompasses a rural landscape that includes forests, productive lands, protected areas, and forest concessions. The Integrated Forest Landscape Management Project (IFLMP) tested new approaches by improving sustainable land management (SLM) practices in productive landscapes, expanding the scope of Sustainable Management Plans to enhance biodiversity conservation, and establishing community-managed forest concessions, which are managed, among others, by Indigenous Peoples (IPs).

SLM activities were often situated between core protected areas and human settlements, presenting unique opportunities for sustainable, nature-based practices that support both conservation and local economies.

Although the IFLMP did not conduct systematic biodiversity assessments (such as species richness, relative abundance, genetic variability, and the proportion of endangered species) for the period 2019-2020, various testimonies from project beneficiaries indicate that the variety of plant and animal species present within the areas under restoration has significantly increased compared to the before the project. Wildlife began to reappear, and non-timber forest products (such as mushrooms and caterpillars) became available on lands where sustainable land management (SLM) activities were implemented.

- Surface of community forests under conservation (ha) 136 045 ha of primary forest conserved
- Surface of natural regeneration 13 994 ha (of which 9 669 ha well preserved, and the rest was disturbed by uncontrolled fire)
- Surface of reforestation in savannah (ha) 5 233 ha
- Surface of conservation concession (ha) 1 131 726 ha

Figure 1. Protected areas and forest concessions



Protected/preserved areas

2.3 What amount (in ha) of protected or conserved areas are included in your CF program area? Has this amount increased or decreased in the last year? If so, by how much?

Formally designated protected areas represent about 16% of the Mai Ndombe Province (Figure 1):

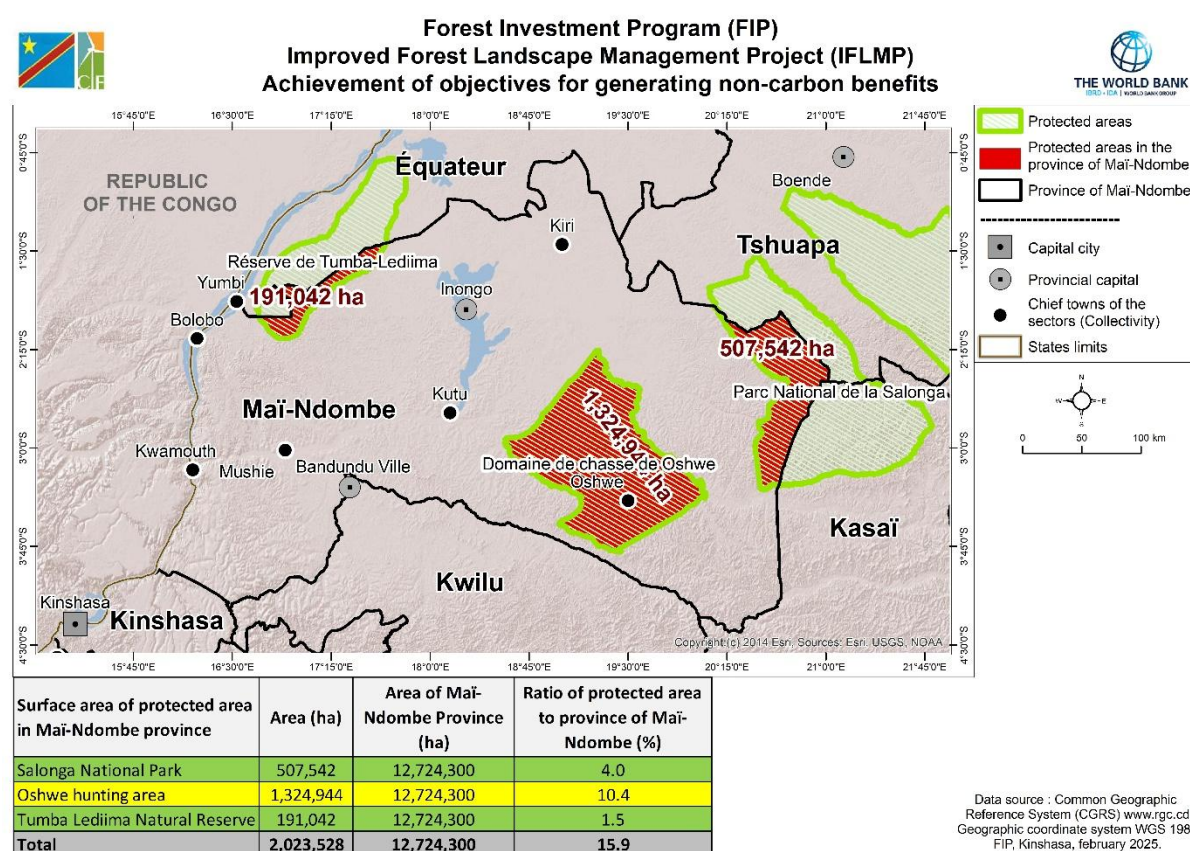
- Tumba-Lediima Natural Reserve (TLNR) -- only a part of the Reserve is located within the province and it partially overlaps with a forestry concession;
- Salonga National Park; occurs partially within the province;
- Oshwe Hunting Reserve; it overlaps with forestry concessions and there currently is no presence of Congolese Nature Conservation Institute (ICCN, Institut Congolais pour la Conservation de la Nature);
- Hippopotamus Reserve on the Sankuru, Kasai, and Kwa Rivers where there is some ICCN presence;
- Mangai Hippopotamus Reserve with no ICCN presence; and

- f. Hippopotamus Reserve on the Kasai and Kwa Rivers with no permanent ICCN presence.

Salonga National Park benefitted from GEF funding through a project being implemented by WWF. Supporting Oshwe Hunting Reserve is not appropriate for a project of short duration given that there is no presence of ICCN. The three hippopotamus reserves are not actively managed protected areas. ICCN has indicated that the highest priority in the province for investment support to protected areas is the Tumba-Lediima Natural Reserve (TLNR).

The PIREDD Maï Ndombe provided critical support to the Tumba Lediima Natural Reserve, a globally important biodiversity area that had to date received virtually no funding from national or international sources. A background study of Tumba Lediima Natural Reserve was published in 2016 by ICCN and WWF. The report provides a wealth of detail on the globally important biodiversity of the natural reserve. The Reserve was created in 2006 and covers a large area of 767,800 ha. The forests of the Reserve are substantially intact with only small areas of deforestation evident in the southern part of the Reserve. There is however a human population settlement in and adjacent to the Reserve and anthropic pressures are growing. The PIREDD Maï Ndombe provided support for institutional support to the ICCN, development of co-management structures with local communities (consultations, putting in place truly consultative planning and reserve management implementation with stakeholders), delineation of the reserve and likely reissuance of the decree to resolve jurisdictional overlaps with forestry concessions and other problems with the existing reserve, infrastructure investments in the reserve and support to reserve operational costs.

Figure 2. Protected areas in the jurisdiction of Mai-Ndombe



Re/afforestation and rehabilitation

2.4 Total forest area re/afforested or restored (in ha) through the program

For the period 2019-2020, the status of land area under restoration is:

- Surface of natural regeneration 13 994 ha (of which 9 336 ha well preserved, and the rest was disturbed by uncontrolled fire)

- Surface of reforestation in savannah (ha): 5 233 ha

Partnerships with the financial sector and the private sector

2.5 *Update on CF program budget (as originally presented in ERPD), with updated detail on secured (i.e. fully committed) finance, in US\$*

- 2.5.1 Detail the amount of finance received (including ER payments) in support of development and delivery of your CF program. Figures should only include secured finance (i.e. fully committed): ex ante (unconfirmed) finance or in-kind contributions should not be included:

Investing in agricultural and forestry projects in the Democratic Republic of Congo (DRC) is challenging for the private sector due to deferred profitability and lower returns compared to the commercial sector. This is primarily because of the lack of banking services tailored to such investments. Consequently, the IFLMP has made public investments with a private promoter under a co-financing model. In this model, the financial resources required for the development of a hectare are contribution from both the private project promoter and the FIP-CU. It is important to point out that the choice of this financing approach was guided by the concern to avoid fiduciary control requirements for private-sector accounting. FIP contribution was made in the form of results payment based.

Montant (US\$)	Source	Date committed	Public or private financing ?	ERP, grants, loans, others
\$ 14.2 MILLIONS	FIP	8 October 2014	Public	Grant
\$ 30 MILLIONS	CAFI	18 July 2017	Public	Grant
\$ 6.2 MILLIONS	GEF	20 June 2019	Public	Grant

- 2.5.2 Excluding FCPF Carbon Fund ER payments, what is the value of REDD+ ER payments that your CF projects have received, and that your country has received in general?

The following table provides on total REDD+ payment to date (\$US)

	Total REDD+ payments to date (\$US)
Carbon Fund project(s) (i.e. RE payments from sources other than the Carbon Fund)	\$ 0
Other REDD+ national projects	\$ 0

2.5.3 How many formal partnerships have been established between your CF program and private sector entities? Formal partnerships are defined as follows

- The partnership is based on a written memorandum of understanding (or equivalent), and/or
- The partnership involves tangible financial exchanges, and/or
- The partnership involves tangible non-financial exchanges (e.g. in-kind contributions).

It should be noted that in the case of the jurisdictional program only one private nested project is involved.

	Established in the last year (July to June)	Total to date
Number of partnerships with the private sector involving financial exchanges	1	1
Number of partnerships with the private sector involving non-financial exchanges	0	0

Other Non-Carbon benefits and additional information

Policy development

3.1 Is your CF program engaged in contributing to the development, reform and/or implementation of policies to help institutions/people/systems/sectors? Please provide information on the approach taken and any other relevant indicators or outcomes.

The homologation decree set out in Order n°047/CAB/MIN/EDD/AAN/MML/05/2018 of May 9, 2018, determines that government of DRC, as holder of the Mai-Ndombe Emission Reduction Program, has an exclusive right to any Emission Reduction Unit that may be generated by the ER Program³¹. In accordance with the action plan proposed in the ERP agreement, work is underway to revise and operationalize the 'homologation' decree with the objective of resolving all outstanding issues³² that prevent the country from authorizing the transfer of emission reduction securities in full compliance.

As a first step, the Government, through the Ministry of Environment and Sustainable Development (MEDD), has initiated a process of reform of the legal framework in place to provide a comfortable legal and institutional basis for the valuation of emission reductions generated in the DRC. The option taken by the Government, through the MEDD, is to proceed to the modification of the law n° 11/009 of July 09, 2011, on the fundamental principles related to environmental protection. The bill to amend the latter law was introduced by the MEDD to the Government and was adopted on February 3rd, 2023. The revised law established the Carbon Market Regulatory Authority, whose organization and operation shall be determined by decree of the Prime Minister and provides a legal basis for the definition of a certification procedure for carbon projects and related transactions.

Capacity Building

3.2 Is your CF program involved in training, education or provision of capacity building opportunities to increase the capacity of institutions/people/systems? Please provide information on the approach taken and any other relevant indicators or results.

Stakeholders involved in the implementation of project activities received regular capacity-building from project experts. The technical departments (Agriculture, Environment, Rural Development, Land Affairs and Interior) involved in implementing the project's activities signed 20 collaboration agreements between these governmental agencies, 5 per territory. These agreements defined the specific areas of collaboration, the procedure for mobilizing Technical Services, the definition of mutual tasks, the deliverables, as well as the terms and conditions for supporting teams in implementing the project.

The teams benefited from capacity building on the project's approaches, and actively participated in the implementation and monitoring of activities at community level. The aim of this capacity-building was to enable teams from the various technical departments involved to sustain the project's innovative approaches to natural resource management beyond the implementation period. In addition, the project supported the administrative teams of the 4 Territories in the process of drawing up Territorial Development Plans in which natural resource management aspects are considered. The PIREDD also contributed to build capacities of local structures at all levels, such as LDCs, farmers' organizations and Territorial Rural Agricultural Council (CARTs), to manage natural resources sustainably.

Safeguards Plans and Environmental and Social Management Framework (ESMF)

3.3 Has your CF program realized any Non-Carbon Benefits as a result of implementing the safeguards plans and ESMF? Please provide details on any relevant indicators or outcomes.

(i) The Environmental and Social Management Framework (ESMF) for the IFLMP, updated in January 2019, oversees the environmental and social (E&S) impacts of the PIREDD Mai-Ndombe and additional GEF-financed activities. The ESMF recommends mitigation measures such as selecting crop planting sites away from forests and protected areas, using local species, limiting phytosanitary products, and supporting users while prohibiting pesticide use. Agroforestry practices were promoted to prevent soil erosion, and all investments were based on

³¹ See ERPD and letter from the MEDD to the FMT on 18 September 2018 regarding the ability of DRC to transfer ERs titles.

³² The Homologation Decree approved in 2018 did not include the procedure manual as an annex while being referenced in the decree. In addition, the scientific committee reviewing the REDD+ projects for homologation was never established and the REDD+ registry was not been fully operationalized. As a result, a revision of the homologation decree and its manual of procedures is required to ensure the transfer of emission reductions as per the ERPA requirements.

land use and natural resource management plans. Local recruitment was encouraged, and staff were provided with employment contracts and equipped with codes of good conduct. Indigenous populations were involved in activities, with training on environmental monitoring, sexually transmitted diseases, and Sexual and Gender-Based Violence.

(ii) The Complaints Management Mechanism and FPIC procedures were operationalized. In practice, prior to the implementation of activities, the project actively organized community consultations and awareness-raising efforts to obtain voluntary consent, known as Free, Prior, and Informed Consultation (FPIC). These consultations and information sessions were conducted in various territories to facilitate land use planning activities and participatory mapping with Indigenous Peoples and Local Communities (IPLCs). These awareness-raising activities and consultations enabled the communities to better understand the project, freely accept the implementation of activities within their territories/villages, and agree to the structuring of communities into Local Development Committees (LDCs). Also, as part of the Stakeholder Consultations and Expectations Management in the Emission Reductions Program (ERP), in-depth consultations were held to gather expectations, preferences, and priorities of IPLCs beneficiaries. The feedback was reflected in the Benefit Sharing arrangements. The various stakeholders involved include the national civil society platform, the Working Group on Climate and REDD+ (GTCR-R), and the Indigenous Peoples network at national and local level, the Network of Indigenous and Local Populations for the Sustainable Management of Forest Ecosystems (REPALEF).

(iii) The project's Environmental Specialist conducted screenings of sub-projects to determine necessary safeguard instruments ([ESMF](#), [RPF](#), [PF](#), [IPP](#) and [IPMF](#) see details in section 4.2 Annex 1). Agroforestry activities aimed to preserve forests, reduce emissions, increase agricultural yields and production, improve food security, increase incomes, create jobs, strengthen government services, improve land management, and support indigenous peoples.

(iv) The Forest Investment Program Coordination Unit (UC-PIF) was responsible for implementing E&S measures. During 2019-2020, 3,519 people, including 729 women, benefited from capacity building. The Grievance Redress Mechanism (GRM) was fully functional, with the registry made public (Figure 1). The Environmental and Social Safeguards Specialist (ESSS) monitors and reports on grievances as follows: (a) provide grievance redress reports detailing complaint reference numbers and statuses. He also reports and analyzes complaint types, levels, actions taken to reduce complaints, and map initiators of such actions. (b) Delegated Implementing Agencies (DIA) and Local Implementing Agencies (LIAs) are trained in the GRM and must meet its requirements. Their representatives attend community sessions on GRM and safeguards awareness or training by ESSS. They are responsible for lodging all complaints and non-compliance incidents in the site logbook. They ensure grievance lodging avenues are accessible, including face-to-face, telephone, writing, suggestion boxes, or email. Grievances are acknowledged within three days. Investigations may include site visits and meetings to determine the grievance's scale and impact and explore response options. All grievances are responded to within seven days after investigation completion. If more time is needed, the complainant is informed in advance. Grievances are closed out as soon as possible after all reasonable attempts to resolve them. The response communicates investigation findings and resolutions, seeking complainant approval. If satisfied, the complainant signs the agreement, closing the grievance.

(v) Overall, the GRM received 55 complaints, of which 51 were resolved (*see Annex 1, section 2.4*). Throughout the implementation of the GRM, no SEA/SH related complaints was recorded. UC-PIF organized three missions to monitor E&S measures, focusing on E&S screening, safeguard policies, and the validation of disputed natural resource management plans in Bolobo territory.

Figure 1 Institutional arrangements for the GRM

Level 1

Local development Committee (LDCs), Rural Agricultural Management Councils (CARGs), Designated and Local Implementation Agencies, nodal complaint coordinator

- Sensitization of communities and other stakeholders on the GRM
- Receiving and processing the vast majority of low and medium severity complaints
- Receive and refer GBV/SEA/HS complaints to designated committee and professional service providers
- Report received grievance Project Coordination Unit

Level 2

Project Coordination Unit at the national level

- GM Oversight and assign complaint resolution responsibilities to existing staff
- Design of GRM sensitization tools and communicate for effective GRM
- Intake and handling of serious/hyper-sensitive and unresolved complaints at Level 1
- Handling of appeals in case of satisfaction at the first level
- Compilation of complaints and design of one centralized grievance registration database
- Analyze grievance data, draw lesson and make improvement

Level 3

Project Steering Committee

- Handling of serious complaints (except GBV/SEA/HS complaints) not resolved at level 2
- Follow-up participation in the event of compensation
- Referral to other bodies or mechanism in case of Unresolved complaints at level 2
- Monitoring, evaluation, accountability and Learning from the results and communicate back to all parties involved;

(vi) As described in Annex 1 section 1.1, during the implementation of the activities and during the supervision missions, cascade training was deployed to give as much hands-on experience of environmental and social issues as possible. During FIP-CU joint monitoring missions with DIA, the safeguards specialist conducts refresher sessions with the field-based safeguards specialists. The field-based specialists in turn replicate the refresher sessions with the stakeholders as needed. These refresher training sessions focused on i) monitoring the implementation of the grievance and redress mechanism, ii) monitoring the implementation of environmental and social management instruments, iii) monitoring incidents and accidents, iv) monitoring the process of obtaining FPICs from communities, v) monitoring E&S with recommendations etc. The stakeholders trained include the staff of the delegated implementing agencies and members of the local development committees. Overall, 3516 people (of which 21% women) were trained.

ANNEX 4: CARBON ACCOUNTING - ADDENDUM TO THE ERP

Technical corrections

Technical corrections have been made to the original Reference Level. All the technical modifications are in line with paragraph 2 of the "Guideline on the application of the methodological framework Number 2: Technical corrections to GHG emissions and removals reported in the reference period". Two categories of technical corrections have been applied: i. Improvement of emission factors and ii. Improvement of activity data. Note that technical corrections do not compromise the consistency of GHG emissions and removals estimates between the Reference Period and monitoring periods, as both calculations apply the improvements. None of the improvements relate to a change in policy and design decisions affecting the Reference Level. Carbon pools and gases, GHG sources, reference period, forest definition, REDD+ activities, Accounting Areas, and forest types remain unchanged. Changes in data sources, methods, and the re-estimation of activity data and emission factors have been made in calculating the FREL/FRL of DRC.

The following technical corrections have been made to improve emissions factors:

- **Removals from enhancement of carbon stocks:** Initial FREL included regrowth of forestland remaining forestlands. Updated FREL considers only removals from the conversion of non-forest lands to forest land. A conservative default period of 20 years is assumed for the forest to grow from the carbon stock levels of non-forest to the level of biomass in the average forest instead of the ten years used for the initial FREL. Carbon enhancement in transitions from secondary to primary forest has been excluded.
- **Mean AGB AND BGB by stratum:** The mean total biomass per stratum has been updated with a new dataset (see table below). AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF). Different methods were used to estimate updated values of mean total biomass per stratum (i.e., Root-shoot ratio). Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014).

Table A4-0-1-0-1: Mean total biomass per stratum comparison, initial vs. updated FREL calculation.

Land-use type	Total Biomass	
	Initial FREL	Updated FREL
Dense Forest [tdm/ha]	376.88	432.30 ^[1] ; 415.48 ^[2]
Secondary Forest [tdm/ha]	192.9	236.71
Non-Forest [tdm/ha]	25.2	32.90
Removal Factor [tCO ₂ /ha/yr.]	-15.9	NA
Secondary Regrowth [tCO ₂ /ha/yr.]	-14.4	-17.56

^[1] Primary Forest terra firma; ^[2] Dense Humid Wetland forest.

The following technical corrections have been made to improve activity data:

- **Activity data estimate:** The sample-based area estimation of activity data has been updated. Initial FREL was estimated using **systematic grids** (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using **pixel-based stratified random sampling** with 2,000 sampling points. We estimate activity data using **pixel-based stratified random sampling**. Stratified random sampling is a method meant to increase sampling efficiencies by targeting homogeneous populations with regards to the categories of interest. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes. The new methodological approach sought to produce activity data estimates with low uncertainties using a method that may be readily extended to all provinces in implementing a national monitoring system. In this way, the method aimed to reduce errors associated with the estimates of forest extent and change, but also the time, human resource and effort invested, while maintaining the scientific rigor of and compliance with IPCC requirements.

Table A4-0-2-0-2: Activity data per transition, initial vs. updated FREL calculation.

REDD+ Activity	Transition	Activity data [ha/yr.]	
		Initial FREL	Updated FREL
Deforestation	Primary forest to non-forest	21,838	15,464
	Dense Humid Wetland deforestation	0	0
	Secondary forest to non-forest	44,226	38,134
Degradation	Primary to Secondary Forest	64,536	14,475
Removals from enhancement of carbon stocks	Non-forest to Secondary Forest	15,040	23,923
	Secondary Forest to Primary Forest	4,318	NA

Start Date of the Crediting Period

The start date of the crediting period is January 1st, 2019. This date corresponds to the definition of the start date of the crediting period provided in the FCPF Glossary, i.e. follows:

1. The Start Date of the Crediting Period is set after the first ER Program Measures begin generating ERs. The following ERP activities were implemented before 2019 (see Table 1 in Section 1):

- April 2015 – June 2020. Improved Forest Landscape Management Project (IFLMP, P128887), Component 1, Integrated Project REDD+ Plateau (PIREDD Plateau).
- May 2018 – Dec 2022. Improved Forest Landscape Management Project (IFLMP, P128887), Additional funding for Mai-Ndombe REDD+ project (P162837, PIREDD Mai-Ndombe).
- April 2016 – July 2021. DGM, Support to forest dependent communities (P149049).
- Since 2011. Wildlife Works Mai Ndombe project.

2. The Start Date is justified with evidence by the ER Program Entity (see items 1, 3, 4, and 5), and it is independently assessed by a Validation Verification Body during Validation.

3. The Start Date is not earlier than January 1st, 2016.

4. The Start Date does not fall under the reference period 2000-2015.

5a. The Start Date demonstrates that the ER Program complies with requirements since the start date on safeguards. DRC has conducted a Strategic Environmental and Social Assessment (SESA) of the national REDD+ strategy and has put in place the following six REDD+ safeguards instruments: ESMF, Indigenous Peoples Planning Framework, Resettlement Policy Framework (RPF), Pest and Pesticide Management Framework, Cultural Heritage Management Framework (CHMF), and Process Framework (PF). All six safeguards' instruments produced under the FCPF Readiness Project have been reviewed and cleared by the World Bank and found to meet its operational policy requirements.

5b. The Start Date is demonstrated that the ER Program complies with requirements since the start date on Carbon accounting and double counting as specified in the MF. In order to comply with requirements under Criteria 23 and 38 and avoid double counting and double issuance. The MaiNdombe REDD+ Project has, according to [the project description](#), a baseline of 8,524,210 tCO₂e for 2019 and of 9,642,568 tCO₂e for 2020. The verification for the period 2017-2020 was conducted in March 2022 and the implementation report is available [here](#), as well as all the project relevant information under that standard. The project reported 1,248,955 tCO₂e for 2019 and 1,778,581 tCO₂e 2020 emissions for a total of tCO₂e 3,027,536 emissions for the reporting period 2019-2020.

In addition the revision and operationalization of the Program's Data Management System will be carried out with the support of the OPERPA project. The revision of the registry system will demonstrate that Emission Reduction will be issued exclusively through the National REDD+ Registry. Registry accounts will be created for all authorized project holders and the government (with specific sub-accounts for regional/jurisdictional programs). Once the Emission Reductions have been reported and verified, the respective ERs will be issued directly to the relevant accounts, with a separate allowance paid to one or more relevant (government) buffer accounts (so as to account for uncertainties and reversals). The issuance of ERs is subject to verification of carbon and other relevant social and environmental thresholds, which are defined in national standards. Project owners are free to transfer their issued ERs through sales contracts, conversion (from national ERs to Verified Carbon Units (VCUs)) or any other means. Thus, the DRC government has decided to use a centralized registry of ER transactions (CATS) managed by the FCPF until the operationalization of its own registry.

7. CARBON POOLS, SOURCES AND SINKS

7.1 Description of Sources and Sinks selected

In response to indicator 3.1 of the methodological framework (MF), the ER-Program *identifies which anthropogenic sources and sinks associated with any of the REDD+ Activities will be accounted for in the ER Program*. The table below illustrates the REDD+ activities (adopted by **1/CP.16, paragraph 70**) selected by the ER-Program and thus the associated emission sources and sinks.

The following table briefly discusses which carbon sinks and sources are included or excluded:

Table 7-0-1-0-1: Sources and Sinks accounted for under the ER-Program

Sources/Sinks	Included?	Justification/Explanation
Emissions from deforestation	Yes	According to the MF, ER programs must account for deforestation. Emissions from deforestation are identified as GHG emissions from the IPCC Land Use change category forest land to non-forest land.
Emissions from forest degradation	Yes	The ER Program also accounts for emissions from forest degradation. These are defined as GHG emissions from the IPCC Land Use change category forest land remaining forest land caused by long term losses in forest carbon stocks. Within the framework of the ER Program these are characterized by transitions between Primary Forest to Secondary Forest which comply with this definition. According to the REL calculation, emissions from degradation account for approx. 20% of all forest-related emissions in the reference period (2005-2014) so they are considered to be significant (>10% of all forest-related emission in the reference period).
Removals from enhancement of carbon stocks	Yes	The ER-Program accounts for GHG removals as a result of Conversion of non-forest land to forest land as defined by the IPCC whether natural, natural assisted or of anthropogenic origin.
Emissions and removals from conservation of carbon stocks	No	There is not a national definition for this REDD+ activity. However, there is a comprehensive accounting for GHG emissions and removals from forests so GHG emissions and removals that could potentially be included in this activity are included in previous REDD+ activities.
Emissions and removals from sustainable management of forest	No	There is not a national definition for this REDD+ activity. However, there is a comprehensive accounting for GHG emissions and removals from forests so GHG emissions and removals that could potentially be included in this activity are included in previous REDD+ activities.

7.2 Description of carbon pools and greenhouse gases selected

This section outlines which carbon pools and which greenhouse gases (GHG) are included or excluded under the ER Program. Generally, the exclusion carbon pools is justified by the argument of conservativeness, i.e. that the exclusion will underestimate emissions in the REL (in line with indicator 4.2 ii of the MF). Hence, where the exclusion is justified by conservativeness, no additional proof of (in)significance is provided.

Table 7-0-0-2-2: Carbon Pools accounted for under the ER-Program

Carbon Pools	Selected?	Justification/Explanation
Above Ground Biomass (AGB)	Yes	Emissions from AGB constitute the majority of emissions from all baseline activities within the ER-Program accounting area and are

Carbon Pools	Selected?	Justification/Explanation
		thus considered to be significant (>10% of total forest related emissions in the Accounting Area during the Reference Period). Likewise, emissions reductions and removals in the Program scenario are expected to result in a major increase of the AGB carbon pool compared to the reference emission level. In consequence, this pool must be included
Below Ground Biomass (BGB)	Yes	The ER-Program makes use of root-shoot ratios with an order of magnitude of 20-37% of AGB, this means that emissions from BGB constitute a significant carbon pool (>10% of total forest related emissions in the Accounting Area during the Reference Period). Likewise, emissions reductions and removals in the Program scenario are expected to result in a major increase of the AGB carbon pool and hence also the BGB carbon pool compared to the reference emission level. In consequence, this pool must be included.
Dead Wood	No	For the activities “reducing emissions from deforestation” and “enhancement of carbon stocks” in non-forest land the exclusion of dead wood would be conservative. In the former, dead wood stocks are higher in forest than in non-forest so conversion from one to another would result in emissions which would be reduced by the activities of the ER program. Moreover, this assumption is confirmed by the 2006 IPCC GL (Vol. 4, chapter 2, page 2.25, section 2.3.2.2, 2nd paragraph³³) that preconizes that in the forestland to non-forestland IPCC category it must be assumed that the DOM pools in non-forest land categories after the conversion are zero, i.e., they contain no carbon. In the latter, it is expected that the amount of dead wood would increase as forestlands have higher carbon stocks than non-forestlands. For the activities occurring in forestland remaining forestland such as “reducing emissions from degradation” and “enhancement of carbon stocks” in forestland, the dead wood pool would not be significant as indicated by the 2006 IPCC GL. According to the IPCC 2006 guidelines (Vol. 4, chapter 2, page 2.21, section 2.3.2.1, 2nd paragraph), [...] countries that use Tier 1 methods³⁴ to estimate DOM pools in land remaining in the same land-use category, report zero changes in carbon stocks or carbon emissions from those pools [...], therefore, emissions from dead wood pool in forestland remaining forestland would be zero. Based on the rationale provided above, the ER-Program does not account for the deadwood carbon pool.
Litter	No	In line with the above, the exclusion of this pool is expected to be conservative for the activities “reducing emissions from deforestation” and “enhancement of carbon stocks” in non-forestland as the ER program is going to reduce emissions or enhance removals from this carbon pool so its exclusion would reduce the emission reductions generated by the ER program. As indicated in the previous pool for forestland remaining forestland REDD+ activities, the dead organic matter pool is not significant as GHG emissions may be assumed to be zero. According to the IPCC 2006 guidelines, (Vol. 4, chapter 2, section 2.2.1, page 2.9, 2nd bullet

³³ [...] the Tier 1 assumption is that DOM pools in non-forest land categories after the conversion are zero, i.e., they contain no carbon. The Tier 1 assumption for land converted from forest to another land-use category is that all DOM carbon losses occur in the year of land-use conversion [...].

³⁴In accordance with Point 18 (page 37) of the Carbon Fund methodological framework, IPCC Tier 2 method is defined as a method [...] use of the same methodological approach as Tier 1 but applies emission factors and activity data which are defined by the host country for the most important land uses or activities [...].

Carbon Pools	Selected?	Justification/Explanation
		point), [...] under Tier 1, dead wood and litter pools are often lumped together as 'dead organic matter' [...] (DOM), so the above applies to the litter carbon pool. In consequence, the ER-Program does not account for the litter carbon pool.
Soil Organic Carbon (SOC)	No	For REDD+ activities occurring in forestland remaining forestland GHG emissions may be assumed to be zero in accordance with the 2006 IPCC GL ³⁵ . In REDD+ activities in forestland to non-forestland and non-forestland to forestland, it is expected that these will lead to less areas deforested (largely by burning), i.e. emissions from the soil organic carbon pool will be lower in the program scenario compared to the baseline scenario. As such omission of this pool is conservative, because program emissions are very likely to be lower than baseline emissions (REL), i.e. emission reductions will be underestimated. This is in line with indicator 4.2 ii of the MF.

The ER Program accounts for the following greenhouse gases:

Table 7-0-3-0-3: Greenhouse Gases accounted for under the ER-Program

GHG	Selected?	Justification/Explanation
CO ₂	Yes	The ER Program shall always account for CO ₂ emissions and removals
CH ₄	No	According to the DRC Biennial Update Report (BUR1)-National Inventory Report (NIR), ³⁶ CH ₄ and N ₂ O emissions represent 0.73% of Agriculture, Forestry, and other Land Uses (AFOLU) Sector total emissions (CH ₄ 0.47% and N ₂ O 0.26%). CH₄ emissions estimate includes the following sources: 3A1 Livestock-Enteric Fermentation; 3A2 Livestock-Manure Management; 3C1 Biomass Burning and 3C7 Rice Cultivation.
N ₂ O	No	N₂O emissions estimate includes the following sources: 3A2 Livestock-Manure Management; 3C1 Biomass Burning; 3C4 Direct N₂O Emissions from Managed; 3C5 Indirect N₂O Emissions from Managed soils and 3C6 Indirect N₂O Emissions from Manure Management. Furthermore, the ER Program's mitigation activities will result in fewer areas burnt. The non-CO₂ emissions related to burning are conservatively neglected.

8 REFERENCE LEVEL

8.1 Reference Period

The Methodological Framework (MF) of the FCPF, Indicator 11.1 notes: *"The end-date for the Reference Period is the most recent date prior to two years before the TAP starts the independent assessment of the draft ER*

³⁵Forest soil carbon stocks do not change with management according to Tier 1 assumption provided in Section 4.2.3.1 - Chapter 4 – Volume 4 – 2006 IPCC GL

³⁶ DRC-BUR National Inventory Report <https://unfccc.int/documents/629121>

Program Document and for which forest-cover data is available to enable IPCC Approach 3. An alternative end-date could be allowed only with convincing justification, e.g., to maintain consistency of dates with a Forest Reference Emission Level or Forest Reference Level, other relevant REDD+ programs, national communications, national ER program or climate change strategy” .

Considering the above guidance and national / local circumstances, DRC will apply a reference period from 2004 to 2014 for its Mai-Ndombe ER-Program. This is done in order to ensure consistency with the national FREL/FRL, which will be submitted in September 2016 to the UNFCCC:

- As part of the national process for the development of the national FREL/FRL supported by FAO, it was decided in 2014 when that process was first started, that the reference period would end in 2014. This resulted in a number of technical decisions:
 - A sub-national 2014 forest cover benchmark Map for the Old Bandundu province would be produced by DIAF with technical support of the Japanese International Cooperation Agency (JICA)
 - A national forest cover benchmark Map for the year 2014 would be produced by DIAF with technical support of FAO
 - A biomass map for the year 2014 would be produced based on a LiDAR collection campaign (see map Annex 19).
- Consistent with this, DRC **decided in April 2014 to use a historic reference period from 2004 to 2014 in order to align the end-date of the reference period with the national FREL/FRL.**
- In order to formalize the above, in consultation with stakeholders and with the support from FAO, DRC decided in November 2015 that **the reference period for the national FREL/FRL would be January 1st 2005-December 31st 2014**, allowing the start date and end date to coincide with the national forest cover maps produced by DIAF. This decision has been presented during the UNFCCC COP21 in Paris in a methodological note describing features of the national FREL/FRL.

Although a 2014 end date was decided for consistency with the national FREL/FRL, this end-date is justified for other reasons:

- Using a reference period which ends 2 years before the operational ER Program start date (2016) and 3 years from the ERPA start date mitigates the inaccuracy of the 5-year gap that would be created by maintaining a 2012 end date.
- An end date of 2014 ensures that assessment of carbon stocks is up to date (e.g. the average carbon stock for forest strata may change over time, which could have minor impacts on the Emission Factors). Temporal alignment between the end of the reference period and the measurement of carbon stock data minimizes such effects. Equally important, the REL envisages measurement of conversion of Savannah to forest under the ER Program’s A/R activities. For this reason, temporal alignment between the end of the historic reference period and carbon stock data is also of advantage. Finally, choosing a 2014 end date offers the important co-benefit that the ER Program presents the alignment of the FCPF and VCS-JNR reference levels. (Because VCS JNR requires a maximum difference of 10 years between the historical reference period end-date and the start of the ER program).

Although the reference period end date would be temporally aligned in both sub-national and national RL, the ER Program start date would differ. In order to maximize consistency with the national REL, collaboration with FAO and DIAF has resulted in a mutual agreement by to use the January 1st 2005- December 31st, 2014 samples used by the ER-Program to calculate the sub-national REL to conduct an accuracy assessment of the January 1st 2005- December 31st, 2014 Land Cover Change (LCC) map in the ER-Program area. These accuracy values will then in turn be used to adjust national map deforestation area results for the Mai Ndombe province. (See Section 8.6 below).

8.2 Forest definition used in the construction of the Reference Level

DRC submitted a host country specific definition to UNFCCC³⁷ that was applied in the design of the Jurisdictional ER Program. Respective minimum values for crown cover, tree height and area according to the official DRC forest definition are as follows:

Table 8-18-1: Forest Definition of DRC

<i>Item</i>	<i>Value</i>
Minimum Crown Cover (%)	30%
Minimum Land Area (ha)	0.5
Minimum Tree Height (m)	3

This forest definition was applied in order to conduct the analysis of forest cover and forest cover change. Forest was further stratified in Primary Forest and secondary forest (see definition in table above) in order to enable the estimation of forest degradation and enhancement of carbon stocks in existing forests.

Table 8-28-2: Land Use / Land Cover categories

<i>Land Use Land Cover class</i>	<i>Description</i>
Primary forest	This category consists of all forests without a significant human influence and it includes old growth <i>terra firme</i> forest, semi-deciduous forests and swamp forests. This class is identified in satellite imagery by its distinct color (deep green), roughness and the shape of its patches. Analysts are instructed to estimate canopy cover based on forest definition, but ultimately use all contextual information available to them to perform ocular separation of this category from secondary forest.
Secondary Forest	This category consists of all forests, which are not primary forests, and it includes all secondary and degraded forests. Secondary forests are those forests regenerated after forest clearing and degraded forests are those forests that have been disturbed but in which the vegetation has never been under the thresholds of the forest definition. Secondary forest is identified in satellite imagery primarily using an image enhancement technique developed at the University of Kinshasa. Histogram equalization results in the enhancement and separation of secondary forest by causing it to appear as a yellow color, rendering it clearly separable from primary forest. Analysts are similarly trained to identify the lower bound of secondary forest class by estimating crown cover, but they are ultimately instructed to use all contextual information available to them.
Non-Forest	This category includes all lands that contain vegetation under the thresholds of the forest definition. It includes the following sub-classes: Cropland; Grassland; Wetland/Water; Settlement; Bare Soil; and Burn Scar. This class is identified in satellite imagery by its brown to red color, roughness (smooth, except for sparse vegetation) and its boundary with primary and secondary forests (forest edge shadows, etc.). The upper bound of the non-forest class is identified by estimating canopy cover, but ultimately analysts are instructed to use all contextual information available to them.

Land Use / Land cover categories were identified using a manual / visual interpretation of sampling units, in which analysts were trained according to a robust set of rules allowing them to identify and distinguish common land cover categories present in the Mai Ndombe forest. These rules were developed and based on the definition shown above. Interpretations of each sampling unit selected for analysis began with a decision tree that provided a dichotomous rule set for assigning labels. Standard operating procedure³⁸ required experienced

³⁷ Submitted under the framework for the Clean Development Mechanism. It was decided its application as part of the national REDD+ program.

³⁸ See Annex 1 in **Quantifying the forest Reference Level of the emissions reduction program of Mai-Ndombe province, Democratic Republic of Congo. Final Report. 2020.** https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0

analysts to interpret landscape pattern and land cover and land use extent and change using tone, texture and other image attributes, both per single image and in time-series, along with graphs of time-series spectral measures, to assign land cover and land use labels.

The decision tree for assigning land cover is based on physiognomic-structural attributes of vegetation, specifically height and cover. Vegetation cover and height are used to differentiate forests from savanna and non-forest categories, with 30% cover and >3m height defining forests. For Mai-Ndombe, previous reference level studies have concerned only dense humid and secondary tropical forest types, as other formations are of negligible extent in the province (FCPF, 2016). We include open forests having $\geq 30\%$ and $< 60\%$ tree canopy cover in our legend of forest cover categories, but do not expect to have sufficient samples to make estimates of their extent or change, as Mai-Ndombe has limited extent of dry tropical Mikwati or Miombo woodlands found further south in Kwango and Kwilu provinces. For tree canopy cover $\geq 60\%$, we separate dense tree cover into dense humid (primary) terra firma and wetland forests and secondary (regrown) forests. Dense humid forest is differentiated from secondary humid forest by the spectral signature from greater vertical variation and texture associated with old growth forests compared to the more uniform canopies associated with colonizing tree species. Spectral responses for the three classes of interests are summarized as follows:

- 1) Non-forest – low greenness (Normalized Difference Vegetation Index) for water bodies, savannas and settlements, higher greenness and high red reflectance for croplands, shrublands, woodlands, and open forests.
- 2) Dense humid forest (terra firma) – low red and shortwave infrared reflectances, overall dark albedo, texture associated with complex, mature tree canopies.
- 3) Dense humid forest (wetland) – more uniform canopies, landscape with visible hydrographic features indicating saturated soils, wetland floristic associations, and landscape-scale drainage patterns.
- 4) Secondary forest – high near infrared reflectance associated with uniform canopies, higher overall albedo, with regrowth spatially associated with land use at the landscape scale.
- 5) Forest loss – sharp increase in shortwave infrared and red reflectance.
- 6) Forest gain – slow, multi-year decrease in shortwave infrared and red reflectance.
- 7)

8.3 Average annual historical emissions over the Reference Period

Description of method used for calculating the average annual historical emissions over the Reference Period

Criterion 5 of the MF requests that [...] *The ER Program uses the most recent Intergovernmental Panel on Climate Change (IPCC) guidance and guidelines, as adopted or encouraged by the Conference of the Parties as a basis for estimating forest related greenhouse gas emissions by sources and removals by sinks [...].*

UNFCCC Decision 2/CP.13 paragraph 6 [...] *encourages the use of the most recent reporting guidelines as a basis for reporting greenhouse gas emissions from deforestation, noting also that Parties not included in Annex I to the Convention are encouraged to apply the Good Practice Guidance for Land Use, Land-Use Change and Forestry [...].*

On the most recent reporting guidelines for reporting greenhouse gas emissions from deforestation, UNFCCC Decision 17/CP.8, including FCCC/CP/2002/7/Add.2, states that [...] *Non-Annex I Parties should use the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories [...].*

To summarize, the Democratic Republic of the Congo as a non-Annex I country should use the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* and is encouraged to use the 2003 IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry

Despite this, the ER-Program has voluntarily opted to make use of data and methods as set out in the 2006 IPCC guidelines. This should be regarded as a voluntary commitment to increase the accuracy of reporting on emission sources and sinks.

Based on the identification of the drivers of deforestation and forest degradation (section 4.1), the ER-Program in the following provides an overview of the 2006 IPCC methods used for GHG estimation in the ER-Program area. A detailed description of the methodologies is provided in the following subsection (8.3.2)

The methodology used to quantify the REL for DEF/DEG is - by IPCC definition –a so-called gain-loss methods, since the methodology is a process-based approach, which estimate the net balance of additions to and removals from a carbon stock (cp. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2, page 2.9 ff). See **Error! Reference source not found.** for an overview.

Table 8-38-3: IPCC equations used to quantify emission and removals for the REL

REDD+ activity (sources & sinks)	Equation from the 2006 IPCC guidelines used as a basis for GHG estimation (for AGB and BGB)	Reference to 2006 IPCC guidelines
General	Equation 2.2 Equation 2.3	Vol. 4, chapter 2, section 2.2.1, page 2.7
Emissions & removals from deforestation and enhancement of forest carbon stocks (forest land to non-forest land and vice versa)	Equation 2.15 Equation 2.16	Vol. 4, chapter 2, section 2.3.1.2, page 2.20 Vol. 4, chapter 2, section 2.3.1.2, page 2.20
Removals from forest degradation (forest land remaining forest land)	Equation 2.7	Vol. 4, chapter 2, section 2.3.1.1, page 2.12

Net emissions of the RL over the Reference Period (RL_{RP}) are estimated as the sum of annual change in total biomass carbon stocks (ΔC_{B_t}) during the reference period.

$$RL_{RP} = \frac{\sum_t^{RP} \Delta C_{B_t}}{RP} + AE \quad \text{Equation 14}$$

Where:

RP = Reference period; years.

AE = Upward adjustment of emissions $tCO_2 \cdot year^{-1}$. For further details on the quantification of the upward adjustment to the average annual historical emission over the reference period, see Annex 4, section 8.4.

ΔC_{B_t} = Annual change in total biomass carbon stocks at year t; $tCO_2 \cdot year^{-1}$; The annual changes in carbon stocks over the reference period in the Accounting Area are equal to the sum of annual change in carbon stocks for each of the i REDD+ activities (ΔC_{LU_i}). Following the IPCC notation, the sum of annual change in carbon stocks for each of the i REDD+ activities (ΔC_{LU_i}) would be equal to the annual change in carbon stocks in the aboveground biomass carbon pool (ΔC_{AB}) and the annual change in carbon stocks in belowground biomass carbon pool (ΔC_{BB}) accounted.

$$\Delta C_{LU} = \sum_i \Delta C_{LU_i} \quad \text{GL)} \quad \text{Equation 15 (Equation 2.2, 2006 IPCC)}$$

$$\Delta C_{LU_i} = \Delta C_{AB} + \Delta C_{BB} = \Delta C_B \quad \text{GL)} \quad \text{Equation 16 (Equation 2.3, 2006 IPCC)}$$

Annual change in total biomass carbon stocks forest land converted to another land-use category (ΔC_{B_t})

Following the 2006 IPCC Guidelines, the annual change in total biomass carbon stocks forest land converted to other land-use category (ΔC_{B_t}) would be estimated through the following equation:

$$\Delta C_{B_t} = \Delta C_G + \Delta C_{\text{CONVERSION}} - \Delta C_L \quad \text{Equation 17 (Equation 2.15, 2006 IPCC GL)}$$

Where:

- ΔC_{B_t} = Annual change in carbon stocks in biomass on land converted to other land-use category, in tones C yr⁻¹;
- ΔC_G = Annual increase in carbon stocks in biomass due to growth on land converted to another land-use category, in tones C yr⁻¹;
- $\Delta C_{\text{CONVERSION}}$ = Initial change in carbon stocks in biomass on land converted to other land-use category, in tones C yr⁻¹; and
- ΔC_L = Annual decrease in biomass carbon stocks due to losses from harvesting, fuel wood gathering and disturbances on land converted to other land-use category, in tones C yr⁻¹.

Following the recommendations set in chapter 2.2.1 of the GFOI Methods Guidance Document³⁹ for applying IPCC Guidelines and guidance in the context of REDD+, the above equation will be simplified and it will be assumed that: a) the annual change in carbon stocks in biomass (ΔC_B) is equal to the initial change in carbon stocks ($\Delta C_{\text{CONVERSION}}$); b) it is assumed that the biomass stocks immediately after conversion is the biomass stocks of the resulting land-use. Therefore, the annual change in carbon stocks would be estimated as follows:

$$\Delta C_B = \Delta C_{\text{CONVERSION}}$$

$$\Delta C_{B_t} = \sum_{j,i} (B_{\text{Before},j} - B_{\text{After},i}) \times CF \times \frac{44}{12} \times A(j, i)_{\text{RP}} \quad \text{Equation 18 (Equation 2.16, 2006 IPCC GL)}$$

Where:

- $A(j, i)_{\text{RP}}$ = Area converted/transited from forest type j to non-forest type i during the Reference Period, in hectares per year. In this case, two forest land conversions are possible:

- Primary forest terra firme to non-forest type i; and
- Secondary forest to non-forest type i

One type of non-forest land is considered:

- Crops and regeneration of abandoned crops (CRCA-Culture et Régénération de Culture Abandonnée).

Technical corrections: The sample-based area estimation of activity data has been updated. Initial FREL was estimated using **systematic grids** (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using **pixel-based stratified random** sampling with 2,000 sampling points.

³⁹Page 44, GFOI (2013) Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative: Pub: Group on Earth Observations, Geneva, Switzerland, 2014.

$B_{\text{Before},j}$ = Total biomass of forest type j before conversion/transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{Before},j}$) and belowground biomass ($BGB_{\text{Before},j}$) and it is defined for each forest type.

$B_{\text{After},i}$ = Total biomass of non-forest type i after conversion, in tons dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{After},i}$) and belowground biomass ($BGB_{\text{After},i}$) and it is defined for each of the non-forest IPCC Land Use categories.

Technical corrections: $B_{\text{Before},j}$ and $B_{\text{After},i}$ were technically corrected. Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

CF = Carbon fraction of dry matter in tC per ton dry matter. The value used is:

- **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3.

44/12 = Conversion of C to CO₂

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta C_{B_{\text{DEG}}}$)

Following the 2006 IPCC Guidelines the annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta C_{B_{\text{DEG}}}$) could be estimated through the Gain-Loss Method or the Stock-Difference Method as described in Chapter 2.3.1.1 of Volume 4 of the 2006 IPCC Guidelines.

$$\Delta C_B = \Delta C_G - \Delta C_L \quad \text{Equation 19 (Equation 2.7, 2006 IPCC GL)}$$

$$\Delta C_B = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)} \quad \text{Equation 20 (Equation 2.8 (a), 2006 IPCC GL)}$$

Where:

ΔC_B = Annual change in carbon stocks in biomass for each land sub-category, in tonnes C yr⁻¹

ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr⁻¹

ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr⁻¹

C_{t_2} = total carbon in biomass for each land sub-category at time t_2 , tonnes C

C_{t_1} = total carbon in biomass for each land sub-category at time t_1 , tonnes C

Following the recommendations set in chapter 2.2.2 of the GFOI Methods Guidance Document⁴⁰ for applying IPCC Guidelines and guidance in the context of REDD+, the above equation will be simplified, and it will be assumed that: a) the annual change in carbon stocks in biomass (ΔC_B) due to degradation is equal to the annual decrease in carbon stocks (b) the decrease in carbon stocks occurs the year of conversion. The long-term decrease in carbon stocks indicated in equation (1) of the GFOI MGD is assumed here to be zero. Therefore, considering the GFOI MGD the IPCC equation for forest degradation could be expressed as an Emission Factor time activity data as follows:

⁴⁰Page 48, GFOI (2013) Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative: Pub: Group on Earth Observations, Geneva, Switzerland, 2014.

$$\Delta C_{B_{DEG}} = \sum_j \{EF_{DEG} \times A(a, b)_{RP}\} \quad \text{Equation 21}$$

EF_{DEG} = Emission factor for degradation of forest type a to forest type b, tones CO₂ ha⁻¹. The Emission Factor is calculated with the equation 9.1 where B_{Before,a} is total biomass of forest type **a** before transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{Before,a}) and belowground biomass (BGB_{Before,a}) and B_{After,b} is total biomass of forest type **b** after transition, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{after,b}) and belowground biomass (BGB_{after,b}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

$$EF_{DEG} = (B_{Before,a} - B_{After,b}) \times CF \times \frac{44}{12} \quad \text{Equation 9.1}$$

A(a, b)_{RP} = Area of forest type a converted to forest type b (transition denoted by a,b) during the Reference Period, ha yr⁻¹.

Technical corrections: Calculation of annual change of carbon stocks on forestland remaining forestland has been technical corrected. Enhancement of carbon stocks in existing forest is not included in the updated FREL.

Annual change in carbon stocks in biomass on non-forestland converted in forestland ($\Delta C_{B_{SREG}}$)

Land converted to forest land CO₂ removals has been estimated following the recommendations set in the Guidance Note for accounting of legacy emissions/removals of the FCPF (version 1). Since the FCPF Methodological Framework requires IPCC Tier 2 or higher method, the net annual CO₂ removals are calculated using equations 2.15 and 2.16 from the 2006 IPCC Guidelines, Volume 4, Chapter 2. These equations were simplified by assuming that the conversion from non-forest to forest occurs during a period from average carbon stocks in non-forest to average carbon stocks in forests. A conservative default period of 20 years is assumed for the forest to grow from the carbon stock levels of non-forest to the level of biomass in the average forest. The removal estimate considers changes in carbon stocks in above- and below-ground biomass. Using the outcome of equation 2.15 and 2.16, it was determined the changes in the total carbon stocks in biomass (removals) during the reference period as the sum of the total carbon stocks in biomass of all land units. From the point of view of notations, the emission factors in equation EQ5 above would be replaced by **RF_{SREG}** in enhancement of carbon stocks in new forests.

$$\Delta C_{B_{SREG}} = \sum_{LU=1}^n \{RF_{SREG} \times A(i, j)_{RP}\} \quad \text{Equation 22}$$

RF_{SREG} = enhancement of carbon stocks in new forests [tCO₂*ha*year⁻¹]. The Removal Factor is calculated with the equation 10.1 where B_{CRCA} is total biomass of crops and regeneration of abandoned crops, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{CRCA}) and belowground biomass (BGB_{CRCA}) and B_{SecondaryForest} is total biomass of Secondary Forests, in tons of dry matter per ha. This is equal to the sum of aboveground (AGB_{SecondaryForest}) and belowground biomass (BGB_{SecondaryForest}). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

According to the FCPF guidance note for accounting of legacy emissions/removals⁴¹ and the IPCC guidelines, after a change in land use, it is good practice to assume that the carbon stocks in the relevant area change from one steady value (associated with the land use before the land use change) to another steady value (associated with the land use after the land use change) over at least 20 years with the emissions and removals being spread over the whole transition period. Therefore, the total biomass gained from abandoned crops to secondary forests was divided by 20 years to estimate the removal factor.

$$RF_{SREG} = \frac{(B_{CRCA} - B_{SecondaryForest}) \times CF \times \frac{44}{12}}{20} \quad \text{Equation 10.1}$$

$A(i, j)_{RP}$ = Area of non-forestland i converted to forestland j (transition denoted by i, j) in the reference period, ha yr⁻¹.

LU = Land unit.

Activity data and emission factors used for calculating the average annual historical emissions over the Reference Period

Activity data

Parameter:	$A(j, i)_{RP}$ Equation 6 $A(a, b)_{RP}$ Equation 9 $A(i, j)_{RP}$ Equation 10					
Description:	$A(j, i)$: Area converted/transited from forest type j to non-forest type i during the Reference Period (Deforestation transition denoted by j, i) $A(a, b)$: Area of forest type a converted to forest type b (Degradation transition denoted by a, b). $A(i, j)$: Area of non-forestland i converted to forestland j (Regeneration transition denoted by i, j)					
Data unit:	hectare.					
Value monitored during this Monitoring / Reporting Period:	Table 8-48-4: Value monitored during the Reference Period					
	Code	Land cover transition	Land cover transition 2005-2009 (ha)	CI 2005-2009 (ha)	Land cover transition 2010-2014 (ha)	CI 2010-2014 (ha)
	AUTRE_AUTRE	Stable non-forest	3,543,685	108,864	3,583,473	109,271
	AUTRE_FS	Secondary Forest regeneration (forest gain / non-forest to Secondary Forest)	112,734	21,780	126,499	22,330
	FDHSH_FDHSH	Stable Dense humid Wetland Forest	2,392,511	289,802	2,392,511	289,802
	FHTF_AUTRE	Dense humid terra firma deforestation (DH terra firma to non-forest)	58,501	11,907	96,142	15,014
	FHTF_FHTF	Stable Dense humid (DH) Terra firma Forest	5,813,199	299,055	5,625,863	298,453
	FHTF_FS	Dense humid terra firma degradation (DH terra firma to secondary forest)	53,562	13,453	91,194	19,227
	FS_AUTRE	Secondary Forest deforestation (Secondary Forest to non-forest)	107,786	21,105	273,558	43,992
	FS_FS	Stable Secondary Forest	766,342	108,697	659,081	103,217
Source of data and	A probability-based sample of time-series imagery was used as reference data in estimating activity data for the province of Maï-Ndombe, DRC, from 2005 to 2014 for the reference period (including					

⁴¹ FCPF guidance note for accounting of legacy emissions/removals can be accessed at the following link: https://www.forestcarbonpartnership.org/system/files/documents/fmt_note_2020-5_application_of_ipcc_guidelines_v2_.pdf

description of measurement /calculation methods and procedures applied⁴²:	two sub-periods for the 2005-2009, and 2010-2014 intervals), and for the performance period. We employed an approach with a goal of delivering a method that can readily be applied to all provinces in the DRC. <u>Sampling design:</u> A stratified random sampling design based on mapped classes closely aligned with activity data definitions was employed to maximize the efficiency of the sample allocation. An initial sample of 100 samples per stratum was drawn for each of the following classes in Mai-Ndombe province. Based on the target class proportions identified in each stratum from the interpretation of the initial sample, we calculated the number of sampling units per stratum required to reach the target 90% confidence interval of $\pm 20\%$ of the estimated area for the reporting classes. The required sample size for a given target variance for each target class can be found using Equation 5.66 from Cochran (page 110) for the optimal allocation with fixed n. Optimal sample allocation among strata (minimized variance for fixed n) was achieved using Equation 5.60 from Cochran (page 108) and replacing the true population class proportion for each stratum with the one estimated from the initial sample. Final sample allocation totaling 2000 sampling units. <u>Response design:</u> The Response design included defining the assessment unit as 30m pixels from the mapped strata population, source reference data in the form of 16-day Landsat composite time-series data from 2000 through 2019, supplemented by Google Earth imagery. A detailed labeling protocol is described exhaustively in Standard Operating Procedures and includes decision trees and LULC classification systems in order to allow the unambiguous classification of the sample units. The sample-based analysis consisted of stratified randomly selected pixels across the area of Mai-Ndombe province. While the sampling unit was a pixel, and each pixel was examined at annual timescales, assessment was also facilitated by spatiotemporal context. Each sampling unit was interpreted using time-series Landsat and Google Earth imagery and time-series of individual spectral measures. Expert image interpreters analyzed the reference sampling units and labeled them at annual intervals as either primary forest, secondary forest, and non-forest, as well as transitions, type of change (loss or gain), driver, and the year of change. For pixels that were not interpreted consistently between the analysts, an additional analyst was engaged, and all analysts worked together to reach a consensus in making final assignments. The interpretation team included participants from the project consortium of DIAF/OSFAC/UMD. <u>Sampling unit interpretation protocol:</u> Interpretations of each sampling unit selected for analysis began with a decision tree that provided a dichotomous rule set for assigning labels. The decision tree for assigning land cover is based on physiognomic-structural attributes of vegetation, specifically height and cover. Vegetation cover and height are used to differentiate forests from savanna and non-forest categories, with 30% cover and >3m height defining forests. For tree canopy cover $\geq 60\%$, we separate dense tree cover into dense humid (primary) terra firma and wetland forests and secondary (regrown) forests. Dense humid forest is differentiated from secondary humid forest by the spectral signature from greater vertical variation and texture associated with old growth forests compared to the more uniform canopies associated with colonizing tree species. <u>Area estimation for activity data:</u> Area estimates were made for three scenarios: 1) consensus labels of all sampling units, 2) only samples where all interpretations agreed, and 3) subsets of sampling units with the same average annual number of observations per epoch, for example where we have at least 5 good annual Landsat observations per sample for all samples. Scenarios 2) and 3) served
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⁴² Further details on source data and methods to estimate activity data can be found in the final report for **Quantifying the forest Reference Level of the emissions reduction program of Mai-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab** - https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0. Please take note that the UMD report is not the official data source for monitoring period activity data estimate, and it's just a preliminary estimate of emission reduction for 2018-2019. The ER-Program process is a lengthy one, and earlier decisions on data and periods were later revised, but such revisions are not reflected in the referenced document. The initial reporting period was set from 21.09.2018 to 31.07.2019 (see schedule 2 on page 15 of the [ERPA](#)). However, the reporting period was later changed from 01.01.2019 to 31.12.2020, as described in the MR. The ER-MR document references the UMD report to provide additional information on the methods used to estimate Activity Data.

	to evaluate the sensitivity the final consensus estimates to removing samples lacking interpreter consensus or removing samples with few quality image observations. For a stratified random sample of pixels within nine strata, annual binary labels of yes/no for each stable land cover and transition class were assigned. Areas for each class were calculated per the following calculations, given the mean proportion of class i in stratum h: $\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h}$ Where: $p_{iu} = 1$ if pixel u is identified as class i, and 0 otherwise n_h – number of samples in stratum h Estimated area of class i: $\hat{A}_i = \sum_{h=1}^H A_h \bar{p}_{ih}$ Where: A_h – total area of stratum h H – number of strata ($H = 9$) Standard error of the estimated area of class i: $SE(\hat{A}_i) = \sqrt{\sum_{h=1}^H A_h^2 \frac{\bar{p}_{ih}(1 - \bar{p}_{ih})}{n_h - 1}}$
QA/QC procedures applied:	QA/QC procedures included the definition of clear roles and responsibilities in terms of QA/QC, the definition SOPs, training on the defined SOPs, multiple interpreters per sample unit, and a final quality assurance check in order to ensure the quality of the data. All sample pixels were initially interpreted by at least two independent experts. Each analyst assigned to each sample pixel the following labels: loss month and year, pre- and post-disturbance land cover type, land cover proportion, availability of high-resolution image, and forest disturbance driver, and expert's confidence (high/medium/low) separately for all labels. After the initial interpretation, a consensus exercise was performed for all sampled pixels featuring disagreement between interpreters or with low confidence for any interpreter. An additional expert joined the exercise, and a group discussion was undertaken to make the final assignment of land cover extent and change dynamics. Given the final interpretations, we assessed the sensitivity of the method as a function of interpreter agreement and data richness. Interpretations of 2005-2014 for all samples versus the subset of 1405 samples for which the two expert interpreters agreed resulted in similar area estimates with overlapping uncertainties. Area estimates for individual forest dynamics derived from the subset are within 11% of the estimate made using all 2000 samples. Results based on data richness show that restricting sampling units by annual minimum number of observations to 2, 3 and 4 images also produced similar estimates. There were 1,914 samples having at least two observations per year and area estimates of all forest change categories were less than 6% different across categories. For the 1,426 samples with at least three observations per year, all forest area change estimates differed by less than 9%. For the 584 samples with at least 4 observations per year, secondary regrowth differed by 22% and dense humid forest degradation by 14%, and others by less than 9%. The results indicate a robust method not biased by variation in measurements related to interpreter or observation richness. Importantly, all results from all scenarios document the within reference period increase in forest loss.
Uncertainty for this parameter:	Uncertainty stems primarily from: iii. Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. iv. The sampling errors. The presented work sought to improve the accuracy of the existing reference emissions level calculations through a more robust methodology to estimate activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Mai-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as

	a function of interpreter agreement and data richness. The principal improvement was derived from the stratification that enabled the efficient allocation and interpretation of reference data. Our goal of <20% uncertainty at the 90 th percentile confidence interval for activity data from 2005-2014 was achieved using 2,000 samples. The initial FREL had higher uncertainties derived using over 30,000 samples. The methodological efficiency points to the possible extension of the approach to the national scale. Concerning the differences in areas, we believe that fewer samples interpreted by a small team of experts following a strict protocol of signal-based identification of forest loss and gain is a more robust approach.
Any comment:	Initial FREL was estimated using systematic grids (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using pixel-based stratified random sampling with 2,000 sampling points.

Emission factors

Parameter:	B_{Before,j} ; Equations 6 and 12 B_{After,i} ; Equations 6 and 12 CF ; Equation 6																																														
Description:	B_{Before,j} : Total biomass of forest type j before conversion/transition. This is equal to the sum of aboveground (AGB _{Before,j}) and belowground biomass (BGB _{Before,j}) and it is defined for each forest type. B_{After,i} : Total biomass of non-forest type i after conversion. This carbon content is equal to the sum of aboveground (AGB _{After,i}) and belowground biomass (BGB _{After,i}), and it is defined for each of the non-forest IPCC Land Use categories. CF : Carbon fraction of dry matter in tC per ton dry matter. The value used is: 0.47 is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3																																														
Data unit:	Carbon content : tones of dry matter per ha (tCO ₂ ha ⁻¹).																																														
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Spatial Level: National Source of Data⁴³: The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. Table 8-58-5: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops). <table><tr><th rowspan="2">Land cover class</th><th rowspan="2">Inventoried area (ha)</th><th colspan="4">SU type</th><th rowspan="2">Total</th></tr><tr><th>WWF (square cluster)</th><th>PRE-IFN (square plot)</th><th>DIAF-JICA (square cluster)</th><th>PRE-IFN & DIAF-JICA (circular cluster)</th></tr><tr><td>FDHTF</td><td>46.1</td><td>7</td><td>13</td><td>13</td><td>15</td><td>48</td></tr><tr><td>FDHSH</td><td>7.56</td><td></td><td></td><td>6</td><td></td><td>6</td></tr><tr><td>FSFC</td><td>6.29</td><td></td><td></td><td></td><td>11</td><td>11</td></tr><tr><td>FSc</td><td>3.32</td><td></td><td></td><td></td><td>14</td><td>14</td></tr><tr><td>Savannah</td><td>8.48</td><td></td><td></td><td></td><td>29</td><td>29</td></tr></table>	Land cover class	Inventoried area (ha)	SU type				Total	WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	FDHTF	46.1	7	13	13	15	48	FDHSH	7.56			6		6	FSFC	6.29				11	11	FSc	3.32				14	14	Savannah	8.48				29	29
Land cover class	Inventoried area (ha)			SU type					Total																																						
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⁴³ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

	CRCA	3.46				14	14																				
	Methods for developing the data:																										
	After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them.																										
	<u>Wood Density:</u> The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the "Global Wood Density database" (Chave et al., 2005; Chave et al ., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database.																										
	<u>Estimation of tree heights:</u> For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012).																										
	<u>AGB estimation:</u> Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/).The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used – $AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$																										
	<u>Mean AGB by Land-use type:</u> The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i , obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000): $AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$																										
	The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., $DBH < 10$ cm), a correction factor was applied to $AGB \geq 10$ cm according to the formula below: $AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$																										
	<u>Belowground Biomass Estimation:</u> Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.																										
Value applied:	Table 8-68-6: Estimation of biomass values by forest type and non-forest land use. <table><tr><th>Land use</th><th>Label</th><th>Value (tdm/ha)</th><th>IC (tdm/ha)</th></tr><tr><td>FSc</td><td>Secondary Forest</td><td>236.71</td><td>58.30</td></tr><tr><td>FDHTF</td><td>Primary forest terra firme</td><td>432.30</td><td>20.00</td></tr><tr><td>FDHSH</td><td>Dense humid wetland forest</td><td>415.48</td><td>44.45</td></tr><tr><td>CRCA</td><td>Culture et Régénération de Culture Abandonnée).</td><td>32.90</td><td>5.61</td></tr></table>							Land use	Label	Value (tdm/ha)	IC (tdm/ha)	FSc	Secondary Forest	236.71	58.30	FDHTF	Primary forest terra firme	432.30	20.00	FDHSH	Dense humid wetland forest	415.48	44.45	CRCA	Culture et Régénération de Culture Abandonnée).	32.90	5.61
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QA/QC procedures applied	DRC FREL Modified Submission ⁴⁴ includes a description of methods and procedures applied during data collection: Annex 7 - WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 - Methodology of the National Forest Pre-Inventory.
Uncertainty associated with this parameter:	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB_{10cm}. Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The SUs retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of SUs come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017). -For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals aimed (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$ Where E_B is the Total Biomass error (in tms*ha⁻¹), E_{AGB_{1cm}} is the error on the quantity AGB_{1cm} (in tms*ha⁻¹), and E_{BGB} the error on the quantity of BGB (in tms*ha⁻¹). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

Parameter:	EF_{DEG} Equations 9 and 13
Description:	EF_{DEG} : Emission factor for degradation of forest type a to forest type b, tones CO ₂ ha ⁻¹ .
Data unit:	Emission Factor : tones of dry matter per ha (tCO ₂ ha ⁻¹).

⁴⁴ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Spatial Level: National																																																									
	Source of Data⁴⁵: The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. Table 8-78-7: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops). <table border="1"> <thead> <tr> <th rowspan="2">Land cover class</th><th rowspan="2">Inventoried area (ha)</th><th colspan="4">SU type</th><th rowspan="2">Total</th></tr> <tr> <th>WWF (square cluster)</th><th>PRE-IFN (square plot)</th><th>DIAF-JICA (square cluster)</th><th>PRE-IFN & DIAF-JICA (circular cluster)</th></tr> </thead> <tbody> <tr> <td>FDHTF</td><td>46.1</td><td>7</td><td>13</td><td>13</td><td>15</td><td>48</td></tr> <tr> <td>FDHSH</td><td>7.56</td><td></td><td></td><td>6</td><td></td><td>6</td></tr> <tr> <td>FSFC</td><td>6.29</td><td></td><td></td><td></td><td>11</td><td>11</td></tr> <tr> <td>FSc</td><td>3.32</td><td></td><td></td><td></td><td>14</td><td>14</td></tr> <tr> <td>Savannah</td><td>8.48</td><td></td><td></td><td></td><td>29</td><td>29</td></tr> <tr> <td>CRCA</td><td>3.46</td><td></td><td></td><td></td><td>14</td><td>14</td></tr> </tbody> </table> Methods for developing the data: After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them. Wood Density: The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the "Global Wood Density database" (Chave et al., 2005; Chave et al., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database. Estimation of tree heights: For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012). AGB estimation: Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/). The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used – $AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$ Mean AGB by Land-use type: The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i, obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000):						Land cover class	Inventoried area (ha)	SU type				Total	WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	FDHTF	46.1	7	13	13	15	48	FDHSH	7.56			6		6	FSFC	6.29				11	11	FSc	3.32				14	14	Savannah	8.48				29	29	CRCA	3.46				14
Land cover class	Inventoried area (ha)	SU type				Total																																																				
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⁴⁵ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

	$AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$ The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., DBH < 10 cm), a correction factor was applied to AGB ≥ 10 cm according to the formula below: $AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$ Belowground Biomass Estimation: Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.								
Value applied:	Table 8-88: Estimation of Degradation Emission Factor. <table><tr><th>Emission Factor</th><th>Label</th><th>Value [tCO2/ha]</th><th>IC^[1]</th></tr><tr><td>EF Degradation</td><td>Transition from primary terra firme forest to secondary forest)</td><td>337.07</td><td>106.22</td></tr></table> [1] For illustrative purposes, Eq 3.2 Vol 1, Chapter 3 IPCC 2006 Guidelines were used to calculate IC. Uncertainty propagation in Monte Carlo analyses is based on carbon densities’ uncertainties.	Emission Factor	Label	Value [tCO2/ha]	IC ^[1]	EF Degradation	Transition from primary terra firme forest to secondary forest)	337.07	106.22
Emission Factor	Label	Value [tCO2/ha]	IC ^[1]						
EF Degradation	Transition from primary terra firme forest to secondary forest)	337.07	106.22						
QA/QC procedures applied	DRC FREL Modified Submission⁴⁶ includes a description of methods and procedures applied during data collection: Annex 7 - WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 - Methodology of the National Forest Pre-Inventory.								
Uncertainty associated with this parameter:	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB_{10cm}. Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The SUs retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of SUs come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017).								

⁴⁶ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

	-For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$ Where E_B is the Total Biomass error (in tms*ha⁻¹), E_{AGB_{1cm}} is the error on the quantity AGB_{1cm} (in tms*ha⁻¹), and E_{BGB} the error on the quantity of BGB (in tms*ha⁻¹). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

Parameter:	RF _{SREG} Equations 10 and 14																																																				
Description:	RF _{SREG} : Enhancement of carbon stocks in new forests. The removal factor is estimated by dividing the Emission Factor of Secondary Forest by 20 years.																																																				
Data unit:	Removal Factor: tCO2 ha year ⁻¹ .																																																				
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Spatial Level: National																																																				
	Source of Data ⁴⁷ : The carbon density used to estimate net emissions for the reference and monitoring periods is based on a Data compilation of three datasets (see table below). In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi.																																																				
	Table 8-98-8: Inventoried areas and number of sampling units by land use class. Acronyms of land cover classes: FDHSH (dense humid wetland forest on hydromorphic soil), FDHTF (dense humid forest on terra firma), FSFC (dry forest or clear forest), FSc (secondary forest), CRCA (Crops and regeneration of abandoned crops).																																																				
	<table><tr><th rowspan="2">Land cover class</th><th rowspan="2">Inventoried area (ha)</th><th colspan="4">SU type</th><th rowspan="2">Total</th></tr><tr><th>WWF (square cluster)</th><th>PRE-IFN (square plot)</th><th>DIAF-JICA (square cluster)</th><th>PRE-IFN & DIAF-JICA (circular cluster)</th></tr><tr><td>FDHTF</td><td>46.1</td><td>7</td><td>13</td><td>13</td><td>15</td><td>48</td></tr><tr><td>FDHSH</td><td>7.56</td><td></td><td></td><td>6</td><td></td><td>6</td></tr><tr><td>FSFC</td><td>6.29</td><td></td><td></td><td></td><td>11</td><td>11</td></tr><tr><td>FSc</td><td>3.32</td><td></td><td></td><td></td><td>14</td><td>14</td></tr><tr><td>Savannah</td><td>8.48</td><td></td><td></td><td></td><td>29</td><td>29</td></tr><tr><td>CRCA</td><td>3.46</td><td></td><td></td><td></td><td>14</td><td>14</td></tr></table>	Land cover class	Inventoried area (ha)	SU type				Total	WWF (square cluster)	PRE-IFN (square plot)	DIAF-JICA (square cluster)	PRE-IFN & DIAF-JICA (circular cluster)	FDHTF	46.1	7	13	13	15	48	FDHSH	7.56			6		6	FSFC	6.29				11	11	FSc	3.32				14	14	Savannah	8.48				29	29	CRCA	3.46				14
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FSc	3.32				14	14																																															
Savannah	8.48				29	29																																															
CRCA	3.46				14	14																																															

⁴⁷ Further details on source data and methods to estimate land-use carbon densities can be found in the modified submission of the Forest Reference Emission Levels for Reducing Emissions From Deforestation in The Democratic Republic Of Congo (https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf)

Methods for developing the data:

After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were excluded from the centralized database as all forest inventories did not collect them.

Wood Density: The wood densities (WD) of the trees in the plots are taken from a table grouping the wood densities from the following references: (i) the "Global Wood Density database" (Chave et al., 2005; Chave et al., 2009), (ii) density data from the DIAF (Management inventory standards, SPIAF 2007), (iii) the ITTO table (2006), (iv) the IPCC table (2006) and (v) the ICRAF table (2013). Only data from tropical Africa are considered in the Global Wood Density database.

Estimation of tree heights: For trees whose height (H, in m) has not been measured in the field, an allometric height model (H: DBH) is used. This is a 3-parameter Weibull model, frequently used in international scientific publications (e.g., Feldpausch et al., 2012).

AGB estimation: Biomass estimates were carried out using the **BIOMASS package** (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, <https://cran.r-project.org/>). The aboveground biomass of a tree is estimated indirectly using an AGB model. If the diameter at breast height (DBH) of the tree is the most important predictor variable, AGB models that also include wood density (DB) and height (H) of the tree generally perform better. (Chave et al., 2005). Indeed, the relationship between DHP and AGB varies according to species (through DB, in particular) and environmental conditions, the latter influencing the H: DHP relationship. In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used –

$$AGB = 0.0673 * (DB * DHP^2 * H)^{0.976}$$

Mean AGB by Land-use type: The mean AGB by Land-use type and associated confidence intervals are estimated via random sampling with a replacement procedure. Let X_i be the estimate of the AGB of an LU_i , obtained by summing the AGB of the trees of the LU_i and Y_i its area. The average biomass can be calculated using the ratio of means method (Zarnoch and Bechtold, 2000):

$$AGB_i = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$$

The aboveground biomass considers only trees whose DBH is ≥ 10 cm. To incorporate small-diameter trees (i.e., $DBH < 10$ cm), a correction factor was applied to $AGB \geq 10$ cm according to the formula below:

$$AGB_{1cm} = 1.872(AGB_{10cm})^{0.906}$$

Belowground Biomass Estimation: Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB_{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.

Table 8-108: Estimation of removal rate.

FSc Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Total CRCA Biomass $\pm$ 90% IC (tmd*ha ⁻¹)	Removal Factor (tCO ₂ /ha/year) ^[1]
236,71 $\pm$ 58,3	32.90 $\pm$ 56.1	-17.56

^[1] Uncertainty of the removal factor is propagated in the Monte Carlo Analysis based on carbon densities' uncertainties of Secondary Forest and CRCA.

Value applied:

QA/QC procedures applied	DRC FREL Modified Submission ⁴⁸ includes a description of methods and procedures applied during data collection: Annex 7 - WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 - Methodology of the National Forest Pre-Inventory.
Uncertainty associated with this parameter:	Uncertainty sources: AGB of the trees listed in the inventory plots was calculated to estimate the average AGB by land cover classes. Tree AGB estimation is subject to several sources of error, including: -The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB_{10cm}. Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed); - The bias of using an average wood density for several species. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The H: DBH model error to which tree height predictions are subject. This source of error was taken into account in the estimation of the error on the average AGB_{10cm}; -The AGB model error to which tree AGB predictions are subject. This source of error was considered in estimating the error on the average AGB_{10cm}. Also, average AGB_{10cm} estimates based on inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB_{10cm}. The SUs retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of SUs come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC. Total Biomass error propagation: Errors and their propagation were estimated using the “BIOMASS package” of the R software (Réjou-Méchain et al., 2017): -For tree AGB estimation, 1,000 AGB predictions are made for each tree. Each iteration incorporates a randomly drawn error in the distributions of the following error sources: (i) WD error, (ii) allometric height model error, and (iii) allometric biomass model error (see Réjou-Méchain et al., 2017). -For the estimation of the average AGB_{10cm}: for each class, 1e+6 AGB estimates were made by (i) randomly selecting an AGB estimate for each tree among the 1,000 available estimates and (ii) randomly sampling with replacement ns SOS in the stratum. The mean biomass of stratum s and the associated confidence interval are obtained by taking the mean and the 5 and 95 quantiles of the vector of the 1e+6 estimates, respectively. The widest bound estimated with Monte Carlo analysis was used. The Monte Carlo procedure produces asymmetrical confidence intervals aimed (IPCC, 2006). Assuming that the errors on AGB_{1cm} and BGB are independent and random, the error on the total biomass B is estimated by following the classic rule of error propagation in the case of a sum of uncertain quantities: $E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$ Where E_B is the Total Biomass error (in tms*ha⁻¹), E_{AGB_{1cm}} is the error on the quantity AGB_{1cm} (in tms*ha⁻¹), and E_{BGB} the error on the quantity of BGB (in tms*ha⁻¹). The confidence intervals presented in Table 3-2 incorporate the various sources of error shown above and sampling error.
Any comment:	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). AGB and BGB values were updated based on the three datasets compilation of forest inventory data (PRE-INF, DIAF/JICA, and DIAF).

8.4 Estimated Reference Level

⁴⁸ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

The table below depicts the ER program's final Reference Emission Level based on the average historical emissions in the Program area over the historic reference period from 2004 to 2014, as well as the upward adjustment, calculated above.

ER Program Reference level

Crediting Period year t	Average annual historical emissions from deforestation over the Reference Period (tCO _{2-e} /yr)	Average annual historical emissions from forest degradation over the Reference Period (tCO _{2-e} /yr)	Average annual historical removals by sinks over the Reference Period (tCO _{2-e} /yr)	Adjustment (tCO _{2-e} /yr)	Reference level (tCO _{2-e} /yr)
2019	24,038,150	4,879,243	-420,133	5,788,886	34,286,146
2020	24,038,150	4,879,243	-840,267	5,788,886	33,866,012
2021	24,038,150	4,879,243	-1,260,400	5,788,886	33,445,879
2022	24,038,150	4,879,243	-1,680,533	5,788,886	33,025,746
2023	24,038,150	4,879,243	-2,100,666	5,788,886	32,605,612
2024	24,038,150	4,879,243	-2,520,800	5,788,886	32,185,479
Total	144,228,900	29,275,455	-8,822,799	34,733,318	199,414,874

Calculation of the average annual historical emissions over the Reference Period

Based on the method, activity data and emission factors described above; please provide a step-by-step calculation of the average annual historical emissions over the Reference Period. Attach any spreadsheets used in the calculation.

The average annual historical emissions over the reference period have been estimated using all the equations set in Chapter 8.3. Activity data is multiplied by Emission Factors and Removals factors to estimate emissions from deforestation and degradation, and removals from enhancement of carbon stocks in either new forests or existing forests. A summary of adjusted annual historical emissions is reported in the table above.

8.5 Upward or downward adjustments to the average annual historical emissions over the Reference Period (if applicable)

Explanation and justification of proposed upward or downward adjustment to the average annual historical emissions over the Reference Period

FCPF eligibility requirements

The Carbon Fund Methodological Framework states that a Reference Level shall not exceed the average historical emissions over the Reference period, unless the ER Program can demonstrate that the following eligibility requirements can be met:

- i. long-term historical deforestation has been minimal across the entirety of the country, and the country has high forest cover;
- ii. national circumstances have changed such that rates of deforestation and forest degradation during the historical Reference Period likely underestimate future rates of deforestation and forest degradation during the period of the ERPA.

Per the DRC's Forest cover change detection map for the period 1990-2010, prepared in 2015 by the DIAF with the support of FAO, the country had a forest cover of approximately 152 million hectares in 2010. According to

the [World Bank](#) (2015), DRC's land is 226.7 million hectares, i.e. the forest cover amounts to 67%. Accordingly, DRC's Forest cover ratio ranks 19th out of 248 countries. At the same time, DRC's annual deforestation rate has been approximately 0.30% between 1990 and 2010. The DRC is therefore classified as a country with high forest cover and low historic deforestation (HFLD) looking at the entirety of the country.

In 2018 DRC submitted its reference level to the UNFCCC with a reference period 2000-2014. Annual emissions estimates for the 2000-2010 period totaled 483,74 MtCO₂e ± 32,23 MtCO₂e with an increment to 830,53 MtCO₂e ± 66,73 MtCO₂e for the 2010-2014 period. Based on this the DRC proposed a linear trend for its FREL for the period 2015-2019. The same trend has been observed for the province of Mai Ndombe as reported in this report.

Because the DRC has been in a post-conflict situation during the historic reference period, it is assumed that the observed increase in emissions is the combined result of an improving economy, increasing political stability and changing demography. These development trends are expected to continue. Therefore, it is not expected that the high emission levels experienced towards the end of the reference period would significantly decrease in the future. These trends are likely to lead to an influx of investment into the country, increase of available capital, improved infrastructure, and therefore improved access to markets.

Being a hot spot area within an HFLD characterized country, together with evidence of changes in national circumstances, qualifies the ER program to be eligible for an upward adjustment. Key parameters for the justification of the adjustment are discussed in subsequent sections below.

Justification for an adjustment in the Mai Ndombe ER Program

DRC was in a post-conflict situation during the historic reference period. The Great African War, also referred to as the second Congo War, started in August, 1998 and ended with a peace treaty signed in July, 2003. The war involved a wide range of paramilitary groups as well as up to nine countries, with DRC being the main area of conflict. Even after the signature of the peace treaty, some groups remained active, causing turmoil and great harm to the population, as well as hampering DRC's economic development. Because Mai Ndombe supplies important goods to Kinshasa, the provincial economy was negatively affected. It is therefore important to note that the start of the historic reference period is in a post conflict phase. Consequently, all parameters investigated are generally increasing, with demography (population growth) and economic development (economic growth) being the most significant. The development trends of these parameters and their links to deforestation are discussed below.

Population Growth

There is a range of datasets evaluating DRC's population development. Some of them report at the provincial level, others at the national level, which can then be broken down to population estimates for the Mai Ndombe Province. These reports include:

- FAO population data reported at the national level including projected population⁴⁹,
- UNDP population broken down by province and estimated for 1994 and 1998⁵⁰,
- Population data reported by the DRC Ministry of Public Health for 2010 to 2015 by province⁵¹,
- Population data reported by de Saint Moulin (2006),
- Population counts reported by M. Rodriguez et al. (2015) and Bénéficiaire du Dividende Démographique (Gengnant et al., 2014).

For both FAO and the Ministry of Health studies, population increases were 2.75% per year. FAO reports this as the national average, while the Ministry of Health disaggregates the number across provinces⁵². However, each province has the same growth rate of 2.75%, indicating that the FAO reported growth rate has probably been distributed evenly across the provinces. The UNDP number shows varying population growth numbers for different provinces, but when averaged across the country the population growth at national level is zero calling

⁴⁹<http://faostat3.fao.org/download/O/OA/E>

⁵⁰<http://www.cd.undp.org>

⁵¹<http://drcongo.opendataforafrica.org/ayyfgdd/population-distribution-by-province-of-the-drc-2010>

⁵² The report by Rodriguez et al. (2015) also used Ministry of Health data, but they appear to have obtained for Mai Ndombe.

^{33b} http://www.ucpif.cd/images/medias/Etude_de_levolution_indicateur_RMNM_des%20menages.pdf

into question this dataset. Finally, the average annual population growth rate provided by Leon de Saint Moulin is about 3%. Population estimates for health zones using this growth rate are generally consistent with the ones obtained from applying the 3% growth rate to the 1984 population census data. Furthermore, population estimates provided by the Ministry of Interior for the year 2014 in the context of the BioCfpluss study in the Mai Ndombe Province are sometimes double the population counts obtained from applying the 3% growth rate to the 1984 population census data. Gugniant et al. estimate the growth per year at 2.6% in the Mai Ndombe area based on an analysis of data from the de Saint Moulin study and figures from the Ministry of Health and the U.N. with a national average rate of 3.2% between 1984-2010.

Considering that the last census was conducted in 1984 and ever since all population data has been based on estimates or projections, there exists some uncertainty regarding the actual population size and its annual growth. However, there is a consensus among various existing studies that population growth is significant with estimated increases ranging from 2.6% to 3.2% per annum.

If one looks at the following results of two studies in the districts of Plateau and Mai-Ndombe (the latter involving 400 households alone), the link between population growth and deforestation becomes clear: The average household uses an area of 1 hectare for farming, applying a fallow-slash and burn system on forest land, whereas savanna lands are only marginally cultivated or not at all^{33b}. This system requires an area of 5 hectares per household based on a 5-year rotation. With an annual population growth rate of 3%, every year means an additional 6,500 agricultural households, each needing 5 hectares of primary forest (or mature secondary forest) to achieve a stable agricultural production system, equivalent to 32,500 hectares per year.

These findings provide evidence that population growth contributes to increasing deforestation rates in Mai Ndombe and that future deforestation rates are likely to raise because of a growing population. Assuming specific land consumption (i.e. ha/capita) remains constant, population growth is extremely likely to lead to a further increase of deforestation and forest degradation.

Economic Development

Ferretti-Gallon and Busch (2014) reviewed 117 spatially explicit econometric studies of deforestation and concluded that forests are exposed to higher risks to be cleared where economic returns to agriculture and pasture are high. Their meta-study provides two key conclusions:

- Economic returns and related profits from production are depending on access to markets.
- Poverty is highly correlated with lower rates of deforestation, and therefore improved economy is correlated with increasing rates of deforestation.

Following the forest transition curve theory, this may hold true especially for HFLD countries (cp. Fonseca et al., 2007). That means as these countries improve their economic wellbeing, the environmental footprint of production increases in terms of a decrease of forest carbon stocks (see figure below).

The DRC has one of the highest agricultural production potentials in Africa. At the same time, DRC's access to markets is one of the poorest (Ulimwengu et al., 2009): Today, the country's road network is estimated at 24,000 km whereas it was 60,000 km in the 1960s. DRC's poverty and poor access to markets are prevalent also in MaiNdombe, which has limited large-scale development of agriculture, pasture and mining (Dorosh et al., 2010; DRC, In Press; Ulimwengu et al., 2009; Wilkie et al., 2000). Over the historic reference period, the Program area experienced an increase of agricultural productivity at smallholder level fueled by an increase of demand from EU funded road infrastructure measures (mainly road rehabilitation and establishment of one new road).

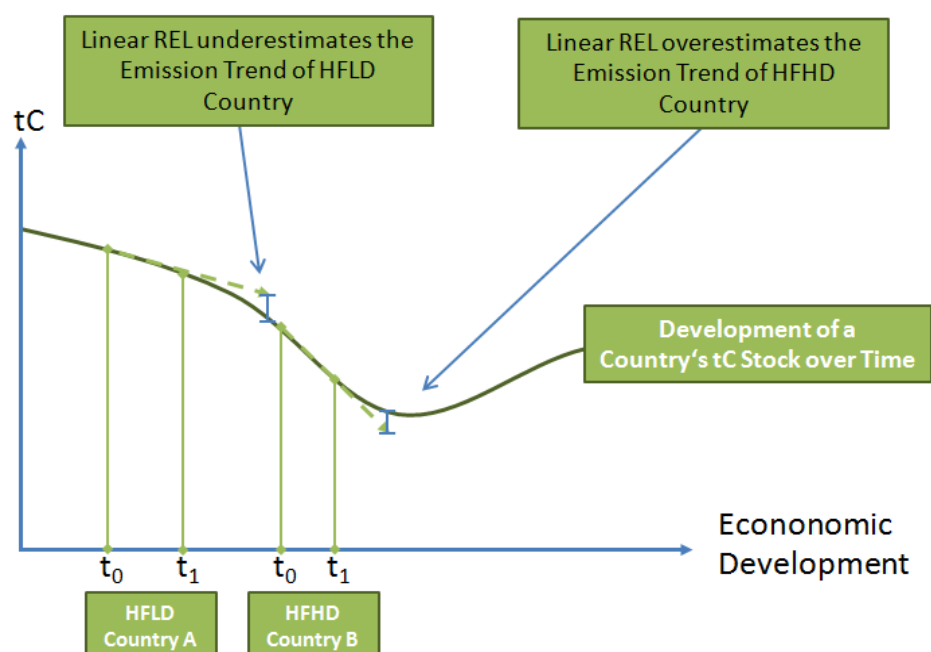


Figure 8-1: REL Establishment and Forest Transition Theory

Along with agriculture, fuelwood is a second source of smallholder income. Demand is increasing due to population growth and lack of alternative energy sources. While the demand for fuelwood does not originate in Mai Ndombe itself, it is high for the ever growing capital of Kinshasa where fuelwood (mainly charcoal) is the primary source of energy (Schure et al., 2010). It is estimated that around 24% of Kinshasa's fuelwood demand is supplied from the Mai Ndombe province (*ibid*).

To account for these circumstances, a number of economic factors were assessed as explanatory variables for adjusting the average historical reference level, namely Gross Domestic Product (GDP), agricultural production index, and the price of agricultural commodities. The GDP and agricultural production index are reported nationally for 2003 to 2013 by the Central Bank of Congo.⁵³ DRC's GDP has steadily risen since 2003 at a rate of 16.8% per year. The agricultural production index, which is the volume of production compared to a base year (i.e. year 2000) also rose steadily between 2003 and 2013 at a rate of 2.8%.

Commodity prices for the primary agricultural products were also evaluated. However, only limited data was available. The primary crops in the program area are cassava, maize, rice, peanut, beans, plantains sweet potato, and potato (see table below).

Cassava dominates the market in DRC and Mai Ndombe province is the biggest producer in DRC with an estimated 22% of the total production (Humpal, et al., 2012; table 2). Data from Humpal, et al. (2012) suggest that over the period 2000-2006 production has remained relatively constant for both DRC and Bandundu and experienced growth ever since.

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Table 8-118-9: Agricultural Production in Mai-Ndombe in 2005

Crop	Green weight (in t)
Cassava	5,158,950
Maize	234,919

⁵³<http://drcongo.opendataforafrica.org/bpkbqw/main-macroeconomic-indicators-of-the-drc-2012>

Rice	68,571
Plantain	62,287
Sweet potato	54,395
Millet	49,385
Potato	3,701
Peanut	623

Source: MONOGRAPHIE DE LA PROVINCE DU BANDUNDU, 2005

Conclusions

This Section summarizes the two parameters discussed above. Figure below presents the development of the population (rural and economic) in the Main Ndombe province, contrasted with the development of GDP and agricultural and livestock indicators at national level. All data was normalized to 100% for the base year of the historic reference period (i.e. 2004) and covers the period up to 2014.

The assessment demonstrates an increase of all parameters over the reference period. Moreover, increase of livestock is above the increase of agricultural production, which indicates a substitution effect of agricultural products by meat related to higher income levels. Finally, it is important to note that all these trends correlate with the increase of deforestation over the same period in the program area. This supports the argument that population growth and improving economic- and agricultural development lead to increasing deforestation.

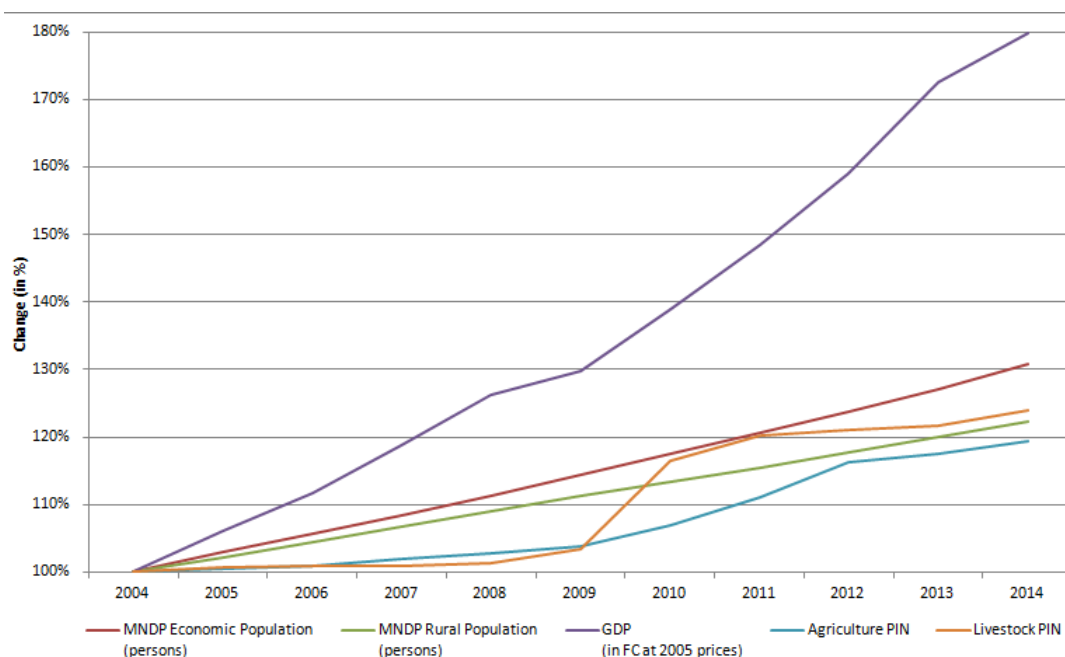


Figure 8-2: Evolution of GDP, population, and agricultural parameters over the reference period

These accentuated trends are consistent with the results other studies such as Zarin et al. (2016) for the whole DRC. Although the study from Zarin refers to gross deforestation of primary forest (i.e. it does not consider degradation and deforestation of secondary forest), it shows a very steep trend in GHG emissions from deforestation of primary forest.

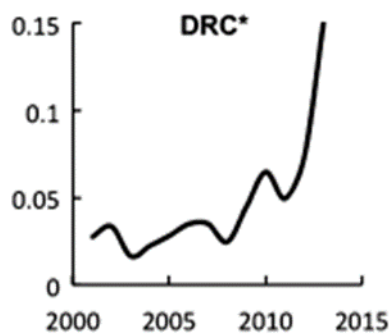


Figure 8-3: Annual carbon GHG emissions from gross deforestation (GtCO₂/year) per Zarin et al. (2016).⁵⁴

In view of this, based on this documented evidence, it can be concluded that there is a very steep change in ER Program circumstances that are not fully reflected in the average annual historical emissions during the Reference period. Although this acceleration of trends would be partially covered in the reference period, the rate is so steep that the average annual historical emissions would be biased with regard to future expected emissions. Hence, following Indicator 13.3 of the Methodological Framework, it would be justified the adjustment of average historical emissions.

Quantification of the proposed upward or downward adjustment to the average annual historical emissions over the Reference Period

As specified in the Methodological Framework, the adjustment is limited to 0.1% of total forest carbon stocks in the program area. The calculation is presented in the table below and the total maximum adjustment is consequently determined at 5.789 million tCO₂ per annum.

Carbon Stocks Reference Period [tCO ₂]	
VALUE	SUM
Degraded forest	24,395,213
Intact moist forest	3,936,749,338
Secondary forest	250,327,565
Dense Humid Wetland forest	1,577,413,198
Total - Stock	5,788,886,314
Meth framework cap [% of total carbon stocks]	0.1%
Max. upward adjustment for the REL of the Mai-Ndombe Emission Reduction Program [tCO ₂ /year]	5,788,886

Quantification of the upwards adjustment to the REL

To quantify the adjustment, the REL's GHG emission trend has been assessed. This is based on the results of the sampling approach presented in the original version of the ER-PD, i.e. based on analyzing all transition patterns for the different strata discussed above (e.g. Primary Forest Core, Primary Forest Edge) for all six time periods (i.e. 2004-2006 up to 2010-2012) and considers the 'adjusted areas'. It is important to note that there are transition patterns that undergo transitions not only during two, but also up to six time periods.⁵⁵ The emissions or removals of such transitions are not accounted during one period but are accounted over all periods that inhibit change. This leads to an overall result that is not highly accurate in terms of the time of emissions

⁵⁴ Emissions from degradation and deforestation of secondary forest are not considered.

⁵⁵ E.g. a sample is classified as secondary forest in the first period (2004-2006), as non-forest in 2006-2008 and thereafter as secondary forest for all three remaining periods. Such a sample is classified as secondary deforestation with 3 periods of regrowth.

occurrence, but that reflects a smoothened emissions trend. This is considered conservative for the determination of the adjustment.⁵⁶

As discussed under the section ‘justification’ above, it is assumed that the future emission levels will not decrease below the level of 2012-2014. A decrease could only be envisaged in the events of A) war or civil turmoil requiring the local population to abandon the area or B) a sudden increase of wealth allowing the local population to produce with high capital intensity and to invest into nature conservation. Both scenarios are considered highly unlikely.

In the April 2021 a Technical note by the FMT to the carbon fund, included updated data based on proposed changes towards informing the ERPD FREL, elaborated by the University of Maryland, the updated biennial estimates indicate a high upward trend between 2005-2015 that it was considered and accepted by the carbon fund, should inform the upward adjustment requested. Note that such adjustment keeps the FREL substantially below emissions levels estimates observed for 2015 (see figure below)

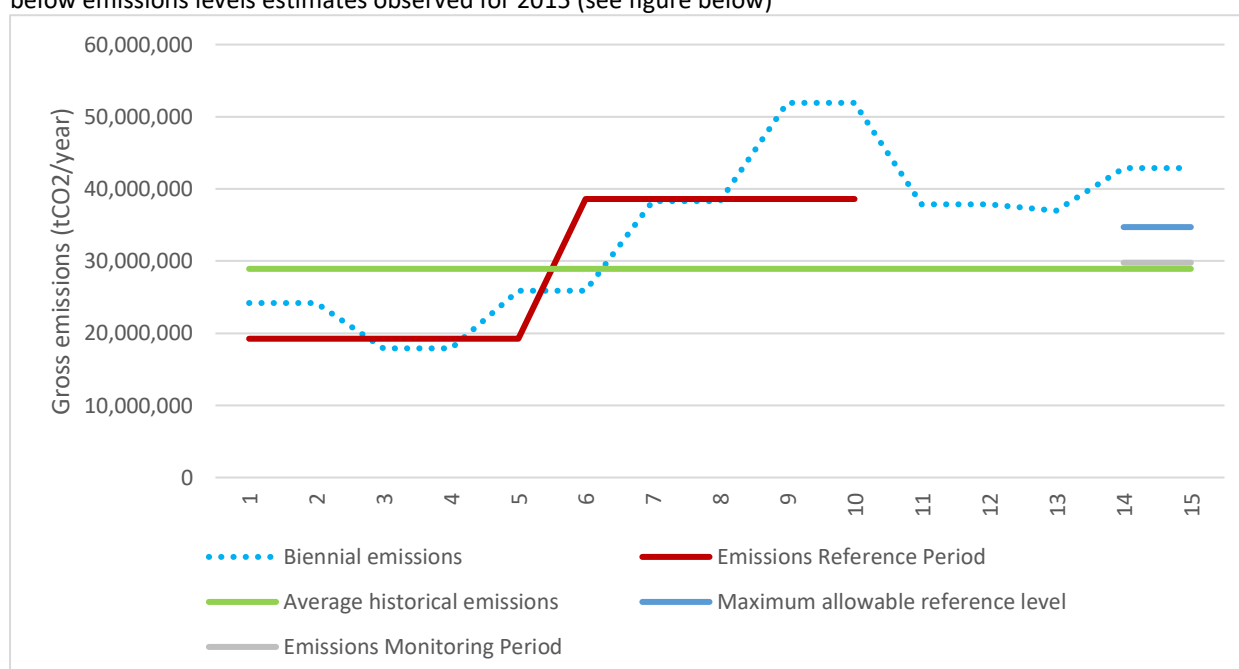


Figure 8-4: Trends in gross emissions, average historical emissions (2005-2014 = 10 in absisa), reference emission level and gross emissions estimates for 2019-2020.

Considering this historic trend, future emissions seem likely to exceed the 2012-2014 emission level (i.e. 130.92 million tCO2e/yr). If future emissions correspond to those of 2012-14, this means that the historic average emissions underestimate future emissions.

Considering this situation based on the evidence of changes in national circumstances, the ER Program is proposed to account for the maximum allowable adjustment of 5.78 million tCO2e/year. The adjustment represents 50% of the required ERs from the current level to the historical REL. This still require a huge effort by DRC to reduce emissions under the adjusted REL and the country’s own contributions remains significant, ambitious, and challenging.

8.6 Relation between the Reference Level, the development of a FREL/FRL for the UNFCCC and the country’s existing or emerging greenhouse gas inventory

The REL/RL of the Mai-Ndombe ER-Program has been influenced by the national FREL/FRL submitted to the UNFCCC. This is visible through the following REL/RL choices made by the ER-Program:

- Reference period: The reference period of the ER-Program is a subset of the national FREL/FRL, with both having the same end date (2014)

⁵⁶The excel file providing the analysis will be provided upon request.

- The ER-Program uses the same forest definition and a subset of the national land-use / land cover classification system.
- The ER-Program is using the same national emission factors provided in the FREL/FRL submission to the UNFCCC

9 APPROACH FOR MEASUREMENT, MONITORING AND REPORTING

The monitoring system uses the same methods for quantifying emissions and removals as the REL to produce fully consistent results as a basis for quantifying emission reductions. Activity Data is estimated using the same Approach 3 method (i.e. sampling using the same methodology). Monitoring of Activity Data (AD) will be done with a probability-based sample of time-series imagery. Emission Factors will be equivalent to those used in the REL, therefore being consistent with Indicators 14.1 - 14.3 of the MF. Uncertainty related to the quantity of emission reductions will quantify using Monte Carlo methods. Underlying sources of error in data and methods for integrated measurements of deforestation, forest degradation and enhancements (e.g. as in a national forest inventory) will be combined into a single combined uncertainty estimate and will be reported at the two-tailed 90% confidence level.

Monitoring occurs at different levels and for different purposes. Hence monitoring can be differentiated as follows:

- **The carbon accounting monitoring system** that is used to report emissions and removals (based on measured activity data) to third parties (i.e. Carbon fund) during the program period is operated by the Program Management Unit (PMU). The PMU will carry out QA/QC measures – either itself or through third parties – to ensure a high quality of monitoring results prior to verification. (The present section describe this monitoring level).
- **Performance monitoring of different emission reduction activities** will be carried out by operators and executing agencies. Here, the PMU will take a verifying role. The monitoring of performance of activities is the basis to implement the benefit-sharing plan.

Measuring, Monitoring and Reporting (MMR) observe the following objectives:

- The primary objective is to monitor land cover change that occurs during the implementation of the ER Program. This system will allow for the subsequent comparison between program emissions and the reference level, leading to the quantification of emission reductions (ERs) which may in turn be sold and generate carbon revenues for ER Program stakeholders.
- The MMR system shall quantify deforestation and degradation in a spatially explicit manner, thereby facilitating the just sharing of financial benefits, based on performance.
- Finally, the MMR system will assess individual activities and provide valuable feedback to the ER Program that could in turn refine ER Program investment strategy and planning. The ER Program plans to integrate the MMR system into its overall adaptive management strategy: MMR results will lead to re-investment of carbon revenues in the ER Program for various high-performing emission reduction activities.

The MMR for the ER Program (sub-national MMR design) was designed to be harmonized with the ER Program's reference level design. As such, the MMR system will employ a sampling approach that utilizes identical manual/visual classification rules used for calculation of the ER Program REL. This will allow full consistency with the methods used to estimate the Activity Data for the REL.

The system will also be subject to the same robust accuracy assessment requirements as the REL, which are based on Olofsson 2014 / Cochran, 1977, and which will serve to adjust the estimated areas and estimate their confidence intervals at 90% of confidence level. The adjusted areas and the respective confidence intervals will serve as input parameters for a Monte Carlo simulation, which will combine the AD to the Emission Factors.

An intelligent and adaptive sample design will be utilized, with a greater density of samples utilized in areas of high importance to the ER Program. This increase in sampling intensity will not impact the consistency with the methods used to estimate the RL as it will only reflect a higher accuracy and precision (as determined by the accuracy assessment) in those areas of interest. Examples of such areas of interest (AOIs) are community forests or conservation concession that engage in a of pay-per-performance emission reduction activities, areas have

been observed to experience particularly high emissions in the past, politically important regions, etc. More (or less) samples can be concentrated in particular areas moving forward as additional information becomes available. For example, if a village is observed to have deforested an unusually high amount of land in 2016, the 2017 MMR system will be implemented with additional samples surrounding that village which will estimate the deforestation in 2017 with higher accuracy and precision. To ensure an unbiased estimator at the ER Program level, these AOIs will be defined as a standalone stratum to avoid that these oversampled areas affect the average estimate. In addition to an adaptive approach to sample design, and like the REL model, the MMR system is designed with a flexible approach toward manual/visual image interpretation. High-resolution imagery may be utilized for AOIs, allowing for increased spatial precision of emission estimates. However, because such imagery can often be both expensive and difficult to obtain, the MMR model does not require a particular image resolution, but simply requires a spatial resolution that allows analysts to identify land cover categories in the ER Program area. The flexibility of both sample design and spatial resolution of imagery allows the MMR model to be integrated into the ER Program's adaptive management philosophy. MMR system attributes are listed below.

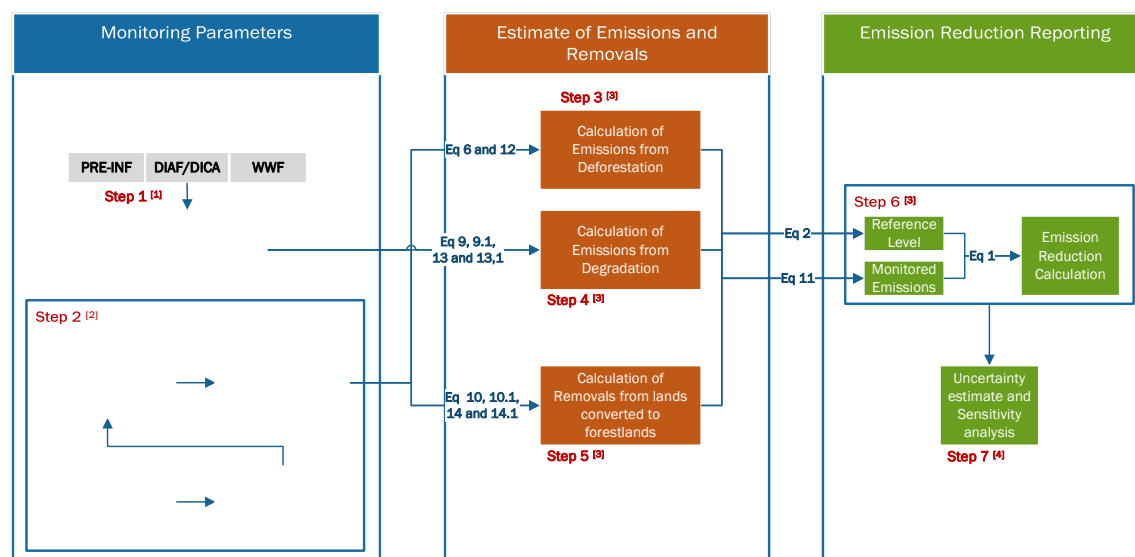
Table 9-19-1: ER Measurement, Monitoring and Reporting System Attributes

Attribute	Advantage
Sampling approach design	Harmonization with reference level model, allowing for accurate calculation of ERs. Primary advantage of sample alignment is the availability of historical land cover information for each sample, allowing for the application of amelioration model.
Flexible sample design	Adaptive management allowing for high sample density in AOIs. This leads to greater precision and accuracy of these areas. The different sampling intensity per AOIs will be considered using a stratified estimator.
Use of various spatial-resolution remote sensing imagery.	Adaptive management / utilization of high-resolution imagery in different areas throughout the ER Program area, allowing for greater precision of ER estimates in AOIs.

9.1 Measurement, monitoring and reporting approach for estimating emissions occurring under the ER Program within the Accounting Area

Line diagrams

The figure below shows a line diagram with relevant monitoring points, parameters, and data integration until reporting.



- [1] See tdm/ha values in Monitoring Parameters table in "ER_Calculation" sheet of "DRC_ER_Calculation.xlsx"
- [2] See activity data estimate for Reference and Monitoring period in "AD_calculationTool_RP.xlsx" and "AD_calculationTool_MP.xlsx".
- [3] Emission from deforestation and degradation, new forest removals and Emission Reductions are calculated with "DRC_ER_Calculations.xlsx" tool.
- [4] The Monte Carlo analysis to estimate global uncertainty of Ers is made with DRC_ER MC Analysis tool. The Sensitivity Analysis is prepared with the "DRC_ER_SensitivityAnalysis.xlsx".

Figure 9-1: Line diagram with monitoring parameters, equations, and the integration of data until reporting.

Calculation steps

The table below describes the set of tools developed by the Democratic Republic of Congo to estimate emissions and removal from deforestation, degradation, and forest regeneration. Also is provided a step-by-step description of the monitoring parameters used to establish the Reference Level and estimate Emissions and Emissions reductions during the Monitoring Period for the Carbon Pools and greenhouse gases selected in the ER-PD. The set of tools for emission and removal estimation can be accessed at the following link:

<https://www.dropbox.com/scl/fo/fnfqubc5cvm07ksyoezp/h?rlkey=0cb794w54jout87exbraba8f8&dl=0>

Table 9-29-2: Step-by-step description of the monitoring parameter and data integration tools to establish the Reference Level and estimate Emissions and Emissions reductions during the Monitoring Period for the Carbon Pools and greenhouse gases selected in the ER-PD.

Monitoring parameters and Data Integration tools	Step	Description of the measurement and monitoring approach
Land use carbon density calculation and uncertainty analysis See tdm/ha values in Monitoring Parameters Table in "ER_Calculation" sheet of "DRC_ER_Calculation ver2.xlsx".	1	The carbon density used to estimate net emissions for the reference and monitoring period is based on a Data compilation of three datasets. In the absence of data from a complete national forest inventory, data from the national forest pre-inventory (PRE-IFN), collected for the whole country (except for North Kivu, South- Kivu, and Kongo Central), were supplemented with two other sets of inventory data: i. The inventory carried out by the DIAF within the framework of the DIAF-JICA Forests project (DIAF-JICA data) in the former province of Bandundu, and ii. The inventory carried out by the DIAF within the framework of the biomass mapping project supported by the WWF-DRC (WWF data) data collected in Tshopo, Maniema, Sankuru, Mongala, Tshuapa, Equateur, and Sud-Ubangi. After analyzing the different data sources, a centralized database was compiled. Data relating to lianas, dead wood, and trees less than 10 cm in diameter at breast height (DBH) were

		excluded from the centralized database as all forest inventories did not collect them. Biomass estimates were carried out using the BIOMASS package (Réjou-Méchain et al., 2017) of the R software (v. 3.2.5). BIOMASS compiles a set of functions allowing, from a classic forest inventory dataset, to (1) correct the taxonomic information, (2) estimate the wood density (WD) of each tree and the associated error, (3) build allometric height models and (4) estimate the aboveground biomass of forest plots and the associated error. A detailed BIOMASS package description is available online in the R software platform (CRAN, https://cran.r-project.org/).
Activity Data estimate and associated uncertainty AD_calculationTool_RP_rev.xlsx AD_calculationTool_MP_rev.xlsx	2	The visual interpretation of land use for the Reference and Monitoring periods is included in both tools' spreadsheet "LU_interpretation." Activity Data calculation and associated uncertainty for Reference and Monitoring Periods are included in the "AreaCalculation" spreadsheet.
Calculation of emissions and removals DRC_ER_Calculations rev3. xlsx	3, 4 and 5	Emissions from deforestation and degradation, and new forest removals is calculated with DRC_ER_Calculation tool.
Emission reduction calculation DRC_ER_Calculations rev3.xlsx	6	Emission Reductions are calculated with DRC_ER_Calculation tool.
Emission reduction uncertainty estimate and sensitivity analysis DRC ER MC Analysis Rev3.xlsx DRC_ER_SensitivityAnalysisRev3.xlsx	7	The Monte Carlo analysis to estimate the global uncertainty of Emission Reduction is made using the DRC ER MC Analysis tool. The Sensitivity Analysis was prepared with the DRC_ER_SensitivityAnalysisRev2.xlsx.

Calculation

Equations and parameters used to calculate GHG emissions and removals are listed below. These equations show the steps from the measured input to the aggregation into final reported values. Changes to the original calculation described in the ER-PD have been highlighted.

Emission reduction calculation

$$ER_{ERP,t} = RL_t - GHG_t \quad \text{Equation 23}$$

Where:

- ER_{ERP} = Emission Reductions under the ER Program in year t; $tCO_2e \cdot year^{-1}$.
- RL_{RP} = Gross emissions of the RL from deforestation over the Reference Period; $tCO_2e \cdot year^{-1}$. This is sourced from Annex 4 to the ER Monitoring Report and equations are provided below.
- GHG_t = Monitored gross emissions from deforestation at year t; $tCO_2e \cdot year^{-1}$;
- T = Number of years during the monitoring period; dimensionless.

Monitored emissions (GHG_t)

Annual gross GHG emissions over the monitoring period in the Accounting Area (GHG_t) are estimated as the sum of annual change in total biomass carbon stocks (ΔC_{B_t}).

$$GHG_t = \frac{\sum_t^T \Delta C_{B_t}}{T} \quad \text{Equation 24}$$

Where:

- ΔC_{B_t} = Annual change in total biomass carbon stocks at year t; $tC \cdot year^{-1}$

T = Number of years during the monitoring period; dimensionless.

Annual change in total biomass carbon stocks forest land converted to another land-use category (ΔC_B)

Following the 2006 IPCC Guidelines, the annual change in total biomass carbon stocks forest land converted to other land-use category (ΔC_B) would be estimated through **Equation 5** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_B = \sum_{j,i} (B_{\text{Before},j} - B_{\text{After},i}) \times CF \times \frac{44}{12} \times A(j,i)_{\text{MP}} \quad \text{Equation 25}$$

Where:

$A(j,i)_{\text{MP}}$ = Area converted/transited from forest type j to non-forest type i during the Monitoring Period, in hectare per year. In this case, two forest land conversions are possible:

- Primary forest terra firme to non-forest type i; and
- Secondary forest to non-forest type i

One type of non-forest land is considered:

- Crops and regeneration of abandoned crops (CRCA-Culture et Régénération de Culture Abandonnée).

$B_{\text{Before},j}$ = Total biomass of forest type j before conversion/transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{Before},j}$) and belowground biomass ($BGB_{\text{Before},j}$) and it is defined for each forest type.

$B_{\text{After},i}$ = Total biomass of non-forest type i after conversion, in tons dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{After},i}$) and belowground biomass ($BGB_{\text{After},i}$) and it is defined for each of the five non-forest IPCC Land Use categories.

CF = Carbon fraction of dry matter in tC per ton dry matter. The value used is:

- **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3.

44/12 = Conversion of C to CO₂

Annual change in carbon stocks in biomass on forestland remaining forestland (ΔC_{BDEG})

Annual change in carbon stocks in biomass on forestland remaining forestland (ΔC_{BDEG}) would be estimated through **Equations 7 and 8** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_{\text{BDEG}} = \sum_j \{EF_{\text{DEG}} \times A(a,b)_{\text{MP}}\} \quad \text{Equation 26}$$

Where:

EF_{DEG} = Emission factor for degradation of forest type a to forest type b, tones CO₂ ha⁻¹. The Emission Factor is calculated with the equation 13.1 where $B_{\text{Before},a}$ is total biomass of forest type **a** before transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{Before},a}$) and belowground biomass ($BGB_{\text{Before},a}$) and $B_{\text{After},b}$ is total biomass of forest type **b** after transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($AGB_{\text{after},b}$) and belowground biomass ($BGB_{\text{after},b}$). CF is the Carbon fraction of dry matter in tC per ton dry matter. The value used is **0.47** is the default for (sub)tropical forest as per IPCC AFOLU guidelines 2006, Table 4.3. 44/12 is the conversion of C to CO₂.

$$EF_{\text{DEG}} = (B_{\text{Before},a} - B_{\text{After},b}) \times CF \times \frac{44}{12} \quad \text{Equation 13.1}$$

$A(a,b)_{\text{MP}}$ = Area of forest type a converted to forest type b (transition denoted by a,b) during the Monitoring Period, ha yr⁻¹.

Annual change in carbon stocks in biomass on non-forestland converted in forestland (ΔC_{BSREG})

Annual change in carbon stocks in biomass on forestland remaining forestland (ΔC_{BDEG}) would be estimated through **Equations 7 and 8** above. Making the same assumptions as described above for the RL the change of biomass carbon stocks could be expressed with the following equation:

$$\Delta C_{B_{SREG}} = \sum_{LU=1}^n \{RF_{SREG} \times A(i, j)_{MP}\} \quad \text{Equation 27}$$

Where:

- RF_{SREG} = enhancement of carbon stocks in new forests [tCO₂*ha*year⁻¹].
 $A(j, i)_{MP}$ = Area of non-forestland *i* converted to forestland *j* (transition denoted by *i, j*) in the monitoring period, ha yr⁻¹.
 LU = Land unit.

Parameters to be monitored

Parameter:	$A(j, i)_{MP}$ Equation 12 $A(a, b)_{MP}$ Equation 13 $A(i, j)_{MP}$ Equation 14																								
Description:	$A(j, i)_{MP}$: Area converted/transited from forest type <i>j</i> to non-forest type <i>i</i> during the Monitoring Period (Deforestation transition denoted by <i>j, i</i>) $A(a, b)_{MP}$: Area of forest type <i>a</i> converted to forest type <i>b</i> during the Monitoring Period (Degradation transition denoted by <i>a, b</i>). $A(i, j)_{MP}$: Area of non-forestland <i>i</i> converted to forestland <i>j</i> during the Monitoring Period (Regeneration transition denoted by <i>i, j</i>)																								
Data unit:	hectare.																								
Value monitored during this Monitoring / Reporting Period:	Table 9-39-3: Value monitored during the Monitoring Period <table> <tr> <th>Parameter</th><th>Land cover transition</th><th>Land cover transition during the Monitoring period (ha)</th><th>CI</th></tr> <tr> <td>$A(i, j)_{MP}$:</td><td>Secondary regeneration-2019-2020</td><td>138,070</td><td>35,773</td></tr> <tr> <td rowspan="3">$A(j, i)_{MP}$:</td><td>Dense humid Wetland Forest deforestation 2019-2020</td><td>759</td><td>919</td></tr> <tr> <td>Dense humid Terra firma deforestation 2019-2020</td><td>23,736</td><td>3,686</td></tr> <tr> <td>Secondary Forest deforestation 2019-2020</td><td>96,651</td><td>19,003</td></tr> <tr> <td>$A(a, b)_{MP}$:</td><td>Dense humid terra firme degradation 2019-2020</td><td>13,808</td><td>3,612</td></tr> </table>			Parameter	Land cover transition	Land cover transition during the Monitoring period (ha)	CI	$A(i, j)_{MP}$:	Secondary regeneration-2019-2020	138,070	35,773	$A(j, i)_{MP}$:	Dense humid Wetland Forest deforestation 2019-2020	759	919	Dense humid Terra firma deforestation 2019-2020	23,736	3,686	Secondary Forest deforestation 2019-2020	96,651	19,003	$A(a, b)_{MP}$:	Dense humid terra firme degradation 2019-2020	13,808	3,612
Parameter	Land cover transition	Land cover transition during the Monitoring period (ha)	CI																						
$A(i, j)_{MP}$:	Secondary regeneration-2019-2020	138,070	35,773																						
$A(j, i)_{MP}$:	Dense humid Wetland Forest deforestation 2019-2020	759	919																						
	Dense humid Terra firma deforestation 2019-2020	23,736	3,686																						
	Secondary Forest deforestation 2019-2020	96,651	19,003																						
$A(a, b)_{MP}$:	Dense humid terra firme degradation 2019-2020	13,808	3,612																						
Source of data and description of measurement /calculation methods and procedures applied⁵⁷:	A probability-based sample of time-series imagery is used as reference data in estimating activity data for the province of Maï-Ndombe , DRC. We employed an approach with a goal of delivering a method that can readily be applied to all provinces in the DRC. <u>Sampling design</u>: A stratified random sampling design based on mapped classes closely aligned with activity data definitions was employed to maximize the efficiency of the sample allocation. The number of sampling strata between the monitoring periods (8 strata) and the reference level period (9 strata) is different. The reference period includes buffered change (strata 4-8) to minimize the uncertainty associated with omission errors, as suggested by Olofsson et al. in 2020⁵⁸. However, for the monitoring periods, including the buffered change strata it could be unnecessary if the uncertainty is at the desired levels.																								

⁵⁷ Further details on source data and methods to estimate activity data can be found in the final report for **Quantifying the forest Reference Level of the emissions reduction program of Maï-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab** - https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0

⁵⁸ Pontus Olofsson, Paulo Arévalo, Andres B. Espejo, Carly Green, Erik Lindquist, Ronald E. McRoberts, María J. Sanz. Mitigating the effects of omission errors on area and area change estimates. Remote Sensing of Environment. Volume 236. 2020, 111492. ISSN 0034-4257. <https://doi.org/10.1016/j.rse.2019.111492> .

Also, an independent sample is determined for each Monitoring Period. An initial sample of 100 samples per stratum was drawn for each of the following classes in Mai-Ndombe province. Based on the target class proportions identified in each stratum from the interpretation of the initial sample, we calculate the number of sampling units per stratum required to reach the target 90% confidence interval of $\pm 20\%$ of the estimated area for the reporting classes. The required sample size for a given target variance for each target class can be found using Equation 5.66 from Cochran (page 110) for the optimal allocation with fixed n . Optimal sample allocation among strata (minimized variance for fixed n) is achieved using Equation 5.60 from Cochran (page 108) and replacing the true population class proportion for each stratum with the one estimated from the initial sample.

Response design: The Response design included defining the assessment unit as 30m pixels from the mapped strata population, source reference data in the form of 16-day Landsat composite time-series data from 2000 through 2024, supplemented by Google Earth imagery. A detailed labeling protocol is described exhaustively in Standard Operating Procedures and includes decision trees and LULC classification systems in order to allow the unambiguous classification of the sample units. The sample-based analysis consisted of stratified randomly selected pixels across the area of Mai-Ndombe province. While the sampling unit was a pixel, and each pixel was examined at annual timescales, assessment was also facilitated by spatiotemporal context. Each sampling unit was interpreted using time-series Landsat and Google Earth imagery and time-series of individual spectral measures. Expert image interpreters analyzed the reference sampling units and labeled them at annual intervals as either primary forest, secondary forest, and non-forest, as well as transitions, type of change (loss or gain), driver, and the year of change. For pixels that were not interpreted consistently between the analysts, an additional analyst was engaged, and all analysts worked together to reach a consensus in making final assignments. The interpretation team included participants from the project consortium of DIAF/OSFAC/UMD.

Sampling unit interpretation protocol: Interpretations of each sampling unit selected for analysis began with a decision tree that provided a dichotomous rule set for assigning labels. The decision tree for assigning land cover is based on physiognomic-structural attributes of vegetation, specifically height and cover. Vegetation cover and height are used to differentiate forests from savanna and non-forest categories, with 30% cover and >3m height defining forests. For tree canopy cover $\geq 60\%$, we separate dense tree cover into dense humid (primary) terra firma and wetland forests and secondary (regrown) forests. Dense humid forest is differentiated from secondary humid forest by the spectral signature from greater vertical variation and texture associated with old growth forests compared to the more uniform canopies associated with colonizing tree species.

Area estimation for activity data: Area estimates were made for three scenarios: 1) consensus labels of all sampling units, 2) only samples where all interpretations agreed, and 3) subsets of sampling units with the same average annual number of observations per epoch, for example where we have at least 5 good annual Landsat observations per sample for all samples. Scenarios 2) and 3) served to evaluate the sensitivity the final consensus estimates to removing samples lacking interpreter consensus or removing samples with few quality image observations.

For a stratified random sample of pixels within nine strata, annual binary labels of yes/no for each stable land cover and transition class were assigned. Areas for each class were calculated per the following calculations, given the mean proportion of class i in stratum h :

$$\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h} \quad \text{where} \quad p_{iu} = 1 \text{ if pixel } u \text{ is identified as class } i, \text{ and } 0 \text{ otherwise}$$

n_h – number of samples in stratum h

Estimated area of class i :

$$\hat{A}_i = \sum_{h=1}^H A_h \bar{p}_{ih} \quad \text{where} \quad A_h = \text{total area of stratum } h$$

H – number of strata ($H = 9$)

	Standard error of the estimated area of class i: $SE(\hat{A}_i) = \sqrt{\sum_{h=1}^H A_h^2 \frac{\bar{p}_{ih}(1 - \bar{p}_{ih})}{n_h - 1}}$
QA/QC procedures applied:	QA/QC procedures included the definition of clear roles and responsibilities in terms of QA/QC, the definition SOPs, training on the defined SOPs, multiple interpreters per sample unit, and a final quality assurance check in order to ensure the quality of the data. All sample pixels were initially interpreted by at least two independent experts. Each analyst assigned to each sample pixel the following labels: loss month and year, pre- and post-disturbance land cover type, land cover proportion, availability of high-resolution image, and forest disturbance driver, and expert's confidence (high/medium/low) separately for all labels. After the initial interpretation, a consensus exercise was performed for all sampled pixels featuring disagreement between interpreters or with low confidence for any interpreter. An additional expert joined the exercise, and a group discussion was undertaken to make the final assignment of land cover extent and change dynamics. Given the final interpretations, we assessed the sensitivity of the method as a function of interpreter agreement and data richness.
Uncertainty for this parameter:	Uncertainty stems primarily from: - Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. - The sampling errors. The presented work sought to improve the accuracy of the existing reference emissions level calculations through a more robust methodology to estimate activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Mai-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as a function of interpreter agreement and data richness. The principal improvement is derived from the stratification that enabled the efficient allocation and interpretation of reference data. The sample size is determined considering <20% uncertainty at the 90th percentile confidence interval for activity data.
Any comment:	

9.2 Organizational structure for measurement, monitoring and reporting

The Program Management Unit (PMU) will assume the overall responsibility for conducting the MRV function. The PMU will implement the monitoring and relevant QA/QC (See table 9-3) procedures with a mixed-team composed of local expert involved in Reference Level measurement (OSFAC) and of administration agents from both national and provincial level (DIAF). This will ensure capacity building and facilitate the link with the National Forest Monitoring System. The PMU will consolidate a carbon monitoring report that will be endorsed by the Provincial REDD+ Steering Committee and then transferred to the Carbon Fund by the central government. (See figure below). This monitoring report will serve as a basis for the ERPA payments.

The monitoring system will also provide information for the benefit-sharing mechanism. The spatial information generated by sampling analysis will be crosschecked with field information reported by operators and executing agencies. For example:

- Forest companies engaged in Reduced-Impact logging will report on specific indicators (to be defined in sub-contracts). The PMU will conduct independent field verification that will be crosschecked with remote-sensing information.

- Communities or local organizations involved in reforestation or assisted natural regeneration activities will report on area reforested. The PMU will verify occurrence of fire based on FIRMs requests.

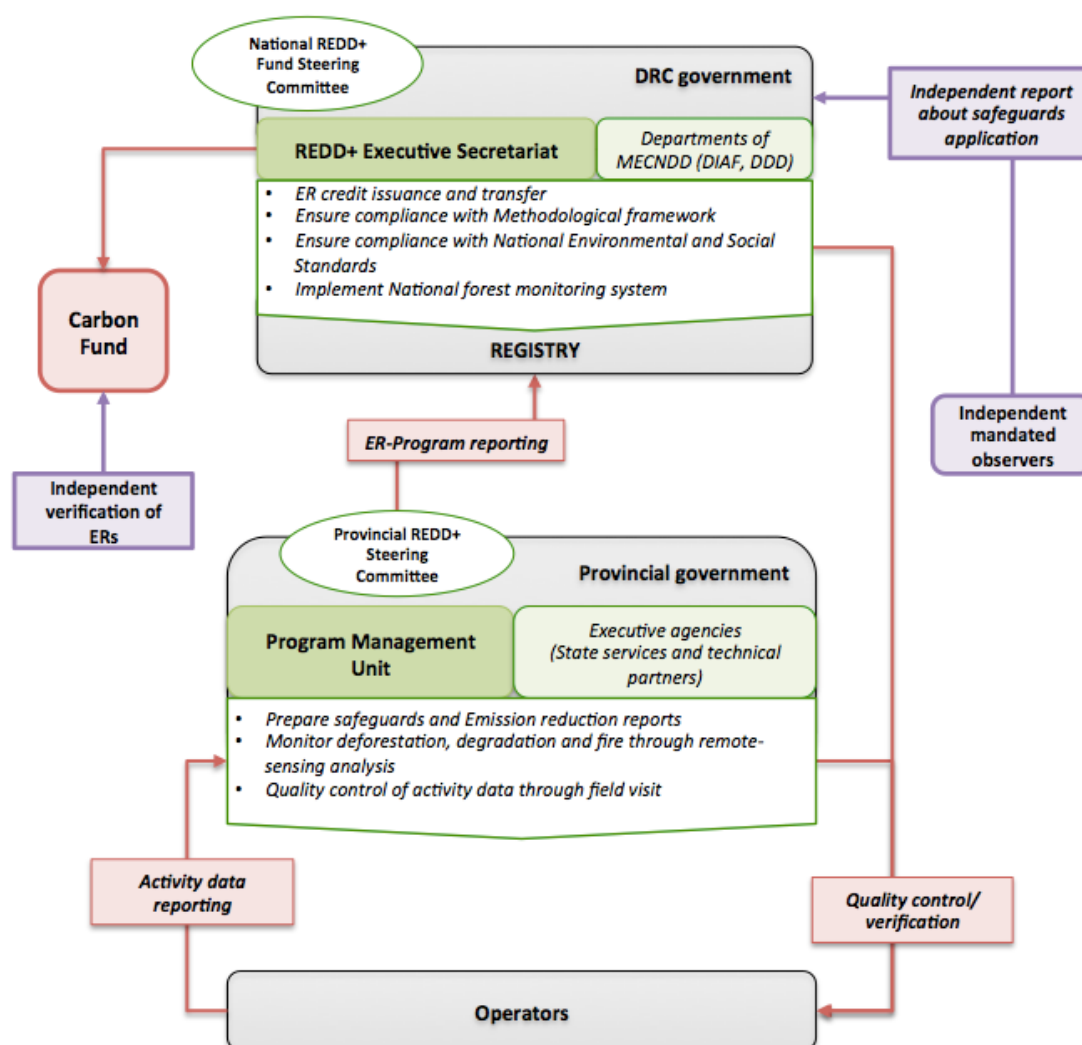


Figure 9-2: Role and responsibilities for monitoring and reporting of carbon and non-carbon performance.

Table 9-9-4: Relevant Standard Operating Procedures (SOP) and QA/QC procedures

Parameter	Document	Changes introduced in the SOP compared to the description that was provided in the ER-PD.
Activity data	Appendix 1 of Final Report "Quantifying the forest Reference Level of the emissions reduction program of Maï-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab" ⁵⁹	The sample-based area estimation of activity data has been updated. Initial FREL was estimated using systematic grids (37,184 samples) with variable spacing between sampling locations (5,000 to 1,600) depending on the stratum. Updated activity data are calculated using pixel-based stratified random

⁵⁹ Final report for Quantifying the forest Reference Level of the emissions reduction program of Maï-Ndombe Province, Democratic Republic of Congo - University of Maryland / GLAD Lab -can be accessed at the following link: https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0

		sampling with 2,000 sampling points. We estimate activity data using pixel-based stratified random sampling.
Emission Factor	DRC FREL Modified Submission ⁶⁰ includes a description of methods and procedures applied during data collection: Annex 7 - WWF Carbon Map and Model Project for Forest Biomass LiDAR Mapping by Airborne LiDAR Remote Sensing Annex 9 - Methodology of the National Forest Pre-Inventory.	Initial FREL was estimated based on Carbon stock data developed under the Carbon Map and Model program by a Light Detection and Ranging (LIDAR) flight campaign in the ER program area (LIDAR flights were conducted from June 2014 to October 2014). The mean total biomass per stratum has been updated with a new dataset. AGB and BGB values were updated based on a compilation of three sets of forest inventory data (PRE-INF, DIAF/JICA, and DIAF). Different methods were used to estimate updated values of mean total biomass per stratum (i.e., Root-shoot ratio).

9.3 Relation and consistency with the National Forest Monitoring System

Activity data alignment

The Mai Ndombe ER Program MMR system will be aligned with the National Forest Monitoring System (NFMS) using the same method described in Section 9. The Mai Ndombe ER Program MMR system has been designed so that it will be possible to use the samples to inform the NFMS in the same way that the ER Program REL samples will inform the national FREL.

Emission factor alignment

Emission factors will not be monitored, the national biomass used for ER Program REL is based on the Data compilation of datasets (**PRE-INF**, **DIAF-JICA**, and **WWF data**) used for the DRC's Forest Reference Level submission to the UNFCCC. Therefore, the national and sub-national emission factors are aligned.

12 UNCERTAINTIES OF THE CALCULATION OF EMISSION REDUCTIONS

12.1 Identification and assessment of sources of uncertainty

In the following table the country identifies and discuss in qualitative terms the main sources of uncertainty and its contribution to total uncertainty of Emission Reductions. The measures that have been implemented to address these sources of uncertainty as part of the Monitoring Cycle are also discussed.

Source of uncertainty	Systematic	Random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimate
Activity Data						
Measurement	✓	✓	Land-use photo-interpretation: Land-use visual assessment uncertainty is associated with the photo-interpretation consistency. Bias in the photo-interpretation of land use was mitigated by: For the purposes of per pixel interpretation forest was assigned only if the physiognomic/structural tree cover criteria were met for the sampling unit being	Low	Yes	No

⁶⁰ https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

Source of uncertainty	Systematic	Random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimate
			analyzed, and if the pixel was part of a 0.5ha or larger contiguous patch of tree cover, which equated to a group of greater than 5 pixels (5 pixels x 30m x 30m / 10000 m2/ha = 0.45ha). - While labels were assigned to pixels at an annual scale, sampling unit assessments employed bi-monthly composites of ~1km² false color Landsat subsets as well as graphs of radiometrically normalized 16-day composite spectral data, both covering the entire study period. Such contextual spatial and temporal data facilitated per pixel labeling. - Each sampling unit was also uploaded into Google Earth in kml format which allowed for greater landscape context and possible very high spatial resolution imagery to further assist interpretations. - The QA/QC portion of our work consisted primarily of the inter-comparison of sampling unit interpretations as well as the data richness per sampling unit. Specifically, individual assessments of sampling units were compared and separated into pools of all interpreted sampling units (pixels) and all sampling units less those of initial disagreement. A multi-interpreter consensus assessment was used to resolve disagreements in making final labels. We then compared the two pools of data in assessing the difference in area estimates between the consensus interpretation of the full sample and the initial (default) agreement sample subset. - We also thresholded the populations based upon minimum annual Landsat observation counts and performed a similar comparison of all data versus a presumably higher confidence subset of data rich samples across all years. - The difference in area estimates of all samples versus comparatively data rich samples was examined. In both assessments, if the estimates based on 'default agreement' and 'data rich' sample subsets are within the uncertainty of the estimates based on the entire sample, it may serve as evidence of the robustness of the final results.			
Representativeness	✓	✓	Time-series Landsat data were used to map the activity in building strata for targeting the themes of interest for sample-based area estimation. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes.	Low	Yes	No
Sampling		✓	We estimate activity data using <i>pixel-based stratified random sampling</i> with 2,000 plots. Stratified random sampling is a method meant to increase sampling efficiencies by targeting homogeneous populations with regards to the categories of interest. The mapped strata were expected to provide substantial sampling efficiencies by targeting largely homogeneous populations, particularly for the relative rare change classes. The new methodological approach sought to produce activity data estimates with low uncertainties using a method that may be readily extended to all provinces in implementing a national monitoring system. In this way, the method aimed to reduce errors associated with the estimates of forest extent and change, but also the time, human resource and effort invested, while maintaining the scientific rigor of and compliance with IPCC requirements.	High	Yes	Yes
Extrapolation	✓		No extrapolation of the Activity Data estimate was necessary. Activity Data were estimated with no stratification. Mapped strata were used to increase sampling efficiencies by targeting homogeneous populations concerning interest categories.	NA	NA	NA
Approach 3	✓		Permanent Sample Units (PSU) of one pixel (30 x 30 meters) were used to ensure the temporal tracking of land use for each period. However, the ER Program conducted two independent surveys to estimate activity data in the Reference Period (2005-2014) and Monitoring Period (2019 – 2020).	High	Yes	No
Emission Factors						
DBH measurement	✓	✓	The error in measuring diameters and heights and potential errors in encoding inventory data. This source of error was not considered in estimating the error on the average AGB _{10cm} . Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers were removed). The H: DBH model error to which tree height predictions are subject was considered in the estimation of the error on the average AGB _{10cm} .	Low	Yes	No
H measurement	✓	✓		High	Yes	Yes
Plot delineation	✓	✓		Low	Yes	No
Wood density estimation	✓	✓	The bias of using an average wood density for several species was considered in the estimation of the error on the average AGB _{10cm} .	High	No	Yes

Source of uncertainty	Systematic	Random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimate
Biomass allometric model	✓	✓	In the absence of a national or regional AGB model, the pantropical model of Chave et al. (2014) was used. The AGB model error to which tree AGB predictions are subject was considered in estimating the error on the average AGB _{10cm} .	High	No	Yes
Sampling		✓	Average AGB _{10cm} estimates based on different inventory plots are subject to a potentially significant sampling error. The latter was considered in estimating the error on the average AGB _{10cm} .	High	Yes	Yes
Other parameters (e.g. Carbon Fraction, root-to-shoot ratios)			Belowground biomass (BGB) was estimated using a root-shoot ratio (RSR), considering AGB _{1cm} as the leaf part. For the classes (i) dry forest/open forest (miombo) and (ii) savannah, the RSR used is 0.2021, corresponding to the ecological zone of tropical moist deciduous forest (Mokany et al. quoted in IPCC 2006). For the classes (i) dense humid forest on terra firma, (ii) dense humid forest on hydromorphic soil, (iii) secondary forest, and (iv) cultivation and regeneration of abandoned cultivation, the RSR used is 0.3720, corresponding to the rainforest ecological zone (Fittkau and Klinge, 1973 et al. cited in IPCC 2006). It should be noted that the crop and abandoned crop regeneration class can be found in both ecological zones, dense tropical forests, and tropical moist deciduous forests. The RSR of 0.37 was used for this class in the two ecological zones to simplify and keep a conservative spirit.	High	Yes	No
Representativeness	✓		Average AGB _{10cm} estimates based on different inventory plots are subject to a potentially significant representativeness bias. The SUs retained for estimating biomass values come from different inventories with independent sampling plans and therefore do not respect strictly random samples. It should indeed be emphasized that a large proportion of SUs come from the former province of Bandundu (southwest of the country) and that they are therefore not representative of the whole of the DRC. However, it should be noted that the former province of Bandundu presents all the land cover classes encountered across the DRC.	High	Yes	No
Integration						
Model	✓		Control Mechanisms of material errors have been included in emission and removal calculations tools, i.e., sums of sampling points by forest type coincide with sample size ensuring no double counting in the sample-based activity data estimate.	Low	Yes	No
Integration	✓		Activity Data and Emission Factors are comparable. Carbon densities have been estimated according to the forest types (permanent and secondary), and non-forest land uses interpreted in the visual assessment of Landsat imagery.	Low	Yes	No

12.2 Quantification of uncertainty in Reference Level Setting

Parameters and assumptions used in the Monte Carlo method

Monte Carlo methods (IPCC Approach 2) were applied to quantify the Uncertainty of the Emission Reductions. The parameters subject to the Monte Carlo simulation and the Probability Distribution Function (PDF) type are shown in the table below.

Parameter included in the model	Parameter values	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Assumptions
Activity Data				
Secondary regeneration-2005-2009 [ha]	112,724 ± 21,780		Normal truncated, positive values	

Parameter included in the model	Parameter values	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Assumptions
Secondary regeneration-2010-2014 [ha]	126,499 ± 22,330	Activity data quantified sampling errors only. Updated AD estimates improved the accuracy of the existing reference emissions level calculations through a more robust methodology for estimating activity data. Improvements to the method included 1) stratification on activities for which emissions are estimated using maps of forest cover dynamics of Mai-Ndombe province derived from dense time-series Landsat imagery, 2) more intensive use of the Landsat archive as reference data, 3) sensitivity assessment of measurements of reference data as a function of interpreter agreement and data richness. The principal improvement was derived from the stratification that enabled the efficient allocation and interpretation of reference data.	Normal truncated, positive values	
Dense Humid Def. 2005-2009 [ha]	58,501 ± 11,907		Normal truncated, positive values	
Forest degradation 2005-2009 [ha]	53,562 ± 13,453		Normal truncated, positive values	
Secondary Def. 2005-2009 [ha]	107,786 ± 21,105		Normal truncated, positive values	
Dense Humid Def. 2010-2014 [ha]	96,142 ± 15,014		Normal truncated, positive values	
Forest degradation 2010-2014 [ha]	91,194 ± 19,227		Normal truncated, positive values	
Secondary Def. 2010-2014 [ha]	273,558 ± 43,992		Normal truncated, positive values	
Primary terra firma forest 2005-2009 [ha]	5,813,199 ± 299,055		Normal truncated, positive values	
Primary terra firma forest 2010-2014 [ha]	5,626,863 ± 298,453		Normal truncated, positive values	
Dense Humid Wetland Forest 2005-2009 [ha]	2,392,511± 289,802		Normal truncated, positive values	
Dense Humid Wetland Forest 2010-2014 [ha]	2,392,511 ± 289,802		Normal truncated, positive values	
Secondary forest 2005-2009 [ha]	766,342 ± 108,697		Normal truncated, positive values	
Secondary forest 2005-2009 [ha]	659,023 ± 103,212		Normal truncated, positive values	
Carbon densities				
FSc (secondary forest) [tdm/ha]	237 ± 58	The following error sources were quantified for the estimation of the error on the total biomass per stratum: -The bias of using an average wood density for several species. -The H: DBH model error to which tree height predictions are subject. -The AGB model error. -Sampling error of the estimate of the average Total Biomass per stratum.	Normal truncated, positive values	
CRCA (non-forest) [tdm/ha]	33 ± 6		Normal truncated, positive values	
FDHTF (primary forest terra firma) [tdm/ha]	432 ± 20		Normal truncated, positive values	
FDHSH (dense humid wetland forest) [tdm/ha]	415 ± 44		Normal truncated, positive values	

Quantification of the uncertainty of the estimate of the Reference level

		Deforestation	Forest degradation	Enhancement of carbon stocks
A	Median	23,965,086	4,759,681	-1,451,349
B	Upper bound 90% CI (Percentile 0.95)	31,807,802	7,946,588	-740,770
C	Lower bound 90% CI (Percentile 0.05)	16,934,832	2,166,785	-2,196,613
D	Half Width Confidence Interval at 90% (B – C / 2)	7,436,485	2,889,902	727,922
E	Relative margin (D / A)	31%	61%	-50%
F	Uncertainty discount	4%	12%	8%

Sensitivity analysis and identification of areas of improvement of MRV system

The sensitivity analysis can be found in Section 5 UNCERTAINTY OF THE ESTIMATE OF EMISSION REDUCTIONS of this report.