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:	01-01-2021 to 31-12-2022
Number of FCPF ERs:	5,896,317 tCO_2e
Quantity of ERs allocated to the Uncertainty Buffer:	1,300,657 tCO_2e
Quantity of ERs to allocated to the Pooled Reversal Buffer:	1,474,078 tCO_2e
Number of FCPF ERs from enhanced removals through afforestation/ reforestation	n.a.
Number of FCPF ER from High Forest Low Deforestation (HFLD)	3,544,487 tCO_2e
Date of Submission:	10-30-2025
Version	1.1

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LIST OF ACRONYMS

AD	:	*Activity Data*
AGB	:	*Above Ground Biomass* – Biomasse épigée
AOI	:	*Area of Interest*
AT	:	Autres Terres
BGB	:	*Below Ground Biomass* – 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	:	*Central Africa Forest Initiative* – Initiative pour la Forêt d'Afrique Centrale
CCNUCC	:	Convention-Cadre des Nations Unies sur le Changement Climatique
CIF	:	*Climate Investment Fund* – Fonds d'Investissement Climat
CM&M	:	*Carbon Map and Model* – 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 Agreemen
ERP	:	Emission Reductions Program
ER-PD		Emission Reduction Program Document
FAO	:	*Food and Agriculture Organization* – Organisation des Nations Unies pour l'Alimentation et l'Agriculture
FC	:	Fraction de carbone ou Forêt Claire
FCPF	:	*Forest Carbon Partnership Facility* – 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	:	*Global Forest Observation Initiative* – Initiative Globale pour l'Observation de la Forêt
GIEC	:	Groupe Intergouvernemental d'Experts sur l'Évolution du Climat
HFLD	:	High Forest, Low Deforestation
ICRAF	:	*World Agroforestry Centre*
IFLMP	:	*Improved Forest Landscape Management Project*
IFN	:	*National Forest Inventory*
IPCC	:	Intergovernmental Panel on Climate Change
IPs	:	Indigenous Peoples
JAFTA	:	*Japanese Forest Technology Association* – Association Japonaise pour la Technologie Forestière
JICA	:	*Japanese International Cooperation Agency* – Agence Japonaise de Coopération Internationale
LCC	:	Land Cover Change
LDC	:	Local Development Committee
LiDAR	:	*Light Detection And Ranging*
LU/LC	:	*Land Cover / Land USE*
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	:	*Operationalization of the Emissions Reduction Payment Agreement*
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-Iventaire 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	:	*Readiness Preparation Plan*
SA	:	Forêt Secondaire Adulte
SEPAL	:	*System for Earth Observation Data Access, Processing and Analysis for Land Monitoring*
SJ	:	Forêt Secondaire Jeune
SMC	:	*Southern Mapping Company*

TH	:	Terres Humides

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 the implementation of ERP activities

The Emission Reduction Program (ER) in Mai-Ndombe province has reached several important milestones that show its effective operationalization. In particular, the Democratic Republic of Congo (DRC) has benefited from a first payment based on the results of emissions reductions verified and transferred to the World Bank, under the ERPA contract signed in September 2018, which came into force in July 2022.

Key milestones include:

1. Submission and validation of the first monitoring report (2019-2020) by a Verification and Validation Body (VVB), enabling the first World Bank payment to be made for the emissions reductions generated.
2. Technical capacity building for the MRV team of the Forest Inventory and Management Department (DIAF), notably through specialized training provided by the University of Maryland, to improve knowledge and application of tools for analyzing activity data and calculating emissions reductions.
3. The start-up of the OPERPA project, financed in part by resources from the first payment, whose aim is to strengthen the implementation of the ERPA through the reinforcement of institutional capacities, monitoring systems and coordination, at both provincial and national levels.
4. The continuation and extension of projects, such as PIREDD Plateaux, PIREDD Mai-Ndombe, and community projects financed by the Dedicated Grant Mechanism (DGM). These projects have consolidated the results of the first implementation cycle.
5. Maintaining multi-sectoral approaches, combining sustainable agriculture, community forest management, local governance and involvement of indigenous peoples and local communities (PACL).

The Program relies on a system that includes: (i) the MRV operated by DIAF with the support of the University of Maryland, ensuring the operational deployment of the MRV system, guaranteeing the transparency and scientific rigor of the measurements; (ii) the UC-PIF for management and coordination; (iii) operational interfaces with embedded projects (e.g., Wildlife Works), optimizing synergies and avoiding redundancies; and (iv) a multisectoral approach ensuring the full and effective participation of the PACL, in accordance with international standards of participatory governance.

The effectiveness of this system is evidenced by:

- Regular MRV deliverables that have enabled the quantification of emission reductions according to a methodology replicable at the national level;
- Holding of governance fora such as COPIL/PTC, the diversity of PACL participation, and controlled decision-making timelines;
- The operationalization of the BSP and the disbursement rate and publication of information[1];
- Data exchanges with embedded projects and their integration into the national registry, avoiding any double counting.

The results are published and are subject to a continuous improvement loop (monitoring of indicators, corrective actions, and reassessment at each reporting period).

During the MR2 period, no major changes were made to the technical assumptions and fundamental principles of the ER Program as defined in the ER Program Document (ER-PD). The strategic framework remains focused on a landscape-based, inclusive and results-oriented approach.

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[1] https://www.worldbank.org/en/news/press-release/2025/06/06/drc-afe-communities-set-to-benefit-as-country-receives-19-47-million-for-reducing-deforestation-emissions

1.1.2 *Update on driving factors and lessons learned*

The direct drivers of deforestation previously identified - slash-and-burn agriculture, wood-energy production, uncontrolled fires, mining and logging - remain relevant. Enhanced monitoring efforts have led to a better understanding of the spatio-temporal dynamics of these drivers. The implementation of PSATs (Plans Simples d'Aménagement du Terroir), combined with agricultural intensification, continues to be key for mitigating the risk of leakage.

Several lessons have been learned from the first cycle:

- The importance of synchronizing technical efforts (MRV), community actions and local governance.
- Improved planning of interventions, particularly in identified critical areas.

With the Emission Reductions Purchase and Sale Agreement (ERPA) coming into effect in July 2022, several key actions have been completed:

1. Submission of the approval letter in October 2019.
2. Finalization and validation of the Benefit Sharing Plan[2], drawn up with stakeholder participation between 2019 and 2020, presented to the Provincial Steering Committee on April 21, 2022 in Inongo, and validated at national level on May 6, 2022 in Kinshasa. The BSP was updated in December 2024 mainly to reflect changes in the flow of funds arrangement. The revised BSP is now the operational framework for distributing results-based payments from the ERPA, following the first payment made in 2025.
3. Revision and submission of an updated reference level, aimed at improving the accuracy of activity data relating to deforestation, forest degradation and the increase in forest carbon stocks. This process was conducted with the support of the University of Maryland and national institutions, with publication of preliminary results in October 2020 and final results in January 2021.
4. Designation of the UC-PIF (Unité de Coordination du Programme d'Investissement Forestier) as the ER Program management unit.
5. Development of an operational action plan, detailing the steps required to demonstrate the ability of the Ministry of the Environment and Sustainable Development to transfer ownership of emission reductions.
6. Mobilization of USD 5 million in funding to operationalize and strengthen the components of the ER Program.
7. Submission and validation of the first monitoring report (2019-2020) by the OVV, enabling the first payment to be made by the World Bank.
8. Start of negotiations with potential buyers with a view to monetizing surplus credits.

In terms of implemented activities contributing to emissions reduction, the ERP continues to rely on a holistic approach that recognizes the link between sustainable forest management and use, community agricultural development and improved forest governance. For the period 2021-2022, the ERP's emission reduction results are based on activities implemented by:

- Improved Forest Landscape Management Project (IFLMP, P128887)
- Programme d'Investissement Forestier - Componante 1 Projet Intégré REDD+ dans les Plateaux (PIREDD Plateaux)
- Additional funding for the Maï-Ndombe integrated REDD+ project (P162837, PIREDD Maï-Ndombe) from CAFI
- Additional funding for the Maï-Ndombe integrated REDD+ project from GEF (P160182)
- Dedicated grant mechanism: Forest-dependent communities support project (P149049), supplemented by additional CAFI funding to support indigenous peoples.
- Mai Ndombe REDD+ project implemented by Wildlife Works

In addition to directly mitigating the drivers of deforestation within the geographical scope of the Emission Reduction Programme (ERP), the Programme adopts a proactive strategy to identify and address the potential displacement of deforestation and forest degradation pressures to surrounding areas. This preventive strategy is based on the critical dimensions of displacement:

Spatial Displacement of Activities

[2] updated_final_benefit_sharing_plan_drc_feb_2025.pdf

The Programme anticipates and monitors the migration of activities that contribute to deforestation—such as extensive agriculture, wood energy exploitation, and artisanal logging—to areas of influence located on the periphery of the project boundary.

Integrated Mitigation Strategy

The displacement mitigation strategy employs a multidimensional approach, integrating five complementary intervention levers:

(i) Spatial Planning and Agricultural Intensification

The deployment of Simple Land Use Plans (PSAT) is coupled with agricultural intensification initiatives designed to sustain and enhance yields. Supported by the development of structured value chains, this approach enables the Programme to meet demand while preventing the expansion of agricultural activities into new areas.

(ii) Strengthened Governance and Incentive Mechanisms

Robust governance measures are established and reinforced by sustainable economic alternatives, notably through the implementation of Payments for Ecosystem Services (PES). These mechanisms provide local communities with alternative sources of income, reducing pressure on forests.

(iii) Institutional Coordination

Effective coordination with provincial departments ensures that interventions are coherent and that sectoral policies are aligned with the Programme's forest conservation objectives.

(iv) Targeted Redistribution of Benefits

The Benefit-Sharing Plan (BSP/PPB) incorporates disbursement mechanisms strategically directed towards areas of influence, creating direct economic incentives for conservation in regions at risk of displacement.

(v). Monitoring and Evaluation System: A robust monitoring and evaluation system is established to track progress, assess the effectiveness of interventions, and ensure adaptive management throughout the Programme's implementation.

The implementation of this strategy is rigorously monitored and documented in accordance with Indicator 17.3, utilizing several measurement instruments:

- Direct Operational Monitoring: Systematic controls are conducted on the transport of coal and wood flows, enabling early detection of changes in supply chains and operational practices.
- Integrated Monitoring System: A dedicated system combines remote sensing to track forest loss, analyzes wood and charcoal production statistics, and conducts household surveys to assess shifts in community practices and incomes.
- Evaluation of Intervention Effectiveness: The outcomes of PSAT implementation and agricultural intensification activities are continuously evaluated, allowing for strategic adjustments based on demonstrated field effectiveness.

This systems-based approach enables the prioritization and targeted management of displacement risk sources, ensuring full compliance with Criterion 17 of the Methodological Framework and safeguarding the environmental integrity of the Program.

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

Project	**Amount**	**Period**	**Status update**

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 Maï-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 Bootootango/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.

1.2 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 management in general.

Slash-and-burn agriculture and charcoal production pose a medium risk for potential leakage and displacement 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 project, limiting the risk of leakage through displacement of slash-and-burn agriculture to other 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, the risk of shifting charcoal production to areas outside of the ER Program area is being addressed too. In addition, the PI-REDD supported the development of 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 of artisanal logging has been considered low and has been addressed through the creation of community led concessions which helped to better plan and structure the logging activities conducted by communities.

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).

Experience feedback confirms that incentives (PSAT, intensification, BSP) are more effective and less risky than purely coercive approaches, if payment predictability and usage security are ensured. Targeting charcoal supply areas reduces activity shifts when coupled with traceability and the dissemination of improved stoves. Inter-project coordination and community monitoring allow for rapid corrections via alert thresholds (remote sensing, deforestation alert system, access channels to MGP/FGRM). However, fluctuations in charcoal prices can generate market leaks; these call for a mix of incentives/light control, conditionalities (non-expansion clauses, usage agreements), and the extension of PSAT along risk corridors. Implementation and adjustments are monitored through dedicated indicators: PSAT coverage of influence areas/corridors, hectares intensified under agreements, BSP disbursement rates and predictability, response times to alerts, proportion of traced charcoal, dynamics of forest losses in the rings.

1.3 Methodological deviations

Intentionally left blank as not methodological deviations have occurred for MR2

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 FREL 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 FREL, therefore being consistent with Indicators 14.1 - 14.3 of the MF. Uncertainty related to the quantity of emission reductions will be estimated using Monte Carlo methods. Underlying sources of error in data and methods for integrated measurements of deforestation, forest degradation and carbon stock 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 describes 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) serves 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 FREL.

Table 2-1: 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.

2.1.1 Organizational structure

The National Forest Monitoring System (SNSF) of the Democratic Republic of Congo (DRC), which generates information for REDD+ Measurement, Reporting and Verification (MRV), was established in line with the Warsaw Framework for REDD+ in 2009 to access results-based payments. Following the adoption of the REDD+ National Framework Strategy by the Council of Ministers in 2012, the SNSF was developed to cover all land use and land use change at national level, in line with the 2003 IPCC Good Practice Guidelines. The system is now operational for the Measurement, Reporting and Verification of land use change in the AFOLU sector (agriculture, forestry and other land uses).
The SNSF comprises two data collection mechanisms:

- The first is the Satellite Land Monitoring System (SLMS), which collects data on land use and land change (Activity Data). The institution responsible for SLMS is the Direction des Inventaires et Aménagement Forestiers (DIAF).
- The second data collection mechanism is the National Forest Inventory (IFN), which collects field forestry data to estimate and update the country's emission factors (EF). This part of the SNSF is also managed by the DIAF.

Other government bodies involved in the REDD+ program are:

- The Coordination Nationale REDD+ (CN-REDD), which manages the REDD+ process and maintains the national REDD+ register,
- The Direction du Développement durable (DDD), which handles greenhouse gas (GHG) inventories.

The Mai-Ndombe Province Emission Reduction Program relies on national MRV tools for calculating emission reductions and reporting to ensure consistency.

2.1.2 *Data collection, processing, consolidation and communication processes*

The monitoring system uses the same methods for quantifying emissions and removals as those used for constructing the reference level (FREL), in order to produce fully consistent results as a basis for quantifying emission reductions. Activity data are estimated using the same approach 3 method (i.e. sampling using the same methodology). Activity data (AD) will be monitored using a probabilistic sample of time-series images. Emission factors will be equivalent to those used in the FREL (see MR1 Appendix 4: CARBON ACCOUNTING - ADDENDUM TO ERPD), and therefore consistent with indicators 14.1 to 14.3 of the Methodological Framework (MF). The uncertainty associated with the quantity of emission reductions will be quantified using Monte Carlo methods. The underlying sources of error in the data and methods of integrated measurements of deforestation, forest degradation and forest carbon stock enhancement (for example, as in a national forest inventory) will be combined into a single overall uncertainty estimate and reported at the two-tailed 90% confidence level.

Monitoring takes place at different levels and for different purposes. We can therefore differentiate monitoring as follows:

- The carbon accounting monitoring system used to report emissions and removals (based on measured activity data) is being implemented by DIAF with technical support from third parties (including FCPF and the University of Maryland) during the program period. DIAF will carry out quality assurance/quality control measures, either itself or through third parties, to ensure a high quality of monitoring results prior to verification. (This section describes this level of monitoring).
- Performance monitoring of the various emission reduction activities will be carried out by DIAF. Within this framework, the Program Management Unit (PMU) will play the role of verifier. Monitoring the performance of activities forms the basis for implementing the benefit-sharing plan.

Measurement, monitoring and reporting (MMR) has the following objectives:

- The main objective is to monitor land cover changes that occur during the implementation of the ER program. This system will enable subsequent comparison of program emissions with the baseline, leading to the quantification of emission reductions (ERs) which can in turn be sold and generate carbon revenues for ER program stakeholders.
- The MMR system will quantify deforestation and degradation in a spatially explicit way, facilitating the equitable sharing of financial benefits based on performance.
- Finally, the MMR system will evaluate individual activities and provide valuable information to the ER program, which in turn could refine the ER program's investment strategy and planning. The RE program plans to integrate the MMR system into its overall adaptive management strategy: MMR results will lead to the reinvestment of carbon revenues in the ER-Program for various high-yield emission reduction activities.

The ER program's MMR (sub-national MMR model) has been designed to be harmonized with the ER program's reference level. As such, the MMR system will use a sampling approach that applies the same manual/visual classification rules as those used to calculate the ER-Program's FREL.

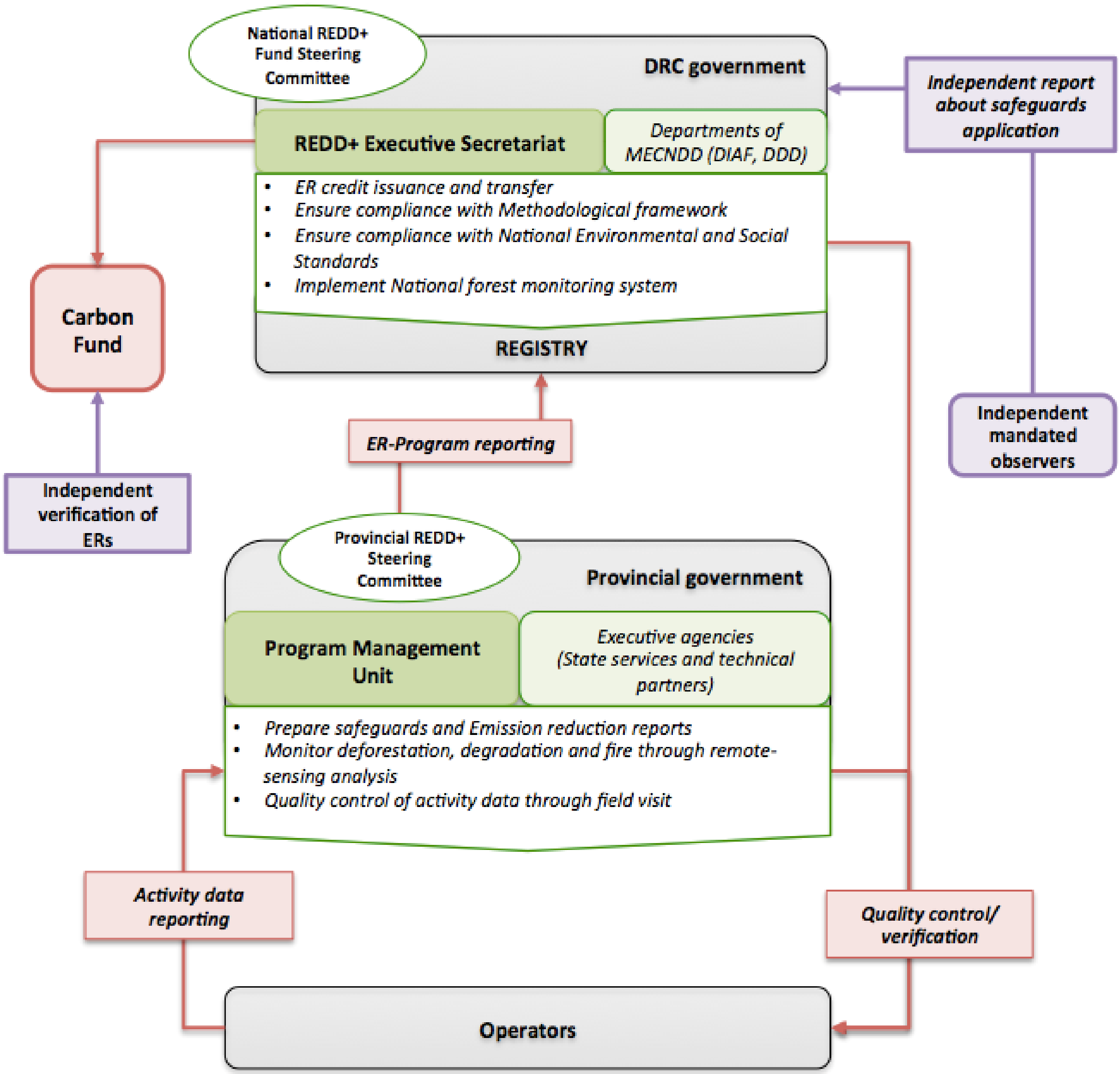


Figure 2-1: Role and responsibilities for monitoring and reporting of carbon and non-carbon performance.

Table 2-2: 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	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

	Republic of Congo - University of Maryland / GLAD Lab"[3]	sampling points. We estimate activity data using pixel-based stratified random sampling.
Emission Factor	DRC FREL Modified Submission[4] 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 the development of the ER-Program, notably through consultations launched by the Environmental Civil Society Group (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 total, 24 people were designated to participate directly as delegates in all relevant ER-Program activities.
- Since then, these delegates have participated as stakeholders in ERP activities, most importantly 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 BSP between 2014 and 2016, with a consultation workshop on the principles of the BSP in 2017. After the ERPA was signed, 13 consultation workshops with communities and PAs were held between September and November 2019 were conducted by REPALEF 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).

[3] 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/scl/fo/fnfqupbc5cvm07ksyoezp/h?dl=0&preview=rdc_documentnerf_soumissionfinale_29112018+(1).pdf&rlkey=0cb794w54jout87exbraba8f8

[4] https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

- 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.

- The Program has explored and encourages community participation in monitoring and information sharing when appropriate considering methodological requirements. In accordance with the Methodological Framework, deforestation is mapped and estimated according to the IPCC Approach 3, with centralized processing (DIAF/UMD) ensuring consistency with national data; consequently, activity data (AD) and emission factors (EF) fall under the responsibility of technical entities.
- In parallel, the Program will leverage the participation of PACL for: (i) field verification of change alerts (georeferenced points, photos, standardized forms); (ii) documentation of safeguards and operation of the MGP/FGRM; (iii) local monitoring of the implementation of the PPB/BSP and non-carbon benefits (NCB).
- A community validation protocol (SOP) and a training plan are being developed to integrate these contributions into the national MRV system, with quality control (QA/QC) ensured by the DIAF. This approach meets the requirement to explore and encourage participation "where appropriate."
- It is also worth noting the involvement of communities in the collection of floristic data as part of the National Forest Inventory (NFI) — notably the identification of species in local languages — which has contributed to the production of emission factors used by the Program.

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/fnfqupbc5cvm07ksyoezp/h?rlkey=0cb794w54jout87exbraba8f8&st=nr7gte9k&dl=0

Table 2-3: 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 2sdERMR_withdata.xlsx[5].	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*[6]** ***AD_calculationTool_MP2ERMR.xlsx*[7]**	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.

[5] https://www.dropbox.com/scl/fi/il0jmdxblrbqkx15d9vyl/DRC_ER_Calculations-2sdERMR_withdata.xlsx?rlkey=5vfp79bwbdfh44y53eolq9umh&st=pcvfi4yc&dl=0

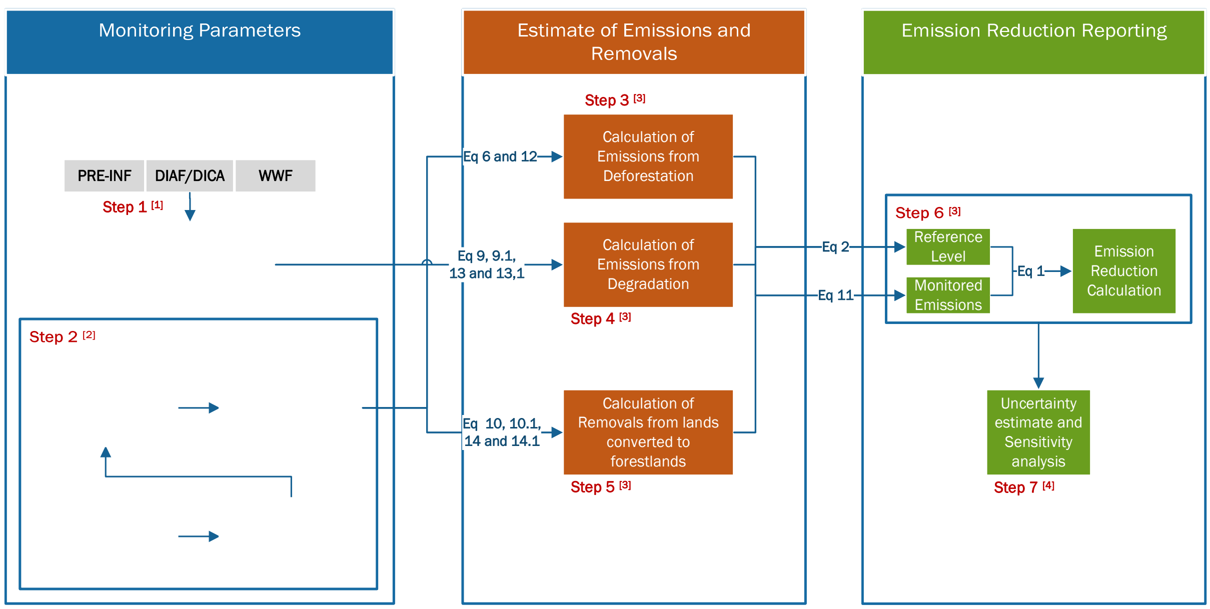
[6] Activity data estimate tool for the Reference Period can be accessed at the following link: https://www.dropbox.com/scl/fo/fnfqupbc5cvm07ksyoezp/h?dl=0&preview=AD_calculationTool_RP_rev.xlsx&rlkey=0cb794w54jout87exbraba8f8

[7] Activity data estimate tool for the Monitoring Period can be accessed at the following link: https://www.dropbox.com/scl/fi/2exhpo0nfaekzjdzf6lxl/AD_calculationTool_MP2ERMR.xlsx?rlkey=y25fv42ysr8mk9uihqd9j1d9b&st=l95ldcdl&dl=0

Calculation of emissions and removals ***DRC_ER_Calculations 2sdERMR_withata(1). Xlsx***[8]	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 2sdERMR_withdata(1).xlsx***	6	Emission Reductions are calculated with DRC_ER_Calculation tool.
Emission reduction uncertainty estimate and sensitivity analysis ***DRC_ER_Calculation 2sdERMR_MC_D.xlsx*** [9] ***Sensivity_DRC_ER_Calculations 2sdERMR_D.xlsx***[10]	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 2-2 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_SensitivityAnalisys.xlsx".

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

[8] Calculation of emission and removal tool can be accessed at the following link: https://www.dropbox.com/scl/fi/il0jmdxblrbqkx15d9vyl/DRC_ER_Calculations-2sdERMR_withdata.xlsx?rlkey=5vfp79bwbdfh44y53eolq9umh&st=bqulavl0&dl=0
[9] Emission Reduction Uncertainty Estimate tool can be accessed at the following link: https://www.dropbox.com/scl/fi/t29jpr90owc138mmmfx5s/DRC_ER_MC_Calculations-2sdERMR_withdata.xlsx?rlkey=b11du5t1yihqvikqgmk5k0iox&st=0sk4q5l4&dl=0
[10] Emission Reduction Sensitivity Analysis tool can be accessed at the following link: https://www.dropbox.com/scl/fi/t29jpr90owc138mmmfx5s/DRC_ER_MC_Calculations-2sdERMR_withdata.xlsx?rlkey=b11du5t1yihqvikqgmk5k0iox&st=0sk4q5l4&dl=0

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.

Emission reduction calculation

$$ER_{ERP,t} = RL_t - GHG_t \qquad \textbf{Equation 1}$$

Where:

ER_{ERP}	=	Emission Reductions under the ER Program in year t; $tCO_2e*year^{-1}$.
RL_{RP}	=	Gross emissions of the RL over the Reference Period; $tCO_2e*year^{-1}$.
GHG_t	=	Monitored gross emissions from deforestation at year t; $tCO_2e*year^{-1}$;
T	=	Number of years during the monitoring period; dimensionless.

Reference Level (RL_t)

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.

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

Where:

RP	=	Reference period; years.
AE	=	Upward adjustment of emissions tCO_2*year^{-1}. For further details on the quantification of the upward adjustment to the average annual historical emission over the reference period.
ΔC_{B_t}	=	Annual change in total biomass carbon stocks at year t; tCO_2*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 $\boldsymbol{i}$ REDD+ activities ($\Delta \boldsymbol{C_{LU_i}}$). Following the IPCC notation, the sum of annual change in carbon stocks for each of the $\boldsymbol{i}$ REDD+ activities ($\Delta \boldsymbol{C_{LU_i}}$) would be equal to the annual change in carbon stocks in the aboveground biomass carbon pool ($\Delta \boldsymbol{C_{AB}}$) and the annual change in carbon stocks in belowground biomass carbon pool ($\Delta \boldsymbol{C_{BB}}$) accounted.

$$\Delta \boldsymbol{C_{LU}} = \sum_{\boldsymbol{i}} \Delta \boldsymbol{C_{LU_i}} \qquad \textbf{Equation 3} \text{ (Equation 2.2, 2006 IPCC GL)}$$

$$\Delta \boldsymbol{C_{LU_i}} = \Delta \boldsymbol{C_{AB}} + \Delta \boldsymbol{C_{BB}} = \Delta \boldsymbol{C_{B}} \qquad \textbf{Equation 4} \text{ (Equation 2.3, 2006 IPCC GL)}$$

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:

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

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 Document[11] 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 ($\Delta \boldsymbol{C_B}$) is equal to the initial change in carbon stocks ($\Delta \boldsymbol{C_{CONVERSION}}$); 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:

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

$$\Delta C_{B_t} = \sum_{j,i} \left(B_{Before,j} - B_{After,i}\right) \text{ x CF x} \frac{44}{12} \times A(j,i)_{RP}$$ **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). Activity data for this report period were calculated using a remote sensing-derived stratified random sampling with sampling points allocated using and optimization approach based on strata proportions [12].
$B_{Before,j}$	=	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.
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 CO_2

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

Following the 2006 IPCC Guidelines the annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta \boldsymbol{C_{B_{DEG}}}$) 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.

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

[11] Page 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.

[12] 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/fnfqupbc5cvm07ksyoezp/h?dl=0&preview=UMD-WB_final_2000_samples.kml&rlkey=0cb794w54jout87exbraba8f8

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

Where:

$\Delta \boldsymbol{C_B}$	=	Annual change in carbon stocks in biomass for each land sub-category, in tones C yr^{-1}
$\Delta \boldsymbol{C_G}$	=	annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tones C yr-
$\Delta \boldsymbol{C_L}$	=	annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tones C yr-1
$\boldsymbol{C_{t_2}}$	=	total carbon in biomass for each land sub-category at time $\boldsymbol{t_2}$, tonnes C
$\boldsymbol{C_{t_1}}$	=	total carbon in biomass for each land sub-category at time $\boldsymbol{t_1}$, tonnes C

Following the recommendations set in chapter 2.2.2 of the GFOI Methods Guidance Document[13] 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 ($\Delta \boldsymbol{C_B}$) 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:

$$\Delta \boldsymbol{C_{B_{DEG}}} = \sum_{\boldsymbol{j}} \{\boldsymbol{EF_{DEG}} \times \boldsymbol{A}(\boldsymbol{a},\boldsymbol{b})_{\boldsymbol{RP}}\}$$ **Equation 9**

$\mathbf{EF_{DEG}}$	=	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 $B_{Beforea,a}$ is total biomass of forest type ***a*** before transition, in tons of dry matter per ha. This is equal to the sum of aboveground ($\mathrm{AGB_{Before,a}}$) and belowground biomass ($\mathrm{BGB_{Before,a}}$) 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 ($\mathrm{AGB_{after,b}}$) and belowground biomass ($\mathrm{BGB_{after,b}}$). 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 CO_2. $EF_{DEG} = \left(\mathrm{B}_{Before,\mathrm{a}} - \mathrm{B_{After,b}}\right)\ \mathrm{x\ CF\ x}\frac{44}{12}$ **Equation 9.1**
$\boldsymbol{A}(\boldsymbol{a},\boldsymbol{b})_{\boldsymbol{RP}}$	=	Area of forest type a converted to forest type b (transition denoted by a,b) during the Reference Period, ha yr^{-1}.

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

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

[13]Page 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.

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 $\mathbf{RF}_{SREG}$ in enhancement of carbon stocks in new forests.

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

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 CO_2.

According to the FCPF guidance note for accounting of legacy emissions/removals[14] 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.

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

$A(i,j)_{RP}$ = 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}).

$$GHG_t = \frac{\sum_t^T \Delta C_{B_t}}{T} \qquad \textbf{Equation 11}$$

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:

[14] 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

$$\Delta C_B = \sum_{j,i} \left(B_{Before,j} - B_{After,i}\right) \text{ x CF x} \frac{44}{12} \times A(j,i)_{MP}$$ **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.
$B_{AftIr,i}$	=	Total biomass of non-forest Iype 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 CO_2

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta \boldsymbol{C}_{\boldsymbol{B}_{\boldsymbol{DEG}}}$)

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta \boldsymbol{C}_{\boldsymbol{B}_{\boldsymbol{DEG}}}$) 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:

$$\Delta \boldsymbol{C}_{\boldsymbol{B}_{\boldsymbol{DEG}}} = \sum_{j} \{\boldsymbol{EF}_{DEG} \times \boldsymbol{A}(\boldsymbol{a},\boldsymbol{b})_{\boldsymbol{MP}}\}$$ **Equation 12**

Where:

$\mathbf{EF_{DEG}}$	=	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 $B_{Beforea,a}$ 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 CO_2. $EF_{DEG} = \left(B_{Before,a} - B_{After,b}\right) \text{ x CF x} \frac{44}{12}$ **Equation 13.1**
$\boldsymbol{A}(\boldsymbol{a},\boldsymbol{b})_{\boldsymbol{MP}}$	=	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 ($\Delta \boldsymbol{C}_{\boldsymbol{B}_{\boldsymbol{SREG}}}$)

Annual change in carbon stocks in biomass on forestland remaining forestland ($\Delta \boldsymbol{C}_{\boldsymbol{B}_{\boldsymbol{DEG}}}$) 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:

$$\Delta C_{B_{SREG}} = \sum_{LU=1}^{n} \{ RF_{SREG} \times A(i,j)_{MP} \}$$ **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 CO_2.

According to the FCPF guidance note for accounting of legacy emissions/removals[15] 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.

$$RF_{SREG} = \frac{(B_{CRCA} - B_{SecondaryForest}) \text{ x CF x} \frac{44}{12}}{20}$$ **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.

[15] 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 for the reference period[16]

Parameter:	$\mathrm{A(j,i)_{RP}}$ *Equation 6* $\mathrm{A(a,b)_{RP}}$ *Equation 9* $\mathrm{A(i,j)_{RP}}$ *Equation 10*
Description:	$\mathrm{A(j,i)_{RP}}$*:* Area converted/transited from forest type j to non-forest type i during the Reference Period (Deforestation transition denoted by j, i) $\mathrm{A(a,b)_{RP}}$*:* Area of forest type a converted to forest type b during the Reference Period (Degradation transition denoted by a, b). $\mathrm{A(i,j)_{RP}}$*:* Area of non-forestland *i* converted to forestland *j* during the Reference Period (Regeneration transition denoted by i, j)
Data unit:	*ha*
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	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. 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. An initial sample of 100 samples per stratum was drawn for each of the following classes in Maï-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 ± 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

[16] Further details on the data sources and methods for estimating activity data can be found in the final report for the quantification of the forest reference level of the emission reduction program in the province of Maï-Ndombe, Democratic Republic of Congo - University of Maryland / GLAD Laboratory at_ https://www.dropbox.com/s/flsg2p1hp1ogvpx/UMD-WB_final_report_EN-last.docx?dl=0 .
Please note that the UMD report is not the official data source for the monitoring period activity data estimate, and is merely a preliminary estimate of emissions reduction for 2018-2019. The ER program process is lengthy, and previous decisions on data and periods were subsequently revised, but these revisions are not reflected in the referenced document. The initial reporting period was set from 21.09.2018 to 31.07.2019 (see Appendix 2 on page 15 of the ERPA). However, the reporting period was subsequently modified from 01.01.2019 to 31.12.2020, as described in the MR1. The MR1 document refers to the UMD report to provide further information on the methods used to estimate activity data.

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 Maï-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 >=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 $\boldsymbol{i}$ in stratum $\boldsymbol{h}$:

$$\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h}$$

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 $\boldsymbol{i}$:

	$$\hat{A}_i = \sum_{h=1}^{H} A_h \bar{p}_{ih}$$ Where: A_h – total area of stratum h H – number of strata ($H = 9$) Standard error of the estimated area of class ***i:*** $$SE(\hat{A}_i) = \sqrt{\sum_{h=1}^{H} A_h^2 \frac{\bar{p}_{ih}(1-\bar{p}_{ih})}{n_h - 1}}$$
Value applied:	**Table 3-1: Value monitored during the Reference Period** (table below)
QA/QC procedures applied	QA/QC procedures included the definition of clear roles and responsibilities in terms of QA/QC, the definition SOPs[17], 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

Table 3-1: 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

[17] SOPs: UMD-WB_final_report_EN-last.docx pp11

	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 associated with this parameter:	Uncertainty stems primarily from: i. Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. ii. 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:	

Emission Factors

Parameter:	$\mathbf{B_{Before,j}}$ **;** Equations 6 and 12 $\mathbf{B_{After,i}}$; Equations 6 and 12

	CF; Equation 6
Description:	$\mathbf{B_{Before,j}}$: 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. $\mathbf{B_{After,i}}$: 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 Data**[18]: 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 3-2: 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).

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

[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)

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):

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

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:

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

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 3-1: Estimation of biomass values by forest type and non-forest land use.

Land use	Label	Value (tdm/ha)	IC (tdm/ha)	Value (tCO2/ha)	IC (tCO2/ha)
FSc	Secondary Forest	236.71	58.3	407.93	100.47
FDHTF	Primary forest terra firme	432.3	20.0	745.0	34.47
FDHSH	Dense humid wetland forest	415.48	44.45	716.01	76.6

<table>
<tr><td></td><td><table><tr><td>CRCA</td><td>Culture and Regeneration of Abandoned Culture</td><td>32.9</td><td>5.61</td><td>56.7</td><td>9.67</td></tr></table></td></tr>
<tr><td>QA/QC procedures applied</td><td>DRC FREL Modified Submission[19] 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.</td></tr>
<tr><td>Uncertainty associated with this parameter:</td><td>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 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 AGB10cm: 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:
$$E_B = \sqrt{E^2_{AGB_{1cm}} + E^2_{BGB}}$$</td></tr>
</table>

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

	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:	

Parameter:	$\mathbf{EF_{DEG}}$ Equations 9 and 13
Description:	$\mathbf{EF_{DEG}}$: Emission factor for degradation of forest type a to forest type b, tones CO2 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 including the spatial level of the data (local, regional, national, international):	**Spatial Level**: National **Source of Data**[20]: 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 3-4: 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). (see table below) **Methods for developing the data**:

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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CRCA	3.46				14	14

[20] 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)

	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): $$\mathrm{AGB_i} = \frac{\sum_{i=1}^{n_s} X_i}{\sum_{i=1}^{n_s} Y_i}$$ 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: $$\mathrm{AGB_{1cm}} = 1.872(\mathrm{AGB_{10cm}})^{0.906}$$ 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 3-5: 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.
QA/QC procedures applied	DRC FREL Modified Submission[21] 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 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 AGB10cm: 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).

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

	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: $$E_B = \sqrt{E^2_{AGB_{1cm}} + E^2_{BGB}}$$ 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**[22]: 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 3-6: 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	PRE-IFN & DIAF-JICA	

[22] 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)

				(square cluster)	(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 –

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

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):

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

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:

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

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

<table>
<tr><td></td><td>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.</td></tr>
<tr><td>Value applied:</td><td>Table 3-7: Estimation of removal rate.
<table>
<tr><th>FSc Total Biomass ± 90% IC ($tmd*ha^{-1}$)</th><th>CRCA Total Biomass ± 90% IC ($tmd*ha^{-1}$)</th><th>Removal Factor (tCO^2/ha/year) [1]</th></tr>
<tr><td>236,71±58,3</td><td>32.90±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.</td></tr>
<tr><td>QA/QC procedures applied</td><td>DRC FREL Modified Submission[23] 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.</td></tr>
<tr><td>Uncertainty associated with this parameter:</td><td>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 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):</td></tr>
</table>

[23] https://redd.unfccc.int/files/rdc_documentnerf_soumissionfinale_29112018.pdf

	-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 AGB10cm: 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: $$E_B = \sqrt{E_{AGB_{1cm}}^2 + E_{BGB}^2}$$ 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:	

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:	$\mathrm{A(j,i)_{MP}}$: Area converted/transited from forest type j to non-forest type i during the Monitoring Period (Deforestation transition denoted by j, i) $\mathrm{A(a,b)_{MP}}$: Area of forest type a converted to forest type b during the Monitoring Period (Degradation transition denoted by a, b). $\mathrm{A(i,j)_{MP}}$: 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 3-8: Value monitored during 2021-2022 Monitoring Period**

Parameter	Land cover transition	Land cover transition 2021-2022 (ha)	CI
$\mathrm{A(i,j)_{MP}}$:	**Secondary regeneration 2021-2022**	43,831	15,130

$A(j,i)_{MP}$:	**Dense humid Wetland Forest deforestation 2021-2022**	152	175
	Dense humid Terra firma deforestation 2021-2022	9,992	2,971
	Secondary Forest deforestation 2021-2022	65,332	15,459
$A(a,b)_{MP}$:	**Dense humid terra firme degradation 2021-2022**	10,673	4,113

Source of data and description of measurement /calculation methods and procedures applied[24]:

Landsat images from January 2013 to February 2023 were used to map the ER-Program area, and these maps were then used to allocate a stratified random sample for probabilistic analysis of baseline data from Landsat, Google Earth and Planet time series. The stratification layer was updated by generating spectral categories using the Mahalanobis approach combined with the layers used for the FREL and MR1 to maintain consistency and comparability of estimates with this monitoring period. The interpreted baseline data were used to calculate activity data for forest change with an uncertainty target of ±20% at the 90 percent confidence interval per activity class, using stratified pixel-based random sampling, a target achieved by using 1308 baseline sample units for all activities except forest degradation. Mahalanobis distances were calculated for stable primary forest pixels up to 2020 for the period 2013-2020 and up to 2022 for the period 2021-2022. Thresholds were interpreted by experts to identify strata targeting dense rainforest loss, secondary forest loss and degradation. Sample iterations targeting sources of high uncertainty resulted in additional sub-strata. The initial stratification comprised 14 strata and the final stratification 23.

Table 3-9: initial samples allocation

Strata ID	Strata	Stratum pixel count (Nh)	Initially sampled pixels (nh)
1	dense humid	69172678	30
2	low	1380570	50
3	med	422766	50
4	high	373046	50
5	second	5645387	30
6	low	2038919	50
7	high	1390592	50
8	wet forest	36704763	30
9	loss	49362	50
10	non-forest	37975974	30
11	water	5102224	30
12	gain	1133899	50
13	count<5	185646	30
14	fallow	5627733	50

An improved sample allocation based on initial stratum performance resulted in the inclusion of 728 additional sample units (Table 3-9). During this optimization, we focused our strategy on those strata that contributed significantly to the initial uncertainty of the estimates for the dynamic classes, leaving some strata unchanged.

The sample size required for a given target variance for each target class can be found using Cochran's equation 5.66 (page 110) for the optimal allocation with fixed n. The optimal sample allocation between strata (minimized variance for fixed n) is obtained by using Cochran's equation 5.60 (page 108) and replacing the true population class proportion for each stratum with that estimated from the initial sample. The final sample distribution totals 1308 sampling units.

Table 3-10: final samples allocation

Strata ID	Strata	Stratum pixel count (Nh)	Final sampling unit allocation (nh)
1	dense humid	68035455	29
2	low	1157628	40
3	med	237565	28
4	high	109648	15
5	second	5645387	200
6	low	1926690	100
7	high	1156319	45
8	wet forest	36564285	30
9	loss	49362	50
10	non-forest	37464522	30
11	water	5102224	30
12	gain	1133899	50
13	count<5	185646	30
14	fallow	5461642	150
15	gfw+fallow	511452	30
22	gfw+low	222942	50
23	gfw+med	185201	50
24	gfw+high	263398	50
26	gfw+sec low	112229	50
27	gfw+sec high	234273	50
34	gfw+fallow	166091	50
35	gfw+dense	1020293	101
36	buff gfw+dense	257408	50

Note that there is a different number of sampling strata between the first monitoring period (8 strata), the second monitoring period (23 strata) and the reference level period (9 strata). The table in the “AreaCalculation” sheet (cells L 27.. 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 the buffered changes (strata 4 to 8) and also the second monitoring period (strata 15 to 18) to minimize the uncertainty associated with omission errors, as suggested by Olofsson et al. in 2020. On the other hand, for the first monitoring period, the inclusion of strata of buffered changes was unnecessary, as uncertainty was already at the desired levels.

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 Maï-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/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 >=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 $\boldsymbol{i}$ in stratum $\boldsymbol{h}$:

$$\bar{p}_{ih} = \frac{\sum_{u \in h} p_{iu}}{n_h}$$

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 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: i. Errors made in interpretations of Landsat imagery resulting in incorrect landcover change classes. ii. 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 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

All reported estimates in this section are calculated using the template tool provided by the FCPF: https://www.dropbox.com/scl/fo/fnfqupbc5cvm07ksyoezp/h/2nd_Rapport_ER_MNB/Evidemces%20Calculs%20DRC%20MR2?dl=0&preview=template+sections+4_7_8_FCPFMR_FMT+v8+TEST+Completeness+check+DRC.xlsm&subfolder_nav_tracking=1

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

Year of Monitoring *t*	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)
2021	24,038,150	4,879,242	-1,260,399	5,788,886	33,445,879	27,656,993
2022	24,038,150	4,879,242	-1,680,533	5,788,886	33,025,746	27,236,859
Total	**48,076,300**	**9,758,484**	**-2,940,932**	**11,577,772**	**66,471,624**	**54,893,852**

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. The Emission Reductions calculation tool (DRC_ER_MC_Calculations 2sdERMR_withdata.xlsx) can be accessed at the following link:

https://www.dropbox.com/scl/fi/il0jmdxblrbqkx15d9vyl/DRC_ER_Calculations-2sdERMR_withdata.xlsx?rlkey=5vfp79bwbdfh44y53eolq9umh&st=2s2s15sg&dl=0

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)
2021	27,315,486	3,569,802	-4,253,346	26,631,942
2022	27,315,486	3,569,802	-6,081,950	24,803,942
Total	54,630,972	7,139,604	-10,335,296	51,435,280

The 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.

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*		Adjustment, if applicable (tCO_{2-e}/yr)		Total (tCO2-e)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Emission or removals in the Reference Level (tCO_{2-e}) *	24,038,150	24,038,150	4,879,242	4,879,242	1,260,399	1,680,533			5,788,886	5,788,886	33,445,879	33,025,745
Emission or removals under the ER Program during the Reporting Period (Tco_{2-e})	27,315,486	27,315,486	3,569,802	3,569,802	-4,253,346	-6,081,950					26,631,942	24,803,338
Emission Reductions during the Monitoring Period (tCO_2-e)	-3,277,336	-3,277,336	1,309,440	1,309,440	2,992,947	4,401,417	0	0	5,788,886	5,788,886	6,813,937	8,222,407
Length of the Reporting period / Length of the Monitoring Period (# days/# days)	1	1	1	1	1	1	1	1	1	1	1	1
Emission Reductions during the Reporting Period (Tco_2-e)	-3,277,336	-3,277,336	1,309,440	1,309,440	2,992,947	4,401,417	0	0	5,788,886	5,788,886	6,814,407	8,222,407

* Please list below which of the ER Program measures other than A/R that are being considered to generate

	Total (tCO2-e) with adjustment			Total (tCO2-e) without adjustment		
	2021	2022	Total RP	2021	2022	Total RP
Emission or removals in the Reference Level (tCO_{2-e})	33,445,879	33,025,745	66,471,624	27,656,992	27,236,858	54,893,850
Emission or removals under the ER Program during the Reporting Period (Tco_{2-e})	26,631,942	24,803,338	51,434,280	26,631,942	24,803,338	51,435,280
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	3,226,888	3,138,404	6,365,292	0	0	0
Total ER (Tco_2-e) available (*Colum F table section 8*)	3,587,049	5,084,003	8,671,052	1,025,299	2,433,520	3,458,570

	2021	2022	Total RP
Percentage of Emission reductions from HFLD [Optional if the country wishes to label HFLD units]	71.42358524%	%52.13378120	60.11360559%

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
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 ~1km^2 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	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
			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 ***pixel-based stratified random sampling*** 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 AGB10cm. Nevertheless, to reduce this type of error, data cleaning was performed for diameter and height values (outliers* 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
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

5.2 Uncertainty of the estimate of Emission Reductions

Parameters and assumptions used in the Monte Carlo method

Monte Carlo methods (IPCC Approach 2) was 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%

Parameters 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]	112,734 ± 21,780	**Sampling error**	Truncated and positive normal values	Normal PDF
Secondary regeneration-2010-2014 [ha]	126,499 ± 22,330		Truncated and positive normal values	Normal PDF
Secondary regeneration-2019-2020 [ha]	138,070 ± 35,773		Truncated and positive normal values	Normal PDF
Secondary Regeneration-2021-2022 [ha]	70,179 ± 18,596		Truncated and positive normal values	Normal PDF
Forest degradation 2005-2009 [ha]	53,562 ± 13,453		Truncated and positive normal values	Normal PDF
Secondary def. 2005-2009 [ha]	107,786 ± 21,105		Truncated and positive normal values	Normal PDF
Dense humid def. 2010-2014 [ha]	96,142 ± 15,014		Truncated and positive normal values	Normal PDF
Forest degradation 2010-2014 [ha]	91,194 ± 19,227		Truncated and positive normal values	Normal PDF
Secondary def. 2010-2014 [ha]	273,558 ± 43,992		Truncated and positive normal values	Normal PDF
Dense humid terra fime def. 2019-2020 [ha]	23,736 ± 3,686		Truncated and positive normal values	Normal PDF
Dense humid terra fime def. 2021-2022 [ha]	23,072 ±4,040		Truncated and positive normal values	Normal PDF
Dense wetland def. 2019-2020 [ha]	759 ± 919		Truncated and positive normal values	Normal PDF
Dense wetland def. 2021-2022 [ha]	646 ± 613		Truncated and positive normal values	Normal PDF
Forest degradation 2019-2020 [ha]	13,808 ± 3,612		Truncated and positive normal values	Normal PDF
Forest degradation 2021-2022 [ha]	21,182 ± 5,422		Truncated and positive normal values	Normal PDF
Secondary def. 2019-2020 [ha]	96,651 ± 19,003		Truncated and positive normal values	Normal PDF
Secondary def. 2021-2022 [ha]	109,114 ± 18,355		Truncated and positive normal values	Normal PDF
Primary terra firme forest 2005-2009 [ha]	5,813,199 ± 299,055		Truncated and positive normal values	Normal PDF

Parameters included in the model	Parameter values	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Assumptions
Primary terra firme forest 2010-2014 [ha]	5,625,863 ± 298,453		Truncated and positive normal values	Normal PDF
Dense humid forest 2005-2009 [ha]	2,392,511 ± 289,802		Truncated and positive normal values	Normal PDF
Dense humid forest 2010-2014 [ha]	2,392,511 ± 289,802		Truncated and positive normal values	Normal PDF
Secondary forest 2005-2009 [ha]	766,342 ± 108,697		Truncated and positive normal values	Normal PDF
Secondary forest 2010-2014 [ha]	659,081 ± 103,217		Truncated and positive normal values	Normal PDF
Carbon densities				
FSc (secondary forest) [tdm/ha]	236.701 ± 58	**Random and systematic measurement errors (DBH, height, plot size, wood specific gravity, allometric model error)** The following sources of error have been quantified for estimating the error in 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 • AGB model error • Sampling error in estimating average total biomass per stratum	Truncated and positive normal values	Normal PDF
CRCA (non-forest) [tdm/ha]	32.90 ± 6		Truncated and positive normal values	Normal PDF
FDHTF (primary forest terra firme) [tdm/ha]	432.30 ± 20		Truncated and positive normal values	Normal PDF
FDHSH (dense humid wetland forest) [tdm/ha]	415.48 ± 44		Truncated and positive normal values	Normal PDF

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/t29jpr90owc138mmmfx5s/DRC_ER_MC_Calculations-2sdERMR_withdata.xlsx?rlkey=b11du5t1yihqvikqgmk5k0iox&st=h4tfe4nk&dl=0

		Reporting period	Crediting Period
		Total Emission Reductions*	**Total Emission Reductions***
A	**Median**	15,071,030	31,750,941
B	**Upper bound 90% CI** (Percentile 0.95)	29,635,720	55,538,214
C	**Lower bound 90% CI** (Percentile 0.05)	-778,561	4,296,963
D	**Half Width Confidence Interval at 90% (B – C)/ 2**	15,207,140	25,620,625
E	**Relative margin (D / A)**	101%	81%
F	**Uncertainty discount**	15%	12%

*Forest degradation has not been estimated using proxy data.

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

Activity data contributes 94.8 % of the variability in the uncertainty of emission reductions. With almost 50%, secondary deforestation for the period 2021-2022 is by far the most significant source of variability in the uncertainty estimate of activity data. Additional sources are secondary deforestation for the period 2010-2014 (11.4%), dense humid terra firme deforestation 2021-2022 (9.2%), secondary regeneration 2019-2020 (5.8%) and dense humid terra firme deforestation 2010-2014 (5.1%). Secondary Forest carbon density contributes 4,0 %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/t29jpr90owc138mmmfx5s/DRC_ER_MC_Calculations-2sdERMR_withdata.xlsx?rlkey=b11du5t1yihqvikqgmk5k0iox&st=h4tfe4nk&dl=0

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

Input variable	Low output	Reference case	High output	Percent
Secondary Def. 2021-2022 [ha]	127,468.7581	109,113.5083	90,758.25845	49.6%
Secondary Def. 2010-2014 [ha]	229,565.8316	273,557.8884	317,549.9453	11.4%
Dense Humid Def. Terra firme 2021-2022 [ha]	27,112.60045	23,072.46357	19,032.32669	9.2%
Secondary regeneration-2019-2020 [ha]	102,297.4964	138,070.4818	173,843.4672	5.8%
Dense Humid Def. 2010-2014 [ha]	81,128.20244	96,142.00763	111,155.8128	5.1%
FSc (secondary forest) [tdm/ha]	295.01	236.71	178.41	4.0%
Forest degradation 2021-2022 [ha]	26,603,24101	21,181.5729	15,759.9048	4.0%
Dense Humid Def. 2005-2009 [ha]	46,594.07616	58,501.3936	70,408.71104	3.2%
Secondary Def. 2005-2009 [ha]	86681,69148	107,786.4494	128,891.2074	2.6%

Input variable	Low output	Reference case	High output	Percent
Forest degradation 2010-2014 [ha]	71,966.30376	91,193.53333	110,420.7629	2.0%
FDHTF (primary forest terra firme) [tdm/ha]	412.3	432.3	452.3	1.0%
Forest degradation 2005-2009 [ha]	40,109.38032	53,562.43351	67,015.48671	1.0%
Secondary regeneration-2021-2022 [ha]	51,583.31258	70,179.41106	88,775.50955	0.3%
Dense Humid Wetland Def 2021-2022 (ha)	1,259.360896	646.1174415	0	0.2%
FDHSH (Dense humid wetland forest) [tdm/ha]	371.03	415.48	459.93	0.1%
Secondary regeneration-2010-2014 [ha]	148,829.9091	126,499.4261	104,168.9432	0.1%
Secondary regeneration-2005-2009 [ha]	134,514.5424	112,734.2527	90,953.96293	0.1%
Primary terra firme forest 2005-2009 [ha]	5,514,143.632	5,813,198.717	6,112,253.802	0.1%
Primary terra firme forest 2010-2014 [ha]	5,327,409.905	5,625,863.176	5,924,316.447	0.1%
Dense humid wetland forest 2005-2009 [ha]	2,102,708.423	2,392,510.867	2,682,313.311	0.0%
Dense humid wetland forest 2010-2014 [ha]	2,102,708.423	2,392,510.867	2,682,313.311	0.0%
CRCA (non-forest) [tdm/ha]	38.51	32.9	27.29	0.0%
Secondary forest 2005-2009 [ha]	657,644,965	766,342.3172	875,039.6695	0.0%
Secondary forest 2010-2014 [ha]	555,864,204	659,081.115	762,298.0259	0.0%
Dense humid degradation 2010-2014 [ha]	71,966,30376	91,193.53333	110,420.7629	0.0%
Dense humid degradation 2005-2009 [ha]	40,109,38032	53,562.43351	67,015.48671	0.0%
Dense Humid Wetland Def. 2005-2009 [ha]	0	0	0	0.0%
Dense Humid Wetland Def. 2010-2014 [ha]	0	0	0	0.0%
Dense Humid Def. Terra firma 2019-2020 [ha]	20,050.76494	23,736.3023	27,421.83967	0.0%
Dense Humid Wetland Def 2019-2020 (ha)	0	758.8347857	1,677.581781	0.0%
Forest degradation 2019-2020 [ha]	10,196.32407	13,808.29323	17,420.2624	0.0%
Secondary Def. 2019-2020 [ha]	77,648.72479	96,651.28915	115,653.8535	0.0%

6 TRANSFER OF TITLE TO ERS

6.1 Ability to transfer title

The transfer of title is conducted in accordance with the approval framework established by Decree No. 047/CAB/MIN/EDD/AAN/MML/05/2018, dated May 9, 2018, which sets out the procedures for the Democratic Republic of Congo (DRC) to confer and transfer carbon titles. In addition to the legal framework—including the homologation decree and environmental law—the transfer process incorporates a specific assessment of land tenure and resources within the accounting area. This assessment: (i) identifies legal and customary rights related to access, use, management, and exclusion (including those of Indigenous Peoples and Local Communities, IPLCs/IPs); (ii) maps potential rights holders and areas of overlap or conflict; (iii) analyzes gaps and ambiguities in the applicable framework; and (iv) evaluates the potential impacts of the Program on these rights.

The steps for the transfer of carbon title in DRC:

(i) Project Accreditation and Homologation

- Preparation of Documentation: The project proponent prepares all required documentation demonstrating the project's objectives, expected carbon benefits, and compliance with environmental and social safeguards.
- Submission for Homologation: The project is submitted to the Ministry of Environment and Sustainable Development (MEDD) for homologation, in accordance with Decree No. 047/CAB/MIN/EDD/AAN/MML/05/2018. This includes a detailed assessment of land tenure, legal and customary rights (including those of Indigenous Peoples and Local Communities), and potential overlaps or conflicts.
- Review and Approval: The homologation commission reviews the submission, conducts stakeholder consultations, and issues a homologation certificate if all requirements are met. This certificate is essential for the project to be recognized as eligible for carbon title transfer.

(ii) Measurement, Reporting, and Verification (MRV)

- Monitoring Reports: The project implements robust MRV systems to quantify emission reductions or removals. Periodic monitoring reports are produced and submitted for third-party verification.
- Verification: An independent auditor verifies the reported emission reductions. Only verified emission reductions (ERs) are eligible for title transfer.

(iii) Benefit Sharing and Safeguards

- Benefit Sharing Plan (BSP): A BSP is developed and approved, outlining how revenues and benefits from carbon credits will be distributed among stakeholders, including local communities and Indigenous Peoples. This is a prerequisite for payment and title transfer.
- Safeguard Instruments: Environmental and social safeguard instruments are updated and validated to ensure compliance with the buyer (e.g., the World Bank Carbon Fund) and national standards.

(iv) Legal Confirmation and Government Authorization

- Government Letter of Transfer: The MEDD, as the holder of the homologation certificate and owner of the carbon credits, issues a formal letter authorizing the Ministry of Finance (MINFIN) to transfer the title of the ERs to the buyer (e.g., the World Bank Carbon Fund). This letter must confirm the government's capacity to transfer title and the non-retroactivity of any future regulatory changes.
- Legal Opinion: An independent legal opinion (from the State Council, a law firm, or a legal scholar) is provided to confirm the validity of the transfer under Congolese law.

(v) Registry and Transaction Recording

- Carbon Assets Tracking System (CATS): The transaction is recorded in the national or international carbon registry (such as the FCPF's CATS), managed by nominated and trained registry managers from MINFIN and MEDD.
- Data Entry, Verification, and Validation: Registry managers enter, verify, and validate data on carbon assets. The registry ensures traceability and prevents double counting.

(vi) Execution of Transfer and Payment

- Transfer Form: The Ministry of Finance signs a transfer form specifying the quantity of ERs and the corresponding payment amount. This form is countersigned by the buyer (e.g., the World Bank).
- Payment Disbursement: Upon confirmation of title transfer and validation of all required documents, payment is made to the designated account, and the ERs are credited to the buyer's registry account.

(vii) Post-Transfer Audits and Compliance

- Annual Audits: The National REDD+ Registry and its transactional module are audited annually to verify compliance, robustness of carbon accounting, and integrity of the transfer process.
- Stakeholder Consultations: Ongoing consultations and workshops are held to ensure transparency, address grievances, and improve national REDD+ infrastructure.

Key Considerations

- Legal Framework: The process is anchored in the 2018 Homologation Decree; however, ongoing reforms—including the formal establishment of the Carbon Market Regulatory Authority (CMRA) through Decree 23/22 of June 14, 2023 and updates to the homologation manual—are further strengthening the regulatory environment. This authority aims to provide oversight and attract investment in the DRC's burgeoning carbon market by creating a regulatory framework for the voluntary carbon market to operate effectively within the country. On Wednesday, July 23, 2025, a presidential ordinance appointed the Board of Directors of CMRA. However, the implementation of this ordinance has not yet been realized.
- Stakeholder Engagement: Free, Prior, and Informed Consent (FPIC) of local communities and Indigenous Peoples is required throughout the process.
- Transparency and Integrity: The registry system and annual audits are critical for maintaining transparency and preventing double counting or fraud.

International Standards: The process aligns with international standards for carbon markets, including Article 6 of the Paris Agreement and voluntary market requirements.

-

Deviations from the ER-PD and justifications:

Differently from the ER-PD forecasts, which initially relied on a document management system (National REDD+ Registry) pending the registry, the Program now adopts a transactional registry architecture:

- During the transitional phase (before the transactional national registry is operational), verified ERs from the FRE Mai-Ndombe are issued, held, and transferred via a centralized registry (CATS/FCPF). Accounts are opened for the Government (with sub-accounts for jurisdictional or regional programs). Upon issuance, a distinct allocation is credited to the government buffer account (uncertainty and reversal risk).
- Upon the operationalization of the National REDD+ Registry, all units and their history (serialization, issuances, transfers, cancellations) are migrated to the national registry, with full metadata retention.

This transitional measure allows for the management of complex flows (issuance/transfer/cancellation) where a simple file deposit provides neither an audit trail nor anti-double-counting controls. The logging of movements and aggregated public dashboard enhance accountability. The preparation of a gateway to the national registry and, if necessary, the referencing of exports to recognized international registries (monetization of surplus volumes).

In summary, the transition from Dropbox → transactional registry (transitional) → national registry constitutes a functional and governance upgrade compared to the ER-PD: it enhances transparency, reduces the risk of double counting, and secures the execution of PPB/BSP transfers and payments. In line with the ERPA operationalization action plan, the following steps are currently in progress:

- Revision of the approval decree and finalization of the procedures manual (alignment with the decree).
- Organization of Ministry services for implementation (roles, decision circuits, SOP, interoperability with the registry).
- Lifting the requirement for “release” of WWC credits: not required at this stage, given the subtraction of WWC project emission reductions from the total ERP (already accounted for).
- Letter from MEDD to FCPF confirming the DRC's capacity to transfer titles (after completion of the above steps).

In parallel, the Government of the Democratic Republic of Congo (MEDD) has initiated legal reforms to strengthen the framework for valorizing emission reductions (ERs). Central to this effort is the amendment of Law No. 11/009 of July 9, 2011, which defines the core principles of environmental protection. The amendment bill, introduced by MEDD and adopted on February 3, 2023, establishes the Carbon Market Regulatory Authority (CMRA), whose organization and operations are set by a Prime Ministerial decree. This provides a legal basis for certifying carbon projects and facilitating related transactions. Building on the 2018 Homologation Decree, ongoing reforms—including the creation of ARMCA and updates to the homologation manual—continue to reinforce the regulatory environment. Notably, Decree 23/22 of June 14 formally establishes the CMRA’s creation, organization, and operation in the DRC.

whose organization and operation are set by decree of the Prime Minister, and provides the legal basis for the certification procedure of carbon projects and associated transactions.

This revision allows for the implementation of key action plan steps:

- Prepare and approve the decree establishing the Authority (mandate, roles, responsibilities).
- Prepare and approve the revised approval decree, including the procedural manual defining the process and responsibilities for project registration within the ERP.

The preparation and approval of these decrees are supported by the World Bank through the OPERPA project (“Support to the Effectiveness and Operationalization of the ERPA under the Maï-Ndombe ER Program”) as well as the 2023 Budget Support dedicated to the establishment 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, including the DIAF, in producing reliable biennial reports on estimated carbon emissions from the Mai-Ndombe region. This technical assistance will include partnerships with institutions such as the University of Maryland, which has already produced the 2019-2020 and 2021-2022 monitoring reports currently in production. Additionally, the project will facilitate field missions and supply the necessary equipment to operationalize MRV systems within the Mai-Ndombe jurisdiction.

To facilitate stakeholder consultation, the project will support the organization of workshops for the DRC's Plateforme Technique de Consultation (PTC)[25] , which is dedicated to the development and operation of the Mai-Ndombe ERP. Additionally, this activity will provide support to the FIP coordination unit's Geographic Information System (GIS) expert, who will be responsible for quality assurance and training.Currently, all data is accessible to the general public in the DIAF Dropbox (https://www.dropbox.com/scl/fo/fnfqupbc5cvm07ksyoezp/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://imagis-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

Since the transactional national REDD+ registry is not yet operational, its revision and operationalization will be carried out with the support of the OPERPA project. In the meantime, the Program is setting up a transitional system to ensure environmental integrity, traceability of titles, and the absence of double counting.

The validated emission reductions (ER) (after verification of carbon accounting and social and environmental requirements) are recorded and serialized in a centralized transitional registry (CATS of the FCPF), until the national registry becomes operational. Accounts are opened for: (i) the Government (with sub-accounts dedicated to jurisdictional or regional programs), (ii) approved project proponents.

Upon issuance, the ERs are credited to the relevant accounts, and a separate allocation is made to one or more government buffer accounts to cover uncertainty and the risk of reversal. Transfers (e.g., ERPA execution) are processed from or to these accounts, with complete logging (holder, volume, date, audit reference).

Once the national registry is operational, all units issued and movements recorded in the transitional system will be migrated to the national registry, with full retention of metadata (serial numbers, issuance/transfer/cancellation

[25] The PTC has emerged as the primary forum for multi-stakeholder dialogue on climate policy and forest governance in the DRC. It regularly brings together representatives from government institutions, civil society, NGOs, and international technical and financial partners to align, coordinate, and strengthen climate-related actions across sectors.

history). A correspondence table (mapping of identifiers) and an audit protocol will ensure the continuity of titles and the uniqueness of series.

The issuance of ERs is subject to: (i) the conformity of the declared volume to the perimeter/eligibility, (ii) independent verification, (iii) exclusivity control via the database of approved projects (georeferencing, monitoring period, reference level). Any external transfer (e.g., to an internationally recognized registry to monetize surplus volumes) is first recorded in the transitional system, with an "export" marking and the cross-reference of the reissued or converted unit to prevent double issuance. Embedded projects with their own registry perform systematic reconciliation (before issuance) with the national approval database and the transitional log to avoid double registration.

A public (aggregated) dashboard periodically publishes: volumes issued, held, transferred, canceled, and buffer stocks; sensitive account-level information is protected but auditable. Title flows are aligned with the Benefit Sharing Plan (PPB/BSP): payments are derived solely from issued and traceable ERs, and allocations to beneficiary categories follow PPB rules. The integrity rule applies: "one unit, one holder, one accounting," at all stages (issuance, transfer, cancellation).

6.4 ERs transferred to other entities or other schemes

The method, the applied value, and the traceability are documented with supporting documents (correspondence Government–Verra, approval, registry captures.

The MaiNdombe REDD+ nested project, managed by Wildlife Works (WWC), is registered with VCS-VERRA as an active VCU issuer. The project issued a total of 2,904,200 tCO2eq VCU for 2021 and 2,755,283 tCO2eq VCU for 2022 under VCS-VERRA. For the same periods, Verra collected 322,688 tCO2eq VCU for 2021 and 383,121 tCO2eq VCU for 2022 for the non-permanence buffer. The total ERs per year to be deducted to avoid double counting amounts to 3,226,888 tCO2eq for 2021 and 3,138,404 tCO2eq for 2022. These volumes have been deducted from the PRE performances reported in the second monitoring report (see section 8) to comply with the requirements of criteria 23 and 38 and to avoid double counting and double emission reductions.

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 Reporting Period

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

7.3 Quantification of pooled reversal buffer replenishments

Intentionally left blank. No buffer replenishments occurred during the reporting period.

7.4 Reversal risk assessment

The program uses the rollover risk assessment tool to determine the reversal risk reserve percentages for each of these countries. These risk factors, as specified in Section 7.4.1, are as follows:

- FCPF default risk (10%)
- Lack of broad and sustained stakeholder support in current contexts (low, 0%)
- Lack of institutional capacity and/or ineffective vertical/intersectoral coordination, given the limited progress (average, 5%)
- Lack of long-term effectiveness in addressing underlying factors (medium, 5%)
- Exposure and vulnerability to natural disturbances (low, 0%)

This analysis found that the overall risk of reversals in the program area is 20%. The situation in the province has not changed. The Program manages rollover risks through an ER Program buffer reserve; a buffer reserve account has been established for this purpose in an appropriate ER transaction registry (Registry, CATS), in accordance with the terms of the FCPF Registry.
As noted in Section 4, there was no reversal during the reporting period and the program reduced its net emissions by 15,036,853 tCO2e during this period.

Risk Factor	Risk indicators	Default Reversal Risk Set-Aside Percentage	Discount	Resulting reversal risk set-aside percentage
Default risk	*N/A*	**10%**	*N/A*	*10%*
Lack of broad and sustained stakeholder support	Different mechanisms defining and formalizing broader stakeholder support are implemented in various areas and in an integrated approach, including: 1. **Inclusive Governance and Participatory Structures** ○ **Steering Committees (COPIL)** at the national and provincial levels: These bodies bring together the government, civil society, the private sector, and technical and financial partners. ○ **Local Development Committees (CLD)**: They allow communities to participate in the planning and monitoring of activities at the local level. The program plans to train and support about 80% of the CLDs in the province. The program also plans to establish CLDs in areas where they do not yet exist. This includes the development and animation of 531 new PSATs and the animation of 1,200 existing PSATs.	**10%**	*5%*	*5%*

	◦ **Regular Consultations**: Each major step (Benefit Sharing Plan, revision of the reference level, activity planning) has been subjected to public consultations. 2. **Legal Framework and Rights Security** ◦ **Recognition of customary rights and creation of CFCL (Local Community Forest Concessions)** to give communities official management rights. The program plans to implement simple management plans in four CFCLs covering 350,000 hectares of forests. ◦ **Formalization of benefit sharing through the Benefit Sharing Plan (PPB)**, ensuring transparent redistribution of carbon payments. ◦ **Grievance Redress Mechanisms (MGP)** established to resolve conflicts quickly; this mechanism is already in place. 3. **Socio-Economic Co-Benefits** ◦ **Direct investments in livelihoods** (agroforestry, improved stoves, community micro-projects). This includes the introduction of cash crops (cocoa, coffee, banana) and support for local sectors such as beekeeping. ◦ **Creation of local jobs** related to implementation (reforestation, forest monitoring, fire brigade training). ◦ **Capacity building** for local authorities, NGOs, and communities on forest governance and improved agricultural techniques. 4. **Monitoring, Transparency, and Communication** ◦ **Robust MRV system with open data (via SNSF)**, allowing stakeholders to see the results. ◦ **Regular reports and feedback meetings** with communities to share progress. ◦ **Involvement of independent observers** in verification and validation processes. **Conclusion for the evaluation**: Given the multi-stakeholder governance, the effectiveness of the MGP, the operationalization of the ERPA, and the implementation of the BSP (with clearly defined beneficiaries and obligations to return to IPLCS in embedded projects), the Program presents concrete guarantees of support and sustainability that reduce the risk of reversal. The Program still recognizes some capacity and vertical/intersectoral coordination deficiencies, including: (i) some key positions vacant or high staff			

	turnover or regular brain drain, (ii) overlapping mandates and lack of written procedures (SOP) for data sharing and decision-making, (iii) approval and information transmission delays exceeding target thresholds, (iv) limited interoperability between embedded projects and national systems (registry, MRV), and (v) low regularity of instances (COPIL/PTC) and their action follow-ups. Given these elements and considering the efforts made in the framework of the ERPA Operationalization project, the residual risk related to this factor is classified as medium (5%). This assessment will be revised downwards after the implementation of the corrective measures below and the achievement of performance indicators. • **Governance and coordination**: Reactivation of a quarterly COPIL/PTC schedule; adoption of a RACI matrix (roles/responsibilities); decision SLA (≤ 30 days) with tracking register. • **Procedures and data**: Adoption of standard SOPs (information flow, QA/QC, escalation); sharing protocols (MoU) between UC-PIF/DIAF/embedded projects; monthly feeding of the national registry and the MRV system. • **Capacities and resources**: Capacity building plan (MRV, safeguards, procurement); filling of critical positions; dedicated budget line for coordination and monitoring. **Performance monitoring**: Monthly dashboards (meetings held, decision deadlines, data integration rates, QA/QC recommendations applied) and semi-annual review with corrective action plan.			
Lack of institutional capacities and/or ineffective vertical/cross sectorial coordination	The Program still recognizes some capacity and vertical/intersectoral coordination deficiencies, including: (i) some key positions vacant or high staff turnover or regular brain drain, (ii) overlapping mandates and lack of written procedures (SOP) for data sharing and decision-making, (iii) approval and information transmission delays exceeding target thresholds, (iv) limited interoperability between embedded projects and national systems (registry, MRV), and (v) low regularity of instances (COPIL/PTC) and their action follow-ups. Given these elements and considering the efforts made in the framework of the ERPA Operationalization project, the residual risk related to this factor is classified as medium (5%). This assessment will be revised downwards after the implementation of the corrective measures below and the achievement of performance indicators.	**10%**	*5%*	*5%*

	Governance and coordination: Reactivation of a quarterly COPIL/PTC schedule; adoption of a RACI matrix (roles/responsibilities); decision SLA (≤ 30 days) with tracking register. **Procedures and data**: Adoption of standard SOPs (information flow, QA/QC, escalation); sharing protocols (MoU) between UC-PIF/DIAF/embedded projects; monthly feeding of the national registry and the MRV system. **Capacities and resources**: Capacity building plan (MRV, safeguards, procurement); filling of critical positions; dedicated budget line for coordination and monitoring. **Performance monitoring**: Monthly dashboards (meetings held, decision deadlines, data integration rates, QA/QC recommendations applied) and semi-annual review with corrective action plan.			
Lack of long term effectiveness in addressing underlying drivers	The Program recognizes that long-term effectiveness remains fragile in the face of underlying factors (extensive agriculture, informal charcoal sector, illegal exploitation, uncertain access/tenure, road openings, and demographic/market pressures). The observed risks are: (i) partial adoption of PSAT and intensification practices without robust conditionalities (risk of "internal leakage" by extension), (ii) poorly formalized wood-energy value chains (low traceability, price incentives), (iii) insecure access/tenure limiting sustainable investment, (iv) non-guaranteed maintenance/repair financing (sustainability), (v) low coverage of risk rings and delayed response to warning signals. Given these elements and the context of the OPERPA project activities implementation, the residual risk for this Factor is classified as medium (5%). This assessment will be revised downwards after the implementation of the measures below and the achievement of the agreed indicators. • **Secured Intensification**: Condition support (seeds, supervision) on locally recognized usage/tenure agreements; monitor yields and areas to avoid extension. • **Formalized Charcoal Sector**: Deploy traceability, standardized improved kilns, light checkpoints at road nodes, inter-territorial agreements to limit market leakage. • **Tenure & Local Rules**: Support clarification or usage agreements (community rules, PSAT zoning), mediation via MGP to secure investment.	**5%**	*5%*	*5%*

	• **Recurrent Financing**: Reserve a BSP "maintenance and reinforcement" envelope for PSAT/kilns/contracts; co-financing with embedded projects. • **Adaptive Management by Alert Thresholds**: Activate rapid responses (micro-grants, field missions, PSAT adjustments) as soon as a threshold is crossed (annual forest loss, charcoal price spike, increase in MGP complaints). • **MRV Integration & Transparency**: Public dashboards (covered PSAT, hectares intensified under agreements, traced charcoal share, annual loss dynamics). Implementing the above package should reduce the risk of this factor to 5%, subject to achieving the indicators and maintaining finance/conditionalities. .			
Exposure and vulnerability to natural disturbances	Until now, the jurisdictional program has not perceived any major natural risks related to fires, pests, extreme weather phenomena, or any other natural risks. The forest areas remain humid even during dry periods and therefore present a low risk of burning. Thus, the geo-environmental context has not changed, and being in the dense forest zone, they are affected by fires at less than 0.1%. To support this opinion, an analysis of the spatial distribution of fires in the Maï Ndombe province was carried out based on fires recorded by the MODIS sensor on the Terra and Aqua satellites. Fires that occurred between January 2001 and December 2018 were taken into consideration. During these years, a low rate of fires was recorded. Furthermore, no related risks were proven within the Program's perimeter. It is concluded that the existing fire detections do not sufficiently explain the measured variations in forest area. The results of the analysis clearly indicate that, if fire is used by farmers to clear forests, it does not lead to larger-scale forest fires, as is the case, for example, in Indonesia and other Southeast Asian countries.	**5%**	*5%*	*5%*
		Total reversal risk set-aside percentage		*20%*
		Total reversal risk set-aside percentage from ER-PD or previous monitoring report		*20%*

(whichever is more recent)	

8 EMISSION REDUCTIONS AVAILABLE FOR TRANSFER TO THE CARBON FUND

			2021	2022	Total
A.	Emission Reductions during the Reporting period (tCO_2-e)	*from section 4.3*	6,813,937	8,222,407	15,036,344
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)		6,813,937	8,222,407	**15,036,344**
D.	Percentage of ERs (A) for which the ability to transfer Title to ERs is clear or uncontested	*from section 6.1*	100%	100%	**100%**
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	*from section 6.4*	3,226,888	3,138,404	**6,365,292**
	If applicable, any buffer replenishments	*section 7.3 P*			
F.	Total ERs [(B+C)*D-E] minus, if applicable, any replenishments as per section 7.3, Q **8,6**		3,587,049	5,084,003	**8,671,052**

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*	15%	15%	**15%**
H.	**Quantity of ERs to be allocated to the Uncertainty Reversal Buffer (0.15*B/A*F)+(G*C/A*F)**		538,057	762,600	**1,300,657**
I.	**Total reversal risk set-aside percentage applied to the ER program**	*from section 7.4*	20%	20%	**20%**
J.	**Quantity of ERs to be allocated to the Pooled Reversal Buffer (F-H)*I**		609,798	864,280	**1,474,078**
K.	**Number of FCPF ERs (F- H – J)**		2,439,194	3,457,123	**5,896,317**
L.	**Percentage of Emission reductions from enhanced removals from afforestation/reforestation as a percentage of the total FCPF ERs [Optional if the country wishes to generate enhanced removals]**	*From section 4.3*	0%	0%	**0%**
M	**Number of FCPF ERs from enhanced removals from afforestation/reforestation (L * K) [Optional if the country wishes to generate enhanced removals]**		0	0	**0**
N	**Percentage of Emission reductions from HFLD [Optional if the country wishes to label HFLD units]**	*From section 4.3*	71.4235824%	52.13378120%	60.11360559%
O	**Number of FCPF ERs from HFLD (L * K) [Optional if the country wishes to label HFLD units]**		1,742,159	1,802,328	**3,544,487**

ANNEX 1: INFORMATION ON THE IMPLEMENTATION OF THE SAFEGUARDS PLANS

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

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