ISFL Emission Reductions Monitoring Report Template

Name of the ISFL ER Program and Country	Eastern Province Jurisdictional Sustainable Landscape Program (EP-JSLP) | Government Republic of Zambia
Name of the Program Area	Eastern Province
Reporting Period covered in this report	*01-01-2024 to 31-12-2024*
Applicable ERPA Phase and sequence of this Reporting Period *(for example 2nd Reporting Period of ERPA Phase 1 that runs from DD-MM-YYYY to DD-MM-YYYY)*	This is the first Reporting Period 1 of the first (and only) ERPA phase that runs from 01-01-2024 to 31-12-2029. Three more reporting periods are expected: • Reporting Period 2: 01/01/2025 to 12/31/2025 • Reporting Period 3: 01/01/2026 to 12/31/2027 • Reporting Period 4: 01/01/2028 to 12/31/2029
Subcategories included for ISFL Accounting	1. Forest Land remaining Forest Land 2. Forest land converted to Cropland 3. Forest land converted to Settlement 4. Cropland converted to Forest Land 5. Cropland remaining cropland 6. Grassland converted to cropland
Number of ISFL ERs	3,986,222
Quantity of ERs allocated to the Uncertainty Buffer	0

Quantity of ERs to allocated to the Reversal Buffer	703,450
Date of submission	03-12-2025
Version	V2

WORLD BANK DISCLAIMER

The boundaries, colors, denominations, and other information shown on any map in the monitoring report does not imply on the part of the World Bank any legal judgment on the legal status of the territory or the endorsement or acceptance of such boundaries.

The World Bank and the ISFL ER Program host country shall make this document publicly available, in accordance with the World Bank Access to Information Policy.

Contents

List of tables

List of figures

Acronyms

ABG	Above Ground Biomass
AD	Activity Data
AEZ	Agro-Ecological Zone
AFOLU	Agriculture, Forestry and Other Land Use
ANR	Assisted Natural Regeneration
BCEF	Biomass Conversion and Expansion Factor
BCP	Biocarbon Partners
BD	Bulk Density
BEF	Biomass Expansion Factor
BGB	Below Ground Biomass
BioCF ISFL	BioCarbon Fund Initiative for Sustainable Forest Landscapes
BSP	Benefit Sharing Plan
CATs	Carbon Assets Transactions
CBNRM	Community-Based Natural Resource Management
CBO	Community Based Organisation
CCP	Climate Change Portal
CEO	Camp Extension Officer
CERPA	Chiefdoms Emissions Reduction Performance Agreements
CF	Carbon Fraction
CFM	Community Forest Management
CFMA	Community Forest Management Area
CH_4	Methane
CI	Confidence Interval
CO_2	Carbon Dioxide
COMACO	Community Markets for Conservation
CRB	Community Resource Board
CRM	certified reference materials
CSA	Climate Smart Agriculture
CSO	Civil Society Organisation
DBH	Diameter at Breast Height
DC	District Commissioner
DFO	District Forestry Officer
DGECC	Department of Green Economy and Climate Change
DMT	District Multi-Sectoral Team
DW	Dead Wood
EF	Emission Factor
EF	Emission Factor
EPJSLP	Eastern Province Jurisdictional Sustainable Landscape Programme
ER Programme	Emissions Reduction Programme
ERC	Emissions Reduction Certificate
ERMR	Emissions Reduction Monitoring Report
ERPD	Emission Reduction Programme Document
ESCAP	Environmental and Social Commitment Plan

ESIO	Environmental Social Inclusion Officer
ESMF	Environmental and social Management Framework
EU	European Union
FCSM	Forest Carbon Stock Permit
FD	Forestry Department
FGRM	Feedback and Grievance Redress Mechanisms
FMNR	Farmer Managed Natural Regeneration
FMT	Fund Management Team
GBVAP	Gender Based Violence Action Plan
GEDSI	Gender Equality Disability and Social Inclusion
GEE	Google Earth Engine
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GHGi	Green House Gas inventory
GIS	Geographical Information System
GMP	General Management Plan
GPS	Global Positioning System
GRZ	Government Republic of Zambia
Ha	Hectare
HFO	Honorary Forest Officers
HH	Household
HTWG	Harmonisation Technical Working Group
ILUA II	Integrated Land Use Assessment Phase Two
IMRV	Integrated Measuring Reporting and Verification System
IPCC	Intergovernmental Panel on Climate change
ISFL	Initiatives for Sustainable Forest Landscape
KCA	Key Category Area(s)
LCFF	Luangwa Community Forest Project
LF	Lead farmer
LFR	low forest degradation reduction
LULUCF	Land use, land-use change, and forestry
M&E	Monitoring and Evaluation
MGEE	Ministry of Green Economy and Environment
MoA	Ministry of Agriculture
MoFNP	Ministry of Finance and National Planning
MRV	Measurement Reporting ad Verification
N_2O	Nitrous Oxide
NDC	Nationally Determined Contribution
NDVI	Normalized Difference Vegetation Index
NERPA	Nested Emissions Reduction Performance Agreement
NGO	Non-Governmental Organisation
NRM	Natural Resources Management
PACO	Provincial Agricultural Coordinator
PC	Programme Coordinator
PDF	Probability Density Function

PDO	Project Development Objective
PFM	Participatory Forest Management
PFO	Provincial Forestry Officer
PIU	Project Implementation Unit
PPSC	Provincial Project Steering Committee
PSC	Program Steering Committee
PWD	People with Disability
QA	Quality Assurance
QC	Quality Control
RBF	Results Based Financing
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RS	Remote Sensing
SALM	Sustainable Agriculture Landscape Management
SD	Standard Deviation
SDMC	Satellite Disaster Management Committee
SEP	Stakeholder Engagement Plan
SESA	Strategic Environmental and social Assessment
SFM	Sustainable Forest Management
SOC	Soil Organic Carbon
SOP	Standard Operating Procedures
SRTM	Shuttle Radar Topography Mission
SWM	Sustainable Wildlife Management
TASC	The African Stove Company Limited
tCo_2e	Tonnes of Carbon equivalent
TWG	Technical Working Group
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Chang
VCM	Voluntary Carbon Market
WB	World Bank
ZAMSTATs	Zambia Statistical Agency
ZARI	Zambia Agriculture Research Institute
ZEMA	Zambia Environmental Management Agency
ZIFLP	Zambia Integrated Forest Landscape Project

Executive summary

The Eastern Province Jurisdictional Sustainable Landscape Programme (EPJSLP) is Zambia's first Landscape Results-Based Climate Finance (RBCF) Emissions Reductions Programme. It is an initiative supported by Government with funding from the Global Environment Facility (GEF) and the BioCarbon Funds' Initiatives for Sustainable Forest Landscape (ISFL). The Government is implementing the EPJSLP as a programmatic umbrella for climate-positive interventions. The Program is Jurisdictional in terms of approach and performance-based in nature. It aims to promote Greenhouse Gas (GHG) emissions reduction or removal in the Agriculture Forest and Other Land Use (AFOLU) sector, while simultaneously improving rural livelihoods including wildlife conservation and habitat management.

The EP-JSLP envisages to achieve emission reductions by promoting interventions that prevent deforestation and forest degradation as well as reducing emissions from land categories. This includes improved land-use planning, Climate Smart Agriculture (CSA) development, Sustainable Forest Management, efficient cookstoves in rural areas, and support to Laws and Policies that protect Forests and Wildlife. The Project is governed by a Project Steering Committee, co-chaired by Permanent Secretary, Ministry of Green Economy and Environment (MGEE) and Eastern Province Permanent Secretary who provide overall project oversight and guidance to the ER Program. Implementation is driven by a combination of grants from the Initiative for Sustainable Forest Landscapes (ISFL) and Global Environment Facility (GEF) financing, and investments from partners such as Community Markets for Conservation (COMACO) and Biocarbon Partners (BCP), alongside other landscape-level organizations.

The Government of Zambia signed an Emissions Reductions Purchase Agreement (ERPA) with the World Bank as Trustees for the ISFL, on 17 June 2024. The ERPA agreed for a purchase of 3 million tonnes of ERs at a floor price of USD 10 per tonne for 98% of the contract ERs and USD 8 per tonne for 2% of Contract. During the monitoring period, the Emission Reductions (ER) Program implemented a comprehensive Measurement, Reporting, and Verification (MRV) framework consistent with the World Bank's ISFL protocols (programme and process requirements, ISFL guidance note on application of IPCC guidelines) and aligned with IPCC 2006 Guidelines. The MRV system integrates satellite-based remote sensing, calibrated ground-based forest and land-use inventories, and process-based modelling to ensure transparency, consistency, and reproducibility in GHG estimation. Associated Standard Operating Procedures (SOPs) were also developed to guide implementation and support adaptive management.

Data collection for the 2024 monitoring period was carried out collaboratively by mandated institutions including, the Forest Department, Ministry of Agriculture, Department of Energy, Ministry of Livestock and Fisheries, Zambia Agricultural Research Institute (ZARI), Zambia Environmental Management Agency (ZEMA), and the ER Program's Project Implementation Unit (PIU). This was in coordination with Nested Project (BCP and COMACO) teams and supported by an Emissions Reduction Consultant.

During the monitoring period (2024), the ER programme recorded GHG emissions and removals (in tCO_2e) across various land-use change subcategories:

- Forestland Remaining Forestland emitted 7034579 tCO_2e;
- Forestland converted to cropland contributed 780259 tCO_2e;
- Forestland converted to Settlements added 160233 tCO_2e;
- Grassland converted to Cropland released 591 tCO_2e;
- Cropland remaining Cropland showed -480230 tCO_2e removals; and
- Cropland converted to Forestland functioned as a sink, removing -1968888 tCO_2e.

The Uncertainty Analysis for AFOLU sectors was conducted using Approach 2, applying Monte Carlo simulation methods in accordance with the ISFL requirements. This method allows for a robust subcategory-by-subcategory quantification of uncertainty, reflecting variability in activity data, emission factors, and modelling assumptions in line with the ISFL protocol.

Total Emission Reductions achieved during the reporting period is 4,689,672 tCO_2eq.

To ensure that investment activities under the Emission Reductions (ER) Program are socially inclusive and environmentally sound, a suite of Environmental and Social Risk Management (ESRM) instruments has been developed and implemented. Building on the original frameworks established during the Zambia Integrated Forest Landscape Project (ZIFLP), instruments such as the Strategic Environmental and Social Assessment (SESA), Environmental and Social Management Framework (ESMF), Resettlement Policy Framework (RPF), and Process Framework (PF). These have been aligned to the EP-JSLP and further enhanced during the 2024 monitoring period, with the ESRM system by deploying additional instruments in compliance with World Bank Environmental and Social Framework (ESF) and ISFL safeguard protocols. These include the Labor Management Plan (LMP), Stakeholder Engagement Plan (SEP), Environmental and Social Commitment Plan (ESCP), Gender-Based Violence Action Plan (GBVAP), Feedback Grievance Redress Mechanism (FGRM), and the Benefit Sharing Plan (BSP). These instruments support effective risk mitigation, inclusive benefit distribution, and transparent stakeholder engagement.

1 implementation status of the ISFL ER Program

1.1 Implementation status of the ISFL ER Program

Progress on the actions and interventions under the ISFL ER Program

The Eastern Province Jurisdictional Sustainable Landscape Programme (EPJSLP) is a Results-Based Climate Finance (RBCF) follow up programme to the Zambia Integrated Forest Landscape Project (ZIFLP), an initiative supported by Government with funding from the Biocarbon Fund (BioCF), Global Environment Facility (GEF) and International Development Association (IDA). The government is implementing the EPJSLP as a programmatic umbrella for climate-positive interventions. The Programme is Jurisdictional in terms of approach and performance-based in nature. The EP-JSLP's aim is to promote actions that result in reduced greenhouse gas emissions reduction or removal from Agriculture Forest and Other Land Use (AFOLU) sector, while simultaneously improving rural livelihoods. The specific interventions include improved land-use planning, Climate Smart Agriculture (CSA) development, Sustainable Forest Management, efficient cookstoves, and Laws and Policies that protect Forests and Wildlife.

The implementation of these mitigation interventions commenced under the ZIFLP and have continued with upfront grant provided by the Initiatives for Sustainable Forest Landscape (ISFL) and the Global Environmental Facility (GEF). In addition, mitigation interventions have also been undertaken through investment by the private sector and other organizations. Provided in Table 1 is a summary progress on the actions and interventions under the ISFL ER Program and these are elaborated in Annex 6.

Table 1: Status of progress actions and interventions under the ER Program

Type of intervention (Sector)	Interventions (Projects/Programmes)	Status of Key Actions and Interventions
Emissions Reduction Framework	Zambia Integrated Forest Landscape Project January 2018 – February 2024	The ERPD and four key instruments were developed i.e., GHG Baseline, SESA, MRV System and Benefits Sharing Plan[1]
Climate smart agriculture	Zambia Integrated Forest Landscape Project January 2018 – February 2024	❖ Brought 162,334[2] hectares of agriculture land area under climate smart agriculture ❖ Established 21 Farmer Led Irrigation Schemes, each measuring 5ha giving a total of 105 ha of agricultural land brought under irrigation ❖ 15,122.1 hectares of cashew planted across the province ❖ Raised and distributed about 5million agroforestry seedlings to farmers. ❖ Conducted the soil fertility mapping for the entire EP.
	EPJSLP - September 2024 – October 2030	Ongoing activities ❖ Maintaining the 162,334[3] hectares of agriculture land under climate smart agriculture ❖ Bring additional 80,000ha of agriculture land area under CSA
	Community Markets for Conservation (COMACO)	❖ 37,939,119 *Gliricidia Sepium* seedlings transplanted across 49,221 farmers in EP for improved soil fertility and crop yield.[4] ❖ 1,571,000[5] kg assorted crops purchased from 2,705 farmers i.e., 1,246,000 kg rice, 252,000 kg, 12,600 kg cowpeas, 14,400kg honey and 46,000kg maize. ❖ 3112 farmers made compost in 2024 reflecting a growing adoption of sustainable soil fertility practices.[6]
	BCP - Luangwa Community Forest Project (LCFP).	❖ 1,756Faidherbia Albida trees planted since inception[7]. ❖ 938.5 Hectares of farmland under CSA.
Sustainable Forest	Zambia Integrated Forest Landscape Project January 2018 – February 2024	❖ 28 Community Forest Management groups were established[8] ❖ 72, 752 hectares of forest land area was brought under sustainable management practices.[9] ❖ Developed management plans for 25 Forest Reserves covering 256,571 ha.[10]

[1] https://epjslp.org.zm/publications/
[2] Report ZIFL Project Endline Evaluation_final.pdf
[3] See footnote 2
[4] https://itswild.org/causes/sustainable-agriculture/
[5] See footnote 4
[6] See footnote 4
[7] https://bcp.earth/projects/luangwa/
[8] See footnote 2
[9] See footnote 2
[10] https://epjslp.org.zm/publications/

Management		❖ Supported fire management activities in 25 Forest Reserves and 27 CFMGs ❖ 27 CFMGs and 21 Forest Reserves supported to implement fire management and suppression activities[11] ❖ 114.1 hectares of exotic plantations established ❖ Forestry Department ceased issuing Forest Concession Licenses in Areas under Community Forest Management. ❖ Supported the development and implementation of fire management plans for Lukusuzi & Luambe National Parks ❖ Supported the protection and management of 2,720 km^2 and 254km^2 ha[12] of Lukusuzi and Luambe National Parks respectively.
	EPJSLP	Ongoing activities ❖ Maintaining 72, 752 ha of community forest land area under sustainable management practices
	COMACO	❖ A total of 3,118,816 trees[13] are planted in 2022. ❖ 35,957 beehives[14] were installed in community forests areas. ❖ 236,117 ha of forest land under community conservation
	BiCarbon Partners (BCP)	❖ 774,612 Total Hectares[15] of Forest Protected.
	World Vision	❖ 11,168 hectares of individual FMNR sites were established in Sinda (8,083ha) and Katete (3,085ha) Districts. ❖ 26,774 hectares of communal FMNR sites were established in Katete (7,924ha) and Sinda (18,850ha) Districts. ❖ 1,300 traditional leaders engaged in the formation of community By-laws.
Improved cookstoves	ZIFLP	❖ Distributed 156 improved institution cookstoves to 20 boarding schools and 3 prisons.[16] ❖ Supported the construction of 4,185 improved fixed mud stoves
	COMACO	❖ 97,463 fuel efficient cook stoves installed – contributing to the annual saving of 32 trees per household or a total of 3,118,816 trees from all the stoves installed in 2021.
	The African Stove Company (TASC)	❖ 182,633[17] energy efficient cook stoves installed in 36 chiefdoms in the Landscape.

[11] See footnote 2
[12] See footnote 2
[13] See footnote 4
[14] See footnote 4
[15] See footnote 7
[16] See footnotes 1 & 2
[17] https://tasc.je/our-projects/

Effectiveness of the organizational arrangements and involvement of partner agencies

The Ministry of Green Economy and Environment (MGEE) holds the mandate to authorize the transfer of title of Emissions Reductions (ERs) based on key laws and regulations, which include the Green Economy and Climate Change Act No. 18 of 2024, the Forests Act (2015), and Forests (Community Forest Management) Regulations (2018). The Ministry also oversees the broader EPJSLP which is governed by a Project Steering Committee, co-chaired by MGEE Permanent Secretary and Eastern Province Permanent Secretary. The two Permanent Secretaries provide overall project oversight and guidance to the Programme. This structure represents a shift from the original position in the ERPD that proposed to have a national and provincial level steering committees for enhanced operational efficiency.

The Project Implementation Unit (PIU) ensures day-to-day coordination of project activities and harmonization of interventions across the program through the Harmonization Technical Working Group (HTWG). Various implementing institutions play a critical role in the project, including the Forestry Department (FD), Department of National Parks and Wildlife (DNPW), Ministry of Agriculture (MoA), Ministry of Local Government and Rural Development (MLRGD), Ministry of Lands and Natural Resources (MLNR), Ministry of Energy (MOE), and the Zambia Environmental Management Agency (ZEMA). Others are private sector entities that include COMACO and BCP. Traditional leaders also play a crucial role in promoting sustainable forest management, adoption of climate smart agriculture and adoption of efficient cookstove in their respective chiefdoms.

Under the ER Programme, the aforementioned government agencies, private sector entities and communities are effectively participating in developing and implementing of activities that enhance integrated land management system and improve the livelihoods of the people of Eastern Province while reducing GHG emissions. To this effect, fifty-five (55) Chiefdoms Emissions Reduction Performance Agreements (CERPA) have been signed between the EPJSLP and Chiefdoms towards the implementation of the Eastern Province Jurisdictional Sustainable Landscape Program. The CERPA defines the shared roles and responsibilities of stakeholders and each institution's obligations and mandates in rolling out the EPJSLP activities and also serving as a coordination platform to achieve the project goals.

With regards to partner agencies, a similar type of Agreement called the Nested Emissions Reduction Performance Agreement (NERPA) has been signed with COMACO and in the process of signing with BCP and TASC. The NERPAs seek to incentivize and reward service provision in the Nested Project Areas with private carbon projects by defining the roles, performance criteria, and responsibilities, and establishing a results-based benefit-sharing system that offers ERs and monetary rewards to the participating entities and community beneficiaries. While waiting for the signing of the NERPA, the PIU continued to leverage on the expertise of the two private sector organizations to implement its activities. During the MRV data collection, the Program worked closely with BCP and COMACO to undertake the exercise which ran up to December 6, 2024. Similarly, the two legacy projects (COMACO and BCP) were also involved in the Monitoring and Evaluation capacity building workshop for Project Staff and Implementing Agencies.

Updates on the assumptions in the financial plan

This section provides updates on the assumptions in the financial plan and any changes in circumstances that positively or negatively affect the financial plan and the implementation of the ISFL ER Program.

At the time of designing the ER program prior to 2024, it was assumed the first ISFL monitoring period would be bi-annual and that entailed the first revenue being realized by end of year 3 of implementation. The Government sought to fill the financing gap in the early years of the programme, by securing funding from the partners to cover implementation (mitigation) and management costs. The funding is expected to run until year 3 of implementation when carbon revenue is expected. The signed Emissions Reduction Purchase Agreement (ERPA), entailed having reporting periods of annually for the first 2 years and biannually thereafter, as agreed between GRZ and the ISFL. In addition, a commitment of about US$14 million comprising of a Global Environmental Facility (GEF) Grant # TFC4821 of US$2M, BioCFT3 Grant # TFC4847 of US$5M and BioCFplus_ISFL Grant # TFC4829 of US$7M was secured to cover some of the implementation and management costs of the ER Program until year 2026 when carbon revenues are expected to be realised.

In terms of revenue estimates, the assumption in the ERPD was that validation and signing of the ERPA would take place in June 2023, with verification in 2025 and delivered for ISFL for payments in late 2025 and then verified annually thereafter. The assumption price for jurisdictional quality ISFL purchases was assumed to be US$ 10/tonne floor price and for all VERs over the 6 million tonnes that is expected to be purchased under the ISFL ERPA (assuming no optionality is exercised) will be sold to other buyers. However, signing of the ERPA following extensive negotiations took place on 17th June 2024. The floor price was agreed at USD 10 for unit price 2 representing 98% of the contract ERs and USD 8 for unit price 1 representing 2% of Contract ERs over 3 million tonnes of ERs.

Regarding Results-Based Benefits Payments, at the time of developing the ERPD, the Benefit Sharing Plan (BSP) had not yet been finalised. However, the final consultation on the BSP was agreed as provided in **Error! Reference source not found.**.

Table 2: Benefits sharing proportions

SN	***Description***	***Percentage***
1	*Community Groups (nested & non-nested Areas)*	*55*
2	*ER Programme Operational costs (EP-JSLPIU)*	*15*
3	*Existing (nested) REDD+ projects and ER Service Providers*	*30*
	Total	***100***

These final and agreed proportions of the BSP underwent extensive consultations and are based on the government's goal of providing a majority of benefits in the form of results-based payments to proactive initiatives and community efforts.

Key changes or deviations in the ISFL ER Programme

This section of the report provides highlights of key changes and deviations in the ISFL ER Program's design and key assumptions compared to the description of the ER Program in the ISFL ER Program Document (ISFL ER PD) and these are elaborated as follows:

Refinement of the Project Development Objective Statement: The Project Development Objective (PDO) Statement of the ER program was refined to read "To generate payments to the Program Entity for Measured, Reported, and Verified Emission Reductions (VERs) and to distribute the payments according to an agreed BSP" compared to the phrasing in the ERPD i.e., "To improve landscape (forest and agriculture) management and increase environmental and economic benefits for rural communities in the Eastern Province".

Project Coverage: The EP-JSLP is located in the Eastern Province of Zambia and covers an area of 5,097,587 hectares. At the time of its design, the Programme was to operate in fourteen (14) of the fifteen (15) Districts of the Province. Chama District has since been reverted to the Eastern Province from Muchinga province, following a delimitation exercise undertaken by the Government. Following the declaration of the effectiveness and subsequent launch of the Jurisdictional Programme, the process to include Chama in the ER Program were initiated as part of the improvement plan. This process entails recalculating the GHG baseline for the Program as well as putting in place the various coordination structures for effective project implementation. Chama will only be included as part of the 2nd monitoring report and its inclusion will require an update to the baseline emissions and a revalidation of such baseline. The inclusion of Chama will not have an impact on this (2024) Reporting Period.

1.2 Update on major drivers and lessons learned

The main drivers of emissions and removals, as identified in the ERPD (Section 3.1.1 and Annex 1), remain largely the same in the ER Program Area, these include agriculture expansion, wood removal for firewood and charcoal, wood removal for timber, forest fire and settlement expansion. In the 2024 reporting period some notable improvements in emissions reduction have been recorded arising from the implementation of the ER Program and similar interventions. There have been some improvements in reduction of forest fire disturbances, and Land use conversion from forest to non-forest. In addition, increase in forest land has been observed through land conversion from Non-forest to Forest land. The major drivers, lessons learned and improvements are elaborated in the following sections.

Drivers of emissions and removals

The major sources of emissions in the Eastern Province are from forest fires, wood removal for timber and wood removal or firewood and charcoal, forest land converted to other lands especially agriculture and settlement expansion are elaborated as follows:

a) **Wood removal for timber**: Average, wood removal for timber in 2024 was 2,161 m^3/year[18] which is lower than baseline average of 8,595 m^3/year[19]. Efforts to reduce emissions from this source are being achieved through reduced forest concessions for timber harvesting in the Program Area as most chiefdoms are opting to place their land areas preferring to have their areas under community forestry
b) **Wood removal for firewood and charcoal**: Wood removal for firewood decreased 2,499,778 m^3/year in 2018 to 1,124,715 m^3/year in 2024[20]. This reduction is attributed to increase in the deployment and use of efficient cookstoves across the province. On the other hand, wood removal for charcoal increased from 1,709,148 m^3/year in 2018 to 1,940,194 m^3 in 2024[21]. This

[18] GHG Excel workbook "worksheet" F-F_fuelwood, column "N", line 10
[19] GHG workbook
[20] GHG Excel workbook "worksheet" F-F_fuelwood, column "N", line 17
[21] GHG Excel workbook "worksheet" F-F_fuelwood, column "N", line 24

has been attributed to the load shedding by the electricity utility ZESCO as a result of a prolonged drought. Households in urban areas had resorted to using charcoal as an alternative source of energy for cooking. To reduce emissions from this source, energy efficient cook stoves to reduce household and institutional fuel wood consumption are being promoted by the ER Program, COMACO and TASC with over 280, 252 stoves installed and in use. Some chiefdoms through their Royal Establishments have banned the production of charcoal contributing to reduction of fuel extraction for charcoal.

c) **Forest fire disturbance:** In 2024, the area affected by forest fire disturbance was estimated to be 404,449 ha[22] which was a reduction from 573,930 ha on average during the baseline period. The reduction in forest fires is attributed to awareness of communities on the dangers of fire disturbances. The reduction in forest fires is attributed to awareness of communities on the dangers of fire disturbances. The awareness and mindset shift among the communities is attributed to interventions by EPJSLP and its partners, BCP and COMACO. The investments in fire monitoring technology and more effective early response protocols have led to quicker containment of outbreaks before fires spread; there has also been a greater push toward sustainable agriculture and community-based natural resource management in the province, initiatives that discourage unsustainable practices (slash and burn) and promotion of alternative techniques for land clearing resulting in reduced accidental ignitions and uncontrolled burns. Community engagement and promotion of alternative Livelihoods through increased involvement of local communities (CFMGs, CRBs) in conservation programs has led to better awareness of fire risks and improved practices for mitigating these risks. Further, training in alternative income-generating activities has reduced the heavy dependence on traditional methods that involve burning, thus lowering the chances of fire outbreaks.

d) **Land use conversion:** Forestland converted to cropland decreased from 13,063ha in 2018 to 9,027 ha[23] in 2024 which implies reduced emissions from this source. Forest land converted to settlement increased from 796 ha in 2018 to 2,655 ha[24] in 2024, which resulted in emissions. Annual area conversion of cropland to forestland increased from 478 ha between 2009 and 2018 to 20,709 ha[25] between 2019 and 2024 resulting in sequestration of carbon from this occurrence. The improvement in the conversion of cropland to forestland was on account of areas being left to fallow and allowed to regenerate to forest. Conversion of forest land to cropland due to agricultural expansion is driven by unsustainable farming practices and is widely occurring across the EP landscape. A Drivers of Deforestation Study[26] performed at the time of the development of the baseline identifies agriculture as the primary livelihood option for communities in the province, primarily due to lack of other reliable and sustainable options. Rapid growth in population, low productivity in soils, and inadequate support to improve capacity in agriculture production have all contributed to this driver. Grassland converted to Cropland decreased from 2,070.89 ha in 2018 to 265.5 ha[27] in 2024 resulting in reduced emissions from this activity..

During the development of the ERPD and the selection of the significant subcategories to be included in the accounting scope, the subcategory 'grassland to forest' was not included because no conversions

[22] GHG Excel workbook "worksheet" F-F disturbance, column "M", line 17
[23] GHG Excel workbook "worksheet" land AD conversions, column "V", line 16
[24] GHG Excel workbook "worksheet" land AD conversions, column "V", line 8
[25] GHG Excel workbook "worksheet" land AD conversions, column "V", line 27
[26] Gilbert Wathum et al, 2016
[27] GHG Excel workbook "worksheet" land AD conversions, column "V", line 34

were observed. During the period 2019 -2024, 97,173 ha of grassland was found to have been converted to forest. This increase is partly due to an increase in reforestation activities by the ERP and other partners/projects in the Program Area. In addition, there have also been improvement in data analysis compared to the baseline through the use of drones and high-quality imagery supported by AxleSpace.

Lessons from the ER Program's efforts to mitigate potential Displacement

Specifically, displacement of emissions due to wood removal for firewood did not result in shift in demand outside the Eastern Province. Reduction in firewood was as a result of decrease in consumption at household level facilitated by use of efficient cookstoves. It should be pointed out that charcoal production has continued to occur in the province. Further, displacement of emissions due to fire disturbances did not result in shift in fire incidences to areas outside the Eastern Province. Reduction in fire incidences occurred as a result of awareness and sensitization on the need to practice early burning. Communities have started adopting sustainable practices related to forest fires which has resulted in the reduction in forest fire disturbances.

Furthermore, displacement of emissions due to land use conversion could not have resulted in shift of land conversions to other province since conversions are localized withing the jurisdiction. Land conversions of forestry to agriculture occur due to the need for increase in crop production while forestry to settlement is as a result of increasing demand for settlements. Forest land conversion to cropland was achieved through awareness and sensitization over the years on the need to restore and manage forests sustainably.

From the identified and discussed primary drivers of deforestation in the Programme Area and the various mitigation interventions being promoted by the ER Programme and other public and private sector interventions, a number of lessons have been learned that will contribute to enhanced and sustainable management of natural resources resulting in emissions reductions. These include the following:

a) **Expansion of Smallholder Agriculture:** The major lesson learnt is that subsistence farming remains key driver emissions. It was observed that farmers practicing Climate-Smart Agriculture (CSA) supported by the program have increased productivity per hectare even during the drought period were able to yield better compared to those farmers who practiced conventional farming and experienced total losses.

b) **Charcoal Production and use of wood energy:** Some chiefdoms have banned production of charcoal and there has been significant improvement in forest regeneration and overall forest growth culminating in emissions reductions. Promotion of efficient energy cook stoves is one of the initiatives being promoted by the ER Program and other public and private sector led interventions. It has been learnt that investing in energy-efficient cook stoves is a crucial strategy to reduce the reliance on traditional biomass fuels such as charcoal and fuelwood

c) **Weak Land Tenure Security:** As about 74% of deforestation occurs in areas with contested customary land rights, it is imperative that local communities are involved in the management of natural resources in their localities. This entails Formalizing CFMGs and other natural resources management groups and cooperatives to ensure there is reduced illegal or unsustainable utilisation of natural resources.

d) **Sustainable Land Management:** Climate-smart agriculture and agroforestry strategies have proven effective in mitigating deforestation while simultaneously enhancing food security.

e) **Diversification of Livelihoods:** Livelihood diversification has proven effective in mitigating unsustainable practices by encouraging alternative income streams such as forest-based enterprises and ecotourism, that reduce reliance on deforestation-driven activities. Further, the diversification initiative designed to support livelihood alternatives have facilitated the adoption of low-emission technologies and practices across communities, including SFM, CSA, and Sustainable Wildlife Management (SWM). These initiatives also serve as an effective mechanism for reinforcing behavioral change among beneficiaries, ensuring a more sustainable and resilient local economy.

f) **Community Engagement as a pillar of effective conservation:** Local communities play a vital role in conservation efforts and initiatives that involve them in sustainable natural resources management have proven more effective. Technical frameworks, such as Community-Based Natural Resource Management (CBNRM), have shown that when local stakeholders are engaged in decision-making and resource monitoring, conservation outcomes improve significantly.

2 System for measurement, monitoring and reporting Emissions and Removals occurring within the monitoring period

2.1 Forest Monitoring System

At the time of developing the ERPD, the Project MRV System was still under development and relied on the existing legislation, the Forest Act No. 4 of 2015 and subsidiary legislation in the Carbon Stock SI No. 66 of 2021. However, in the First Monitoring period 2024, the Climate Change Act No. 18 of 2024 was enacted to provide for climate change adaptation, mitigation, disaster risk reduction; regulation of carbon markets, provide for environmental and social safeguards in climate change actions and establish the national MRV System among others. In addition, during the first reporting period (2024), the MRV system for the EPJSLP was fully developed consisting of Institutional arrangements, data management system and data collection protocols.

The implementation of the MRV system provided support to climate change mitigation efforts, sustainable land management, and informed decision-making by ensuring strong Institutional Coordination with clear roles and responsibilities among agencies and stakeholders. It also fostered robust Data Management by ensuring High-quality data collection and management practices. The system also established transparency and accountability by ensuring open access to data and reports, and independent verification.

Roles and responsibilities

The Green Economy and Climate Change Act No. 18 of 2024[28] provides for the Department of Green Economy and Climate Change (DGECC) to establish and maintain an Integrated Measuring Reporting and Verification System (IMRV) for the purposes of documenting emissions, mitigation and adaptation activities, financial support and technology transfer received and deployed including any other components that may be determined by DGECC.

All projects, including interventions under EP-JSLP, are required to submit up to date shapefiles and details of Emissions reduced of the areas of ER generation. All Project developers will make use of an ER Transactional Registry system in accordance with the permit system of the Forest (Carbon Stock Management) Regulations, 2021[29].

At Provincial/Programme level, the EP-JSLP Implementation Unit works in close collaboration with the ZEMA and other key sector line Ministries, Statutory Agencies within the context of implementation and reporting responsibilities in line with the National REDD+ Strategy[30] as outlined Figure 1. Three main MRV functional levels of institutional arrangements were at National, Provincial (and their respective specialised units), and the districts. The national level performed a coordination role and backstopping in

[28] Green Economy and Climate Change Act of 2024
[29] Carbon stock SI 66 of 2021
[30] National REDD+ Strategy 2, Chapter 5.3 on Implementation and Monitoring, Reporting and Verification (MRV), Chapter 5.5, to be consistent with reporting to the National GHG Inventory System.

the implementation of the MRV system, whilst actual monitoring of activities is performed at Provincial, District and chiefdom levels.

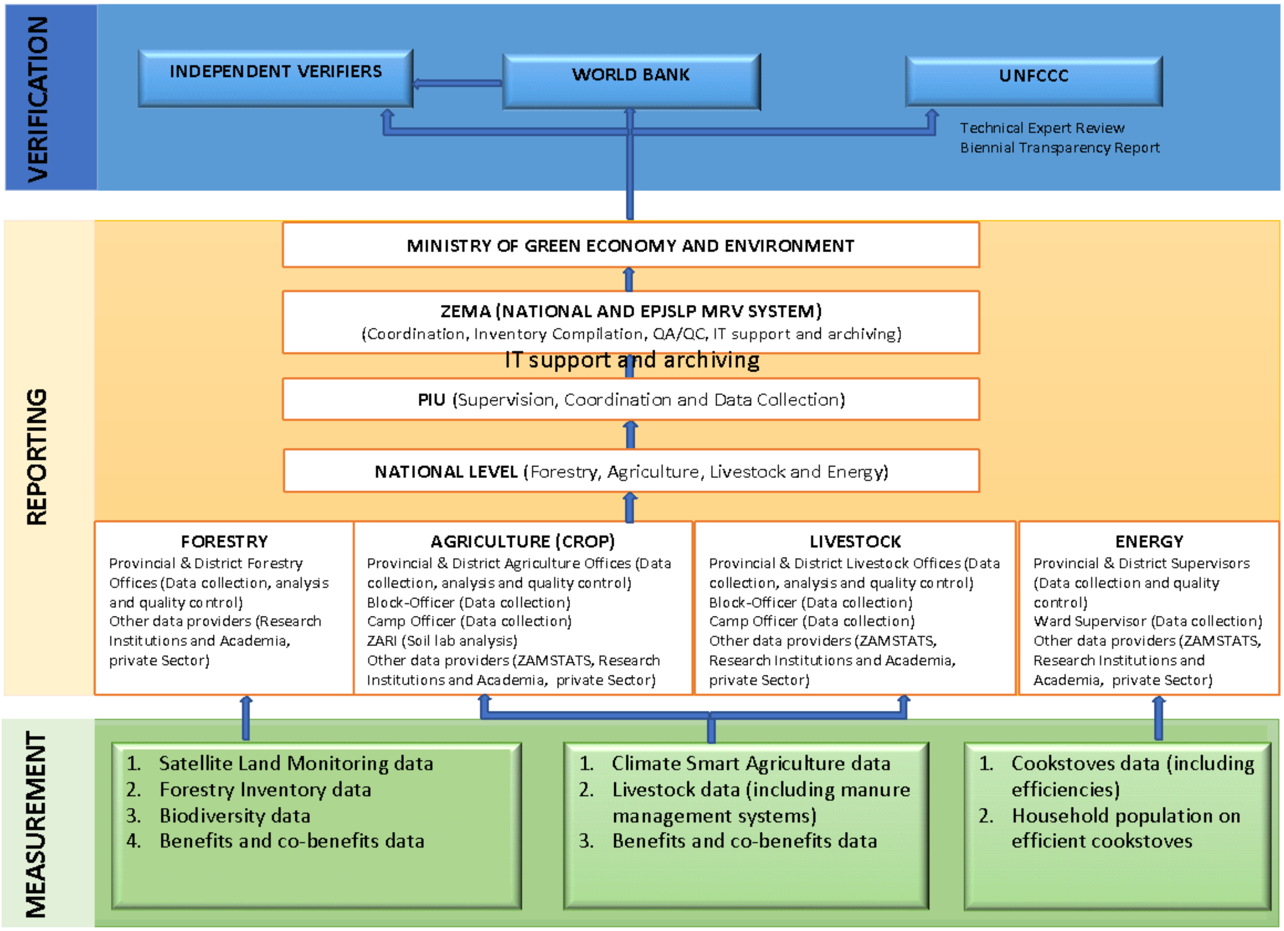

Figure 1: MRV institutional arrangements

The following are the roles and responsibilities for the MRV systems.

a) PIU is responsible for compilation of data and preparation of reports as well as the provision and facilitation of logistical support towards data collection, analysis and reporting including quality control.

b) Forestry Department in collaboration with PIU and supporting institutions including (Department of National Parks and Wildlife, Zambia Agriculture Research Institute, COMACO, and BCP) is responsible for data collection (i.e., remote sensed data, monitoring data, forestry inventory data, biodiversity data, benefits and co-benefits data) and quality control. District forest officers, and selected community members were trained on how to collect biophysical data related to biomass carbon stocks, deadwood and litter, soil carbon removals, fires in national and community forests. Data on land use and land use change is also collected using remote sensing. Remote sensing was used to conduct mapping of vegetation cover, above ground biomass, impact of fires, detecting deforestation and degradation.

c) Ministry of Agriculture in collaboration with PIU and supporting institutions including (Zambia Agriculture Research Institute, BCP, COMACO, and ZAMSTATs) is responsible for collecting agricultural data related to crop production, fertiliser use, soil carbon, tillage practices, climate smart agriculture adoption rates, among others. District agricultural officers and selected community members have been trained on how to collect data.

d) Ministry of Fisheries and Livestock in collaboration with PIU is responsible for collecting data related to livestock population and other relevant information.

e) The Ministry of Energy has no structure at District level; therefore, the Forestry Department was co-opted to support implementation of Energy activities including data collection on firewood and charcoal consumption, efficient cookstoves efficiencies and other related information supported by community members. Community members were identified and trained on how to collect data.

f) Zambia Environmental Management Agency is involved in managing the hosting and maintenance of the Climate Change Portal used for MRV data management. ZEMA also provides support related to MRV System implementation including data collection, analysis and reporting. ZEMA also has delegated function of compiling the Biennial Transparent Reports and National Communication for the Country which are submitted to the UNFCCC periodically.

g) Ministry of Green Economy and Environment is responsible for approval and submission of report to the World Bank. Part of the Programme's information together with other national data are being used to compile the Biennial Transparent Report and National Communication.

h) Independent verifier(s) will be engaged to undertake verification of data and reports submitted.

Data collection and management practices

The EPJSLP MRV System is supported with Standard Operating Procedures (SOPs) and a data management system designed to enable a multi-tiered independent agency/institution to manage the MRV system for the ER Program Area.

a) Standard Operating Procedures: The SOPs for Agriculture, Energy, Forestry and Land Use Mapping details how to set up and execute data collection for measurement and inventory approaches to assist in quantifying the amount of carbon within the various organic pools found within the programme area aimed at improving landscape management and reducing deforestation. Technical Teams comprised of Agriculture, Energy, Forestry, GHG, Land use and Soil Specialists among others, were formed to conduct biophysical assessments covering data collection in forestland, cropland, grassland, wetland, and other lands, focusing on various vegetation types and soil carbon.

b) Data management: Data management system consists of Web based Climate Change Portal and an Integrated Android based Mobile Application anchored on the ZEMA Climate Change Portal was used to collect and manage the data. The Android based application was used to capture data from the field and transmit into the climate change portal database on real time basis. The application has offline data capturing capabilities as well as being suitable for use in remote areas, where internet connectivity is very weak or not available, to allow data export when internet connectivity is established.

2.2 Measurement, monitoring and reporting approach

This monitoring report covers the subcategories that were found to be eligible in the final selection of the subcategories eligible for ISFL Accounting:

1. Forest Land remaining Forest Land
2. Forest land converted to Cropland
3. Forest land converted to Settlement
4. Cropland converted to Forest Land
5. Cropland remaining cropland
2. Grassland converted to cropland

This section provides the approach for measuring and reporting on these subcategories. Figure 2 provides an overview of the general process of data collection which was preceded by sampling design, response design, data collection and data analysis.

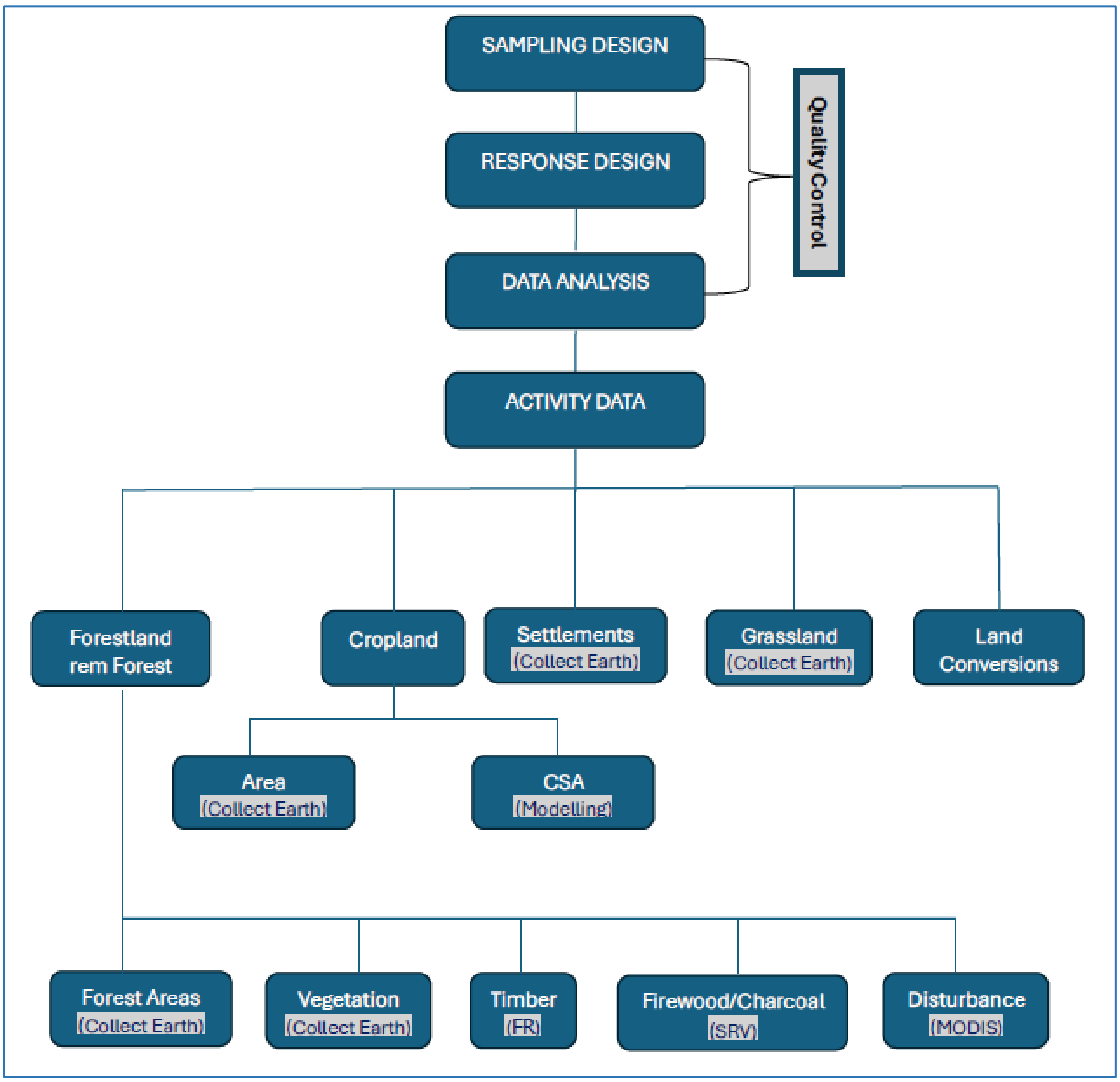

Figure 2: Line diagram- Data collection process

The Carbon Pools considered were: Above-Ground Biomass, Below-Ground Biomass and Dead wood and litter, and soil carbon.

Underlying land use and land use change analysis

A general analysis of land use and land use change was performed based on the IPCC land use categories and following the SOPs for Land Use Mapping. The assessment was using Collect Earth[31] and RS/GIS. The outcome of this analysis is used as the basis for the activity data for the different subcategories.

Sample Design

The sample design was based on random sampling from a systematic grid at an equidistance of 4 x 4 kilometres[32] over the Program Area. The assessment unit in the survey was 70 x 70 meters. The random systematic sampling approach is recognized as a more efficient and practical method compared to purely random sampling techniques, particularly in land use and land cover change assessments. By ensuring an even spatial distribution of sample points while maintaining randomness, this method reduces sampling bias and enhances the precision of area estimates. Moreover, it provides a consistent framework that simplifies future re-assessments. The present approach to area estimation and uncertainty analysis adheres to the 2006 IPCC Guidelines, thereby ensuring methodological rigor and alignment with international standards.

A total of 3,200[33] sample plots (SP) were assessed to identify land use transitions over the six-year period (2019 to 2024). The sample size was determined based on a second phase sampling system extracted using the boundary extent[34] of Eastern Province from a grid sampling frame of 4 x 4 km distance[35]. All plots that fell within the borders of administrative boundaries were taken as the final sample size. Each sample plot measured and had 49 control points used for assessing the land use categories.

Response Design

Land-use classification followed the framework recommended by the Intergovernmental Panel on Climate Change (IPCC), which defines the six main, land-use categories that serve as the foundation for more detailed land-use sub-divisions.

Each sample plot was assigned a subcategory reflecting both its initial and current land use class, enabling the identification of transitions over the six-year period. These subcategories include stable land uses (e.g., Cropland > Cropland, Forest > Forest) as well as conversions (e.g., Forest > Cropland, Grassland > Forest. The 3,200 plots were classified into 15 unique subcategories as shown in **Error! Reference source not found.**.

[31] More information and resources about the Open Foris Collect Earth software can be found at http://www.openforis.org/tools/collect-earth.html.
[32] 4x4 km grid
[33] Final_EPJSLP_MRV_Clusters_WGS_84_Zone_36_S.xlsx (included in the shared drive which will be made available to the VVB)
[34] Eastern Province.zip
[35] CEP File.rar

Table 3: Land Use Subcategory (latest conversions)

No.	Plot Count	Initial (2018)	Current (2024)	Land Use Subcategory (Latest Conversion) (Over 6 Years)
1	918	Cropland	Cropland	Cropland remaining cropland
2	17	Cropland	Forest	Cropland to Forest land
3	1	Cropland	Grassland	Cropland to grassland
4	0	Cropland	Settlement	Cropland to settlement
5	3	Forest	Grassland	Forest land converted to grassland
6	34	Forest	Cropland	Forest land converted to crop land
7	1717	Forest	Forest	Forest land remaining Forest land
8	7	Grassland	Settlement	Grassland converted to settlement
9	1	Grassland	Cropland	Grassland to Copland
10	342	Grassland	Grassland	Grassland remaining Grassland
11	61	Grassland	Forest	Grass land converted to Forest land
12	17	Other land	Other land	Other land remaining other land
13	57	Settlement	Settlement	Settlement remaining settlement
14	15	Wetland	Wetland	Wetland remaining wetland
15	10	Forest	Settlement	Forest land converted to settlement
	3,200			

The response design incorporates clear classification rules and methods aligned with IPCC land use categories. **Error! Reference source not found.** below outlines the structured set of hierarchical rules used to classify each assessment unit during the Collect Earth exercise.

Each assessment plot in the survey contained a structured array of 49 control points. To determine forest cover, interpreters counted how many of these points fell directly on the tree canopy. The canopy proportion was then calculated by dividing this number by 49. In line with Zambia's national forest definition, a unit is classified as forest, if more than 4 points (over 10% canopy cover) intersect tree canopy, provided the area meets the minimum size requirement of 0.5 hectares and the vegetation has the potential to reach at least 5 meters in height. For non-forest classes, the IPCC classification hierarchy was applied following a weighting hierarchy of settlement, cropland, forest followed by other classes applied (e.g., largest land use at time of assessment in terms of percentage coverage) fall on cropland, the unit was classified as cropland. This structured and rule-based approach ensured consistent interpretation across plots and reliable detection of land use and land cover changes.

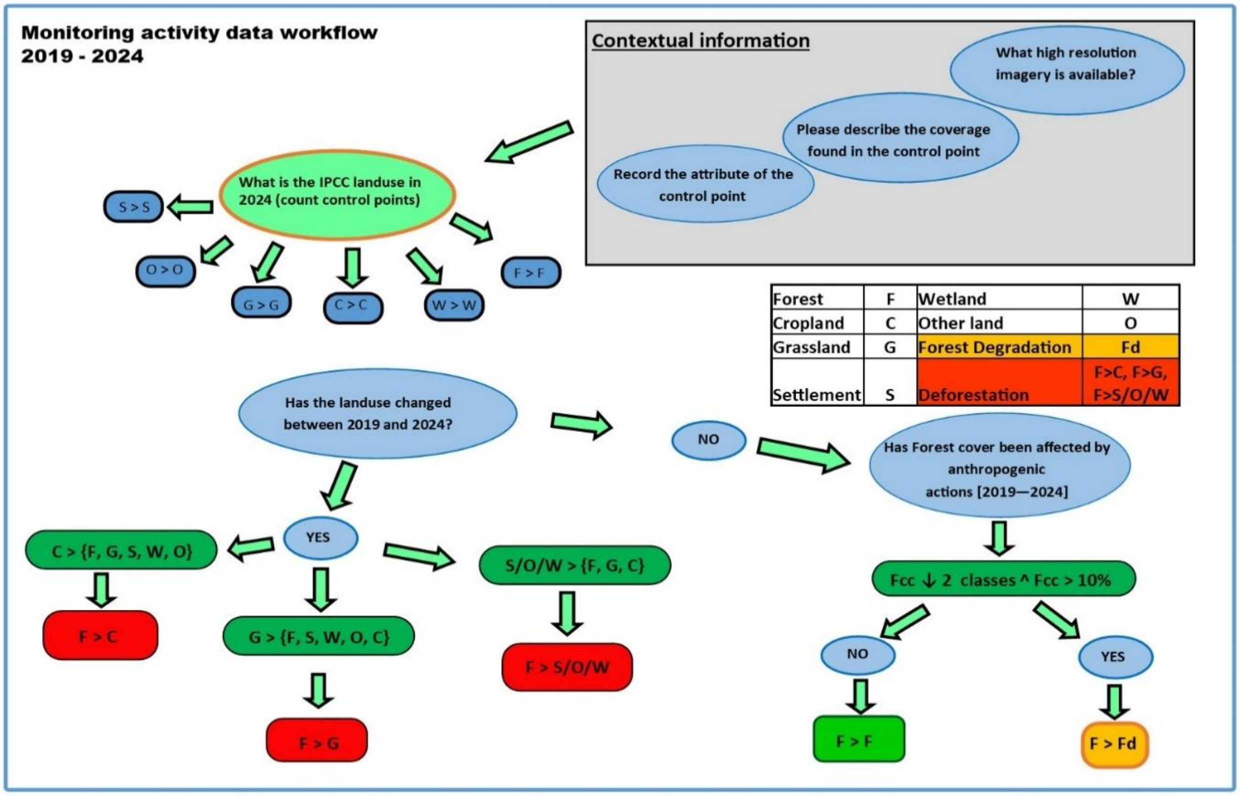

Figure 3: Structured set of hierarchical rules used to classify each assessment unit in Collect Earth

The Collect Earth project file provided interpreters with a range of supporting materials to improve the precision and consistency of land use and land cover interpretation. High-resolution reference images from Google Earth Pro, Bing Maps, and the Google Earth Engine platform were among these resources. In order to recognize land use transitions, interpreters could use time series images to evaluate temporal variations. Furthermore, spectral indices like the Normalised Difference Vegetation Index (NDVI), which are available through Google Earth Engine layers, offered additional context for classifying land cover and vegetation health. Multiple imagery and data sources made it possible for interpreters to choose the best visual or analytical reference for each plot, increasing the reliability of interpretation and reducing categorization errors. In addition, drone imagery was used in some selected clusters to ground truth and enhance the interpretation. **Error! Reference source not found.**, lists all the data sources used during the monitoring

Table 4: Data available to interpreters

Data name	Data type	Provider	Distributor	Resolution		Period available
				Spatial	Temporal	
Maxar	Optical	NASA/Maxar	Google Earth Pro	5cm	3 months	From 1999 to present
Landsat 8	Optical	NASA and USGS	Google Earth engine	30 m	16 days	From 2013 to present

Landsat 7	Optical	NASA and USGS	Google Earth engine	30 m	16 days	From 1999 to present
Landsat 5	Optical	NASA and USGS	Google Earth engine	30 m	16 days	From 1984 to 2013
Sentinel-2	Optical	ESA	Google Earth engine	10 m	5 days	From 2013 to present
Spot 4	Optical	CNES	Google Earth engine	10 – 20 m	5 days	From 1998 to 2013
Spot 5	Optical	CNES	Google Earth engine	2.5 – 10 m	2 – 3 days	From 2002 to 2015
Spot 6	Optical	CNES	Google Earth engine	1.5 – 6 m	Daily	From 2012 to present
Spot 7	Optical	CNES	Google Earth engine	1.5 – 6 m	Daily	From 2014 to present
Worldview 1-4	Optical	Maxar/Digital Globe	Google Earth engine	< 1 m	Daily	From 2007 to present

Quality Control and Assurance Steps

The project conducted a series of comprehensive training events leading up to the finalization of the activity data collection in 2025. The structured training approach aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments of EPJSLP's forest monitoring efforts. Additionally, maintaining the core group of trained interpreters who were part of the activity data collection during the baseline survey was crucial for ensuring consistency and accuracy in future assessments.

Implementation of the response design was carried out through a structured process involving trained interpreters, while quality management and archiving protocols were established to ensure data integrity and long-term accessibility. Additionally, a strong emphasis was placed on capacity building and training, equipping technical staff with the skills necessary to apply the methodology consistently and support ongoing monitoring and reporting efforts.

A separate interpretation key was developed to support consistent and accurate classification of land use and land use change within the province. This key, along with accompanying graphics, provided interpreters with visual and descriptive guidance on how to classify assessment units according to the land use categories selected for the project. It illustrated the key features to look for when assigning a class, helping to reduce uncertainty and ensure uniform application of classification rules.

Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. This procedure aided in guaranteeing the data's dependability and transparency. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency. For instance, date ranges and coverage of the element's percentages were among the restrictions specified by the validation criteria for the imagery and description cards respectively.

Data processing

The spatial extent of land use change between 2019 and 2024 was estimated through proportional analysis using the Saiku Analytics tool in Collect Earth. Area estimates for each land use change category were derived by first calculating the proportion of sample points falling within each specific change class. This was achieved by dividing the number of points representing a particular land use transition by the total number of classified points. The resulting proportion was then multiplied by the total area of the study region to estimate the corresponding area for each change category. The following equation was applied to generate these estimates:

$$a_i = \frac{n_i}{n} * A \qquad \text{Equation 1}$$

Where:

a_i is Area of the i^{th} change class (ha); n_i is the number of points in land use category i, (count); n is the total number of sample points, (count); A is the total area of the region of interest (ha).

The standard error of the area estimate provides a statistical measure of uncertainty associated with the estimated area of each land use change class. It quantifies the variability in the area estimate due to sampling and is computed using equation 2.

$$SE_i = a_i * \sqrt{\frac{P_{i(1-P_i)}}{(n-1)}} \qquad \text{Equation 2}$$

Where:

SE_i is the standard error for the ith change class (in hectares); a_i is the estimated area of that class; P_i is the proportion of sample points in the class; n is the total number of sample points

Confidence Interval at 90%

To express the uncertainty at a statistically meaningful level, final uncertainty estimates were calculated at the 90% confidence interval using the equation 3:

$$Cl_i = a_i \pm (SE_i * 1.65) \qquad \text{Equation 3}$$

Where:

Cl_irepresents the confidence interval for the i^th^ change class; a_i is the estimated area of that class; SE_i is the standard error for the ith change class (in hectares; 1.65 is the z-score corresponding to the 90% confidence level.

Error! Reference source not found. below shows the output of this analysis.

Table 5: Latest Land Use conversion

Land Area Extents in Hectares		Latest Land Use (2024)						
		Forest	**Cropland**	**Grassland**	**Otherland**	**Wetland**	**Settlement**	**TOTAL**
Initial Land Use (2018)	**Forest**	2,735,174	54,162	4,779	0	0	15,930	2,810,045
	Cropland	27,081	1,462,370	1,593	0	0	0	1,491,044
	Grassland	97,173	1,593	544,805	0	0	11,151	654,721
	Otherland	0	0	0	27,081	0	0	27,081
	Wetland	0	0	0	0	23,895	0	23,895
	Settlement	0	0	0	0	0	90,801	90,801
	TOTAL	**2,859,428**	**1,518,125**	**551,177**	**27,081**	**23,895**	**117,882**	**5,097,587**

In order to obtain land use conversion estimates for different forest types, a Vegetation Dataset was integrated into the sampling workflow. This dataset contains detailed vegetation-type classifications within the province. This was spatially overlaid with all the 3200 sample plots through a spatial intersection to determine corresponding forest type for each sample plot categorized as Forest. This method ensured consistency with the ratios utilized in the baseline which equally utilized the vegetation dataset.

Forest Land remaining Forest Land

For forest remaining forest land, annual carbon stock change in a given pool have been calculated using the general IPCC equation for the Gain-Loss Method (equation 2.7 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories)

$$\Delta C = \Delta C_G - \Delta C_L \qquad \text{Equation 4}$$

Where:

ΔC = annual carbon stock change in the pool, tons C yr^{-1}, ΔC_G = annual gain of carbon, tons C yr^{-1}; ΔC_L = annual loss of carbon, tons C yr^{-1}

Above ground and below ground biomass – Gains

The gains for above ground and below ground biomass (equation 5 and 6) are estimated using equations 2.9 and 2.10 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$\Delta C_{G_{F-F}} = \sum_{i} (A_i * G_{TOTAL\,i} * CF) \qquad \text{Equation 5}$$

Where:

ΔCG = annual increase in biomass carbon stocks due to biomass growth in forest remaining forest, tonnes C yr^{-1} , A_i = area of forest type *i*, ha; G_{TOTAL},i= mean annual biomass growth of forest type *i* , tonnes d. m. ha^{-1} yr^{-1}; CF = carbon fraction of dry matter, tonne C (tonne d.m.)$^{-1}$

and

$$G_{Total} = I_v * BCEF_I * (1 + R) \qquad \text{Equation 6}$$

Where:

$I_{v,i}$ = average net annual increment for forest type *i*, m^3 ha^{-1} yr^{-1} , $BCEF_I$: biomass conversion and expansion factor for conversion of net annual increment in volume (Including bark) to above-ground biomass growth for forest type *i*, tons above-ground. biomass growth (m^3 net annual increment)$^{-1}$. R: Ratio of below-ground biomass to above-ground biomass for forest type *i*.

$A_{i,}$ the area of each forest type *i*, was based on the area of forest in 2024 where the area of each forest type was extracted by intersecting the data with the Vegetation Dataset with the detailed vegetation-type classifications within the province. For this the shapefile of the vegetation dataset was clipped to Eastern Province boundary and converted to a raster dataset. Raster values representing the dominant vegetation type (characterized by 7 vegetation type classes (Grasslands, Baikiaea Forest, Miombo woodland, Mopane woodland, Munga woodland, Parinari forest, and Riparian forest) at each sample plot location was then extracted. These vegetation classes were subsequently reclassified into five (5) broader vegetation type categories (dry evergreen, dry deciduous, moist evergreen and forest woodlands) for analysis and estimation of areas.

The values for $I_{v,i}$, $BCEF_I$ and R remain the same as the values used for the baseline and are derived from the Integrated Land Use Assessment Report II.

Above ground and below ground biomass – Loss

The annual biomass loss is the sum of losses (equation 7) from wood removal (harvest), fuelwood removal (not counting fuelwood gathered from woody debris), and other losses resulting from disturbances, such as fire, storms, and insect and diseases.

$$\Delta C_L = L_{wood-removals} + L_{fuelwood} + L_{disturbance} \qquad \text{Equation 7}$$

Where:

ΔC_L = annual decrease in carbon stocks due to biomass loss in forest remaining forest, tonnes C yr^{-1} ; $L_{wood-removals}$ = annual carbon loss due to wood removals, tonnes C yr^{-1} ; $L_{fuelwood}$ = annual biomass carbon loss due to fuelwood removals, tonnes C yr^{-1} ; $L_{disturbance}$ = annual biomass carbon losses due to disturbances, tonnes C yr^{-1}

Loss of biomass and carbon from wood removal ($L_{wood-removals}$)

The method for estimating the annual biomass carbon loss due to wood-removals (equation 8) is based on equation 2.12 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories:

$$L_{wood\ removals} = H * BCEF_R * (1 + R) * CF \qquad \text{Equation 8}$$

Where:

$L_{wood\ removals}$ = annual carbon loss due to biomass removals, tons C yr^{-1}, H = annual wood removals, round wood, $m^3\ yr^{-1}$, R = ratio of below-ground biomass to above-ground biomass, in ton d.m. below-ground biomass (ton d.m. above-ground biomass)$^{-1}$. CF = carbon fraction of dry matter, ton C (ton d.m.)$^{-1}$, $BCEF_R$ = biomass conversion and expansion factor for conversion of removals in merchantable volume to total biomass removals (including bark), tons biomass removal (m^3 of removals)$^{-1}$.

The value for $BCEF_R$ remains the same as in the baseline and was taken from Chidumayo (1990).[36]

Wood removal for timber values (H) were derived from Forest Department annual timber production records aggregated by province. These were based on legally harvested timber under tree felling permits as provided under Section 53 (1)(h) of the Forests Acts No.4 of 2015. This data is captured mainly from Forest concession areas; as tree harvesting is done through tree felling permits issued by the Forestry Department to allow Concessionaires to fell or harvest timber based on the scale of license (Small, Medium and Large). The concessionaires are by law[37] required to submit monthly returns of the logging operations of the previous month, showing the number of trees/logs, or volume by tree species removed from the harvesting compartment. Further all tree felling permits are paid for before cutting commences, and the assessments are conducted by a Senior Forestry Officer under the Forestry Department while the Concessionaires are required by Law to engage a qualified Forester as part of their team to ensure forest operations are undertaken in compliance with the law.

Loss of biomass and carbon from fuelwood removal ($L_{fuelwood}$)

Loss of biomass and carbon from fuelwood removal is calculated using equation 2.13 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. In this equation, fuelwood removal comprises of two components. First, removal for fuelwood of living trees and parts of trees such as tops and branches, where the tree itself remains in the forest, will reduce the carbon in the biomass of growing stock and should be treated as biomass carbon loss. The second component is gathering of dead wood and logging slash. This will reduce the dead organic matter carbon pool. The method used for estimating annual carbon loss in biomass of fuelwood removal is provided in Equation 9.

[36] Chidumayo, E.N. (1990). Above-ground woody biomass structure and productivity in Zambezian woodland. Forest Ecology and Management, 36(1), 33–46.

[37] The Forest (Concession Licence) Regulations, 2016

$$L_{fuelwood} = FG_{trees} * BCEF_R * (1 + R) + (FG_{part} * D) \bullet CF \qquad \text{Equation 9}$$

Where

$L_{fuelwood}$ = annual carbon loss due to fuelwood removals, tons C yr^{-1}, FG_{trees} = annual volume of fuelwood removal of whole trees, m^3 yr^{-1}, FG_{part} = annual volume of fuelwood removal as tree parts, m^3 yr^{-1}, R = ratio of below-ground biomass to above-ground biomass, in ton d.m. below-ground biomass, (Ton d.m. above-ground biomass$)^{-1}$; CF = carbon fraction of dry matter, ton C (ton d.m.$)^{-1}$, D = basic wood density, tons d.m. m-^{3}; $BCEF_R$ = biomass conversion and expansion factor for conversion of removals in merchantable volume to biomass removals (including bark), tons biomass removal (m^3 of removals$)^{-1}$

Values for D were taken from the ILUA II Technical Report

and FG_{part} it was assumed that the consumption of firewood equals FG_{trees} and the consumption of charcoal equals FG_{part}.

The survey was conducted following the SOP for Energy. The SOP provides a standard field measurement approach for quantifying the amount of biomass consumed for firewood and charcoal within the program area for households, commercial entities (hotels, lodges, breweries and restaurants), health institutions, learning institutions (colleges, schools), tobacco and fishing.

According to the 2022 Census of Population and Housing, the total household population in the program area was 495,616 in 2022. The study used a simple random sampling method, based on equation 10[38], to estimate the sample size for the study.

$$\boldsymbol{n} = \frac{\boldsymbol{t_p^2} * \boldsymbol{p} * (\boldsymbol{1} - \boldsymbol{p}) * \boldsymbol{N}}{\boldsymbol{t_p^2} * \boldsymbol{p} * (\boldsymbol{1} - \boldsymbol{p}) + (\boldsymbol{N} - \boldsymbol{1}) * \boldsymbol{y^2}} \qquad \text{Equation 10}$$

Where:

n is sample size; $\boldsymbol{t_p}$ is the confidence level of 95% (z value being 1.96), N is the total population size, $\boldsymbol{p}$ **is** estimated population proportion; y is margin of error =0.02

The total sample size was 2,390 at 95% confidence and 2% margin of error. General sampling framework is provided as follows:

- Household using efficient cookstoves-at least 60 in a survey area;
- Households using ordinary 3 stone fire-At least 60 in a survey area;
- Household using ordinary Mbaula- at least 60;
- Lodges, covering every lodge in a district;
- Restaurants targeting every market restaurant at district level;

[38] Louis M. et.al, 2014: Designing and Conducting survey research-a Comprehensive guide. 4th Edition. Page 169 equation 8.6.

- Schools and colleges available in a district;
- Clinics covering every clinic/hospital in a district;
- Tobacco covering at least 10 tobacco farmers in a district;
- Fishing covering at least 20 fishermen;
- Breweries covering at least 3 brewing companies and at least 5 individual local brewers; and
- Bakeries covering at least 5 commercial bakeries and at least 5 individual local bakers.

Prior to data collection, officers involved in data collection were trained on how to undertake the assignment. The process started by identifying the community leaders for the purposes of randomly identifying and choosing householders, tobacco farmers and fishermen that met the criteria as stipulated in the SOP. Enumerators explained to target households, farmers, and institutions the purpose of the survey and arranged to measure their fuel consumption. In conducting Household Surveys, instruments used included weighing scales. A detailed wood fuel consumption questionnaire and a data entry form for households were utilized; institutional forms for installations such as schools, hospitals, bakeries, breweries, restaurants, prisons and similar establishments using the corresponding sector-specific questionnaires. Others included forms for assessing fuel wood utilisation for tobacco farming and fish farming. These forms were developed into a Mobile application, which is a part of the Climate Change Portal hosted by ZEMA. The Mobile App allowed for the collection of data without internet connectivity, allowing for synchronization later on when an enumerator has internet connectivity. The Mobile Application was developed with certain parameters open for input while others like location coordinates were auto recorded or captured as a mechanism for ensuring accurate locations are actual field locations where the data had been collected. The collection of geographic coordinates (via GPS) and digital photographs supported the contextualization and geospatial validation of the data.

Firewood and charcoal consumption for households was collected for the wet, hot and cold seasons. For each season, the whole exercise lasted a minimum of 3 days applying the following approach. Planning for data collection, including identifying data to be collected i.e., the baseline fuel usage was identified through a survey covering aspects of demographics, cooking habits and socio-economic characteristics of the target areas using a detailed questionnaire for every household. Identification of areas and households in the district for sampling as a second step.

Daily wood fuel use was weighed typically over a 3-day period using guidance provided by the CDM Executive Board[39] for identifying the average household wood fuel usage in Zambia. For each of the selected households, wood fuel to be used for day 1 was physically measured with a weighing scale a day before. At the end of day 1, wood fuel for day 2 was again physically measured for use for day 2. At the beginning of day 2, remaining wood fuel meant for day 1 was measured to arrive at wood fuel consumed on Day 1. This process was then repeated for the remaining actual fuel consumed for the next two days.

As regards commercial and institutional facilities, data collection for commercial and institutional survey covered hotels, lodges, restaurants, schools, colleges, hospitals and clinics. Data collection also involved one-off measurements conducted for restaurants in some cases.

Following the conclusion of data collection, all paper-based measurements were transcribed into the MRV mobile application and subsequently exported into a central database from where data for analysis was obtained. The data was subjected to Quality Checks and auxiliary data checks as described in the SOP to

[39] EB 50, Annex 30 and EB 47, Annex 27

flag and correct inconsistent or missing data before analysis. After the data checks were concluded Data Assembly by way of field data, along with corresponding metadata (e.g., date, location, enumerator ID), were compiled and archived following the detailed SOP on data storage.

For each measured unit (household, institution, or sector), net daily consumption was calculated using the formula (equation 11). The formula was embedded into the Mobile Application for automatic calculation of daily consumption. This was important for ensuring that they were less or reduced human error in calculation of daily consumption and contributed to enhanced data quality and accuracy.

$$F_{cd\ i} = W_f - W_s \qquad \text{Equation 11}$$

Where:

F_{cd} is daily firewood/charcoal consumption for day i for each household, institution, W_f is mass of firewood/charcoal on the first reading for day i; W_s is mass of firewood/charcoal on the second day reading for day i.

Estimate average firewood/charcoal consumption for each household for three days using equation 12.

$$F_{ca} = \frac{f_{cd1} + f_{cd2} + f_{cd3}}{3} \qquad \text{Equation 12}$$

Where:

F_{ca} is daily average firewood/charcoal consumption for each household, f_{cd1} is firewood/charcoal consumption for day 1 for each household; f_{cd2} is firewood/charcoal consumption for day 2 for each household; f_{cd3} is firewood/charcoal consumption for day 3 for each household

Estimate average household firewood/charcoal consumption for all the household in the sampling area using equation 13.

$$F_{cv} = \frac{f_{ca\ 1} + f_{ca\ 2} + \cdots \ldots \ldots .. + f_{ca\ n}}{n_v} \qquad \text{Equation 13}$$

Where:

F_{cv} is daily average firewood/charcoal consumption for each sampling area/location, $f_{ca\ i}$ is average firewood/charcoal consumption for household 1 to n; n_v is number of households in a sampling area/location.

Estimate charcoal consumption (FG_{part}) for the province using the following equation 14.

$$F_{p\ charcoal} = \frac{f_{d\ charcoal} * H_c * 365}{1000 * Dw} \qquad \text{Equation 14}$$

Where:

$F_{p\ charcoal}$ is annual charcoal consumption in the province (m^3), $f_{d\ charcoal}$ is average provincial charcoal consumption (kg/day), H_c number of households using charcoal in the province; , Dw -Wood density ($tonnes/m^3$)[40]

Estimate firewood consumption (FG_{trees}) for the province using equation 15.

$$FG_{firewood} = \frac{f_{d\ firewood} * H_f * 365}{1000 * Dw} \qquad \text{Equation 15}$$

Where:

$F\ G_{firewood}$ is annual firewood consumption in the province(m^3), $f_{d\ firewood}$ is average provincial firewood consumption(kg/day), H_f number of households using firewood in the province, Dw -Wood density (tonnes/m3)[41]

Loss of biomass and carbon from disturbance ($L_{disturbance}$)

The calculation of the annual carbon losses in biomass due to disturbances (equation 16) is calculated based on equation 2.14 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$L_{disturbances} = A_{disturbances} * B_{ABG\_forest,i} * (1 + R) * CF * fd \qquad \text{Equation 16}$$

Where

$L_{disturbances}$ = annual other losses of carbon, tons C yr^{-1} , $A_{disturbances}$ = area affected by disturbances, ha yr^{-1}, $B_{AGB\_orest,i}$ = biomass stocks in above ground biomass of forest type *i* ,, tons d.m. ha^{-1}, R = ratio of below-ground biomass to above-ground biomass, in ton d.m. below-ground biomass, (Ton d.m. above-ground biomass)$^{-1}$, CF = carbon fraction of dry matter, ton C (tons d.m.)$^{-1}$, fd = fraction of biomass lost in disturbance .

Similar to the baseline, $A_{disturbances}$ is limited to the occurrence of fires. The estimation of burned areas for each land use category was carried out using data from the Moderate Resolution Imaging Spectroradiometer (MODIS), focusing on the Eastern Province (excluding Chama District) for the period 2018–2024. Fire events were categorized into early fires (March–May), mid-season fires (June–August), and late-season fires (August–November) for each year. The MODIS MCD64A1 Burned Area Product (Collection 6), which provides a monthly, global gridded dataset at 500 m resolution, was used. This product contains per-pixel burned-area estimates and quality information. The burned-area data was

[40] Dw=0.619
[41] Dw=0.619

overlaid with land cover datasets to identify the distribution of fire impacts across different land use categories. Late-season fires were emphasized in the analysis, as they are generally more intense and destructive compared to early- and mid-season burns.

The MODIS burned-area product was validated at a 90% confidence level, with reference to other products such as the Fire Information for Resource Management System (FIRMS), which provides active fire detections. In addition, spectral indices such as the Mid-Infrared Burned Index (MBR) and the Normalized Burn Ratio (NBR) were considered to improve the accuracy of burned-area detection and to validate fire scar mapping.

The SOP for land use and mapping provided guidance to ensure quality, consistency and transparency in land use and land use change analysis which has the resolution of 10m to enhance the accuracy of the analysis. A comparison analysis was further undertaken using Landsat 8, which has pixel resolution of 28m. In addition, the assessment card to indicate fire disturbance was also implemented in collect earth analysis.

The value for $\mathrm{B}_{\mathrm{Forest},i}$ remains unchanged from the baseline and was derived from the second phase of the Integrated Land Use Assessment (ILUA) project. ILUA was implemented by the Forestry Department as a country-wide inventory in two phases: ILUA I (2005–2008) and ILUA II (2010–2016). ILUA II was designed to provide information at the provincial level that supports sustainable forest management (SFM), REDD+ initiatives and Green-House Gas (GHG) inventories. Data used are taken from a report that collates and compiles the data produced by ILUA II.

The fraction of biomass (Fd) burned during a disturbance, as well as combustion efficiency, follows seasonal patterns linked to vegetation moisture content, which influences both the type and quantity of carbon emissions. Consequently, Fd values can range from 1% to 47% in miombo woodlands (Hoffa et. al., 1999)[42]. However, a moderated value of 25% was applied in the baseline period and is being applied in the 2024 monitoring year with uncertainty of +/-0.02%, reflecting recent interventions in the province that have contributed to a reduction in late-season fires. In general, surface fuels tend to burn most completely, while larger surface materials such as coarse woody debris or young shrubs are consumed to a lesser extent. This is often due to higher moisture content in live standing fuels or the rapid passage of fire, which limits ignition of larger objects. Mature trees are typically the least affected and usually remain intact during low-severity fires (Russell-Smith et al. 2009)[43].

Dead organic matter and carbon stocks in mineral soils

Following the same practices as used in the baseline, the changes in dead organic matter (DOM) pools in forestland remaining forestland are assumed to be zero. Similarly, for soil organic carbon (SOC) in forestland remaining forestland it is assumed that the stocks remain in equilibrium and no changes occur.

42 Hoffa, E. A., D. E. Ward, W. M. Hao, R. A. Susott, and R. H. Wakimoto (1999), Seasonality of carbon emissions from biomass burning in a Zambian savanna, J. Geophys. Res., 104(D11), 13841–13853, doi:10.1029/1999JD900091.

43 Russell-Smith J, Murphy BP, Meyer CP, Cook GD, Maier S, Edwards AC, Schatz J, Brocklehurst P (2009) Improving estimates of savanna burning emissions for greenhouse accounting in northern Australia: limitations, challenges, applications. International Journal of Wildland Fire 18(1), 1–18. doi:10.1071/WF08009

Forest land converted to Cropland

Estimation of the emissions from Forest Land converted to Cropland follows the general IPCC approach for land converted to new land use category.

Above-ground biomass and below-ground biomass

For changes in biomass carbon stocks, equation 17, (above-ground biomass and below-ground biomass) as estimated using equation 2.15 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been applied:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L \qquad \text{Equation 17}$$

Where:

ΔC_B = annual change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, ΔC_G= annual increase in carbon stocks in biomass due to growth on land converted to new land, in tons C yr^{-1}, $\Delta C_{Conversion}$= initial change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, 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 tons C yr^{-1}

For conversions from forest to cropland, the changes in above-ground biomass and below-ground biomass are assumed to occur instantaneously based on the average biomass values of the land use before and after the conversion. ΔC_g and ΔC_L are therefore considered as zero and $\Delta C_{CONVERSION}$ is estimated using equation 18.

Equation 18

$$\Delta C_{Cropland\_to\_Forest} = \sum_{I} \left(B_{forest,i} - B_{cropland}\right) * \Delta A_{C-F,i} * CF$$

Where:

$\Delta C_{Fores\_to\text{-}Cropland}$ = initial change in biomass carbon stocks on forest converted to cropland, tons C yr^{-1}, $B_{Cropland}$ = biomass stocks on cropland, tons d.m. ha^{-1}, $B_{Forest,i}$ = biomass stocks in forest of forest type *i* , tons d.m. ha^{-1}, $\Delta A_{F,i-C}$ = area of forest type *i* converted to cropland in the monitoring period, ha yr^{-1}, CF = carbon fraction of dry matter, ton C (tons d.m.)$^{-1}$

The values for $B_{Cropland}$ and $B_{Forest,i}$ have remain unchanged from the baseline and are derived from the from a report that collates and compiles the data produced by ILUA II.

The value for $\Delta A_{F,i-C}$ is estimated using the process described in the section above on the 'Underlying land use and land use change analysis'. $\Delta A_{F,i-C}$ is taken from **Error! Reference source not found.** using the value for conversions from forest to cropland divided by 6 years. The area per forest type *i*, was determined by intersecting the data with the Vegetation Dataset with the detailed vegetation-type classifications within the province.

Dead organic matter

Loss of carbon stocks in dead organic matter due to land conversion (equation 19) is calculated using equation 2.23 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$\Delta C_{DOM} = \frac{\left(C_{litter,C} - C_{litter,F}\right) * \Delta A_{F,i-C}}{T_{F-G}}$$ Equation 19

Where,

ΔC_{DOM} = Annual change in carbon stocks in dead wood/litter (tons C yr^{-1}), $\Delta A_{F,i-C}$ i = area of forest type *i* converted to cropland in the monitoring period, $C_{litter,F}$ = Dead wood/litter stock for forest land (tons C ha^{-1}), $C_{litter,C}$ = Dead wood/litter for cropland (tons C ha^{-1}), T_{F-G} =-Time period of the transition from old to new land-use category (default value is 1) (year)

Carbon stocks in mineral soils

In general, the IPCC equilibrium theory and equation 20 is followed:

$$\Delta C_{mineral} = \frac{\left(SOC_0 - SOC_{(0-T)}\right)}{D}$$ Equation 20

Where

SOC_0 representing SOC equilibrium of the initial land use category, SOC_{0-T} representing SOC equilibrium of the land use category converted to another –and; D - Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values. NOTE: D= 20 Years IPCC default period

In line with the IPCC equilibrium theory, a change in land use will cause SOC to reach a new SOC equilibrium using the default IPCC timeframe of 20 years.

To derive emission factors for forest land converted to Cropland, the SOC equilibrium factors for forest and cropland were used which were derived from an analysis that was done during the development of the baseline by the Zambia Agriculture Research Institute (ZARI) to measure SOC stocks (Tier 2) of AFOLU land use categories in Eastern Province (the Soil Organic Carbon Analysis For Eastern Province).

<u>Forest land converted to Settlement</u>

Estimation of the emissions from Forest Land converted to Settlements follows the general IPCC approach for land converted to new land use category.

Above-ground biomass and below-ground biomass

For changes in biomass carbon stocks, equation 21, (above-ground biomass and below-ground biomass), equation 2.15 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been applied:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L \qquad \text{Equation 21}$$

Where:

ΔC_B = annual change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, ΔC_G= annual increase in carbon stocks in biomass due to growth on land converted to new land, in tons C yr^{-1}, $\Delta C_{Conversion}$= initial change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, 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 tons C yr^{-1}

For conversions from forest to settlement, the changes in above-ground biomass and below-ground biomass are assumed to occur instantaneously based on the average biomass values of the land use before and after the conversion. ΔC_g and ΔC_L are therefore considered as zero and $\Delta C_{CONVERSION}$ is estimated using equation 22.

Equation 22

$$\Delta C_{Forest\_to\_settlement} = \sum_{I} \left((B_{Forest,i} - B_{settlement} \right) * \Delta A_{F,i-S} * CF$$

Where:

$\Delta C_{Fores\_to\text{-}settlement}$ = initial change in biomass carbon stocks on forest converted to settlement, tons C yr^{-1}, $B_{Settlement}$ = biomass stocks on settlement, tons d.m. ha^{-1}, $B_{Forest,i}$ = biomass stocks in forest of forest type *i* , tons d.m. ha^{-1}, $\Delta A_{F,i-S}$i = area of forest type *i* converted to settlement in the monitoring period, ha yr^{-1}, CF = carbon fraction of dry matter, ton C (tons d.m.)$^{-1}$

The values for $B_{Settlement}$ and $B_{Forest,i}$ have remain unchanged from the baseline and are derived from the second phase of the Integrated Land Use Assessment (ILUA) project (see above).

The value for $\Delta A_{F,i-S}$ is estimated using the process described in the section above on the 'Underlying land use and land use change analysis'. $\Delta A_{F,i-S}$i is taken from **Error! Reference source not found.** using the value for conversions from forest to settlement divided by 6 years. The area per forest type *i*, was determined by intersecting the data with the Vegetation Dataset with the detailed vegetation-type classifications within the province.

Dead organic matter

Loss of carbon stocks in dead organic matter due to land conversion, equation 23, is calculated using equation 2.23 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$\Delta C_{DOM} = \frac{\left(C_{litter,S} - C_{litter,F}\right) * \Delta A_{F,i-S}}{T_{F-S}} \qquad \text{Equation 23}$$

Where,

ΔC_{DOM} = Annual change in carbon stocks in dead wood/litter (tons C yr^{-1}), $\Delta A_{F,i-C}$i = area of forest type *i* converted to settlement in the monitoring period, $C_{litter,F}$ = Dead wood/litter stock for forest land (tons C ha⁻

[1]), $C_{litter,S}$ = Dead wood/litter for settlement (tons C ha^{-1}), T_{F-G} =-Time period of the transition from old to new land-use category (default value is 1) (year)

Carbon stocks in mineral soils

In general, the IPCC equilibrium theory and equation 24 is followed:

$$\Delta C_{mineral} = \frac{(SOC_0 - SOC_{(0-T)})}{D} \qquad \text{Equation 24}$$

Where

SOC_0 representing SOC equilibrium of the initial land use category, SOC_{0-T} representing SOC equilibrium of the land use category converted to another –and; D - Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values. NOTE: D= 20 Years IPCC default period

In line with the IPCC equilibrium theory, a change in land use will cause SOC to reach a new SOC equilibrium using the default IPCC timeframe of 20 years.

To derive emission factors for grassland converted to cropland, the SOC equilibrium factors for grassland and cropland were used which were derived from the abovementioned ZARI Soil Organic Carbon Analysis For Eastern Province. In the GHG Excel workbook, the EF can be found on "worksheet" Land Emission Factors.

Cropland converted to Forest Land

Estimation of the emissions from cropland converted to forest land follows the general IPCC approach for land converted to new land use category.

Above-ground biomass and below-ground biomass

For changes in biomass carbon stocks (above-ground biomass and below-ground biomass), equation 2.15 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been applied:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L \qquad \text{Equation 25}$$

Where:

ΔC_B = annual change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, ΔC_G= annual increase in carbon stocks in biomass due to growth on land converted to new land, in tons C yr^{-1}, $\Delta C_{Conversion}$= initial change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, 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 tons C yr^{-1}

Following the ISFL Guidance note on application of IPCC guidelines, this equation has been simplified by assuming that during the conversion from cropland to forest, carbon stocks will go from average carbon stocks in cropland to average carbon stocks in forests during a period of 20 years. Therefore $\Delta C_{CONVERSION}$ is estimated as

Equation 26

$$\Delta C_{\text{Cropland to\_Forestland}} = \sum_{I} (B_{\text{cropland}} - B_{forest,i})/20 * \Delta A_{C-F,i} * CF$$

Where:

$\Delta C_{cropland\_to\_forest}$ = initial change in biomass carbon stocks on cropland converted to forest land, tons C yr^{-1}, B_{Cropland} = biomass stocks on cropland, tons d.m. ha^{-1}, $B_{\text{Forest},i}$ = biomass stocks in forest of forest type *i* , tons d.m. ha^{-1}, $\Delta A_{C-F,i}$ = area of cropland converted to forest type *i* in the monitoring period, ha yr^{-1}, CF = carbon fraction of dry matter, ton C (tons d.m.)$^{-1}$

For B_{forest} the value for Dry Evergreen Forest was used for all the conversions from cropland to forestland. The values for $B_{cropland}$ and $B_{\text{Forest},}$ for dry evergreen forest have remain unchanged from the baseline and are derived from the second phase of the Integrated Land Use Assessment (ILUA) project (see above).

The value for $\Delta A_{C-F,i}$ is estimated using the process described in the section above on the 'Underlying land use and land use change analysis'. $\Delta A_{C-F,i}$ is taken from **Error! Reference source not found.** using the value for conversions from forest to cropland divided by 6 years.

Dead organic matter

Loss of carbon stocks in dead organic matter due to land conversion is calculated using equation 2.23 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$\Delta C_{\text{DOM}} = \frac{\left(C_{litter,F} - C_{litter,C}\right) * \Delta A_{C-F,i}}{T_{F-S}}$$ Equation 27

Where,

ΔC_{DOM} = Annual change in carbon stocks in dead wood/litter (tons C yr^{-1}), $\Delta A_{C-F,i}$ = area of cropland converted in forest type *i* in the monitoring period, $C_{litter,F}$ = Dead wood/litter stock for forest land (tons C ha^{-1}), $C_{litter,C}$ = Dead wood/litter for cropland (tons C ha^{-1}), T_{F-G} =-Time period of the transition from old to new land-use category (default value is 1) (year)

Carbon stocks in mineral soils

In general, the IPCC equilibrium theory and equation 28 is followed:

$$\Delta C_{mineral} = \frac{\left(SOC_0 - SOC_{(0-T)}\right)}{D}$$ Equation 28

Where

SOC_0 representing SOC equilibrium of the initial land use category, SOC_{0-T} representing SOC equilibrium of the land use category converted to another –and; D - Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values. NOTE: D= 20 Years IPCC default period

In line with the IPCC equilibrium theory, a change in land use will cause SOC to reach a new SOC equilibrium using the default IPCC timeframe of 20 years.

To derive emission factors for grassland converted to cropland, the SOC equilibrium factors for grassland and cropland were used which were derived from the abovementioned ZARI Soil Organic Carbon Analysis For Eastern Province. In the GHG Excel workbook, the EF can be found on "worksheet" Land Emission Factors.

Cropland remaining cropland

Cropland is a pivotal land-use category in the AFOLU sector and a central focus of the ISFL. The main carbon changes in cropland remaining cropland comes from the implementation of Climate Smart Agriculture (CSA) which is one of the key interventions under the program to halt the expansion of smallholder agriculture. As noted in section 1.2 above, it was observed that farmers practicing CSA supported by the program have increased productivity per hectare even during the drought period were able to yield better compared to those farmers who practiced conventional farming and experienced total losses.

As also noted in the ERPD, to account for the impact of CSA practices within the cropland remaining cropland subcategory, an approach has been applied that is based on Tier 3 farm-based survey data and Tier 2 soil modelling approach in line with the logic of the IPCC Steady State Method of the 2019 Refinement to the 2006 IPCC Guidelines. This IPCC Tier 2 steady-state method provides an optional alternative method for estimating soil C stock changes in the 0-30 cm layer of mineral soils in Cropland remaining Cropland related to CSA practices. Using this approach, a model is used to derive a baseline soil carbon equilibrium factor which is applied during ex-post accounting of CSA benefits. The detailed approach applied by the EP-JSLP under this steady-state method is a scaled-up version of the project level approach developed under Verra VCS methodology VM0017 (inactive) and the modelling approach under the new VCS ALM Methodology. VM0042. [44]

The overall approach is as follows:

- SOC changes of specific CSA practices are accounted for and not absolute carbon stock changes in the soil.
- The adoption rates of the specific CSA practices are collected during the baseline period as well as during ex-post monitoring and accounting. The practices include soil inputs from residue management (mulching), soil inputs from composted manure and soil inputs from soil fertility trees (mainly Gliricidia trees).

[44] The current approach follows in parts Quantification Approach 1 of VM0042: Measure and Model – a biogeochemical, process-based model is used to estimate GHG fluxes related to SOC stock changes, soil methanogenesis, and use of nitrogen fertilizers and nitrogen-fixing species. Edaphic characteristics and actual agricultural practices implemented, measured initial SOC stocks, and climatic conditions in sample fields are used as model inputs. This approach further requires periodic measurements of SOC stocks every five years at minimum in order to 'true-up' the modelling results. Currently this is not implemented in this project, however, is under discussion for future monitoring periods.

- Baseline soil carbon changes are conservatively considered zero on cropland that is subject to historic and ongoing land degradation.
- Soil carbon stocks are modelled using the RothC soil carbon model (RothC Excel Version 26.3). Inputs for the model include the adaptation rate of the CSA practices as well as program specific values for soil clay content, topsoil thickness, decomposability of incoming plant material, proportion vegetative matter cover by month, monthly mass of carbon input, average monthly temperature, average monthly precipitation, and average monthly evapotranspiration. The RothC model is run both for the baseline and the monitoring period.
  Removals due to changes in soil organic carbon are calculated applying equation 29.

$$PRS_t = \frac{1}{20} * \left(PS_{equil,t} - BS_{equil,0}\right) * \frac{44}{12} * A_{crop,t} \qquad \text{Equation 29}$$

Where

PRS_t = Removals due to changes in soil organic carbon in year t, t CO_2e;
$BS_{equil,0}$ = Baseline SOC in equilibrium year 0, tC;
$PS_{equil,t}$ = Project SOC in equilibrium year t, tC;
20 = the IPCC default transition period required for SOC to be at equilibrium after a change in land use; or
$A_{crop,t}$ = Cropland remaining cropland area in year t, ha

- By applying this equation for each year of the project with monitoring data and soil modelling to establish $PS_{equil,t}$ the net CSA SOC benefits will be derived for the aforementioned CSA practices by deducting the baseline CSA SOC equilibrium $BS_{equil,0}$ representing those farmers in the program who already implement these practices in the baseline.
- Before the total PRS is calculated, ha-based BS_{equil} and PS_{equil} for each CSA practice are modelled which are then combined and adjusted with the specific CSA practice adoption rates (in %) which is then multiplied with the total cropland remaining cropland area (see table 5 above)
- In this project two Agroecological zones in Zambia are used to stratify the total cropland remaining cropland area into tow strata, i.e. AEZ I and AEZ IIa as illustrated in figure 4:

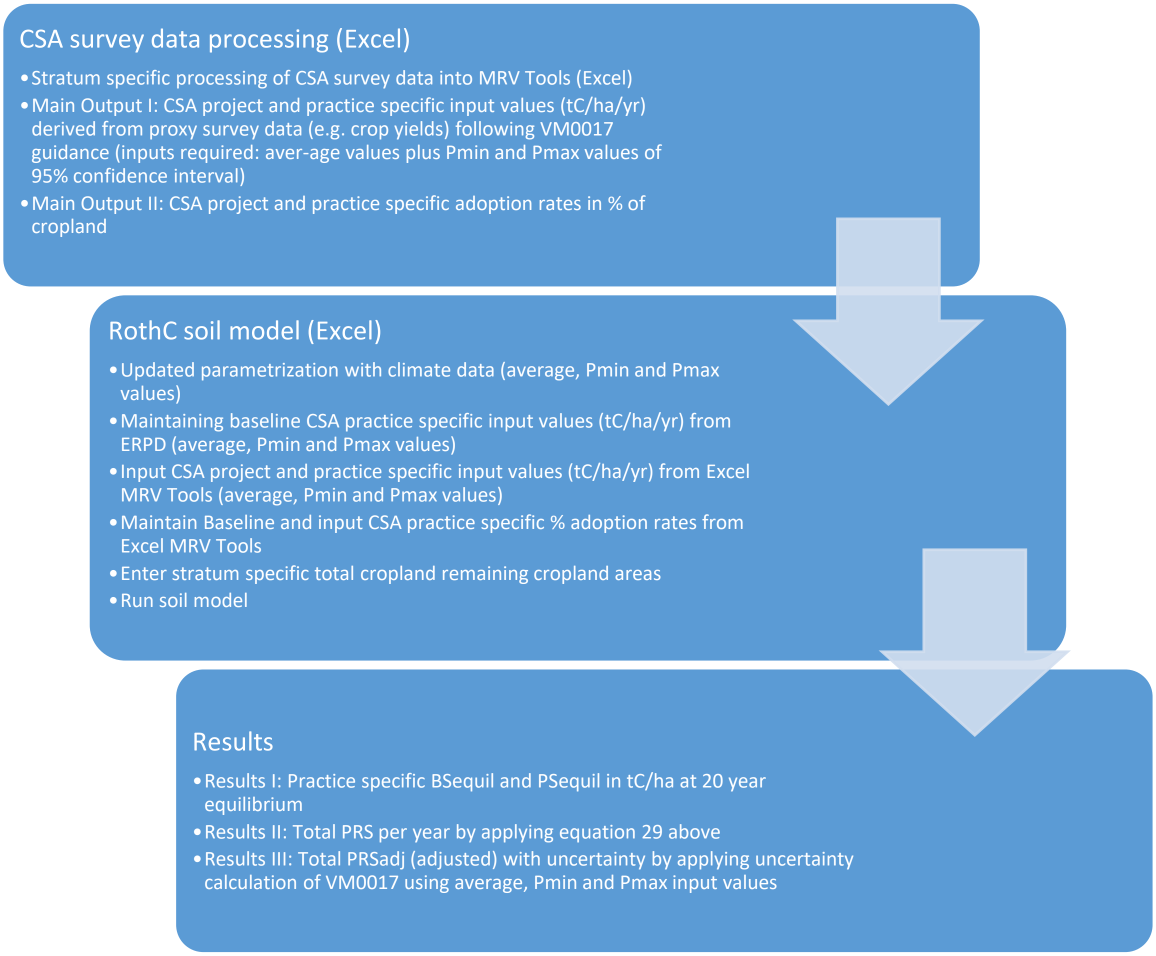

Figure 4: Diagram of the approach used to calculate SOC changes from the implementation of CSA practices in cropland remaining cropland

Survey data processing

A survey was conducted of identified farmers in the landscape area covering farm plots within the targeted districts/chiefdoms. The data collected included demographic, agricultural types (conventional, conservation, and agroforestry), type of crops cultivated, and socio-economic characteristics of the target areas using detailed questionnaires for every farm sampled. Enumerators physically visited the respective sample farms and inquired from Farm owners/farmers questions pertaining to the kind of agricultural practices currently in use (i.e., fertilizers or manures, seed types, type of tillage, among others). The sampling frame used for MRV data collection for CSA is outlined in **Error! Reference source not found.**.

Error! Reference source not found.summarizes the sampling frame while resources used in the analysis are contained in the relevant Excel documentation including Survey data[45] and MRV Tools[46].

45 ZIFLP_CSA_survey_data_2024 (Excel)

46 20250709 MRV Tool Zone Update 2025 (Excel)

Table 6: CSA Sampling frame

Description	Status (#)
Total number of farmers under conventional farming	588,325
Sample size for conventional farmers	384
Total Number of Farmers under Conservation farming	196,634
Sample size for farmers practicing conservation farming	384
Total number of farmers under agroforestry	94,484
Sample size for farmers practicing agroforestry	383

Data collection was preceded by training of enumerators and supervisors to enable them to become familiar with the data collection tools and technologies used, so as to reduce errors and increase efficiency of data collection. The training covered a number of topics including but not limited to; (a) a brief project background and purpose of collecting the data; (b) the survey design, sampling requirements and instruments for data capture; (c) understanding on how to administer the questionnaire; (d) how to collect spatial information using GPS and recording; (e) how to use mobile devices(tablets/smart phones) in entering of data using the MRV Mobile Applications; (f) methods of conducting measurements of the size of sampling plots and the use of measuring instruments and aspects of quality management practices.

The following steps provide data collection process:

- ❖ **Step 1:** Contacting of the farmers sampled to participate in the sampling following prior identification.
- ❖ **Step 2:** The enumerators explained to farm owners the purpose of the sampling exercise and the process of measurements and collection of samples from their farms to obtain Free Prior Informed Consent (FPIC). This was done to ensure the farmers were well aware of the exercise and the importance of adopting sustainable and environmentally friendly farming practices.
- ❖ **Step 3**: Following the engagement with the farmers, the enumerators conducted their interviews using the standard questionnaire using the Mobile Application to capture the measurements and responses from the farmers as per questionnaire design.
- ❖ **Step 4:** Following the start of the data collection by enumerators, quality control teams conducted random checks on the sampled farmers to take note of challenges and limitations as well as potential sources of bias during the data collection.
- ❖ **Step 5**: Following the completion of the data collection exercise, the enumerators produced an MRV data collection activity report detailing the full process which was submitted to the MRV Coordinator.
- ❖ **Step 6**: Consolidation of the reports and production of a data collection report in readiness for data analysis and Emissions Reduction Monitoring Reporting.

The farm-based monitoring data from 2024 surveys were fed into an Excel based tool (MRV Tool) which allowed to perform the processing in line with the steps outlined in VCS methodology VM0017 to derive the input values per CSA practice and the corresponding adoption rates.

20250709 MRV Tool Zone IIa_update 2025 (Excel)

The results of the different sub-steps in the calculation process are shown in detail in section 3.2 and all prepared and used Excel workbooks and tabs are also referenced in this section.

Grassland converted to cropland

Estimation of the emissions from grassland converted to cropland follows the general IPCC approach for land converted to new land use category.

Above-ground biomass and below-ground biomass

For changes in biomass carbon stocks (above-ground biomass and below-ground biomass), equation 2.15 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been applied:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L \qquad \text{Equation 30}$$

Where:

ΔC_B = annual change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, ΔC_G= annual increase in carbon stocks in biomass due to growth on land converted to new land, in tons C yr^{-1}, $\Delta C_{Conversion}$= initial change in carbon stocks in biomass on land converted to new land, in tons C yr^{-1}, 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 tons C yr^{-1}

For grassland converted to cropland, the changes in above-ground biomass and below-ground biomass are assumed to occur instantaneously based on the average biomass values of the land use before and after the conversion. ΔC_g and ΔC_L are therefore considered as zero and $\Delta C_{CONVERSION}$ is estimated as

$$\Delta C_{grassland\_to\_cropland} = \sum_{I} (B_{cropland} - B_{grassland}) * \Delta A_{G-C} * CF \qquad \text{Equation 31}$$

Where:

$\Delta_{Cgrassland\_to\text{-}Cropland}$ = initial change in biomass carbon stocks on grassland converted to cropland, tons C yr^{-1}, $B_{cropland}$ = biomass stocks on cropland, tons d.m. ha^{-1}, $B_{grassland}$ = biomass stocks on grassland , tons d.m. ha^{-1}, $\Delta A_{G-C^{i}}$ = area of grassland converted to cropland in the monitoring period, ha yr^{-1}, CF = carbon fraction of dry matter, ton C (tons d.m.)$^{-1}$

The values for $B_{cropland}$ and $B_{grassland}$ have remain unchanged from the baseline and are derived from the second phase of the Integrated Land Use Assessment (ILUA) project (see above).

The value for $\Delta A_{G-C^{i}}$ is estimated using the process described in the section above on the 'Underlying land use and land use change analysis'. $\Delta A_{G-C^{i}}$ is taken from **Error! Reference source not found.** using the value for conversions from forest to cropland divided by 6 years.

Dead organic matter

Loss of carbon stocks in dead organic matter due to land conversion is calculated using equation 2.23 from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$$\Delta C_{DOM} = \frac{(C_{litter,C} - C_{litter,G}) * \Delta A_{G-C}}{T_{F-S}}$$ Equation 32

Where,

ΔC_{DOM} = Annual change in carbon stocks in dead wood/litter (tons C yr^{-1}), ΔA_{G-C}i = area of grassland converted to cropland in the monitoring period, $C_{litter,C}$ = Dead wood/litter stock for cropland (tons C ha^{-1}), $C_{litter,G}$ = Dead wood/litter for grassland(tons C ha^{-1}), T_{F-G} =-Time period of the transition from old to new land-use category (default value is 1) (year)

Carbon stocks in mineral soils

In general, the IPCC equilibrium theory and equation is followed:

$$\Delta C_{mineral} = \frac{(SOC_0 - SOC_{(0-T)})}{D}$$ Equation 33

Where

SOC_0 representing SOC equilibrium of the initial land use category, SOC_{0-T} representing SOC equilibrium of the land use category converted to another –and; D - Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values. NOTE: D= 20 Years IPCC default period

In line with the IPCC equilibrium theory, a change in land use will cause SOC to reach a new SOC equilibrium using the default IPCC timeframe of 20 years.

To derive emission factors for grassland converted to cropland, the SOC equilibrium factors for grassland and cropland were used which were derived from the abovementioned ZARI Soil Organic Carbon Analysis For Eastern Province.

2.3 Data and parameters

2.3.1 Fixed Data and Parameters

This section of the report provides an overview of all data and parameters that remain fixed throughout this ERPA Phase for estimating emissions under forestland, cropland, grassland, settlements and other lands. These parameters include; Aboveground biomass, Dead wood and litter, Basic Wood density, Carbon Fraction of dry matter, Root to shoot ratio and Soil organic carbon and these are provided as follows:

Biomass

<table>
<tr><td>Parameter:</td><td>$B_{AGB\_Forest,i}$</td></tr>
<tr><td>Description:</td><td>Biomass stocks in above ground biomass of forest type</td></tr>
<tr><td>Subcategory for which the parameter is used:</td><td>Forest land remaining forestland (equation 16)</td></tr>
<tr><td>Data unit:</td><td>tons d.m. ha^{-1}</td></tr>
<tr><td>Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):</td><td>The source is Integrated Land Use Assessment Phase Two (ILUA II) Report i.e., Table 17[47]. The values were calculated from the biophysical measurements collected during 2010-2016.

ABG is a function of tree diameter, tree height and specific wood density derived using formula as outlined in the Forestry SOP

In an individual carbon pool, ABG stock density consists of Tree biomass, pole biomass, saplings, understory and stump biomass.</td></tr>
<tr><td>Value applied:</td><td><table>
<tr><th>Forest type</th><th>Total Biomass (tons d.m. ha^{-1})</th></tr>
<tr><td>Dry evergreen forest</td><td>67.8</td></tr>
<tr><td>Dry deciduous forests</td><td>37.2</td></tr>
<tr><td>Moist evergreen forest</td><td>34.2</td></tr>
<tr><td>Woodlands (semi-evergreen forests)</td><td>43.1</td></tr>
<tr><td>Eucalyptus</td><td>70.8</td></tr>
<tr><td>Pine</td><td>70.8</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures applied</td><td>The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report.
The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field</td></tr>
</table>

[47] ILUA II Final report 2017, Table 17 Mean Tree Volume, biomass and Carbon stock from all major vegetation types, page 41

	booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	ABG uncertainty is 5% obtained from the ILUA II 2017 Final Report, Table 17[48]. The Monte Carlo generated values of ABG for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "K to Z", and Rows "247 to 10,246. Sources of uncertainty were; • Field equipment limitations used for measurements • Bias in interpretation of imagery due to seasonal variation in data
Any comment:	

Parameter:	$B_{Forest,i}$
Description:	Biomass stocks in forest of forest type (above ground and below ground biomass)
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 18) Forest land converted to Settlement (equation 22) Cropland converted to Forest Land (equation 26)
Data unit:	tons d.m. 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):	The source is Integrated Land Use Assessment Phase Two (ILUA II) Report i.e., Table 17[49]. The values were calculated from the biophysical measurements collected during 2010-2016. ABG is a function of tree diameter, tree height and specific wood density derived using formula as outlined in the Forestry SOP In an individual carbon pool, ABG stock density consists of Tree biomass, pole biomass, saplings, understory and stump biomass.
Value applied:	(see table below)

Forest type	Total Biomass (tons d.m. ha^{-1})
Dry evergreen forest	86.8
Dry deciduous forests	47.6
Moist evergreen forest	43.8
Woodlands (semi-evergreen forests)	55.1

[48] See footnote 34

[49] ILUA II Final report 2017, Table 17 Mean Tree Volume, biomass and Carbon stock from all major vegetation types, page 41

QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	ABG uncertainty is 5% obtained from the ILUA II 2017 Final Report, Table 17[50]. The Monte Carlo generated values of ABG for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "K to Z", and Rows "247 to 10,246. Sources of uncertainty were; • Field equipment limitations used for measurements • Bias in interpretation of imagery due to seasonal variation in data
Any comment:	

Parameter:	$B_{Cropland^i}$
Description:	Biomass stocks on cropland
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 18) Cropland converted to Forest Land (equation 26) Grassland converted to cropland (equation 31)
Data unit:	tons d.m. 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):	The source is Integrated Land Use Assessment Phase Two (ILUA II) Report i.e., Table 17[51].The values were calculated from the biophysical measurements collected during 2010-2016.
Value applied:	7.9
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory

[50] See footnote 34

[51] ILUA II Final report 2017, Table 17 Mean Tree Volume, biomass and Carbon stock from all major vegetation types, page 41

	tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Total biomass uncertainty is 5% obtained from the ILUA II 2017 Final Report. The Monte Carlo generated values of total biomass for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "K to Z", and Rows "247 to 10,246.
Any comment:	

Parameter:	$B_{Settlement}$
Description:	Biomass stocks in settlement
Subcategory for which the parameter is used:	Forest land converted to Settlements (equation 22)
Data unit:	tons d.m. 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):	The source is Integrated Land Use Assessment Phase Two (ILUA II) Report, Table 17[52]. The values were calculated from the biophysical measurements collected during 2010-2016.
Value applied:	20.8
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Total biomass uncertainty is 5% obtained from the ILUA II 2017[53] Final Report. The Monte Carlo generated values of Total biomass for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "K to Z", and Rows "247 to 10,246. Sources of uncertainty were; • Field equipment limitations used for measurements

[52] See footnote 34
[53] See footnote 43

	• Bias in interpretation of imagery due to seasonal variation in data
Any comment:	

Parameter:	$B_{grassland}$
Description:	Biomass stocks in grassland
Subcategory for which the parameter is used:	Grassland converted to cropland (equation 31)
Data unit:	tons d.m. 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):	The source is Integrated Land Use Assessment Phase Two (ILUA II) Report, Table 17[54]. The values were calculated from the biophysical measurements collected during 2010-2016.
Value applied:	8.8
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Total biomass uncertainty is 5% obtained from the ILUA II 2017 Final Report., Table 17[55]. The Monte Carlo generated values of Total biomass for respective vegetation types are provided in GHG Excel workbook “worksheet” land emission factors, columns “K to Z”, and Rows “247 to 10,246. Sources of uncertainty were; • Field equipment limitations used for measurements • Bias in interpretation of imagery due to seasonal variation in data
Any comment:	

Dead wood and Litter

[54] See footnote 43
[55] See footnote 43

Parameter:	$C_{litter,F}$,
Description:	Dead wood/litter stock for forest land forest type *i*
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 19) Forest land converted to Settlement (equation 23) Cropland converted to Forest Land (equation 27)
Data unit:	tons C 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):	Source is Integrated Land Use Assessment Phase Two (ILUA II) Report *2017*[56]. The values were calculated from Derived from an analysis of the biophysical measurements collected during the National Forest Inventory. Litter is a function of weight of fresh field sample of litter, size of area from which litter is collected, weight of oven dry sample of litter, weight of fresh sample of litter. Deadwood is a function of deadwood length, DW diameters.
Value applied:	**Forest type** / **Tonnes C/hectare** Dry Evergreen Forest: 2.3 Dry Deciduous Forest: 0.8 Moist Evergreen Forest: 0.48 Woodlands Forest: 0.9
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Dead wood and litter uncertainty is 5% obtained from the ILUA II 2017, Table 27[57] Final Report. The MonteCarlo generated values of for respective vegetation types are provided in GHG Excel workbook “worksheet” land emission factors, columns “AA to AG”, and Rows “247 to 10,246. Sources of uncertainty:

Value applied table:

Forest type	Tonnes C/hectare
Dry Evergreen Forest	2.3
Dry Deciduous Forest	0.8
Moist Evergreen Forest	0.48
Woodlands Forest	0.9

[56] Table 27, Biomass and Carbon in Deadwood by major vegetation types
[57] Refer to footnote 50

	• Field equipment limitations used for measurements
Any comment:	

Parameter:	$C_{litter,C}$
Description:	Dead wood/litter stock for cropland
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 19) Cropland converted to Forest Land (equation 27) Grassland converted to cropland (equation 32)
Data unit:	tons C 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):	Source is Integrated Land Use Assessment Phase Two (ILUA II) Report2017[58]. The values were calculated from Derived from an analysis of the biophysical measurements collected during the National Forest Inventory. Litter is a function of weight of fresh field sample of litter, size of area from which litter is collected, weight of oven dry sample of litter, weight of fresh sample of litter. Deadwood is a function of deadwood length, DW diameters.
Value applied:	0.5
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Dead wood and litter uncertainty is 5% obtained from the ILUA II 2017 Final Report, table 27. The MonteCarlo generated values of for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "AA to AG", and Rows "247 to 10,246. Sources of uncertainty: • Field equipment limitations used for measurements
Any comment:	

[58] Refer to footnote 50

Parameter:	$C_{litter,S}$
Description:	Dead wood/litter stock for Settlement
Subcategory for which the parameter is used:	Forest land converted to Settlement (equation 23)
Data unit:	tons C 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):	Source is Integrated Land Use Assessment Phase Two (ILUA II) Report Table 27. The values were calculated from Derived from an analysis of the biophysical measurements collected during the National Forest Inventory. Litter is a function of weight of fresh field sample of litter, size of area from which litter is collected, weight of oven dry sample of litter, weight of fresh sample of litter. Deadwood is a function of deadwood length, DW diameters.
Value applied:	0.1
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Dead wood and litter uncertainty is 5% obtained from the ILUA II 2017 Final Report, . The MonteCarlo generated values of for respective vegetation types are provided in GHG Excel workbook “worksheet” land emission factors, columns “AA to AG”, and Rows “247 to 10,246. Sources of uncertainty: • Field equipment limitations used for measurements
Any comment:	

Parameter:	$C_{litter,G}$
Description:	Dead wood/litter stock for grassland
Subcategory for which the parameter is used:	Grassland converted to cropland (equation 32)

Data unit:	tons C 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):	Source is Integrated Land Use Assessment Phase Two (ILUA II) Report. The values were calculated from Derived from an analysis of the biophysical measurements collected during the National Forest Inventory. Litter is a function of weight of fresh field sample of litter, size of area from which litter is collected, weight of oven dry sample of litter, weight of fresh sample of litter. Deadwood is a function of deadwood length, DW diameters.
Value applied:	0.2
QA/QC procedures applied	The data collection and QA/QC procedures are described in section 3.1.2 of the ILUA II Report. The data collection was preceded by intensive training of field teams and enumerators over a period of 2 weeks after which they were ushered in the field to collect the data. The teams were introduced to specialized forest inventory tools and equipment, interpretations of the manuals and field booklets (data entry forms). They were practically trained on the correct use of the tools and equipment, in-situ data quality controls and enumeration of the field data. Overall data collection was supervised by the quality assurance teams that followed all the teams at different times of the field work.
Uncertainty associated with this parameter:	Dead wood and litter uncertainty is 5% obtained from the ILUA II 2017 Final Report, Table 27[59]. The MonteCarlo generated values of for respective vegetation types are provided in GHG Excel workbook "worksheet" land emission factors, columns "AA to AG", and Rows "247 to 10,246. Sources of uncertainty: • Field equipment limitations used for measurements
Any comment:	

Biomass expansion factors and biomass to carbon conversions

Parameter:	Iv(Average net annual increment for specific vegetation type)
Description:	Average net annual increment for specific vegetation type for natural forest, eucalyptus and pine
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 6)

[59] Refer to footnote 50

Data unit:	m^3/ha/yr
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Source is Integrated Land Use Assessment Phase Two (ILUA II) Report 2017. The values were derived from an analysis of the biophysical measurements collected during the National Forest Inventory.
Value applied:	<table><tr><th>Forest type</th><th>Average net annual increment for specific vegetation type</th></tr><tr><td>Natural Forest</td><td>1.3</td></tr><tr><td>Forest Plantations (Pinus)</td><td>15</td></tr><tr><td>Forest Plantations (Eucalyptus)</td><td>15</td></tr></table>
QA/QC procedures applied	The source is Integrated Land Use Assessment Phase Two (ILUA II) Report i.e., Table 17[60]. The values were calculated from the biophysical measurements collected during 2010-2016. Therefore, there was no QAQC procedures applied during the 2024 Reporting Period.
Uncertainty associated with this parameter:	5%, provided in GHG Excel workbook "worksheet" land emission factors, columns "F", and Rows "242 to 10246".
Any comment:	

Parameter:	R
Description:	Ratio of below-ground biomass to above-ground biomass for forest type *i*.
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 6, 8, 9 and 16)
Data unit:	Tonne d.m below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Source is IPCC 2006 *g*uidelines, volume 4, table 4.4.
Value applied:	<table><tr><th>Forest type</th><th>Ratio of below-ground biomass to above-ground biomass</th></tr></table>

[60] ILUA II Final report 2017, Table 17 Mean Tree Volume, biomass and Carbon stock from all major vegetation types, page 41

	<table><tr><td>Dry Deciduous Forest</td><td>0.28</td></tr><tr><td>Dry Evergreen Forest</td><td>0.28</td></tr><tr><td>Forest Plantations (Pinus)</td><td>0.28</td></tr><tr><td>Forest Plantations (Eucalyptus)</td><td>0.28</td></tr><tr><td>Moist evergreen Forest</td><td>0.28</td></tr><tr><td>Woodlands</td><td>0.28</td></tr></table>
QA/QC procedures applied	Not applicable, IPCC default value.
Uncertainty associated with this parameter:	10% provided in GHG Excel workbook "worksheet" land emission factors, columns "i", and Rows "244.
Any comment:	

Parameter:	$BCEF_R$
Description:	Biomass conversion and expansion factor for conversion of wood fuel and removal volume to above ground biomass removal
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 8 and 9)
Data unit:	tonnes biomass (m^3 of volume of wood)$^{-1}$
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Chidumayo, E.N. (1990). Above-ground woody biomass structure and productivity in Zambezian woodland. Forest Ecology and Management, 36(1), 33–46.
Value applied:	1.53 (see GHG Excel workbook "worksheet" land emission factors, columns "C", and Rows "33").
QA/QC procedures applied	Calculated value
Uncertainty associated with this parameter:	5%, provided in GHG Excel workbook "worksheet" land emission factors, columns "C", and Rows "244.
Any comment:	

Parameter:	D
Description:	Basic wood density
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 9)
Data unit:	tons d.m. m^{-3}

Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	ILUA II Technical Report (2016), Biomass Volume Calculations, Table 2.4. The Smalian's model: Specific wood density of trees in drier and wetter miombo woodland in Zambia - page 2
Value applied:	0.602 (see GHG Excel workbook "worksheet" land emission factors, columns "C", and Row "38".
QA/QC procedures applied	Literature value
Uncertainty associated with this parameter:	5%
Any comment:	

Parameter:	BCEFi
Description:	Biomass conversion and expansion factor for conversion of net annual increment in volume (including bark) to above ground biomass growth for specific vegetation types.
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 8 and 9)
Data unit:	tonnes biomass removal (m3 of removals)$^{-1}$
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Chidumayo, E.N. (1990). Above-ground woody biomass structure and productivity in Zambezian woodland. Forest Ecology and Management, 36(1), 33–46.
Value applied:	1.18 (see GHG Excel workbook "worksheet" land emission factors, columns "D", and Rows "26")
QA/QC procedures applied	Calculated value using equation 2.10 of the IPCC Guidelines
Uncertainty associated with this parameter:	5%, provided in GHG Excel workbook "worksheet" land emission factors, columns "C", and Rows "244.
Any comment:	

Parameter:	fd
Description:	fraction of biomass lost in disturbance
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 16)
Data unit:	dimensionless

Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Hoffa et. al., 1999)[61] show that Fd values can range from 1% to 47% in miombo woodlands following seasonal patterns linked to vegetation moisture content, which influences both the type and quantity of carbon emissions. Therefore, same moderated value of 25% was applied as in the baseline period. (see GHG Excel workbook "worksheet" land emission factors, columns "G", and Rows "42".)
Value applied:	0.25
QA/QC procedures applied	No application of QC in the reporting period because it was derived from the baseline
Uncertainty associated with this parameter:	0.02%,
Any comment:	

Parameter:	CF
Description:	carbon fraction of dry matter
Subcategory for which the parameter is used:	Forestland remaining forestland (equation 5, 8, 9, 16) Forestland converted to cropland (equation 18) Forestland converted to settlement (equation 22) Cropland converted to forestland (equation 26 Grassland converted to cropland (equation 31)
Data unit:	ton C (tons d.m.)$^{-1}$
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	IPCC default value for forest 2006 IPCCC guidelines, vol4, chapter 4, table 4.3. Same values as in the baseline were adopted for this parameter, thus there were no QA/QC procedures applied during the monitoring period
Value applied:	0.47
QA/QC procedures applied	N/A
Uncertainty associated with this parameter:	unknown - IPCC Emission Factor Data Base
Any comment:	

61 Hoffa, E. A., D. E. Ward, W. M. Hao, R. A. Susott, and R. H. Wakimoto (1999), Seasonality of carbon emissions from biomass burning in a Zambian savanna, J. Geophys. Res., 104(D11), 13841–13853, doi:10.1029/1999JD900091.

Soil Organic Carbon

Parameter:	SOC_F
Description:	SOC of forest land
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 20) Forest land converted to Settlement (equation 24) Cropland converted to Forest Land (equation 28)
Data unit:	Tonnes C 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):	This was derived from the ZARI Soil Organic Carbon Analysis For Eastern Province[62] , Table 17 and 19[63] In the GHG Excel workbook the value can be found on "worksheet" Land Emission Factors.
Value applied:	33.38667
QA/QC procedures applied	Same values as in the baseline were adopted for this parameter, QA/QC applied as described in ZARI report
Uncertainty associated with this parameter:	The total uncertainty calculated using Monte Carlo analysis tool was ±25%. This uncertainty arises from several sources, including sampling design (spatial variability), lab measurement precision, extrapolation methods, and human error (e.g., inconsistent data entry, method selection, equipment usage, and calibration issues).
Any comment:	

Parameter:	SOC_C
Description:	SOC of cropland
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 20) Cropland converted to Forest Land (equation 28) Grassland converted to cropland (equation 33)
Data unit:	Tonnes C 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):	Derived from the ZARI Soil Organic Carbon Analysis For Eastern Province[64] , Tables 17 and 19. In the GHG Excel workbook the value can be found on "worksheet" Land Emission Factors
Value applied:	30.85667

[62] Soil Organic Carbon Analysis for Eastern Province
[63] Table 17: Estimated SOC in Forest Landscape in Eastern Province
Table 19: Estimated SOC in Agriculture Landscape in Eastern Province
[64] Soil Organic Carbon Analysis for Eastern Province

QA/QC procedures applied	Same values as in the baseline were adopted for this parameter, QA/QC applied as described in ZARI report
Uncertainty associated with this parameter:	The total uncertainty calculated using Monte Carlo analysis tool was ±25%. This uncertainty arises from several sources, including sampling design (spatial variability), lab measurement precision, extrapolation methods, and human error (e.g., inconsistent data entry, method selection, equipment usage, and calibration issues).
Any comment:	

Parameter:	SOC_S
Description:	SOC of settlement
Subcategory for which the parameter is used:	Forest land converted to Settlement (equation 24)
Data unit:	Tonnes C 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):	Derived from the ZARI Soil Organic Carbon Analysis For Eastern Province[65], Tables 17 and 19. In the GHG Excel workbook the value can be found on "worksheet" Land Emission Factors.
Value applied:	30.85667
QA/QC procedures applied	Same values as in the baseline were adopted for this parameter, QA/QC applied as described in ZARI report
Uncertainty associated with this parameter:	The total uncertainty calculated using Monte Carlo analysis tool was ±25%. This uncertainty arises from several sources, including sampling design (spatial variability), lab measurement precision, extrapolation methods, and human error (e.g., inconsistent data entry, method selection, equipment usage, and calibration issues).
Any comment:	

Parameter:	SOC_G
Description:	SOC of grassland
Subcategory for which the parameter is used:	Grassland converted to cropland (equation 33)
Data unit:	Tonnes C ha^{-1}

65 See footnote 59

Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Derived from the ZARI Soil Organic Carbon Analysis For Eastern Province[66] , Tables 17 and 19.. In the GHG Excel workbook the value can be found on "worksheet" Land Emission Factors
Value applied:	30.9
QA/QC procedures applied	Same values as in the baseline were adopted for this parameter, QA/QC applied as described in ZARI report
Uncertainty associated with this parameter:	The total uncertainty calculated using Monte Carlo analysis tool was ±25%. This uncertainty arises from several sources, including sampling design (spatial variability), lab measurement precision, extrapolation methods, and human error (e.g., inconsistent data entry, method selection, equipment usage, and calibration issues).
Any comment:	

Parameter:	$BS_{equil,0}$
Description:	Baseline CSA SOC sequestration at equilibrium for the Programme cropland remaining cropland area of those farmers already implementing CSA practices in the 2009-2018 baseline period
Subcategory for which the parameter is used:	Cropland remaining cropland (equation 29)
Data unit:	tCO_2/ha/year
Source of data and or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Validated ERPD
Value applied:	0.11
QA/QC procedures applied	N/A
Uncertainty associated with this parameter:	13% for AEZ I and 8% in AEZ IIa
Any comment:	

[66] See footnote 59

2.3.2 Monitored Data and Parameters

Parameter:	A_i
Description:	area of forest type *i*,
Subcategory for which the parameter is used:	Forest remaining forest (equation 5)
Data unit:	ha
Source of data and description of measurement/calculation methods and procedures applied:	A systematic grid-based sampling approach was employed using a random systematic sampling frame with point locations approximately 4 km apart, covering the entire province with around 3,200 sample points. The assessment unit used was approximately 0.5 ha in size containing an array of 7x7 control points. In terms of quantifying forest cover within the assessment unit, interpreters counted the number of control points within the assessment unit which fall directly on forest canopy. This number was then used to quantify forest cover within the assessment unit by dividing it by 49 (total number of assessment points). The forest definition requires a canopy cover of at least 10% to be present along with a minimum size of 0.5 ha and a potential tree height of at least 5 m. As such a sample plot was classified as forest if more than 4 control points are deemed to fall on tree canopies. The vegetation type for each sample plot was then extracted from Zambia's vegetation type description shapefile, based on Fanshawe (1976). The shapefile was clipped to Eastern Province boundary and converted to Rasta dataset. Rasta values representing the dominant vegetation type (characterized by 7 vegetation type classes (Grasslands, Baikiaea Forest, Miombo woodland, Mopane woodland, Munga woodland, Parinari forest, and Riparian forest) at each sample plot location was then extracted. These vegetation classes were subsequently reclassified into five(5) broader vegetation type categories (dry evergreen, dry deciduous, moist evergreen and forest woodlands)[67] for analysis and estimation of areas. For the rest of the land use classes a majority approach was used, for example, if 40 of the 49 control points fall on cropland at the end of the monitoring period, the plot was classified as cropland. The same approach was used for the rest of the land use classes.
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	

67 Fanshawe (1971) Forest Research Bulletin No. 7

	<table><tr><th>Forest type</th><th>Area of forest type in the monitoring period (ha)</th></tr><tr><td>Dry evergreen forest</td><td>1,797</td></tr><tr><td>Dry deciduous forests</td><td>1,224,339</td></tr><tr><td>Moist evergreen forest</td><td>28,745</td></tr><tr><td>Woodlands (semi-evergreen forests)</td><td>1,603,741</td></tr><tr><td>Eucalyptus</td><td>561</td></tr><tr><td>Pinus</td><td>203</td></tr><tr><td>**Total**</td><td>**2,859,385**</td></tr></table>
Quality Assurance/Quality Control procedures applied:	QA/QC following the SOPs for Land Use Mapping. The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency
Uncertainty for this parameter:	1.6% provided in GHG Excel workbook “worksheet” land Activity Data, Rows “44.
Any comment:	

Parameter:	H
Description:	Annual wood removals, round wood
Subcategory for which the parameter is used:	Forest remaining forest (equation 8)
Data unit:	m^3 yr^{-1}

Source of data and description of measurement/calculation methods and procedures applied:	These were derived from Forest Department annual timber production records aggregated by province. These were based on harvested timber under tree felling permits as provided under the Forests Acts No.4 of 2015.
Frequency of monitoring/recording:	Annual
Value monitored during this Reporting Period:	<table><tr><th>Forest type</th><th>Wood removals for timber in the monitoring period (m^3 yr^{-1})</th></tr><tr><td>Dry evergreen forest</td><td>65</td></tr><tr><td>Dry deciduous forests</td><td>10</td></tr><tr><td>Moist evergreen forest</td><td>12</td></tr><tr><td>Forest woodlands</td><td>1,651</td></tr><tr><td>Eucalyptus</td><td>10</td></tr><tr><td>Pines</td><td>413</td></tr></table>
Quality Assurance/Quality Control procedures applied:	QC was not applied as the data was obtained from the Forestry Department
Uncertainty for this parameter:	Volume of wood removal uncertainty is 5% obtained from the ILUA II 2016 Final Report. The Monte Carlo generated values of for respective vegetation types are provided in GHG Excel workbook "worksheet" land AD fuel wood, columns "C2 to GB", and Rows "103 to 10
Any comment:	

Parameter:	FG_{trees}
Description:	annual volume of fuelwood removal as whole trees (firewood)
Subcategory for which the parameter is used:	forestland remaining forestland (equation 9)
Data unit:	m^3/year
Source of data and description of measurement/calculation methods and procedures applied:	Field survey, Wood Fuel Study 2017[68], and Living Conditions and Monitoring Survey[69].
Frequency of monitoring/recording:	Annual

68 National Woodfuel Study 2021 final.pdf
69 2022-LCMS-Report.pdf

<table>
<tr><td>Value monitored during this Reporting Period:</td><td>

Forest type	Wood removal for firewood in the monitoring period according to major vegetation types (m^3 yr^{-1})
Dry evergreen forest	641
Dry deciduous forests	461,043
Moist evergreen forest	10,901
Forest woodlands	652,130
subtotal	1,124,715

</td></tr>
<tr><td>Quality Assurance/Quality Control procedures applied:</td><td>The SOP for Energy provided guidance to ensure quality, consistency and transparency of data. A rigorous QAQC procedure was implemented to ensure accuracy consistency and reliability of the fuel wood consumption data. Prior to data collection, field teams were trained, in the survey instruments, measurement techniques and standard data recording procedures to minimise human error. calibration of equipment (scales) and measuring tools were conducted daily to maintain measurement precision. During field work QAQC teams conducted spot checks and cross verification of random subsets to confirm data consistency and detect potential discrepancies. Compiled data forms were reviewed at the end of each day to identify and correct missing or outlier values.</td></tr>
<tr><td>Uncertainty for this parameter:</td><td>Wood removal for firewood uncertainty is 1.6 % obtained from the field survey measurement. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook “worksheet” land AD fuel wood, columns “GD to IW”, and Rows “105 to 10,108”.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Parameter:	FG_{part}
Description:	annual volume of fuelwood removal of tree parts (charcoal)
Subcategory for which the parameter is used:	forestland remaining forestland (equation 9)
Data unit:	m^3/year

<table>
<tr><td>Source of data and description of measurement/calculation methods and procedures applied:</td><td>Field survey, Wood Fuel Study 2017[70], Energy SOP and Living Conditions and Monitoring Survey[71].</td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>Annual</td></tr>
<tr><td>Value monitored during this Reporting Period:</td><td>
<table>
<tr><th>Forest type</th><th>Wood removal for charcoal in the monitoring period according to major vegetation types ($m^3 yr^{-1}$)</th></tr>
<tr><td>Dry evergreen forest</td><td>1,106</td></tr>
<tr><td>Dry deciduous forests</td><td>795,325</td></tr>
<tr><td>Moist evergreen forest</td><td>18,805</td></tr>
<tr><td>Forest woodlands</td><td>1,124,959</td></tr>
<tr><td>subtotal</td><td>1,940,194</td></tr>
</table>
</td></tr>
<tr><td>Quality Assurance/Quality Control procedures applied:</td><td>The SOP for Energy provided guidance to ensure quality, consistency and transparency of data. A rigorous QAQC procedure was implemented to ensure accuracy consistency and reliability of the fuel wood consumption data. Prior to data collection, field teams were trained, in the survey instruments, measurement techniques and standard data recording procedures to minimise human error. calibration of equipment (scales) and measuring tools were conducted daily to maintain measurement precision. During field work QAQC teams conducted spot checks and cross verification of random subsets to confirm data consistency and detect potential discrepancies. Compiled data forms were reviewed at the end of each day to identify and correct missing or outlier values.</td></tr>
<tr><td>Uncertainty for this parameter:</td><td>charcoal uncertainty is 1.6 % obtained from the field survey measurement. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook “worksheet” land AD fuel wood, columns “DI to GB”, and Rows “106 to 10,108”.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Parameter:	$A_{disturbances}$
Description:	Area affected by disturbances

[70] National Woodfuel Study 2021 final.pdf
[71] 2022-LCMS-Report.pdf

Subcategory for which the parameter is used:	Forestland remaining forestland (equation 16)
Data unit:	ha yr^{-1}
Source of data and description of measurement/calculation methods and procedures applied:	The estimation of burned areas for each vegetation type in forestland remaining forestland was carried out using data from the Moderate Resolution Imaging Spectroradiometer (MODIS), focusing on the Eastern Province (excluding Chama District). Fire events were categorized into early fires (March–May), mid-season fires (June–August), and late-season fires (August–November) for each year. The MODIS MCD64A1 Burned Area Product (Collection 6), which provides a monthly, global gridded dataset at 500 m resolution, was used. This product contains per-pixel burned-area estimates and quality information. The burned-area data was overlaid with land cover datasets to identify the distribution of fire impacts across different land use categories. Late-season fires were emphasized in the analysis, as they are generally more intense and destructive compared to early- and mid-season burns.
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	(see table below)
Quality Assurance/Quality Control procedures applied:	The SOP for land use and mapping provided guidance to ensure quality, consistency and transparency in land use and land use change analysis which has the resolution of 10m to enhance the accuracy of the analysis. A comparison analysis was further undertaken using Landsat 8, which has pixel resolution of 28m. In addition, the assessment card to indicted fire disturbance was also implemented in collect earth analysis.
Uncertainty for this parameter:	Burned area by vegetation types uncertainty is 1.5% obtained from the MODIS MCD64A1 Burned Area Product (Collection 6). The Monte

Forest type	**Area affected by forest fires disturbances in the monitoring period (ha)**
Dry evergreen forest	254
Dry deciduous forests	173,224
Moist evergreen forest	4,067
Forest woodlands	226,904
subtotal	404,449

	Carlo generated values of for burned areas by vegetation types are provided in GHG Excel workbook “worksheet” Land AD Disturbance, columns “C to BU”, and Rows “32 to 10,035”.
Any comment:	

Parameter:	$\Delta A_{F,i-C}$
Description:	Area of forest type *i* converted to cropland in the monitoring period
Subcategory for which the parameter is used:	Forest land converted to Cropland (equation 18, 19)
Data unit:	ha yr^{-1}
Source of data and description of measurement/calculation methods and procedures applied:	Analysis of land use and land use change was performed as described in section 2.2, subsection ‘Underlying land use and land use change analysis’. The assessment was using Collect Earth and RS/GIS. Analysis of Landuse change focused on identifying original vegetation types (Grasslands, Baikiaea Forest, Miombo woodland, Mopane woodland, Munga woodland, Parinari forest, and Riparian forest) that had been converted to cropland. To achieve this, each converted plot was linked to its’ pre-conversion vegetation class. The vegetation type for each plot was identified using Zambia’s vegetation type description shape file[72].
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	Over the period 2019-2024 54,162 ha of forest was converted to cropland. This is proportionally allocated and it is assumed that for the monitoring period 2024, 9,027 ha was converted. Using the method described above, this is distributed over the following forest types:
Quality Assurance/Quality Control procedures applied:	QA/QC following the SOPs for Land Use Mapping.

Forest type	Ha of forest type converted to cropland in the monitoring period
Dry evergreen forest	6
Dry deciduous forests	3,866
Moist evergreen forest	91
Woodlands (semi-evergreen forests)	5,064
Total	9,027

[72] See footnote 58

	The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency.
Uncertainty for this parameter:	Land use uncertainty is 1.2 % was derived from satellite imagery analysed using Collect Earth. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook "worksheet" land activity data areas, columns "C to GS", and Rows "47 to 10,046".
Any comment:	

Parameter:	$\Delta A_{F,i-S}$
Description:	Area of forest type *i* converted to settlement in the monitoring period
Subcategory for which the parameter is used:	Forest land converted to settlement (equation 22, 23)
Data unit:	ha yr^{-1}
Source of data and description of measurement/calculation methods and procedures applied:	Analysis of land use and land use change was performed as described in section 2.2, subsection 'Underlying land use and land use change analysis'. The assessment was using Collect Earth and RS/GIS The assessment units were categorised into Land Use subcategories based on the latest observed conversions between 2018 and 2024, as detailed in the provided table (See Saiku Data). Each unit was assigned a subcategory reflecting both its initial and current land use class, enabling the identification of transitions over the six-year period. These subcategories include stable land uses (e.g., Cropland > Cropland, Forest > Forest) as well as conversions (e.g., Forest > Cropland, Grassland > Forest). A total of 3,200 plots covering the entire province were classified into 15 unique subcategories . This classification facilitated the analysis of land use dynamics, particularly changes involving forest cover, which were further summarised under the "Forest Change" column, indicating whether forest land remained

	stable, was converted to non-forest land, or emerged from non-forest origins. The approach provided a structured basis for evaluating the magnitude and direction of land use change across the landscape.
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	Over the period 2019-2024 15,930 ha of forest was converted to cropland. This is proportionally allocated and it is assumed that for the monitoring period 2024, 2,655 ha was converted. Using the method described above, this is distributed over the following forest types:

Forest type	**Ha of forest type converted to settlement**
Dry evergreen forest	1.7
Dry deciduous forests	1,137.1
Moist evergreen forest	26.7
Woodlands (semi-evergreen forests)	1,489.5
Total	2,655

Quality Assurance/Quality Control procedures applied:	QA/QC following the SOPs for Land Use Mapping. The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency.
Uncertainty for this parameter:	Land use uncertainty is 1.2 % was derived from satellite imagery analysed using Collect Earth. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook “worksheet” land activity data areas, columns “C to GS”, and Rows “47 to 10,046”.
Any comment:	

Parameter:	$\Delta A_{C-F,i}$
Description:	Area of cropland converted to forest type *i* in the monitoring period
Subcategory for which the parameter is used:	Cropland converted to forest land
Data unit:	ha yr^{-1}
Source of data and description of measurement/calculation methods and procedures applied:	Analysis of land use and land use change was performed as described in section 2.2, subsection 'Underlying land use and land use change analysis'. The assessment was using Collect Earth and RS/GIS The assessment units were categorised into Land Use subcategories based on the latest observed conversions between 2018 and 2024, as detailed in the provided table (See Saiku Data). Each unit was assigned a subcategory reflecting both its initial and current land use class, enabling the identification of transitions over the six-year period. These subcategories include stable land uses (e.g., Cropland > Cropland, Forest > Forest) as well as conversions (e.g., Forest > Cropland, Grassland > Forest). A total of 3,200 plots covering the entire province were classified into 15 unique subcategories. This classification facilitated the analysis of land use dynamics, particularly changes involving forest cover, which were further summarised under the "Forest Change" column, indicating whether forest land remained stable, was converted to non-forest land, or emerged from non-forest origins. The approach provided a structured basis for evaluating the magnitude and direction of land use change across the landscape
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	Over the period 2019-2024 27,081 ha of forest was converted to cropland. This is proportionally allocated and it is assumed that for the monitoring period 2024, 4,513.5 ha was converted. It is assumed that all the conversions from cropland to forestland are to dry evergreen forest: (see table below)
Quality Assurance/Quality Control procedures applied:	QA/QC following the SOPs for Land Use Mapping. The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters

Forest type	Ha of cropland converted to forest type
Dry evergreen forest	4,513.5
Total	4,513.5

	specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency.
Uncertainty for this parameter:	Land use uncertainty is 1.2 % was derived from satellite imagery analysed using Collect Earth. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook “worksheet” land activity data areas, columns “C to GS”, and Rows “47 to 10,046”.
Any comment:	

Parameter:	$A_{crop,}t$
Description:	Cropland remaining cropland area in year t
Subcategory for which the parameter is used:	Cropland remaining cropland (equation 29)
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):	Analysis of land use and land use change was performed as described in section 2.2, subsection ‘Underlying land use and land use change analysis’. The assessment was using Collect Earth and RS/GIS
Value applied:	1,462,370
QA/QC procedures applied	QA/QC following the SOPs for Land Use Mapping. The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality, consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were

	integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency
Uncertainty associated with this parameter:	Land use uncertainty is 1.2 % was derived from satellite imagery analysed using Collect Earth. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook "worksheet" land activity data areas, columns "C to GS", and Rows "47 to 10,046".
Any comment:	

Parameter:	ΔA_{G-Ci}
Description:	Area of grassland converted to cropland in the monitoring period
Subcategory for which the parameter is used:	Grassland converted to cropland (equation 31, 32)
Data unit:	ha yr^{-1}
Source of data and description of measurement/calculation methods and procedures applied:	Analysis of land use and land use change was performed as described in section 2.2, subsection 'Underlying land use and land use change analysis'. The assessment was using Collect Earth and RS/GIS The assessment units were categorised into Land Use subcategories based on the latest observed conversions between 2018 and 2024, as detailed in the provided table (See Saiku Data). Each unit was assigned a subcategory reflecting both its initial and current land use class, enabling the identification of transitions over the six-year period. These subcategories include stable land uses (e.g., Cropland > Cropland, Forest > Forest) as well as conversions (e.g., Forest > Cropland, Grassland > Forest). A total of 3,200 plots covering the entire province were classified into 15 unique subcategories. This classification facilitated the analysis of land use dynamics, particularly changes involving forest cover, which were further summarised under the "Forest Change" column, indicating whether forest land remained stable, was converted to non-forest land, or emerged from non-forest origins. The approach provided a structured basis for evaluating the magnitude and direction of land use change across the landscape.
Frequency of monitoring/recording:	For each monitoring period
Value monitored during this Reporting Period:	265.5
Quality Assurance/Quality Control procedures applied:	QA/QC following the SOPs for Land Use Mapping. The project conducted a series of comprehensive training events aimed at enhancing the skill set of interpreters, ensuring high-quality,

	consistent, and reliable assessments Two primary steps were put in place to guarantee quality assurance (QA) and quality control (QC) methods. The first step focused on documenting the interpretations' confidence levels for data items pertaining to change. Interpreters specifically expressed their confidence level in using the LULUC card to assign land use change transitions. Assessment units with low confidence levels were then reassigned to experienced users or discussed as a team to ensure that quality activity data was collected. Secondly, in order to avoid misinterpretation of Land use and ensure high integrity of EPJSLP's MRV program, validation rules were integrated throughout the survey, focusing on preventing errors. Each data collection card was subjected to these rules, which guaranteed that data entries followed predefined criteria and logical consistency.
Uncertainty for this parameter:	Land use uncertainty is 1.2 % was derived from satellite imagery analysed using Collect Earth. The Monte Carlo generated values for respective vegetation types are provided in GHG Excel workbook “worksheet” land activity data areas, columns “C to GS”, and Rows “47 to 10,046”.
Any comment:	

Parameter:	$PS_{equil,t}$
Description:	CSA SOC sequestration for the programme cropland remaining cropland area of t farmers implementing CSA practices in the monitoring period
Subcategory for which the parameter is used:	Cropland remaining cropland (equation 29)
Data unit:	tCO_2/ha/year
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	A survey was conducted of identified farmers in the landscape area covering farm plots within the targeted districts/chiefdoms. The data collected included demographic, agricultural types (conventional, conservation, and agroforestry), type of crops cultivated, and socio-economic characteristics of the target areas using detailed questionnaires for every farm sampled. Soil carbon stocks are modelled using the RothC soil carbon model. Inputs for the model include the adaptation rate of the CSA practices as well as program specific values for soil clay content, topsoil thickness, decomposability of incoming plant material, proportion vegetative matter cover by month, monthly mass of carbon input, average monthly temperature, average monthly precipitation, and average monthly evapotranspiration.

Value applied:	*AEZ I* **CSA** | **Value within 95% confidence** | **tC/ha** **Mulching** | Mean | 0.25 **Manure** | Mean | 0.03 **Agroforestry** | Mean | 0.01 **Mulching** | Pmax | 0.32 **Manure** | Pmax | 0.04 **Agroforestry** | Pmax | 0.01 **Mulching** | Pmin | 0.20 **Manure** | Pmin | 0.02 **Agroforestry** | Pmin | 0.00 *AEZ IIa* **CSA** | **Value within 95% confidence** | **tC/ha** **Mulching** | Mean | 0.35 **Manure** | Mean | 0.03 **Agroforestry** | Mean | 0.02 **Mulching** | Pmax | 0.40 **Manure** | Pmax | 0.04 **Agroforestry** | Pmax | 0.03 **Mulching** | Pmin | 0.30 **Manure** | Pmin | 0.02 **Agroforestry** | Pmin | 0.02
QA/QC procedures applied	Data collection was preceded by training of enumerators and supervisors. to enable them to become familiar with the data collection tools and technologies used, so as to reduce errors and increasing efficiency of data collection. The training covered a number of topics including but not limited to; (a) a brief project background and purpose of collecting the data; (b) the survey design, sampling requirements and instruments for data capture; (c) understanding on how to administer the questionnaire; (d) how to collect spatial information using GPS and recording; (e) how to use mobile devices(tablets/smart phones) in entering of data using the MRV Mobile Applications; (f) methods of conducting measurements of the size of sampling plots and the use of measuring instruments and aspects of quality management practices.
Uncertainty associated with this parameter:	AEZ I: 26% AEZ IIa: 18%

AEZ I

CSA	Value within 95% confidence	tC/ha
Mulching	Mean	0.25
Manure	Mean	0.03
Agroforestry	Mean	0.01
Mulching	Pmax	0.32
Manure	Pmax	0.04
Agroforestry	Pmax	0.01
Mulching	Pmin	0.20
Manure	Pmin	0.02
Agroforestry	Pmin	0.00

AEZ IIa

CSA	Value within 95% confidence	tC/ha
Mulching	Mean	0.35
Manure	Mean	0.03
Agroforestry	Mean	0.02
Mulching	Pmax	0.40
Manure	Pmax	0.04
Agroforestry	Pmax	0.03
Mulching	Pmin	0.30
Manure	Pmin	0.02
Agroforestry	Pmin	0.02

Any comment:	

3 Quantification of Emission Reductions

3.1 Emissions Baseline for the Reporting Period covered in this report

In the validated ERPD, the baseline is calculated as 10,715,478.3 tCO_2e. However, it is noted that the calculation of the Emissions Baseline in table 18 of the validated ERPD contains some subcategories that according to table 16 of the validated ERPD are not eligible. The non-eligible subcategories are excluded below and the emissions baseline is recalculated accordingly.

Year of Reporting Period t	Baseline Emissions						
	Sub category 1 *Forestland Remaining Forestland*	Sub category 2 *Forestland converted to Cropland*	Sub category 3 *Forestland converted Settlements*	Sub category 4 *Cropland converted to forestland*	Sub category 5 *Cropland remaining cropland*	Sub category 6 *Grassland converted to Cropland*	Total Emissions Baseline (tCO_2e)
2024	*9,164,186*	*1,041,847*	*46,988*	*-40,107*	*0*	*3,302*	*10,216,216*
Total net Emissions Baseline during the Reporting Period							*10,216,216*

3.2 Estimation of Emissions by Sources and Removals by Sinks included in the ISFL ER Program's scope

The quantification of *the E*missions by Sources and Removals by Sinks for the subcategories included for ISFL Accounting during this Reporting Period have applied the equations detailed in section 2.2 and using the values for the data and parameters in section 2.3. All calculations including the intermediate calculations for the different subcategories are provided in the Excel calculation workbook. However, as this project is not validated against the VM0017 methodology, the value without uncertainty adjustment (PRS) is currently used to quantify the removals from the category cropland remaining cropland. Moreover, the calculated uncertainty values are then later used in chapter 4 to calculate the uncertainty of the estimated emission/reductions together with the other subcategories. Consequently, the PRS represents the total SOC benefits from CSA for the year 2024 in each AEZ

<u>Forest Land remaining Forest Land</u>

Gains have been calculated per forest type as per equations 5 and 6 above

Table 7: Increase in biomass carbon stocks due to biomass growth

Vegetation type	Area (ha) I	Average Net Annual Increment for specific vegetation type(m^3/ ha/ yr)	BCEFi (	Ratio of below-ground biomass to above-ground biomass for a specific vegetation type	Carbon Fraction of dry matter (tonne C/ tonne)	Increase in biomass carbon stocks due to biomass growth (tons C yr^{-1})
Dry evergreen forest	1,797	1.3	1.18	0.28	0.47	1,663
Dry deciduous forests	1,224,339	1.3	1.18	0.28	0.47	1,133,616
Moist evergreen forest	28,745	1.3	1.18	0.28	0.47	26,615
Woodlands (semi-evergreen forests)	1,603,741	1.3	1.18	0.28	0.47	1,484,903
Eucalyptus	1,797	15	1.18	0.28	0.47	5,990
Pinus	1,224,339	15	1.18	0.28	0.47	2,173
Total	**2,859,385**					**2,654,961**

The loss of biomass and carbon from wood removals is estimated using equation 8

Table 8: Carbon loss due to biomass removals

Vegetation type	annual wood removals, round wood (m^3 yr^{-1})	$BCEF_R$ (tons biomass removal (m^3 of removals)$^{-1}$	Ratio of below-ground biomass to above-ground biomass for a specific vegetation type	Carbon Fraction of dry matter (tonne C/ tonne)	annual carbon loss due to biomass removals, tons C yr^{-1}
Dry evergreen forest	65.0	1.53	0.28	0.47	60
Dry deciduous forests	10.0	1.53	0.28	0.47	9
Moist evergreen forest	12.0	1.53	0.28	0.47	11
Woodlands (semi-evergreen forests)	1651.0	1.53	0.28	0.47	1,523
Eucalyptus	10.0	1.53	0.28	0.47	9
Pinus	413.0	1.53	0.28	0.47	381
Total	**2161.0**				**1,993**

The loss of biomass and carbon from fuelwood is estimated using equation 9.

Table 9: Carbon loss due to fuelwood removals

Vegetation type	annual volume of fuelwood removal of whole trees, $m^3 yr^{-1}$	annual volume of fuelwood removal as tree parts, $m^3 yr^{-1}$	$BCEF_R$ (tons biomass removal (m^3 of removals)$^{-1}$	Ratio of below-ground biomass to above-ground biomass for a specific vegetation type	Carbon Fraction of dry matter (tonne C/ tonne)	Basic wood density, tons d.m. m^{-3}	annual carbon loss due to fuelwood removals, tons C yr^{-1}
Dry evergreen forest	1,106.2	641.2	1.53	0.28	0.47	0.602	1,202
Dry deciduous forests	795,324.8	461,043.4	1.53	0.28	0.47	0.602	864,098
Moist evergreen forest	18,804.6	10,900.9	1.53	0.28	0.47	0.602	20,431
Forest woodlands	1,124,958.7	652,129.5	1.53	0.28	0.47	0.602	1,222,235
Total	**1,940,194.2**	**1,124,715.0**					**2,107,965**

The loss of biomass and carbon from disturbances (fires) is estimated using equation 16.

Table 10: Carbon loss due to disturbances

Vegetation type	Area affected by disturbances (ha yr^{-1})	Above ground biomass stocks (tons d.m. ha^{-1})	Ratio of below-ground biomass to above-ground biomass	Carbon Fraction of dry matter (tonne C/ tonne)	fraction of biomass lost in disturbance	annual carbon loss due to disturbance (tons C yr^{-1})
Dry evergreen forest	254	67.8	0.28	0.47	0.25	2,592
Dry deciduous forests	173,224	37.2	0.28	0.47	0.25	969,170
Moist evergreen forest	4,067	34.2	0.28	0.47	0.25	20,919
Woodlands (semi-evergreen forests)	226,904	43.1	0.28	0.47	0.25	1,470,843
Total	**404,449**					**2,463,523**

This results in the following calculation

Table 11: Total carbon stock change in forestland remaining forestland

Vegetation type	Increase in biomass carbon stocks due to	Carbon loss due to biomass	Carbon loss due to fuelwood removals (t C yr^{-1})	Carbon loss due to	Total carbon stock change in forestland

	biomass growth (t C yr^{-1})	removals (t C yr^{-1})		disturbance (tons C yr^{-1})	remaining forestland
Dry evergreen forest	-1,663	60	1,202	2,592	2,191
Dry deciduous forests	-1,133,616	9	864,098	969,170	699,661
Moist evergreen forest	-26,615	11	20,431	20,919	14,746
Woodlands (semi-evergreen forests)	-1,484,903	1,523	1,222,235	1,470,843	1,209,698
Eucalyptus	-5,990	9			-5,981
Pinus	-2,173	381			-1,792
Total (tC)	**-2,654,960**	**1,993**	**2,107,965**	**2,463,523**	**1,918,523**
				Total (tCO2)	**7,034,579.536**

Forest land converted to Cropland

Emissions from Forestland converted to Cropland are estimated using equations 17 – 20 above.

Table 12: Total carbon stock change in above ground and below ground biomass

Vegetation type	Area converted (ha)	Biomas stocks before the conversion (Tonnes/ha)	Biomas stocks after the conversion (Tonnes/ha)	Carbon Fraction of Dry Matter (Tonnes C / Tonne)	Total carbon stock change in ABG and BGB
Dry Evergreen Forest	6	86.8	7.9	0.47	210
Dry Deciduous Forest	3,866	47.6	7.9	0.47	72,140
Moist Evergreen Forest	91	43.8	7.9	0.47	1,532
Woodlands Forest	5,064	55.1	7.9	0.47	112,347
Total	**9,027**				**186,228**

Table 13: Total carbon stock change

	Total carbon stock change in ABG and BGB	Total carbon stock change in deadwood and litter	Total carbon stock change in SOC	Total carbon stock change
T C	186,228	3,194	23,376	212,798.1
			T CO2	780,259.5

Forest land converted to Settlement

Emissions from Forestland converted to settlements are estimated using equations 21 – 24 above.

Table 14: Total carbon stock change in above ground and belowground biomass

Vegetation type	Area converted (ha)	Biomass stocks before the conversion (Tonnes/ha)	Biomass stocks after the conversion (Tonnes/ha)	Carbon Fraction of Dry Matter (Tonnes C / Tonne)	Total carbon stock change in ABG and BGB
Dry Evergreen Forest	1.7	86.8	20.8	0.47	52
Dry Deciduous Forest	1,137.1	47.6	20.8	0.47	14,323
Moist Evergreen Forest	26.7	43.8	20.8	0.47	289
Woodlands Forest	1,489.5	55.1	20.8	0.47	24,012
Total	**2,655**				**38,676**

Table 15: Total carbon stock change

	Total carbon stock change in ABG and BGB	Total carbon stock change in deadwood and litter	Total carbon stock change in SOC	Total carbon stock change
T C	38,676	2,001	3,023	43,700
			T CO2	160,233.6

Cropland converted to Forest Land

Removals from Cropland to Forestland are estimated using equations 25 – 28 above.

Table 16: Total carbon stock change in above ground and below ground biomass

Vegetation type	Area converted (ha)	Biomass stocks before the conversion (Tonnes/ha)	Biomass stocks after the conversion (Tonnes/ha)	Carbon Fraction of Dry Matter (Tonnes C / Tonne)	Total carbon stock change in ABG and BGB
Dry evergreen forest	20,709	7.9	86.8	0.47	-509,034
Total	20,709				

Table 17: Total carbon stock change

	Total carbon stock change in ABG and BGB	Total carbon stock change in deadwood and litter	Total carbon stock change in SOC	Total carbon stock change
T C	-509,034	-11,613	-16,323	-536,970
			T CO2	-1,968,888

Cropland remaining cropland

Below are the steps in the calculation of increased removals from CSA practices in cropland remaining cropland resulting in the calculation using equation 29 above. Dedicated spreadsheets have been used for this calculation which are referenced below.

Survey data processing

The data collection is described in section 2.2. The data used in processing is contained in relevant documents[73] where all the raw data of the surveys conducted for the year 2024 as downloaded from Mobile Applications. These data were stratified based on the two main AEZ in the project area and the districts.

Table 18: Districts and shares of cropland of the two AEZ strata

AEZ	Districts	% Share of cropland of main crops
AEZ I	Nyimba, Mambwe, Petauke	22%
AEZ IIa	Chadiza, Chasefu, Chipangali, Chipata, Kasenengwa, Katete, Lumezi, Lundazi, Lusangazi, Sinda, Vubwi	78%

[73] ZIFLP_CSA_survey_data_2024 (Excel)
20250709 MRV Tool Zone Update 2025 (Excel)
20250709 MRV Tool Zone IIa_update 2025 (Excel)

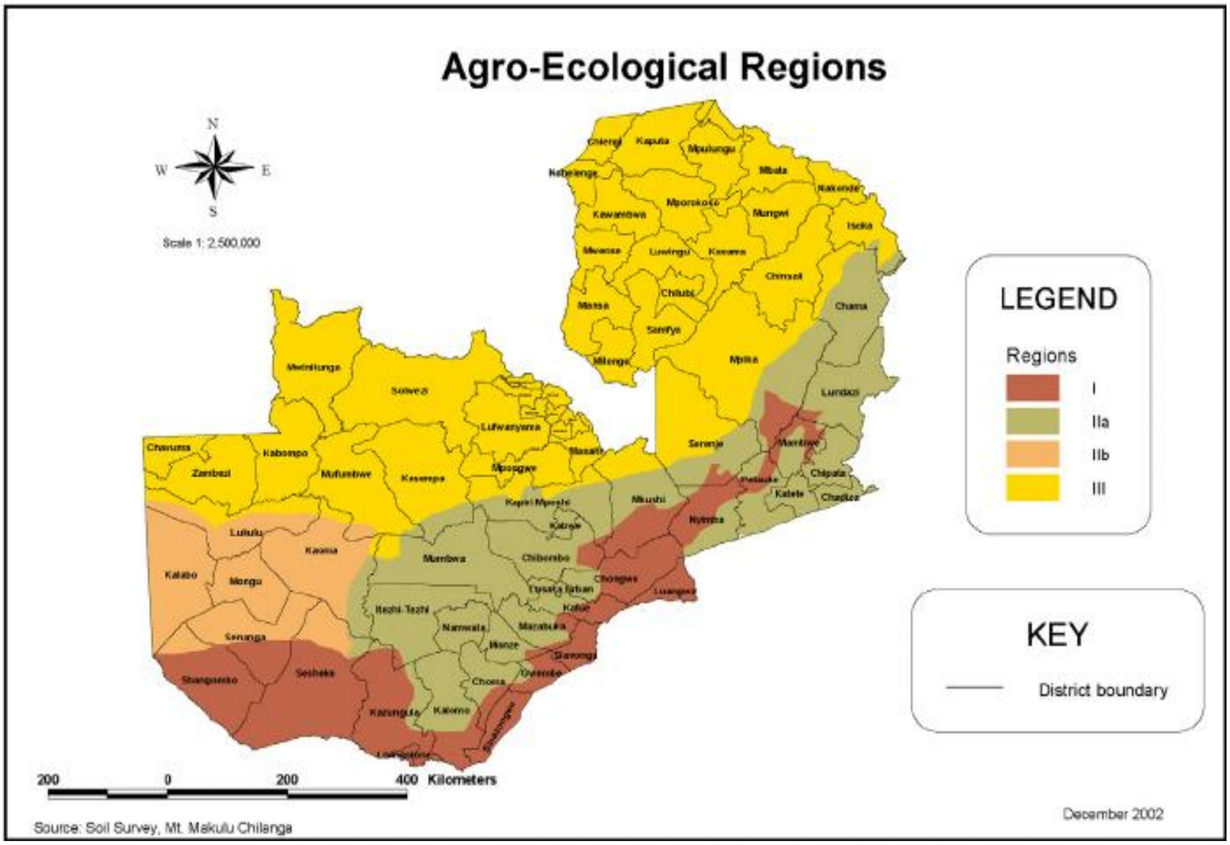

Figure 5: Agroecological Zones in Zambia

The survey data then were fed into the two corresponding MRV Tools '20250709 MRV Tool Zone I_update 2025' and '20250709 MRV Tool Zone IIa_update 2025'. In each of the two workbooks, the yellow tabs represent the survey data structured into survey areas, crop information (only main crops considered), agricultural input information, livestock information and practice adoption areas. The grey tabs represent calculation tabs for the different survey data following the guidance of VM0017. Relevant processing and calculations include:

- Crop yield calculation from local units to metric tonnes
- Crop residue calculation using residue to product ratios (from peer-reviewed literature) for the main crops
- Manure calculation using IPCC equations
- Adoption % calculation of agriculture practices

Results for the year 2024 are shown in the blue tab 'Results monitoring'. Among many other results, the most relevant for the soil modelling of CSA practices are the residue inputs for the main crops and the adoption % of these practices:

- **AEZ I result (the orange marked cells are further pasted into the soil model)**

<u>Mulching inputs</u>

The assessment of mulching inputs for presents detailed results AEZ I on crop residue contributions to soil carbon management within the ISFL program area. The table below reports crop shares (%), total cultivated area (ha), and the estimated residue carbon available (tC) both in aggregate and per hectare. To ensure statistical robustness, the analysis includes the standard deviation (STD), sample count (COUNT), and standard error (SE) of residue carbon available for mulching per hectare. Minimum (PMIN) and maximum (PMAX) values are also provided to capture variability across crop types and production systems. These results highlight the distribution and potential of crop residues to support soil fertility and sustainable land management under ISFL monitoring frameworks.

Table 19: AEZ I Mulching inputs

Crop	Total area (ha)	Total residue carbon available (tC)	Total, residue carbon available per ha (tC/ha)	STD_Residue carbon for mulching per ha (tC/ha)	COUNT_Residue carbon for mulching per ha (No)	SE_Residue carbon for mulching per ha (%)	P_{MIN} _Residue carbon for mulching per ha (tC/ha)	P_{MAX} _Residue carbon for mulching per ha (tC/ha)
Maize	281.62	439.53	1.56	2.78	172	14%	1.15	1.98
Soya beans	48.025	64.99	1.35	1.42	46	15%	0.94	1.76
Groundnuts	27.525	22.72	0.83	0.87	44	16%	0.57	1.08
Sunflower	50.5	16.55	0.33	0.42	48	18%	0.21	0.45
Total		557.39	1.30	2.28	346	9%	1.06	1.54

Manure inputs

The analysis of manure inputs provides detailed results for AEZ I on the contribution of organic amendments to soil carbon enrichment across different land unit types within the ISFL program area. The table below presents values for compost and manure applications, expressed as residue carbon per hectare per application (tC/ha/application). For each input type, the results include measures of variability such as the standard deviation (STD), sample count (COUNT), and standard error (SE), alongside minimum (PMIN) and maximum (PMAX) values. These indicators capture the distribution and range of residue carbon contributions from compost and manure, offering insights into their role in supporting soil fertility, enhancing productivity, and strengthening sustainable land management practices under ISFL monitoring frameworks.

Table 20: AEZ I Manure inputs

Land unit type	Compost (tC/ha/application)	STD_Residue carbon for compost per ha (tC/ha/application)	COUNT_Residue carbon for compost per ha (No)	SE_Residue carbon for compost per ha (%)	PMIN_Residue carbon for compost per ha (tC/ha/application)	PMAX_Residue carbon for compost per ha (tC/ha/application)	Manure (tC/ha/application)	STD_Residue carbon for manure per ha (tC/ha/application)	COUNT_Residue carbon for manure per ha (No)	SE_Residue carbon for manure per ha (%)	PMIN_Residue carbon for manure per ha (tC/ha/application)	PMAX_Residue carbon for manure per ha (tC/ha/application)
ZIFLP	0.17	0.45	264.00	16%	0.12	0.23	0.17	0.45	264.00	16%	0.12	0.23
Total	0.17	0.45	264.00	16%	0.12	0.23	0.17	0.45	264.00	16%	0.12	0.23

Adoption rates

The adoption of climate-smart technologies for AEZ I is tracked to assess their scale of implementation and uptake across the ISFL program area. The table below presents results by technology type, indicating the total area where each practice has been implemented (ha) and the corresponding adoption rate (%). These metrics provide a clear picture of how widely different interventions are being applied, highlighting both the extent of land coverage and the relative share of farmers or land units adopting each technology. The results offer valuable insights into patterns of technology diffusion, supporting evaluation of program effectiveness and guiding future efforts to strengthen sustainable land management practices.

Table 21: AEZ Adoption rates

	2024	
Technology	**Area implemented (ha)**	**Adoption rate (%)**
Full tillage	0.00	0%
Zero tillage	0.00	0%
Reduced tillage	188.30	30%
Residue mulching	243.30	39%
Composting	67.60	11%
Soil fertility trees	164.95	26%
Inorganic fertilizer	362.74	58%

AEZ II result
the orange marked cells are further pasted into the soil model

Mulching inputs

The assessment of mulching inputs for presents detailed results AEZ II on crop residue contributions to soil carbon management within the ISFL program area. The table below reports crop shares (%), total cultivated area (ha), and the estimated residue carbon available (tC) both in aggregate and per hectare. To ensure statistical robustness, the analysis includes the standard deviation (STD), sample count (COUNT), and standard error (SE) of residue carbon available for mulching per hectare. Minimum (PMIN) and maximum (PMAX) values are also provided to capture variability across crop types and production systems. These results highlight the distribution and potential of crop residues to support soil fertility and sustainable land management under ISFL monitoring frameworks.

Table 22: AEZ Mulching inputs

Crop shares (%)	Total area (ha)	Total residue carbon available (tC)	Total residue carbon available per ha (tC/ha)	STD_Residue carbon for mulching per ha (tC/ha)	COUNT_Residue carbon for mulching per ha (No)	SE_Residue carbon for mulching per ha (%)	P_{MIN} _Residue carbon for mulching per ha (tC/ha)	P_{MAX} _Residue carbon for mulching per ha (tC/ha)
Maize	1772.3906	3,485.69	1.97	4.76	1,006	8%	1.67	2.26
Seed cotton	3.4388	2.65	0.77	0.20	6	11%	0.61	0.93
Groundnuts	172.4269	237.38	1.38	1.47	234	7%	1.19	1.56
Sunflower	119.5356	36.70	0.31	0.24	150	6%	0.27	0.35
Total		4,271.24	1.72	3.96	1,725	6%	1.53	1.91

Manure inputs

The analysis of manure inputs provides detailed results for AEZ II on the contribution of organic amendments to soil carbon enrichment across different land unit types within the ISFL program area. The table below presents values for compost and manure applications, expressed as residue carbon per hectare per application (tC/ha/application). For each input type, the results include measures of variability such as the standard deviation (STD), sample count (COUNT), and standard error (SE), alongside minimum (PMIN) and maximum (PMAX) values. These indicators capture the distribution and range of residue carbon contributions from compost and manure, offering insights into their role in supporting soil fertility, enhancing productivity, and strengthening sustainable land management practices under ISFL monitoring frameworks.

Table 23: AEZ II Manure inputs

Land unit type	Compost (tC/ha/application)	STD_Residue carbon for compost per ha (tC/ha/application)	COUNT_Residue carbon for compost per ha (No)	SE_Residue carbon for compost per ha (%)	PMIN_Residue carbon for compost per ha (tC/ha/application)	PMAX_Residue carbon for compost per ha (tC/ha/application)	Manure (tC/ha/application)	STD_Residue carbon for manure per ha (tC/ha/application)	COUNT_Residue carbon for manure per ha (No)	SE_Residue carbon for manure per ha (%)	PMIN_Residue carbon for manure per ha (tC/ha/application)	PMAX_Residue carbon for manure per ha (tC/ha/application)
ZIFLP	0.16	0.50	1536.00	8%	0.13	0.18	0.16	0.50	1536.00	8%	0.13	0.18
Total	0.16	0.50	1536.00	8%	0.13	0.18	0.16	0.50	1536.00	8%	0.13	0.18

Adoption rates

Table 24: AEZ II Adoption rates

Select Technology	Area implemented (ha)	Adoption rate (%)
Full tillage	0.00	0.0%
Zero tillage	0.00	0.0%
Reduced tillage	1,301.23	31.4%
Residue mulching	1,362.56	32.9%
Composting	1,169.27	28.2%
Soil fertility trees	1,147.89	27.7%
Inorganic fertilizer	2,325.47	56.1%

Soil inputs from short-term soil fertility trees (e.g. Gliricidia sepium)

The estimation of soil inputs derived from tree rows established as a Climate-Smart Agriculture (CSA) practice on cropland was informed by a peer-reviewed reference study. In line with ISFL monitoring protocols, calculations were conducted directly within the survey dataset *ZIFLP_CSA_survey_data_2024*, under the tab *Trees soil inputs*. This approach ensures methodological consistency, transparency, and traceability of results, while maintaining alignment with internationally recognized standards for CSA impact assessment.

AEZ I tree soil inputs

The results for tree soil inputs in AEZ I are presented as average totals, alongside minimum (Pmin) and maximum (Pmax) values, providing a clear range of residue carbon contributions across land units.

Table 25: AEZ I Tree soil inputs

Carbon inputs for RothC	Average totals	Pmin totals	Pmax totals
Short term trees per ha	76	22	130
$Input\_AGB_{short\ term\ trees}$ (t d.m./ha)	0.07	0.0200	0.1159
Total Carbon Inputs (tC)	0.0319	0.0094	0.0545

AEZ IIa tree soil inputs

The results for tree soil inputs in AEZ II are presented as average totals, alongside minimum (Pmin) and maximum (Pmax) values, providing a clear range of residue carbon contributions across land units.

Table 26: AEZ IIa Tree soil inputs

AEZ IIa	Average totals	Pmin totals	Pmax totals
Short term trees per ha	256	174	338
$B_{short\ term\ trees}$ (kg d.m./ha)	1,562	1,062	2,061
FCR (kgN/yr)	1.19	0.81	1.57
N2O direct-N (tCO2)	0.0049	0.0034	0.0065

For tree soil inputs, adoption is reported as 100%. This reflects the methodological approach whereby calculations are based on the entire cropland area under consideration, rather than being restricted to plots where tree rows are physically established. By applying this area-wide accounting method, the results capture the full contribution of tree soil inputs within the ISFL program boundary, ensuring consistency with adoption metrics used across CSA practices.

RothC soil modelling

SOC input factors for mulching, composted manure, soil fertility trees, and adoption rates were parameterized from MRV tools[74] and integrated into two RothC soil models representing distinct agro-climatic strata. Both models were updated with five-year average climate data, while baseline parameters from ERPD validation were retained to ensure comparability.

RothC model for AEZ I (tab 'Project_input_data')

[74] 20250612 EP_climate & soil para for RothC
20250612 EP_RothC model_AEZ_I_ex-post
20250612 EP_RothC model_AEZ_IIa_ex-post

Table 27: AEZ I Meteorological and soil parameters

Meteorological and soil parameters		
Mean annual solar radiation W / m²	1,360	
Decimal Latitude	-14.024164	
Inclination	23.44	

Minimum temperature in °C

Month	**Baseline scenario**			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
Jan	19.5	19.1	19.9	19.7	19.3	20.1
Feb	19.3	18.9	19.7	20.0	19.3	20.8
Mar	18.3	17.9	18.7	18.8	18.1	19.5
Apr	16.4	16.2	16.7	17.3	16.6	18.0
May	14.0	13.6	14.3	14.6	14.0	15.1
Jun	11.9	11.7	12.2	12.6	11.9	13.2
Jul	12.0	11.7	12.4	12.5	11.9	13.1
Aug	13.7	13.5	13.9	14.4	14.3	14.6
Sep	17.4	17.1	17.7	17.8	17.1	18.4
Oct	20.6	20.0	21.1	21.2	20.5	22.0
Nov	20.8	20.3	21.2	22.2	21.3	23.0
Dec	20.2	19.8	20.5	22.1	20.8	23.4

Maximum temperature in °C

Month	**Baseline scenario**			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
Jan	28.9	28.3	29.4	29.4	28.9	29.9
Feb	29.2	28.6	29.7	30.0	29.2	30.9
Mar	28.6	28.1	29.1	29.4	28.6	30.2
Apr	28.3	27.9	28.6	29.4	28.6	30.1
May	27.6	27.2	28.0	28.4	27.7	29.0
Jun	25.8	25.3	26.2	26.3	25.5	27.2
Jul	26.0	25.3	26.6	26.3	25.5	27.0
Aug	28.7	28.2	29.2	29.2	28.7	29.6
Sep	32.6	32.2	33.0	32.8	32.1	33.6
Oct	35.4	34.8	36.0	36.0	35.2	36.8
Nov	33.9	33.4	34.5	35.2	34.2	36.2

Dec	30.6	30.1	31.2	32.8	31.4	34.2

Precipitation in mm

Month	Baseline scenario			Project scenario		
	Mean	Pmin	Pmax	Mean	Pmin	Pmax
Jan	248.7	194.5	302.8	323.3	289.0	357.5
Feb	191.1	150.4	231.8	199.9	149.2	250.7
Mar	139.4	96.9	181.9	118.5	74.4	162.6
Apr	20.3	15.1	25.5	35.2	18.1	52.2
May	4.7	1.6	7.8	1.2	0.5	2.0
Jun	1.5	0.8	2.2	1.0	0.4	1.6
Jul	0.3	-0.1	0.7	0.1	0.0	0.2
Aug	0.0	0.0	0.0	0.1	0.0	0.1
Sep	1.1	0.5	1.7	0.3	0.1	0.4
Oct	7.8	5.4	10.3	11.1	6.3	15.9
Nov	67.5	43.3	91.7	57.3	37.0	77.6
Dec	212.4	179.8	245.0	160.0	113.3	206.8

Clay content in %

Baseline scenario			Project scenario		
Mean	Pmin	Pmax	Mean	Pmin	Pmax
24%	24%	25%	24%	24%	25%

Table 28: AEZ I Cropping calendar

Cropping calendar							
		month	year				
Start cropping year		Jul	2024	**Month**	**Code**	**First season**	**Second season**
				Jan	7	First season	
Second cropping season		No		Feb	8	First season	
				Mar	9	First season	
First season	**Start**	Jul		Apr	10	First season	
	End	May		May	11	First season	
				Jun	12		
Second season	**Start**	Jun		Jul	1	First season	
	End	Jun		Aug	2	First season	

				Sep	3	First season	
				Oct	4	First season	
				Nov	5	First season	
				Dec	6	First season	

Table 29: AEZ I Soil inputs of management practices

Soil inputs of management practices in tC / ha									
First season									
	Baseline scenario					Project scenario			
	Mean	Pmin	Pmax	Input		Mean	Pmin	Pmax	Input
Mulching	0.930	0.834	1.026	End	Mulching	1.299	1.059	1.539	End
Compost	0.000	0.000	0.000	Start	Compost	0.000	0.000	0.000	Start
Manure	0.081	0.073	0.089	Start	Manure	0.173	0.118	0.228	Start
Agroforestry	0.00	0.002	0.002	Start	Agroforestry	0.032	0.009	0.054	Start

The adoption rates of the CSA practices and the total cropland remaining cropland areas (from the activity data analysis) are inserted in the tab ‘Project_removals’:

Table 30: Total area in ha and land implementation areas of management practices as percentage of total area

Total area in ha and implementation areas of management practices as percentage of total area			
Total area in ha	321,721		
First season			
	Baseline scenario		Project scenario
Mulching	9%	Mulching	39%
Compost	0%	Compost	0%
Manure	2%	Manure	11%
Agroforestry	5%	Agroforestry	26%

RothC model for AEZ IIa (tab ‘Project_input_data’)

Table 31: AEZ II Meteorological and soil parameters

Meteorological and soil parameters					
Mean annual solar radiation W / m²	1,360				

Decimal Latitude		-13.191779				
Inclination		23.44				
Minimum temperature in °C						
Month	**Baseline scenario**			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
Jan	17.4	17.1	17.7	17.6	17.3	17.9
Feb	17.7	17.3	18.0	18.2	17.4	19.0
Mar	17.1	16.8	17.5	17.4	16.8	18.0
Apr	15.6	15.3	15.8	16.3	15.7	16.9
May	13.4	13.1	13.8	13.8	13.2	14.3
Jun	10.8	10.6	11.0	11.0	10.3	11.7
Jul	10.3	9.9	10.7	10.5	9.7	11.2
Aug	12.2	11.9	12.4	12.9	12.6	13.2
Sep	15.6	15.2	16.0	15.8	15.2	16.5
Oct	18.0	17.6	18.5	18.7	18.2	19.2
Nov	18.2	17.8	18.5	19.5	18.9	20.0
Dec	17.8	17.5	18.1	19.6	18.3	20.8
Maximum temperature in °C						
Month	**Baseline scenario**			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
Jan	27.3	26.7	27.8	27.7	27.0	28.3
Feb	27.4	26.9	28.0	28.3	27.4	29.3
Mar	26.9	26.4	27.4	27.5	26.8	28.2
Apr	27.0	26.6	27.3	27.9	27.1	28.6
May	26.3	25.9	26.6	26.7	26.0	27.4
Jun	24.6	24.3	25.0	24.8	23.9	25.6
Jul	24.7	24.2	25.2	24.9	24.0	25.7
Aug	27.4	26.8	28.0	27.6	27.0	28.2
Sep	30.2	29.4	30.9	30.5	29.4	31.5
Oct	32.4	31.8	33.1	33.0	32.1	33.9
Nov	31.2	30.7	31.7	32.2	31.4	33.1
Dec	28.8	28.4	29.2	30.6	29.3	31.9
Precipitation in mm						
Month	**Baseline scenario**			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
Jan	249.9	220.5	279.4	307.0	261.5	352.5

Feb	258.2	228.4	288.0	228.2	183.3	273.0
Mar	158.4	138.6	178.2	163.8	107.6	219.9
Apr	43.8	33.9	53.7	45.8	25.3	66.2
May	8.0	4.9	11.2	1.7	0.8	2.6
Jun	1.4	0.4	2.4	1.5	-0.1	3.0
Jul	0.3	0.0	0.7	0.5	0.0	0.9
Aug	0.3	0.0	0.6	0.7	0.1	1.3
Sep	0.9	0.5	1.2	0.3	0.2	0.5
Oct	12.4	9.1	15.8	12.9	5.6	20.3
Nov	58.6	42.5	74.7	51.7	41.4	62.1
Dec	226.7	200.1	253.3	173.2	105.2	241.3
Clay content in %						
	Baseline scenario			**Project scenario**		
	Mean	**Pmin**	**Pmax**	**Mean**	**Pmin**	**Pmax**
	24%	24%	25%	24%	24%	25%

Table 32: Cropping calendar- AEZ II

Cropping calendar							
		month	year				
Start cropping year		Jul	2024	**Month**	**Code**	**First season**	**Second season**
				Jan	7	First season	
Second cropping season		No		Feb	8	First season	
				Mar	9	First season	
First season	**Start**	Jul		Apr	10	First season	
	End	May		May	11	First season	
				Jun	12		
Second season	**Start**	Jun		Jul	1	First season	
	End	Jun		Aug	2	First season	
				Sep	3	First season	
				Oct	4	First season	
				Nov	5	First season	
				Dec	6	First season	

Table 33: Soil inputs of management practices in tC/ha

Soil inputs of management practices in tC / ha									
First season									
	Baseline scenario					Project scenario			
	Mean	Pmin	Pmax	Input		Mean	Pmin	Pmax	Input
Mulching	1.262	1.184	1.339	End	Mulching	1.718	1.531	1.905	End
Compost					Compost				
Manure	0.069	0.063	0.075	Start	Manure	0.156	0.131	0.181	Start
Agroforestry	0.007	0.007	0.007	Start	Agroforestry	0.108	0.073	0.142	Start

The adoption rates of the CSA practices and the total cropland remaining cropland areas (from the activity data analysis) are inserted in the tab 'Project_removals':

Table 34: AEZ II Total area in ha and implementation areas of management practices as percentage of total areas

Total area in ha and implementation areas of management practices as percentage of total area			
Total area in ha		1,140,649	
First season			
	Baseline scenario		Project scenario
Mulching	13%	Mulching	33%
Compost	0%	Compost	0%
Manure	1%	Manure	28%
Agroforestry	5%	Agroforestry	28%

Modelling results

RothC modelling results for AEZ I and AEZ IIa show Soil Organic Carbon (SOC) density (tC/ha) as average, minimum (Pmin), and maximum (Pmax) values under ISFL monitoring protocols.

AEZ I:

Table 35: AEZ I SOC density tC/ha

SALM	Scenario	Season	Value	SOC density tC/ha																				Mean (20 years)
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Mulching	Baseline	first	Mean	0.776	1.171	1.488	1.750	1.971	2.162	2.330	2.482	2.621	2.750	2.872	2.988	3.099	3.206	3.310	3.411	3.509	3.605	3.698	3.790	0.189
Compost	Baseline	first	Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Baseline	first	Mean	0.040	0.072	0.099	0.121	0.141	0.158	0.173	0.187	0.200	0.212	0.223	0.234	0.245	0.255	0.265	0.275	0.284	0.293	0.302	0.311	0.016
Agroforestry	Baseline	first	Mean	0.001	0.003	0.003	0.004	0.005	0.005	0.006	0.006	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.000
Mulching	Project	first	Mean	1.076	1.615	2.041	2.388	2.678	2.927	3.148	3.347	3.530	3.701	3.863	4.017	4.166	4.310	4.449	4.584	4.716	4.845	4.971	5.094	0.255
Compost	Project	first	Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Project	first	Mean	0.084	0.150	0.204	0.249	0.287	0.321	0.352	0.380	0.406	0.430	0.454	0.476	0.498	0.519	0.539	0.559	0.579	0.598	0.616	0.634	0.032
Agroforestry	Project	first	Mean	0.021	0.037	0.049	0.059	0.068	0.075	0.081	0.086	0.091	0.095	0.099	0.103	0.107	0.111	0.114	0.118	0.121	0.124	0.127	0.130	0.007
Mulching	Baseline	first	Pmax	0.859	1.300	1.657	1.953	2.203	2.420	2.611	2.784	2.942	3.089	3.227	3.359	3.484	3.605	3.722	3.836	3.946	4.054	4.160	4.263	0.213
Compost	Baseline	first	Pmax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Baseline	first	Pmax	0.045	0.081	0.111	0.136	0.158	0.177	0.194	0.210	0.225	0.238	0.251	0.264	0.276	0.287	0.298	0.309	0.320	0.330	0.341	0.350	0.018
Agroforestry	Baseline	first	Pmax	0.001	0.003	0.004	0.004	0.005	0.005	0.006	0.006	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.009	0.010	0.000
Mulching	Project	first	Pmax	1.287	1.943	2.471	2.906	3.273	3.591	3.872	4.125	4.357	4.573	4.776	4.969	5.155	5.333	5.506	5.674	5.838	5.998	6.154	6.307	0.315
Compost	Project	first	Pmax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Project	first	Pmax	0.113	0.204	0.279	0.343	0.397	0.445	0.488	0.528	0.564	0.598	0.631	0.662	0.692	0.721	0.749	0.776	0.803	0.829	0.855	0.880	0.044
Agroforestry	Project	first	Pmax	0.036	0.065	0.088	0.107	0.122	0.135	0.147	0.157	0.166	0.174	0.181	0.189	0.195	0.202	0.208	0.214	0.220	0.226	0.231	0.237	0.012
Mulching	Baseline	first	Pmin	0.693	1.042	1.320	1.547	1.737	1.901	2.046	2.177	2.297	2.408	2.514	2.615	2.711	2.804	2.895	2.982	3.068	3.152	3.233	3.313	0.166
Compost	Baseline	first	Pmin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Baseline	first	Pmin	0.036	0.064	0.087	0.106	0.123	0.138	0.151	0.163	0.174	0.184	0.194	0.204	0.213	0.222	0.231	0.239	0.247	0.256	0.263	0.271	0.014
Agroforestry	Baseline	first	Pmin	0.001	0.003	0.003	0.004	0.005	0.005	0.006	0.006	0.006	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	0.009	0.000
Mulching	Project	first	Pmin	0.869	1.300	1.635	1.904	2.128	2.321	2.492	2.646	2.788	2.922	3.048	3.169	3.286	3.399	3.508	3.615	3.718	3.820	3.919	4.015	0.201

Compost	Project	first	Pmin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Project	first	Pmin	0.056	0.100	0.135	0.165	0.189	0.211	0.231	0.249	0.266	0.283	0.298	0.313	0.327	0.341	0.354	0.368	0.380	0.393	0.405	0.417	0.021
Agroforestry	Project	first	Pmin	0.006	0.011	0.014	0.017	0.019	0.021	0.023	0.024	0.025	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.002

BSequil and PSequil values (tC/ha) were modelled over a 20-year period for each CSA practice, using average, Pmin, and Pmax input parameters. The resulting outputs are presented in the Results tab and relevant documents[75] to support this is provided in the footnote.

AEZ IIa

Table 36: AEZ II SOC density tC/ha

SALM	Scenario	Season	Value	SOC density tC/ha																				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean (20 years)
Mulching	Baseline	first	Mean	1.067	1.605	2.040	2.398	2.701	2.963	3.194	3.403	3.594	3.771	3.938	4.097	4.249	4.395	4.537	4.675	4.809	4.940	5.067	5.193	0.260
Compost	Baseline	first	Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Baseline	first	Mean	0.035	0.062	0.085	0.105	0.122	0.136	0.149	0.162	0.173	0.183	0.193	0.203	0.212	0.221	0.229	0.238	0.246	0.254	0.262	0.269	0.000
Agroforestry	Baseline	first	Mean	0.005	0.009	0.012	0.014	0.016	0.018	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.000
Mulching	Project	first	Mean	1.450	2.176	2.757	3.234	3.636	3.982	4.288	4.564	4.817	5.053	5.275	5.486	5.689	5.885	6.074	6.259	6.438	6.613	6.785	6.952	0.013
Compost	Project	first	Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Manure	Project	first	Mean	0.077	0.139	0.190	0.232	0.269	0.301	0.330	0.356	0.381	0.404	0.426	0.447	0.467	0.487	0.506	0.524	0.542	0.560	0.577	0.594	0.348

[75] 20250612 EP_RothC model_AEZ_I_ex-post, tabs 'Results' and 'Project removals'

20250612 EP_RothC model_AEZ_IIa_ex-post, tabs 'Results' and 'Project removals'

Agroforestry	Project	first	Mean	0.071	0.127	0.172	0.208	0.237	0.262	0.284	0.303	0.320	0.336	0.351	0.365	0.378	0.390	0.402	0.414	0.426	0.437	0.448	0.458	0.000
Mulching	Baseline	first	Pmax	1.137	1.713	2.182	2.571	2.900	3.186	3.438	3.666	3.874	4.067	4.249	4.421	4.586	4.745	4.899	5.048	5.193	5.335	5.473	5.609	0.000
Compost	Baseline	first	Pmax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Baseline	first	Pmax	0.038	0.069	0.094	0.116	0.134	0.151	0.166	0.179	0.192	0.203	0.214	0.225	0.235	0.245	0.254	0.264	0.273	0.282	0.290	0.299	0.030
Agroforestry	Baseline	first	Pmax	0.005	0.009	0.012	0.014	0.017	0.018	0.020	0.021	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.029	0.030	0.031	0.032	0.032	0.023
Mulching	Project	first	Pmax	1.623	2.447	3.118	3.675	4.149	4.559	4.923	5.249	5.549	5.826	6.087	6.335	6.571	6.799	7.019	7.233	7.440	7.643	7.842	8.036	0.280
Compost	Project	first	Pmax	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Project	first	Pmax	0.091	0.166	0.228	0.280	0.326	0.366	0.402	0.434	0.465	0.493	0.520	0.545	0.570	0.594	0.617	0.639	0.661	0.683	0.703	0.724	0.000
Agroforestry	Project	first	Pmax	0.096	0.173	0.236	0.287	0.329	0.366	0.397	0.425	0.449	0.472	0.493	0.512	0.531	0.548	0.565	0.582	0.598	0.613	0.628	0.643	0.000
Mulching	Baseline	first	Pmin	0.998	1.499	1.902	2.233	2.512	2.753	2.966	3.157	3.333	3.496	3.650	3.797	3.937	4.072	4.203	4.330	4.454	4.575	4.693	4.808	0.015
Compost	Baseline	first	Pmin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Manure	Baseline	first	Pmin	0.031	0.056	0.077	0.095	0.110	0.123	0.134	0.145	0.155	0.165	0.174	0.182	0.190	0.198	0.206	0.214	0.221	0.228	0.235	0.242	0.402
Agroforestry	Baseline	first	Pmin	0.005	0.009	0.012	0.014	0.016	0.018	0.019	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.027	0.028	0.029	0.030	0.030	0.031	0.000
Mulching	Project	first	Pmin	1.280	1.919	2.426	2.839	3.186	3.484	3.748	3.985	4.203	4.407	4.599	4.783	4.959	5.129	5.294	5.454	5.610	5.763	5.912	6.057	0.000
Compost	Project	first	Pmin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manure	Project	first	Pmin	0.064	0.115	0.156	0.191	0.221	0.247	0.270	0.292	0.312	0.331	0.349	0.366	0.382	0.398	0.414	0.429	0.444	0.458	0.473	0.487	0.036
Agroforestry	Project	first	Pmin	0.048	0.085	0.114	0.138	0.157	0.174	0.188	0.200	0.211	0.222	0.231	0.240	0.249	0.257	0.265	0.273	0.281	0.288	0.295	0.302	0.032

In the tab 'Project_removals' finally equation 29 (see above) is applied to derive the total annual PRS of the project (in this case for 2024). This is done in cell B45 of this tab. Further, the same calculation is done for the P_{min} and the P_{max} values (see cells B46 and B47). Based on this and the uncertainty guidance provided in section IV.2.8 (Uncertainty analysis) of VM0017 the uncertainty of PRS is calculated. The final step is then taken by adjusting PRS with the uncertainty discount given in VM0017. Consequently, the PRS_{adj} represents the total SOC benefits from CSA for the year 2024 in each AEZ:

AEZ I

Table 37: AEZ I Project removals due to changes in soil organic carbon

Project removals due to changes in soil organic carbon							
For the cropping year starting in		Jul	2024				
First season							
PRS	103,852.89	tCO_2		PRS adj	92,475	t CO2	
PRS min	78,641.40	tCO_2			0.29	t CO2 / ha of total land	
PRS max	132,552.90	tCO_2					
Uncertainty	26%						

AEZ IIa

Table 38: AEZ IIa Project removals due to changes in soil organic carbon

Project removals due to changes in soil organic carbon							
For the cropping year starting in		Jul	2024				
First season							
PRS	401,769.99	tCO_2		PRS adj	387,756	t CO2	
PRS min	335,051.36	tCO_2			0.34	t CO2 / ha of total land	
PRS max	483,611.33	tCO_2					
Uncertainty	18%						

The resulting modelled results are summarized in **Error! Reference source not found.**.

Table 39: Summary of modelled results for cropland remaining cropland in 2024

Stratum	Area (ha)	Total 2024 PRS (uncertainty adjusted) (tCO2e)
AEZ I	321,721	-92,475
AEZ IIa	1,140,649	-387,756
Total	1,462,370	-480,231

All spreadsheets referenced above will be made available to the VVB for verification.

Grassland converted to cropland

Emissions from Grassland converted to Cropland are estimated using equations 30 – 33 above.

Table 40: Total carbon stock change in above ground and below ground biomass

Vegetation type	Area converted (ha)	Biomass stocks before the conversion (Tonnes/ha)	Biomass stocks after the conversion (Tonnes/ha)	Carbon Fraction of Dry Matter (Tonnes C / Tonne)	Total carbon stock change in ABG and BGB
Cropland	265.5	8.8	7.9	0.47	112
Total					

Table 41: Total carbon stock change

	Total carbon stock change in ABG and BGB	Total carbon stock change in deadwood and litter	Total carbon stock change in SOC	Total carbon stock change
T C	112	0	49	161.2
			T CO2	591.1

Table 42: Emissions/ Removals

Year of Reporting Period t	Emissions/Removals						
	Sub category 1	Sub category 2	Sub category 3	Sub category 4	Sub category 5	Sub category 6	Total Emissions /Removals (tCO_2e)
	Forestland Remaining Forestland	*Forestland converted to Cropland*	*Forestland converted Settlements*	*Cropland converted to forestland*	*Cropland remaining cropland*	*Grassland converted to Cropland*	
2024	7,034,579	780,259	160,233	-1,968,888	-480,230	591	5,526,544
Actual net GHG Emissions from the ISFL ER Program during the Reporting Period							5,526,544

3.3 Calculation of Emission Reductions

Table 43: Calculation of Emission Reductions

T.1	Actual net GHG Emissions from the ISFL ER Program during the Reporting Period (tCO2-e)	5,526,544
	Total net Emissions Baseline during the Reporting Period (tCO2-e)	10,216,216
	Net Emission Reductions during the Reporting Period (tCO2-e)	4,689,672

	Year	2024	20xx	...
T.2	Actual net GHG Emissions from the ISFL ER Program during the Reporting Period (tCO2-e)	5,526,544		
	Total net Emissions Baseline during the Reporting Period (tCO2-e)	10,216,216		
	Net Emission Reductions during the Reporting Period (tCO2-e)	4,689,672		

3.4 Results for Monitoring, Evaluation and Learning (MEL) Framework

Table 44: 3.4 Results for Monitoring, Evaluation and Learning (MEL) Framework

T.3	*Result*	*Unit*	*2024*
Area of forest remaining forest in ISFL Program areas (corresponding to T2.O1.1 on MEL Framework)		*ha*	*2,859,428*
Area of conversions from forest to other land uses in ISFL Program areas (corresponding to T2.O1.2a on MEL Framework)		*ha*	*12,479*
Area of other land uses converted to forest in ISFL Program areas (corresponding to T2.O1.2b on MEL Framework)		*ha*	*20,709*
Emission Reductions from forest remaining forest as compared to a reference level in ISFL Program areas (corresponding to *T2.O1.3* on MEL Framework)		*tCO2e*	*2,129,607*

4 Uncertainty of the estimate of Emission Reductions

4.1 Initial identification and assessment of sources of Uncertainty

As part of the first step of the Monitoring period, Uncertainty Analysis, ISFL Programs shall (UA) for AFOLU sector was estimated using Approach 2 which applies the Monte Carlo simulation analysis. The uncertainty of the emission reductions was a combination of respective baseline and project activity data and emission factor uncertainties. The methodology adopted a stepwise approach including:

- Step 1. Identify all the variables used in the estimation of emissions and removals and *identify and discuss in qualitative terms the main source(s) of Uncertainty and shall conclude whether* they are independent or shared across multiple calculations.
- Step 2. Identify the uncertainty associated with each of these variables. The distributions of the variables used in the calculation was determined by either using a probability density function (PDF) or by randomly sampling values of the variable from a data set (bootstrapping).
- Step 3. Propagate the uncertainties in the estimate of emission reductions using Monte Carlo simulation. Ten thousand iterations were run with random variations in inputs, capturing the uncertainties in determining both the Emissions Baseline and monitored emissions and removals. The resulting distribution of outputs shows the overall impact of these input uncertainties.

Step 4. Evaluate the *contribution* of each source *to* the overall uncertainty. Identifying and understanding which factors contribute most to overall uncertainty helps prioritize refinement efforts. A useful sensitivity analysis method examines how *total* uncertainty changes when specific input variables are assumed to be known with perfect certainty.

Provided in Table 45 are the identified sources of uncertainty.

Table 45: Sources of uncertainty

Sources of Uncertainty	Parameters and applicable subcategories affected by these sources of Uncertainty	Analysis of contribution to overall Uncertainty
Measurements for fuelwood and consumption	Land- Forest land remaining forest land	Access to security facilities where adequate measurements could not be allowed.
Measurement errors	Land- Forest land remaining forest land	Some Enumerators misunderstanding the data collection protocol in energy data collection and human errors DBH and height measurements in steep mountainous areas. Contribution to uncertainty is low.
Data sources on timber extraction	Land- Forest land remaining forest land	The available data is from FD reports which only capture extracted timber. Contribution to uncertainty is low.
Fire disturbances	Land- Forest land remaining forest land	…..Data used for forest fires was from MODIS which has some inherent uncertainties including underestimates low-intensity fires especially African savannas and confuses burned areas with dark soils or shadows. It also has elements of misclassifying shrubland as forest especially in miombo woodlands and struggles with seasonal variations i.e., dry-season vs. wet-season forests. Contribution to uncertainty is low
Landuse class and vegetation type areas	Land- Forest land remaining forest land	Mixed pixels in transitional zones such as forest-agriculture edges introduces errors and

4.2 Selection of methods and development of Standard Operating Procedures and Quality Assurance/Quality Control procedures

Quality assurance and quality control *in the* EPJSLP MRV System is supported through the application *of* SOPs and a data management system designed to enable a multi-tiered independent agency/institution to manage the MRV system for the ER Program Area.

SOPs have been developed for Agriculture, Energy, Forestry and Land Use Mapping. The objective of developing these SOPS was to ensure that every step from method selection to procedural implementation is grounded in technical rigor and adheres to internationally recognized guidelines for forest carbon monitoring. Within this framework, the chosen methodologies are evaluated based on their suitability to accurately capture changes in carbon stocks and their compatibility with the ISFL's approach to emissions and removals reporting. The SOPs translate these methods into actionable, standardized protocols that ensure consistent data collection, processing, and reporting.

Simultaneously, the *QA/QC* procedures in the SOPS were designed to systematically validate data integrity through rigorous calibration, cross-validation, and documentation processes. Technical Teams comprised of Agriculture, Energy, Forestry, GHG, Land use and Soil Specialists among others, were formed to conduct data collection. Prior to data collection, field teams were trained, in the survey instruments, measurement techniques and standard data recording procedures to reduce human error. Calibration of equipment (scales) and measuring tools were conducted daily to maintain measurement precision. During field work QAQC teams conducted spot checks and cross verification of random subsets to confirm data consistency and detect potential discrepancies. Compiled data forms were reviewed at the end of each day to identify and correct missing or outlier values.

A Data Management Team was constituted from the larger group involved in data collection to conduct data analysis. The technical team comprised officers from Forest Department, Ministry of Agriculture, Ministry of Livestock and Fisheries, Department of Energy, Zambia Agriculture Research Institute, Zambia Environmental management Agency, and EPJ SLP(PIU) conducting analysis for forestry, agriculture, soil carbon respectively. The Emissions Specialist from Snow Systems Zambia provided technical guidance to the technical team and conducted emissions estimates for the respective sectors. Data analysis was characterized by data cleaning by the data management team consisting sector experts from Agriculture, Forestry and PIU supported by ER Specialist. This was followed by converting raw data into activity data useful for emission estimates by the respective sectors with the PIU providing QAQC. Final version of the data was quality checked and controlled by ZEMA, PIU and UNIQUE using an iterative process prior to approval of the final version.

In addition to the general process described above, specific QA/QC was applied for certain data as described below.

Timber, firewood and Charcoal removals

Timber extraction data is a critical input for carbon quantification as it directly informs on biomass removal from forest ecosystems. The data sources compiled for the Eastern Province integrated national datasets, ensuring that carbon stock estimates are robust, methodologically sound, and representative. The primary datasets included fuelwood extraction records maintained by the Forestry Department.

The Forestry Department collects comprehensive data on fuelwood extraction through licensing, field surveys, household interviews, and community monitoring efforts. The dataset includes the volume of wood extracted, species classification, extraction locations, seasonal variations, and legal compliance data. Field measurements were integrated with allometric equations to convert timber volumes into aboveground biomass estimates. This process was vital for estimating the carbon contained within removed biomass. Furthermore, temporal trends from these datasets allowed for monitoring deforestation and recovery processes across the Program Area.

The Ministry of Energy contributed energy demand data that contextualizes the scale of fuelwood extraction relative to regional energy supply needs. This information was particularly important when linking extraction rates with overall energy consumption, offering insight into the carbon footprint of biomass fuel use. The data included spatial mappings that corroborate ground realities captured by the Forestry Department.

It was ensured the sample size for measurements for fuelwood and consumption was over and above the sample size required to reach required confidence levels and margin of error.

Fire disturbances

The fire disturbance analysis leveraged a multi-resolution approach to ensure both broad coverage and technical precision in identifying fire disturbances. Cross-Referencing was undertaken with Sentinel Imagery and Validation was done via Landsat 8 and Integration of an Assessment Card in Collect Earth. MODIS, with its 250 m pixel resolution, served as the initial data source to estimate fire disturbances over large spatial scales. While its coarse resolution is advantageous for capturing widespread events, it can introduce uncertainties regarding the precise spatial delineation of fire-affected areas. To refine these estimations, the MODIS data was cross-referenced with Sentinel imagery, which provides a much finer spatial resolution of 10 m per pixel. This high-resolution data enabled a more detailed mapping of fire disturbances, reducing uncertainty by accurately capturing smaller and more fragmented burn patterns that may not be visible in the MODIS dataset. Further, a comparative assessment was conducted using Landsat 8 imagery to strengthen the analysis, with a pixel resolution of 28 m, Landsat 8 balances detailed spatial information and regional coverage. This intermediate resolution helped verify the consistency of the fire disturbance estimates obtained from both the coarse and fine resolution datasets, ensuring robustness in the overall analytical approach.

To augment the remote sensing analysis, an assessment card specifically designed to indicate fire disturbance was implemented within the Collect Earth tool. This integration allowed for an interactive evaluation of the fire impact, providing an additional layer of quality control and facilitating the incorporation of any ground-truth or manual interpretations. This multi-tiered approach, combining MODIS for its comprehensive coverage, Sentinel for high-resolution refinement, Landsat 8 for intermediate validation, and Collect Earth for interactive assessment ensured that the analysis minimized uncertainty and improved the overall accuracy in identifying and quantifying fire disturbances.

Land use class and vegetation type areas

For land use and land use change assessments, The Standard Operating Procedure (SOP) framework was developed, which promotes consistency and transparency in land use and land use change analysis. Key components of the SOP include:

- Interpretation Key: Developed to guide consistent interpretation of land use and land use change over time.
- Response Design: Provides clear rules for assigning land cover/land use classes to spatial points.
- Data Collection Procedure: Details how to set up and conduct sample-based visual interpretation effectively.
- Data Analysis Protocol: Outlines methods for calculating area estimates and updating monitoring, reporting, and verification (MRV) systems.

Imagery inconsistencies and availability gaps (e.g., post-2019 NICFI access loss) were noted, however, preprocessing were applied to harmonize time-series. The data analysis protocol provided the methodological infrastructure for calculating area estimates and updating the MRV System. It outlined statistical methods for uncertainty quantification, including error propagation and confidence interval estimation, which accounted for variabilities in land use classification and vegetation types. This protocol ensured that the data aggregation and area estimation processes were transparent, repeatable, and aligned with international standards, thus fostering greater trust in the findings. It also recommended best practices for iterative model refinement as new, higher-resolution data become available, ensuring the MRV system remains responsive to improving insights and evolving uncertainties.

These components form a comprehensive SOP that not only standardizes the approach to land use and land use change analysis but also incorporates rigorous techniques for addressing and quantifying uncertainties associated with land use classes and vegetation types. The integration of these detailed frameworks helped to ensure that the analysis remained robust, transparent, and scientifically defensible, even in the face of diverse data sources and complex landscapes.

4.3 Residual Uncertainty of Activity Data and Emission Factors

Monte Carlo error propagation for estimating uncertainty in emissions reduction was used for activity data and emission factors. For each uncertainty source in the Activity Data and Emission Factor, the Standard Error(SE) was back-calculated as SE= mean*uncertainty(90% Cl)/100/1.96. The uncertainty are given as half width of the 90% Cl. Monte Carlo Iterations were run in Excel Worksheets for all the Activity data and each of the Emission Factors. The number of simulations was 10,0000 (see Table 46 for an example). The simulations for activity data and emission factors were undertaken using normal cumulative distribution, at the specified probability, mean, and standard deviation (SD). Details of all the simulations are contained in the separate Workbook attached as Annex 7.

Table 46: Example Simulation of Activity data for Forest woodland

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2024
Multiplier	1	1	1	1	1	1	1	1	1	1	1	1
AD (ha)	1,709,790	1,702,008	1,694,231	1,686,451	1,678,676	1,670,864	1,663,079	1,655,294	1,647,510	1,639,734	1,631,958	1,599,138
U (%)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
SE	16681	16605	16529	16453	16377	16301	16225	16149	16073	15997	15922	15601
Iterations												
1	1723340	1696038	1694185	1696349	1666085	1678707	1643637	1643542	1645898	1636503	1616943	1586183
2	1724404	1715049	1673668	1720353	1669673	1662364	1628478	1644051	1670449	1640753	1614605	1600399
3	1720873	1715109	1703015	1682422	1690491	1656319	1676265	1676598	1654377	1651581	1632672	1584211
4	1677657	1683560	1675766	1705960	1689635	1684167	1668281	1634194	1665085	1640165	1642529	1612456
5	1682330	1705962	1680230	1683554	1704586	1674993	1682241	1652100	1665473	1632931	1660151	1608222
6	1720921	1699136	1689203	1679513	1681481	1695780	1656584	1660582	1649706	1647503	1610433	1589394
7	1714192	1719717	1686938	1666000	1686162	1642884	1657586	1645797	1640196	1644529	1627047	1615060
8	1693319	1694818	1700861	1680316	1674232	1665296	1689761	1658098	1662238	1636279	1655099	1595605
9	1719066	1703857	1685719	1672509	1678425	1681042	1659568	1665763	1648375	1629017	1641857	1589190
10	1688577	1698563	1674318	1712011	1664821	1692434	1653371	1635521	1643034	1631046	1635474	1595132
11	1683020	1673431	1685668	1705335	1665312	1659360	1675816	1675605	1650326	1654473	1633447	1603144
12	1721945	1692133	1712179	1648392	1676385	1673517	1705192	1671464	1642268	1634022	1661305	1582466
13	1699828	1684220	1692752	1683106	1678515	1655410	1684831	1634610	1678976	1649307	1590292	1621419
14	1735425	1710217	1674921	1691265	1676284	1671540	1689981	1639549	1645751	1615740	1630920	1599259
15	1696179	1692555	1691509	1656201	1696242	1643931	1643775	1671599	1647281	1657220	1652935	1605889
16	1679285	1686714	1683851	1677858	1673755	1687254	1681487	1629393	1653308	1647420	1634634	1585501
17	1731595	1710657	1701940	1678012	1688301	1667815	1649416	1639859	1655252	1598423	1623208	1605387
18	1729748	1706433	1683505	1662704	1681124	1668233	1662176	1652423	1635806	1645412	1650534	1591267
19	1678941	1703853	1720423	1702588	1702999	1661096	1678293	1666238	1650255	1633750	1608418	1590350
20	1717973	1711752	1715410	1700871	1638882	1705356	1659715	1661581	1638654	1635636	1656362	1604723
21	1722254	1738324	1677218	1678040	1685683	1683716	1677747	1651734	1676515	1658539	1621970	1597841

22	1744580	1685486	1685416	1676956	1684936	1682373	1664154	1654837	1642223	1625093	1616105	1594561
23	1702160	1685307	1681234	1697322	1684733	1654148	1648930	1643555	1672821	1629729	1636181	1594595
9989	1712118	1674027	1699661	1652836	1672400	1683178	1693199	1649488	1654179	1621449	1618228	1589399
9990	1731592	1735683	1709747	1695424	1697579	1672807	1671959	1648308	1648664	1634826	1635048	1599021
9991	1733761	1716005	1687918	1668037	1685655	1667382	1642216	1666446	1639612	1640175	1622252	1580041
9992	1724717	1700249	1694676	1705502	1680458	1687956	1674114	1666901	1649399	1649370	1617140	1620981
9993	1678128	1707961	1690514	1704425	1667705	1668668	1669370	1702499	1662387	1640713	1654229	1584618
9994	1704180	1699886	1695005	1677582	1692745	1649209	1668019	1656317	1667343	1639515	1658414	1601441
9995	1687256	1727662	1683973	1711966	1646989	1691336	1677487	1668009	1653234	1661221	1663066	1607661
9996	1717760	1698979	1693821	1692453	1643826	1675216	1653887	1659097	1660248	1644224	1642023	1612704
9997	1691802	1701411	1675715	1691527	1701601	1652333	1661056	1666679	1655164	1646297	1625993	1559217
9998	1717699	1717328	1685030	1707309	1677115	1651265	1670684	1633137	1652657	1668124	1629368	1566020
9999	1699541	1703885	1704132	1676114	1670675	1671925	1667817	1646471	1669013	1653959	1630639	1583762
10000	1686742	1694845	1678162	1675352	1649976	1668445	1635942	1664804	1621911	1648097	1642985	1599429

Provided in Table 47 is a truncated table of 10, 0000 simulations for part of the emission factors. Details of the emission factors simulations are provided in Annex 7.

Table 47: Example Simulation of Emission Factor

Multiplier	1	1	1	1	1	1	1
	Biomass conversion and expansion factor(BCEFR)	BCEFi	Fraction of biomass lost in disturbance (fd).	Average Net Annual Increment for specific vegetation type(m3/ ha/ yr)	Basic wood density (D)	Root to shoot ration	Carbon Fraction of Dry matter (tonne C/ tonne)
Emission factor	1.53	1.18	0.25	1.30	0.602	0.28	0.47
U (%)	5	5	5	5	5	5	5
SE	0	0	0	0	0	0	0
Iterations							
1	2	1	0	1	1	0	0
2	1	1	0	1	1	0	0
3	1	1	0	1	1	0	0
4	2	1	0	1	1	0	0
5	2	1	0	1	1	0	0
6	1	1	0	1	1	0	0
7	2	1	0	1	1	0	0
8	2	1	0	1	1	0	0
9	2	1	0	1	1	0	0
10	2	1	0	1	1	0	1
11	2	1	0	1	1	0	0
12	2	1	0	1	1	0	0
13	2	1	0	1	1	0	0
14	2	1	0	1	1	0	0
15	1	1	0	1	1	0	0
16	2	1	0	1	1	0	0
17	2	1	0	1	1	0	0
9986	2	1	0	1	1	0	0
9987	2	1	0	1	1	0	0
9988	2	1	0	1	1	0	0
9989	1	1	0	1	1	0	0
9990	2	1	0	1	1	0	0
9991	2	1	0	1	1	0	0
9992	2	1	0	1	1	0	0
9993	2	1	0	1	1	0	0
9994	1	1	0	1	1	0	0
9995	2	1	0	1	1	0	0

9996	2	1	0	1	1	0	0
9997	2	1	0	1	1	0	0
9998	2	1	0	1	1	0	0
9999	2	1	0	1	1	0	0
10000	2	1	0	1	1	0	0

Provided in **Error! Reference source not found.** are the uncertainty estimates for emission factors.

Table 48: Uncertainty assessment for emission factors

		Emission factor	Uncertainty (%)	Standard Error (SE)	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Source of assumptions made
	Biomass conversion and expansion factor(BCEFR)	1.53	5	0.05	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	BCEFi	1.18	5	0.04	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Fraction of biomass loss in disturbances (fd)	0.25	5	0.01	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Average Net Annual Increment for specific vegetation type(m3/ ha/ yr) (Iv)-Natural Forest	1.30	5	0.04	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Average Net Annual Increment for specific vegetation	15.00	5	0.46	Field equipment limitations used for	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

	type(m3/ ha/ yr) (Iv)-Pine and Eucalyptus				measurements		
	Basic wood density (D)	0.60	5	0.02	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Ratio of Below ground biomass to above ground biomass (tonnes Bg / tonnes ag)	0.28	5	0.01	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Carbon Fraction of Dry matter (tonne C/ tonne)	0.47	5	0.01	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Average above ground biomass of area affected (tonnes/ha) (Bw)	Dry evergreen forest	67.80	5	2.07		Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Dry deciduous forests	37.20	5	1.13	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Moist evergreen forest	34.20	5	1.04	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Woodlands (semi-evergreen forests)	43.10	5	1.31	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Eucalyptus	70.80	5	2.16	Field equipment limitations used for	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

					measurements		
	pine	70.80	5	2.16	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Combination of Average above ground biomass and Below Ground Biomass of area affected (tonnes/ha) (Bw)	Dry evergreen forest	86.80	5	2.65	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Dry deciduous forests	47.60	5	1.45	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Moist evergreen forest	43.80	5	1.34	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Woodlands (semi-evergreen forests)	55.10	5	1.68	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Eucalyptus	70.80	5	2.16	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Pine	70.80	5	2.16	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Cropland	Biomass stocks after the conversion (Tonnes/ha) Ba	7.90	5	0.24	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

settlements	Biomass stocks after the conversion (Tonnes/ha) Ba	20.80	5	0.63	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
grassland	Biomass stocks after the conversion (Tonnes/ha) Ba	8.80	5	0.27	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Wetland	Biomass stocks after the conversion (Tonnes/ha) Ba	8.80	5	0.27	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Dead wood / litter stock under the new land use category (tonnes C/ha)	Dry Evergreen Forest	2.30	5	0.07	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 4
	Dry Deciduous Forest	0.80	5	0.02	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 5
	Moist Evergreen Forest	0.48	5	0.01	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 6
	Woodlands Forest	0.90	5	0.03	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 7
Dead wood / litter stock under the new land use category (tonnes C/ha)-Cropland		0.50	5	0.02	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 8

Dead wood / litter stock under the new land use category (tonnes C/ha)- Settlements		0.10	5	0.00	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 9
Dead wood / litter stock under the new land use category (tonnes C/ha)- Grassland		0.20	5	0.01	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 10
SOCref	F = forestland	33.39	5	1.02	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 11
	G = grassland	30.90	5	0.94	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 12
	C = cropland	30.70	5	0.94	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 13

Provided in *Table 49* is sample uncertainty estimates for activity data, areas for forest woodland.

Table 49:Uncertainty assessment for activity data (area) under Forest woodland

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2024
Median (tons of C)	2214017	2204433	2193142	2183694	2172678	2164032	2152884	2143003	2132989	2124550	1183928
5th Percentile	2023959	2016632	2007630	1996906	1988583	1980036	1970353	1957726	1951293	1941760	1083151
95th Percentile	2418087	2407839	2398423	2386111	2376720	2364168	2354153	2340989	2330937	2320850	1295002
Half of 90% CI	197064	195603	195397	194603	194068	192066	191900	191631	189822	189545	105925
Uncertainty (%)	9	9	9	9	9	9	9	9	9	9	9

4.4 Uncertainty of the estimate of Emission Reductions

4.4.1 Parameters and assumptions used in the Monte Carlo method

The assumptions used in this analysis are listed as follows:

- Algorithms are complex functions;
- correlations occur between some of the activity data sets, emission factors, or both;
- uncertainties are different for different years of the inventory(i.e., in the baseline and ERPA phase).

Provided in the table below are the parameters and assumptions used in the Monte Carlo method

Table 50: Parameters and assumptions used in the Monte Carlo method

Parameter included in the model		Parameter values	Error sources quantified in the model (e.g. measurement error, model error, etc.)	Probability distribution function	Source of assumptions made
Biomass conversion and expansion factor(BCEFR)		1.53	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
BCEFi		1.18	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Fraction of biomass loss in disturbances		0.25	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Average Net Annual Increment for specific vegetation type(m^3/ha/yr) (Iv)-	Natural Fores	1.3	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Pine and Eucalyptus	15	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Basic wood density (D)		0.602	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Ratio of Below ground biomass to above ground		0.28	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

biomass (tonnes Bg/ tonnes ag)					
Carbon Fraction of Dry matter (tonne C/ tonne)		0.47	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Average above ground biomass of area affected (tonnes/ha) (Bw)	Dry evergreen forest	67.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Dry deciduous forests	37.2	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Moist evergreen forest	34.2	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Woodlands (semi-evergreen forests)	43.1	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	eucalyptus	70.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	pine	70.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Combination of Average above ground biomass and Below Ground Biomass of area affected (tonnes/ha) (Bw)	Dry evergreen forest	86.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Dry deciduous forests	47.6	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Moist evergreen forest	43.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Woodlands (semi-evergreen forests)	55.1	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

	eucalyptus	70.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	pine	70.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Biomass stocks in cropland after the conversion (Tonnes/ha) Ba		7.9	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Biomass stocks in settlement after the conversion (Tonnes/ha) Ba		20.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Biomass stocks in grassland after the conversion (Tonnes/ha) Ba		8.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Dead wood / litter stock under the new land use category (tonnes C/ha)	Dry Evergreen Forest	2.3	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Dry Deciduous Forest	0.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Moist Evergreen Forest	0.48	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Woodlands Forest	0.9	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Dead wood / litter stock under the new land use category (tonnes C/ha)-Cropland		0.5	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
Dead wood / litter stock under the new land use category (tonnes		0.1	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

C/ha)-Settlements					
Dead wood / litter stock under the new land use category (tonnes C/ha)-Grassland			Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
SOCref	F = forestland	33.3	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	G = grassland	30.9	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	C = cropland	30.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3
	Settlements	30.8	Field equipment limitations used for measurements	Normal Distribution	IPCC2006 Guidelines Vol. Chapter 3

4.4.2 Quantification of the Uncertainty of the estimate of Emission Reductions

		Forestland remaining forestland	Cropland converted to Forestland	Forestland converted to cropland	Forestland converted to Settlement	Grassland converted to Cropland	Cropland remaining cropland	Total
A	**Median**	7,040,733	-1,969,275	769,796	15,8805	1,262.056		7,592,270
B	**Upper bound 90% CI** (Percentile 0.95)	8,100,018	-2,088,454	687,560	144,285	-7,880.98		8,646,820
C	**Lower bound 90% CI** (Percentile 0.05)	6,034,500	-1,850,640	852,597	173,384	10,287.39		6,554,410
D	**Half Width Confidence Interval at 90% (B – C / 2)**	1,032,759	118,907	82,518	14,549	9,084.184		1,046,205
E	**Relative margin of error (D / A)**	15	-0.06038	0.107195	0.091616	7.197926		13.8
F	**Aggregate Uncertainty of Emission Reductions**							13.8
G	**Uncertainty set-aside factor**							0%

4.5 Sensitivity analysis

Switches were set on multipliers of all emission factors and activity data. When the switches in are 'on' the related multipliers are set to 1. When the switches are 'off', the multipliers are set to 0 (or 1E-10, which is close to 0, and avoids errors in the excel formula) (Table 51).

Table 51: Switches on activity data and emission factor

Wood Removals	On
Fire Disturbances	On
Land areas	On
Land Conversions	On
Emission factors	On

Provided in Table 52 are uncertainty estimates when all the switches are turned On for activity data and emission factors

Table 52: Uncertainty estimates with all switches turned on

Switches	Emission Description	Median (tons of C)	5th Percentile (tons of C)	95th Percentile (tons of C)	Half of 90% CI (tons of C)	Uncertainty (%)
Switch is on for the emissions factors while all activity data is switched off.	Baseline (2009-2018	10,278,053	9,102,703	11,491,946	1,194,622	11.6
	Monitoring (2024)	4,319,218	3,375,563	5,262,178	943,308	21.8
	Emission Reduction	5,955,185	5,542,497	6,383,011	420,257	7.1
Activity data for land conversion switched on while the rest are off	Baseline (2009-2018	10,228,403	10,224,797	10,232,168	3,686	0
	Monitoring (2024)	4,279,571	4,248,017	4,311,062	31,523	0.7
	Emission Reduction	5,948,717	5,916,892	5,980,658	31,883	0.5
Activity data for land areas switched on while the rest are off	Baseline (2009-2018	10,228,428	10,193,281	10,264,055	35,387	0.4
	Monitoring (2024)	4,279,540	4,170,897	4,390,116	109,610	2.6
	Emission Reduction	5,948,833	5,834,231	6,064,624	115,196	1.9

Activity data for fire disturbances is switched on while the rest are off	Baseline (2009-2018	10,227,772	10,180,724	10,275,313	47,295	0.5
	Monitoring (2024)	4,279,317	4,196,794	4,362,753	82,979	1.9
	Emission Reduction	5,948,704	5,852,303	6,044,266	95,981	1.6
Activity data for wood removals is switched on while the rest are off	Baseline (2009-2018	10,228,306	10,208,378	10,248,203	19,913	0.2
	Monitoring (2024)	4,279,553	4,205,533	4,356,388	75,427	1.8
	Emission Reduction	5,948,152	5,870,393	6,025,457	77,532	1.3

5 ISFL ER Program Transactions

5.1 Ability to transfer Title to ERs

The Ministry of Green Economy and Environment (MGEE) is the designated authority for the allocation and transfer of Emission Reduction (ER) titles under Zambia's legal framework. This mandate is derived from the Constitution of Zambia, the Forests Act (2015), the Forest (Carbon Stock Management) Regulations, 2021 (SI No. 66 of 2021), and the Green Economy and Climate Change Act (2024). For avoidance of doubt as relates to carbon ownership vesting and sectoral coverage, pursuant to Section 22 of the Green Economy and Climate Change Act (2024), all rights of carbon ownership remain vested in the President on behalf of the Republic until such rights are lawfully transferred or otherwise assigned under the Act or any other applicable law.

The MGEE through the relevant Departments has the governance and oversight responsibility for supervising the transfer process for ERs generated by project-related activities across all sectors of the economy. Under the Forest (Carbon Stock Management) Regulations, the conditions for mandatory Community Forest Management (CFM) Agreements, the nesting of existing REDD+ projects, and the requisite registration and permitting procedures for jurisdictional programs are clearly prescribed. As the overarching body for the Jurisdictional Program (EP-JSLP), MGEE ensures that all ER ownership and transfer mechanisms are executed with full legal integrity.

The Forest (Carbon Stock Management) Regulations specify that GHG emissions reductions or removals may be generated and traded exclusively through the established Forest Carbon Stock Management Permit System. Trading is sanctioned only through formally approved guidelines under Section 18 of the Regulation. Community Forestry Management Groups (CFMGs) that have attained formal recognition by obtaining a signed Community Forest Management Agreement (Form IV), are permitted to engage in carbon trading solely with approved permit holders. The EPJSLP holds a valid FCSM Permit in line with SI 66 of 2021, and is therefore, the mandated entity in the Eastern Province for executing all ER transactions within the Program Area, enabling the trading of ER credits with ISFL as well as other verified third-party buyers.

In order to ensure equitable benefit sharing and adherence to transfer Agreements, within the BSP, Community Groups with legally transferred user rights are formally recognized. Trading rights for ER credits are conveyed through the Carbon Emissions Reduction Purchase Agreement (CERPA) of which all of the 56 chiefdoms have endorsed. Specifically, Section 3.4 of CERPA mandates that the Chiefs/Chieftainesses, both in their personal capacity and as representatives of their chiefdoms to irrevocably transfer all legal claim, title, and interest in the emission reductions generated within the Programme Area to EP-JSLP. This transfer encompasses all rights necessary for the issuance, certification, and forwarding of ER credits under applicable carbon standards, while explicitly excluding any real property rights. The Green Economy and Climate Change Act (2024) further conditions the approval of carbon projects (Section 5) on the demonstration of participatory and equitable benefit-sharing measures with local communities, ensuring that those communities receive fair economic benefits from the sale of ER credits.

Regarding the nested projects, the ER Program has entered into Agreements with both BCP and COMACO through NERPA. The NERPA outlines the roles and responsibilities of all parties including management of benefits. The NERPAs have been finalized and cleared by Ministry of Justice(MOJ). Subsequently, COMACO signed with the Governm[en]t on 2nd June 2025, having had their NERPA cleared earlier while BCP is scheduled to sign by end of October 2025, following clearance of their NERPA by MOJ.

5.2 Participation under other Greenhouse Gas (GHG) initiatives

For the 2024 (Jan 2024 to Dec 2024) Reporting Period, the EP-JSLP is accounting for ERs generated from the mitigation measures taken for sustainable land management including SFM, CSA, and efficient energy in the entire Program Area including from Nested areas.

The Jurisdictional Program in Eastern Province Zambia is informed by the Forest Act[76] of 2015 through the Statutory Instrument No. 66, the Forest (Carbon Stock Management) Regulations of 2021[77]. The Carbon Stock Management Regulations, of 2021 in section 18 (2) and (3), gives the Jurisdictional precedence over any project that is encompassed within the jurisdiction; whereby a permit holder encompassed within the geographical boundaries of the jurisdiction granted may only trade carbon through the jurisdictional entity. For existing permit holders, they shall not be allowed to trade carbon independently unless with the approval of the Director of Forestry.

Given the above context, during the Reporting periods from 2024 to 2030 for the ISFL ER Programme, it is expected that no independent projects (public or private) are expected to trade carbon independently except through the ER Programme from the ISFL mitigation initiatives.

However, given that there are existing private Carbon Projects (LCPF and SALM) in the Jurisdictional Area, it was identified as part of the ISFL ER Programme, the ER Program working with the Government through a Harmonization Technical Working Group whose main objective is to spearhead the harmonization process between ZIFLP and projects trading in carbon operating in Eastern Province prior to validation of the EP-JSLP. The HTWG has since been extended to the ER Program (EP-JSLP) as full harmonization of stakeholders on some aspects remains to be concluded.

[76] Forest Act of 2015
[77] Statutory Instrument No. 66, the Forest (Carbon Stock Management) Regulations of 2021

Through the HTWG, the stakeholders in the Jurisdictional Area adopted the framework for the implementation of the ER Program, which is the Centralised Nesting arrangement in line with the Carbon SI 66. The Centralised Nesting Approach entails that all Carbon Projects in the Jurisdictional Area (Eastern Province) will operate under the supervision of the ER Program. The centralized nesting arrangement was adopted or preferred by stakeholders to ensure transparent tracking and measurement of actual change in reducing deforestation, forest degradation and enhancing transparency in the methodology and allocation of benefits to all stakeholders including the local communities.

Through the engagements under the HTWG and the ERPA provisions, Nested Projects will formalize operations under the ER Program through the NERPA. The NERPA provides for two modalities for ER payments to the Nested Projects including through cash and ER certificates. The option of ER payments allows for the Nested Projects to meet their contractual obligations with the buyers entered into prior to approval of the Jurisdictional Programme by the Director of Forestry. Projects in the Jurisdictional Area have since harmonized their Monitoring Reporting and Verifications systems which includes joint implementation of activities of common interest. The ER Program remains open to receiving more projects provided the align with the Jurisdictional GHG baseline to ensure that reductions are measured against a scientifically valid starting point and adopt the ISFL as the preferred accounting methodology for purposes of ensuring compliance with international standards, consistency, comparability, credibility and transparency for reporting uniformly across different the projects.

The existing private carbon projects LCPF managed by BCP and SALM by COMACO have been in operation for 13 and 22 years respectively. The LCPF is promoting avoided deforestation from which they have been generating ERs and providing carbon revenues to local communities and other stakeholders, and their last accounting period was Jan to Dec 2022. The COMACO project has been involved in avoided deforestation and SALM in which they promote Climate Smart Agriculture, Sustainable Forest Management and Wildlife management. Both initiatives have a heavy component of livelihoods improvement and full details of the two initiatives are explained in annex 6 below.

Another project operating in the Landscape is an Energy efficiency initiative being implemented by the TASC group. TASC was established in 2019 and have distributed 236,414 improved cookstoves (ICS) in Zambia under the Gold Standard PoA (GS 11009), with 182,484 stoves deployed in Zambia's Eastern Province (EP). TASC through their improved cookstove initiatives, generates high-quality, independently verified carbon credits under the Gold Standard. TASC like all the existing projects has been engaged by the ER Program through the HTWG. Further, through the various engagement TASC have expressed their belief that the EP-JSLP holds great promise for Zambia, and they are eager to contribute to its success.

Within the ISFL ER Program Accounting Area, a range of mitigation interventions implemented by various organizations address the drivers of land use change, deforestation, and forest degradation. Although these interventions generate emission reductions (ERs), they operate outside the formal framework of the ISFL ER Program and do not engage in ER transactions. Specifically, they do not seek payment nor transfer generated ERs to other mitigation initiatives during the ISFL ER Program Accounting period.

EP-JSLP leverages all available actions within the jurisdiction that contribute to ER generation. This strategy includes both ongoing and planned initiatives financed by the Government, Development Partners, the Private sector, NGOs, and community groups, thereby enhancing the overall generation of ERs within the Program Area.

5.3 Implementation and operation of Programs and Projects Data Management System.

Central to the successful implementation of the EPJSLP, is the establishment of an integrated Programs and Projects Data Management System. The Programs and Projects Data Management System was developed to serve as a centralized platform for managing data related to ERs, land use changes, and project interventions under the EPJSLP. The system provides a robust mechanism for Monitoring, Reporting, and Verification, ensuring transparency, data integrity, and alignment with both national and international requirements, including those outlined in the ERPA with the World Bank's Carbon Fund.

The system was developed through a collaborative effort involving the PIU, ZEMA, and technical support from the World Bank. The system's development was informed by Standard Operating Procedures (SOPs). ZEMA with direction from MGEE, is responsible for technical functions of United Nations Framework Convention for Climate Change (UNFCCC) and the Paris Agreement related work streams including the MRV and accounting, GHG inventory, registry operations, reporting and applying corresponding adjustments in the country.

The Climate Change Portal[78] serves as the primary interface for the data management system, housing standardized tools and forms for data collection, submission, and review (see Figure 6). The portal is supported by an offline Android mobile data collection application that synchronises collected data into the Climate Change Portal (Figure 7).

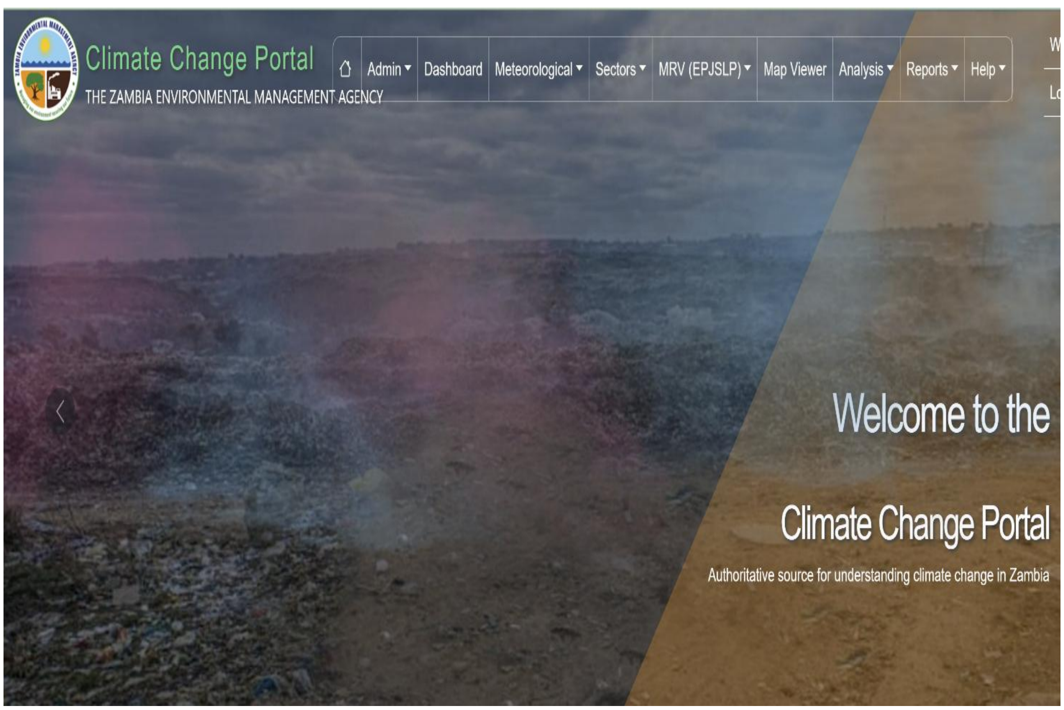

Figure 6: Logged in view of the climate portal

78 https://climateportal.zema.org.zm/

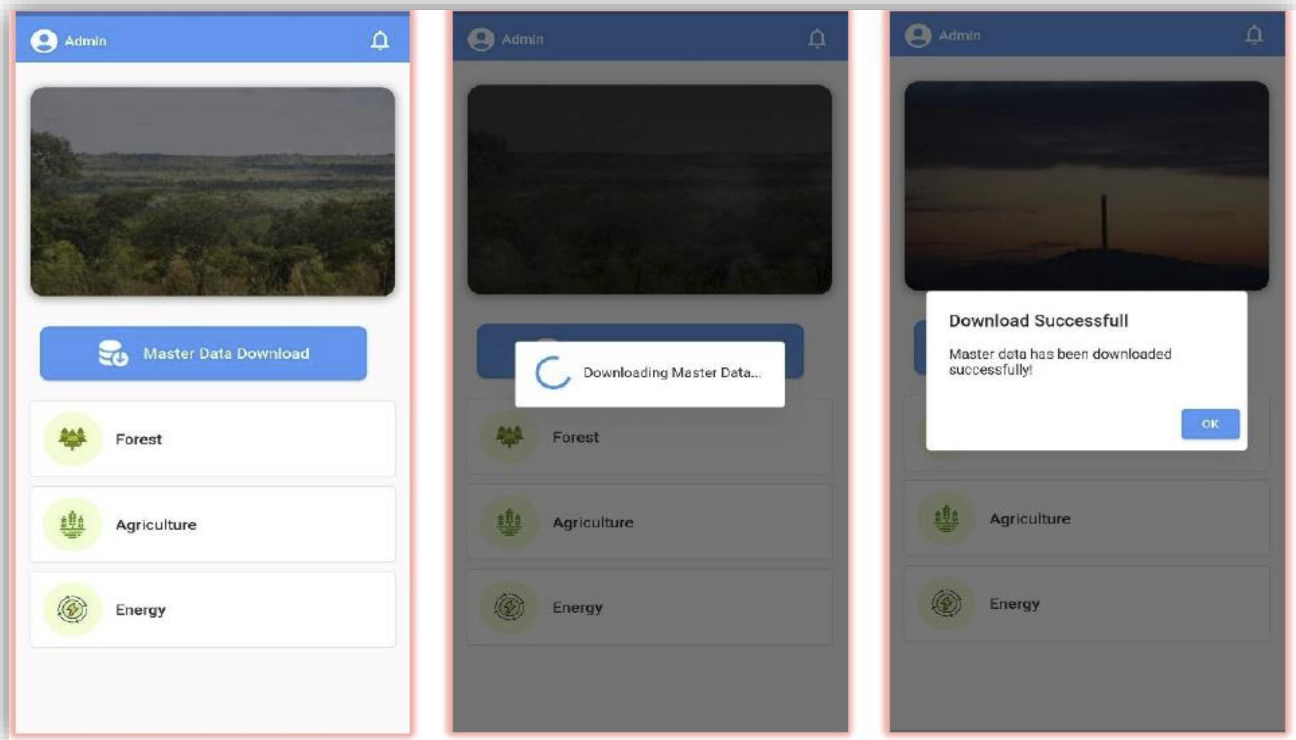

Figure 7: Mobile application interface

Key roles for the implementation of the system include:

- ZEMA: Hosts and maintains the portal; provides regulatory oversight.
- PIU: Coordinates data flow from implementing partners and stakeholders.
- Stakeholders (Sector): Input, validate, and use data for decision-making and reporting.
- Local communities: Communities participate in conducting sampling and measurements across all sectors i.e.,
    - ❖ Agriculture: communities are involved in crop residue sample collection, livestock measurements under the supervision of the Agriculture Specialist.
    - ❖ Forestry: community members are involved in sample collection, tree identification applying indigenous knowledge, field guides in their local environments, and conducting measurements under the supervision of Forestry Specialist.
    - ❖ Energy: communities are involved measurements of quantities of daily use of house/institutional fuel wood and charcoal consumption during data collection under the supervision of Energy Experts.

The Climate Change Portal is designed to support the end-to-end data lifecycle:

- Standardized data collection using forms aligned with EPJSLP SOPs.
- Integration of geospatial data for land use and forest cover monitoring.
- User role management to ensure secure and appropriate access to the system.
- Data validation and audit trails to support independent verification.
- Reporting tools to generate summaries, dashboards, and progress reports.

This system ensures consistent documentation and reporting of project activities and supports the generation of verified ERs in line with the ERPA.

Below is a data management lifecycle:

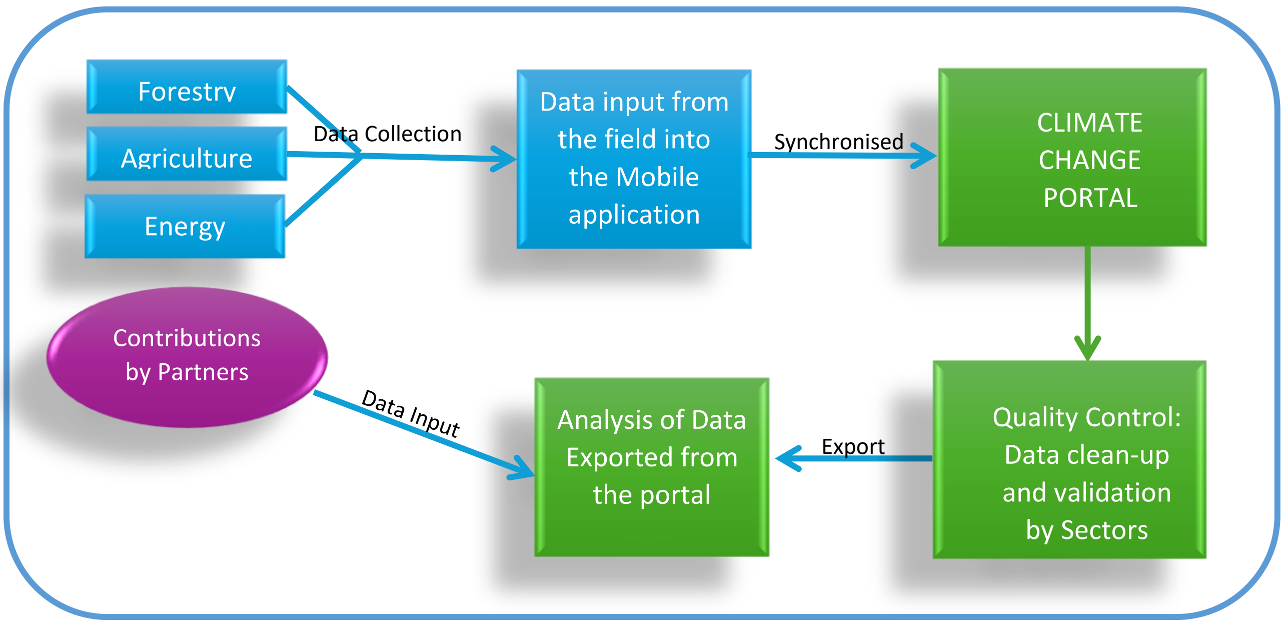

Figure 8: Data Management life cycle

In addition to EPJSLP activities, the Eastern Province is home to other REDD+ and sustainable land use initiatives led by partners such as BCP and COMACO. These organizations operate voluntary carbon market (VCM) projects that contribute to emission reductions in the region.

To avoid conflicts in carbon accounting, the following coordination mechanisms have been established:

A nesting framework has been developed to integrate project-level ERs from BCP and COMACO into the broader jurisdictional accounting system. This ensures:

- No double claiming of ERs under both jurisdictional and project-based systems.
- Clear attribution of ERs for both ERPA and VCM reporting.
- Consistency with national MRV systems and international standards (e.g., VERRA guidance).

Under the EPJSLP, a BSP has been developed to guide the distribution of proceeds from ER sales. The plan ensures:

- Participating communities and project developers receive equitable shares.
- ERs generated by nested projects may be recognized and rewarded under the jurisdictional program based on contribution metrics.

BCP and COMACO collaborate with the PIU by:

- Sharing spatial and activity data to ensure alignment.
- Participating in technical working groups focused on MRV and data harmonization.
- Contributing to safeguards monitoring and capacity building.

The implementation of the Programs and Projects Data Management System under the EPJSLP represents a significant milestone in strengthening Zambia's capacity to manage, monitor, and report on climate change mitigation initiatives. Through the Climate Change Portal, the ER Program has established a centralized, transparent, and efficient platform for Monitoring, Reporting, and Verification (MRV) that meets both national requirements and international standards, particularly under the ERPA with the World Bank.

Looking ahead, the project envisions a system where nested projects, such as those operated by BCP and COMACO, directly contribute their activity and emissions data into the Climate Change Portal. This integration will enhance coordination, minimize duplication, and promote consistency in reporting. To realize this vision, the portal is earmarked for further upgrades, subject to appropriate technical and financial support. These planned improvements will focus on enhancing system features such as stakeholder-specific data input interfaces, advanced data analysis tools, automated data validation processes, and dynamic reporting dashboards.

These enhancements will ensure that the portal remains a scalable, user-friendly, and credible platform for managing climate data and tracking performance across the landscape. Ultimately, the strengthened system will support more robust decision-making, equitable benefit sharing, and the long-term sustainability of climate change interventions in the Program Area and beyond.

5.4 Implementation and operation of ER Transaction Registry

The Jurisdictional Program serves as a platform for harmonizing sustainable land management approaches and interventions, as well as facilitating the accounting and trading of carbon credits at the jurisdictional level in the Eastern Province. The ER Program will provide support through purchase of ERCs, supporting catalytic underlying activities, and establishing program management functions. The World Bank has committed to purchasing 3 million tons of ERCs (after verification and issuance in Carbon Assets Tracking System (CATS) through the signing of an ERPA with the Government.

The ERPA will only consider the purchase of a maximum of 3 million tons of the ERCs that will be verified and then issued in CATS. The other portion will be set aside and distributed to the nested projects operating in the Program Area. Based on those assumptions, the estimated disbursement schedule for the purchase of ERCs by BioCarbon Fund ISFL follows a schedule of payments outlined in the ERPA.

To avoid the risk of double counting of ERCs coming from the Program Area, all ERCs will be registered into the CATS Registry, managed by the World Bank. This will be for purposes of ensuring traceability of each ERC generated by the Program and for use as the transaction registry system until a potential national registry system has been established by ZEMA under the MGEE, to perform the same function as part of Zambia's IMRV system[79].

Zambia is currently establishing a National Carbon Registry, a centralized digital platform designed to record, track, and verify the issuance, transfer, and retirement of carbon credits generated from diverse emissions reduction projects, particularly under Article 6 of the Paris Agreement. The National Carbon Registry will cover a broad spectrum of activities, including REDD+, Afforestation/Reforestation (A/R) projects, Clean Energy Initiatives, and Climate-Smart Agriculture (CSA) programs.

The legal and institutional framework supporting the National Carbon Registry is anchored in the Green Economy and Climate Change Act, 2024, which not only establishes the legal basis for carbon rights ownership and trading but also mandates the creation of a National Carbon Registry under the MGEE. Complementing this, the Forest (Carbon Stock Management) Regulations, 2021 (SI No. 66) prescribe the necessary procedures and require all carbon projects to be registered under a Forest Carbon Stock Management (FCSM) Permit.

Once fully operational, the National Carbon Registry is expected to:

- Record the issuance, transfer, and retirement of carbon credits.
- Prevent double counting of credits, in alignment with Article 6 of the Paris Agreement.
- Ensure transparency in carbon market transactions.
- Facilitate benefit-sharing with local communities.

The development of the registry is being supported by international partners including the SPAR6C Program and Global Green Growth Institute (GGGI). This initiative will also serve as a platform for capacity-building among government and private sector stakeholders, fostering robust compliance markets and reinforcing the integrity of Zambia's carbon framework.

5.5 ERs transferred to other entities or other schemes

The EPJSLP has adopted a centralized nesting, where all VERs will be used as ISFL VERs. There will be no VERs from the ISFL Program to be sold, assigned or otherwise used by any other entity for sale, public relations, compliance or any other purpose including as ERs that have been set-aside to meet Reversal management requirements under other GHG accounting schemes. Only 2% of the total VERs generated by the ER Program will be retained for contribution towards Zambia's NDCs.

In terms of benefits, the BSP prescribes the procedure for handling and managing benefits. The Nested Projects will receive carbon benefits in form of VERs and or cash as they will deem fit. In the case were the option of VERs is adopted; the VERs will be set aside before registering and depositing the VERs in the

[79] Guidelines for the Submission and Evaluation of Proposed Mitigation Activities under Article 6 of the Paris Agreement

CATs Registry. The nested project utilise their earned VERs as they deem fit including transferring them to other standards by retiring them from the CATs registry and issuing them in standards of their choice. They would also use the available coordination mechanism between ISFL and other standards such as Corsia and VCS.

6 Reversals

6.1 Assessment of the level of risk of Reversals

Reversals occur if one or more disturbance event(s) result in the aggregate number of ERs measured and verified within the ISFL ER Programme Accounting Area for one Reporting Period, which is less than the aggregate number of ERs measured and verified within the ISFL ER Programme Accounting Area for the previous Reporting Period.

Reversals can be caused both by natural disturbances and by human activities, which may be driven by a range of factors both internal and external to an ISFL ER Programme. The assessment of the level of risk of Reversals has been elaborated with the use of the most updated version of the Reversals Risk Assessment in the "ISFL Buffer requirements." The assessment is done with no distinction of subcategories, covering forest-related and non-forest-related categories. The table below presents the results of the assessment of the level of risks of reversal for ER Program.

Risk Factor	Risk indicators	Level of risk	Associated Reversal Risk set-aside percentage
A. Lack of long-term effectiveness in addressing the key drivers of AFOLU Emissions and Removals	**Lack of broad and sustained stakeholder support (indicated by a lack of awareness programme, applicable to all eligible sub- categories)** To mitigate the identified risk factors, the ZIFLP and now the EPJSLP has been implementing various mitigation measure among which are: o Taking a multisectoral approach to implementation of project activities. The EPJSLP as an integrated programme incorporates several sectors such as the AFOLU. o The transition to the jurisdictional approach has also provided a platform for multiple actors to contribute and attract financing from both the public and private sectors. So far, 2 private sector companies (COMACO and BCP) have been nested under the ER program.	*low*	*5*

	○ The project has also brought on board 56 chiefdoms in the province to promote emissions reduction by assigning roles, performance criteria, and responsibilities and implementing a results-based benefit sharing mechanism with monetary rewards for participating groups and communities through the signing of the CERPA. Being the principal stakeholders, people living in the project area are aware of the benefits through a well-elaborate Citizens and Communications Engagement Strategy. ZIFLP also has social media outlets such as the Website, which act as engagement platforms for the project activities.		
B. Exposure and vulnerability to natural disturbances	***Significant occurrences of conflicts over land and resources in the programme area (applicable to all eligible sub-categories).*** ○ *There has not been any conflict detected over land in the Eastern Province. Beneficiary communities of the ER Program live on customary land which is inherited along the family lines in the long-term.* ○ *Additionally, the 2015 Forests Act and its subsidiary legislation create a strong legal foundation for Community Forestry Management (CFM). The Act and the regulations devolve significant rights to community forest groups to manage forests and engage in forestry value chain development. The process has the potential to bring forests under sustainable management, generate income and improve livelihoods in rural communities. The communities obtain permission from the Chiefs to administer the CFM and the Director of Forestry signs user rights for use of CFM.* ○ *For people that had encroached the Lukusuzi National Park, the Project working with the Resettlement Division under the Office of the Vice President supported the relocation of the households from the National Park to Kazembe Chiefdom. The households were provided with land, safe drinking water, a*	*Low*	*10*

	school and clinic as part of livelihood restoration.		
Actual Reversal Risk Set-Aside Percentage (A+B)			*15*

6.2 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)[80]

The ER Program is doing its first Emissions Reductions Monitoring Reporting in 2024 and in line with ISFL guidance, this section will be reported on from the second reporting period (2025) onwards.

6.3 Quantification of Reversals during the Reporting Period[3]

This is the first reporting period. There are no reversals.

A.	**Total net Emissions Baseline during the Reporting Period (tCO_2-e)**	*from section 3.1*	10,216,216	
B.	**Sum of net Emissions Baselines for all previous Reporting Periods in the ERPA (tCO2-e).**	*from previous ISFL ER Monitoring Reports*	0	+
C.	**Cumulative Emissions Baseline for all Reporting Periods [A + B]**		10,216,216	
D.	**Estimation of net GHG Emissions from the ISFL ER Program during this Reporting Period (tCO_2-e)**	*from section 3.2*	5,526,544	
E.	**Estimation of net GHG Emissions for all previous Reporting Periods in the ERPA (tCO_2-e)**	*from previous ER Monitoring Reports*	0	
F.	**Cumulative net GHG Emissions including the current Reporting Period (as an aggregate accumulated since beginning of the ERPA) [D + E]**		5,526,544	–
G.	**Cumulative quantity of Emission Reductions estimated including the**		4,689,672	

[80] This section should only be completed starting from the second Reporting Period

	current Reporting Period (as an aggregate of ERs accumulated since beginning of the ERPA) [C – F]		
H.	**Cumulative quantity of Emission Reductions estimated for prior Reporting Periods (as an aggregate of Emission Reductions accumulated since beginning of the ERPA)**	*from previous ER Monitoring Reports*	0
I.	**[G – H], negative number indicates Reversals**		4,689,672

If I. above is negative and reversals have occurred complete the following:

J.	**Amount of Emission Reductions that have been previously transferred to the ISFL, as Contract ERs and Additional ERs**		
K.	**Quantity of Emission Reductions to be canceled from the Reversal Buffer account [J / H × (H – G)]**		

7 Emission Reductions available for transfer to the ISFL

Quantify the Emission Reductions available for transfer to the ISFL by completing the white cells in the table below.

			2024		Total
A.	**Emission Reductions during the monitoring period (tCO_2-e)**	*from section 3.3.3*	**4,689,672**		**4,689,672**
B.	**If applicable, number of Emission Reductions calculated using Activity Data Proxies and methods (use zero if not applicable) *[Corresponds to ISFL ER Program Requirement 4.6.5]***		0		0
C.	**Number of Emission Reductions estimated using measurement approaches (A-B)**		4,689,672		**4,689,672**
D.	**Percentage of ERs (A) for which the ability to transfer Title to ERs is clear or uncontested**	*from section 5.1*	100%		100%
E.	**ERs for which the ability to transfer Title to ERs is unclear or contested because they are sold, assigned or otherwise used by any other entity for sale, public relations, compliance or any other purpose**	*from section 5.2*	0		0
F	**Total ERs [(B+C)*D-E]**		4,689,672		4,689,672
G.	**Conservativeness Factor to reflect the level of Uncertainty from non-proxy based approaches associated with the**	*from section 4.4.2*	0		0

	estimation of ERs during the Term of the ERPA				
H.	**Quantity of ERs to be allocated to the Uncertainty Buffer (0.15*B/A*F)+(G*C/A*F)**		0		0
I.	**Total Reversal Risk set-aside percentage applied to the ISFL ER Program during this Reporting Period**	*from section 6.3*	15%		15%
J.	**Quantity of ERs to be allocated to the Reversal Buffer (F-H)*I**		703,450		703,450
K.	**Number of ISFL ERs (F- H – J)**		3,986,222		3,986,222

Annex 1: Information on the implementation of the Safeguards.

Annex 2: Information on the implementation of the Benefit Sharing Plan

Annex 3: Summary of program results, including Non-Carbon Benefits

Annex 4: Updates to the Emissions Baseline

1. Summary of updates

In the validated ERPD, the baseline is calculated as 10,715,478.3 tCO_2e. However, it is noted that the calculation of the Emissions Baseline in table 18 of the validated ERPD contains some subcategories that according to table 16 of the validated ERPD are not eligible. The non-eligible subcategories have now been excluded and the emissions baseline was recalculated accordingly. No other updates were made

2. ISFL ERPA Phase

N/A

3. Updates to the Program Emissions Baseline

i. Approach for estimating Emissions Baseline

N/A, as per validated ERPD

ii. Emissions Baseline estimate

Provide the estimate of the Emissions Baseline in the tables below:

Emissions Baseline estimate.

ERPA Phase	Emissions Baseline (tCO_2e)
2024 - 2030	10,216,216

Annex 5: Resolution of Forward Action Requests

The final Audit Assessment Report of the ERPD for the EP-JSLP by SCS Global produced a total of 78 queries out of which 3 focused on areas of concern and baseline calculations were captured as Forward Action Requests. The specific areas of concern and PIU response are provided in the table below;

Table 53: Resolution of Forward Action Requests

<table>
<tr><th>No.</th><th>Indicator(s)</th><th>Finding(s)</th><th>Sec.</th><th>Forward Action Request or Potential or Actual Area of Risk or Concern</th><th>PIU Response</th></tr>
<tr><td>01</td><td>R.A. 05</td><td>OBS 55</td><td>PR§4.1.2</td><td>Area of Concern: The program team initially included the stock change factors to calculate the soil organic carbon pools for all subcategories involving land use changes and subsequent emissions or removals from the soil organic carbon pool. In the final version of the calculation workbook, the stock change factors were removed from the equations and only the difference in soil reference carbon stock is applied to determine emissions or removals in soil during land use change. The IPCC guidelines do not include any guidance on situations in which these stock change factors may be omitting stock change factors. The assessment team could not find any evidence that omitting stock change factors is warranted, even in cases where total soil carbon stocks are directly measured. However, through independent recalculation, the assessment team ultimately found that by omitting the stock change factors, it resulted in a more conservative emissions baseline and therefore has no material implications.</td><td>During the preparation of the ERPD, the following F_{LU}, F_{MG} and F_{I} were assumed
<table>
<tr><th>LU Category</th><th>F_{LU}</th><th>F_{MG}</th><th>F_{I}</th></tr>
<tr><td>F = forestland</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>G = grassland</td><td>1</td><td>0.97</td><td>1</td></tr>
<tr><td>C = cropland</td><td>0.58</td><td>1</td><td>0.95</td></tr>
</table>
However, once there factors were applied for the years 2009 and 2018 they gave rise to higher SOC values for 2018 compared to 2009 for Forestland. This would have implied achieving emission reductions for soils in forestland remaining forestland. To be conservative a constant value was applied across the time series so that there were no emissions reduction in land remaining land categories. The converse was observed for SOC values for cropland and grassland. It was for this reason that constant SOC values were assumed for the entire time series.</td></tr>
<tr><td>02</td><td>R.A 41 R.A. 42</td><td>NIR 58</td><td>4.6.1, 4.6.2, 4.6.4</td><td>Forward Actin Request: The assessment team issued finding #58 in reference to the estimation of the baseline uncertainty and the ex-ante uncertainty. This finding was not completely addressed and the audit team discovered that there appears to be confusion between the Uncertainty Set-Aside and the Reversal Set-Aside percentages. We detail these remaining issues:</td><td>The Estimation of the baseline uncertainty and the ex-ante uncertainty, (R.A 41 R.A. 42 & NIR 58) was addressed during monitoring period. Uncertainty analysis was undertaken in retrospect for the baseline period 2009 to 2018 and monitoring year 2024 during the</td></tr>
</table>

				(1) Finding #58 states "The audit team requests a detailed and transparent demonstration of the uncertainty analysis described in section 4.5.3 of the ERPD. Please demonstrate how all relevant data and parameters have been included in the uncertainty estimations for each subcategory. For example, please demonstrate how the uncertainty regarding the area burned (20% of the forest area), percent of biomass burned (25% of biomass), total charcoal removal, total fuelwood removals, and forest growth were included in the forestland remaining forestland subcategory. Please provide such a demonstration for all ISFL eligible subcategories." The response/data provided also does not address the uncertainty of these baseline assumptions included in the forest remaining forest subcategory (fire, charcoal removal, fuelwood removal, etc.). It appears that only the collect earth uncertainty (activity data) and the uncertainty of emission factors (aboveground and belowground biomass) are considered, but the uncertainty of all other parameters impacting the baseline for forest remaining forest have not been considered. The audit team will require clear demonstration and justification of these key baseline assumptions/datasets in the forestland remaining forestland subcategory. *(2) The information provided is not transparent enough for us to confirm the baseline uncertainty for each subcategory and the combined total uncertainty. For example, in the document UNCERTAINTY ASSESSMENT NARRATIVE.docx provided, it states "Data for estimating emissions in the Land category was obtained from the ILUA data in the Eastern Province Analyzed spreadsheet with Activity uncertainty of ±5% and ±3% for emission factor uncertainty. Uncertainty levels for Collect Earth dataset was estimated at ±1.4% as show in the file: EP_Filtered_and_Analyzed_AD_final_16.12.22." It remains unclear how these values of +-5% or +-3% were derived. For instance in the file EP_Filtered_and_Analyzed_AD_final_16.12.22.xlsx, the Fl-FL uncertainty appears to be +-2.6%. However, for other land use transitions, the error is*	emissions estimate for the monitoring period. This analysis demonstrated transparency of uncertainty estimates and the confusion between Uncertainty Set-Aside and the Reversal Set-Aside percentages have been resolved. Uncertainty assessment for both baseline and monitoring period were assessed using Monte Carlo simulation. This is provided in the GHG Excel workbook "worksheet" uncertainty & Sensitivity[81]. The ERPD uncertainty estimates did not employ Monte Carlo approach as is the case with the Monitoring period. Thus, differences in uncertainty estimates between the recalculated uncertainty estimates for the baseline may be expected. Further guidance is required on how to proceed on this issue.

[81] https://drive.google.com/drive/folders/1a7ThDv37XTvxiEOgh5l20kARPw8nh7fH?usp=sharing

				much higher. For instance, FL-CL shows an uncertainty of +-17.9% and FL to SL has an uncertainty of +-73.5%. Thus, it is unclear how a +5% was derived for the activity data for each individual land use class. For the emission factors, a value of +-3% is indicated for each land use subcategory, but it is unclear how this was determined and whether it considered all pools (biomass, dead wood, and soil organic carbon). The audit team will require clear demonstration and justification of these land emission factors, including a justification of why it is appropriate to apply the same uncertainty level to all land subcategories and pools. (3) *The values in the workbook Uncertainty Calculations_2008_2018.xlsx provided do not match those in table 85 in Annex 6 of the ERPD, nor is the calculation of the combined uncertainty for each subcategory demonstrated in the Uncertainty Calculations_2008_2018.xlsx. The audit team will request this demonstration of the total baseline uncertainty for each subcategory as well as the overall uncertainty of all subcategories included.* *Section 4.6 of the ERPD states "Considering the overall uncertainty in LULUCF sector of 15%, the uncertainty set aside factor equals 3%. Considering the overall uncertainty in Forestland Remaining Forest Land (where most of the emissions are emanating), of 2.92%, Forestland converted to Cropland 18.61% and Cropland remaining cropland 50.2%, the uncertainty set aside factor equals 3% being the aggregate uncertainty of emission reductions between 15% and 30%." However, Annex 6, section 6 shows different uncertainty values for these classes. For instance, it shows a total uncertainty of 5.83% for forest remaining forest. Also, there is no demonstration of how an overall uncertainty of 15% was quantified. The audit team requests such a demonstration. Second, according to section 4.6.4 of the ER Program requirements, the uncertainty set-aside factor associated with a 15%-30% uncertainty is 4% (not 3% as stated in the ERPD). Note that this uncertainty set-aside factor is independent of the Reversal Set-Aside Percentages (section 4.7 of the*	

				Program Requirements). Please see the ISFL Buffer Requirements which clearly distinguishes that there are 2 separate set-aside percentages (Uncertainty Set-Aside and Reversal Set-Aside). *This forward action request is being issued to require that a transparent and complete demonstration of the calculation of the baseline uncertainty and an estimation of the uncertainty set-aside percentage be provided in accordance with section 4.6 of the ER Program Requirements and with attention to the points raised above in this FAR.*	
3	R.A. 05	29, 32, 33, NCR 42, NCR 45	PR§4.1.2	*Area of risk: As described in the findings, the audit team continued to express concerns (and nonconformities) regarding the accounting of soil organic carbon (SOC) emissions across subcategories. We concluded that unless the program team had considered that the soil carbon pool was stable for land remaining land (e.g., forest remaining forest, cropland remaining cropland), it would result in double counting of soil emissions for other subcategories involving conversions. For instance, a decline in soil carbon was initially quantified in the subcategory forest converted to cropland. The decline was due to (1) the area of forest declining and (2) the higher soil emissions associated with cropland. However, the decline in SOC due to a decline in the forest area would be double counted in the forestland remaining forestland subcategory as well. This resulted in double counting. The program was ultimately able to address these findings by implementing the assumption of stable soil carbon for land remaining land, as is permitted under the IPCC Guidelines and the ISFL Guidance note on the Application of the IPCC Guidelines. However, for monitoring, the program team intends to track the soil carbon in cropland remaining cropland to account for potential increases in soil carbon associated with project activities. When the program team applies assumption of non-stable SOC for land remaining land (e.g., cropland remaining cropland) under the program's ex-post monitoring, it will introduce significant complexity to the quantification and tracking of emissions to ensure that there is no double counting. The assessment team is has*	Soil carbon stocks are modelled using the RothC soil carbon model for the farm areas under Climate Smart Agriculture Practices. SOC changes of specific CSA practices are accounted for and not absolute carbon stock changes in the soil. Baseline soil carbon changes are conservatively considered zero on cropland that is subject to historic and ongoing land degradation.

				identified the accounting of monitored SOC emissions as an area of risk.	

Annex 6: SUMMARY PROGRESS ON THE ACTIONS AND INTERVENTIONS UNDER THE ISFL ER PROGRAM

The EP-JSLP envisages to achieve emission reductions by promoting interventions that prevent deforestation and forest degradation as well as reducing emissions from agriculture. This includes improved land-use planning, Climate Smart Agriculture (CSA) development, Sustainable Forest Management, rural energy generation, and support to Laws and Policies that protect Forests and Wildlife. As described in the Emission Reduction Program Document (ERPD), the activities leading to the emission reductions are a combination of interventions financed by the ZIFLP upfront grant provided by the Initiatives for Sustainable Forest Landscape (ISFL) and the Global Environmental Facility (GEF), but also due to other relevant investments and interventions by private sector players and organizations across the landscape. The table below presents the progress on the actions and interventions under the ISFL ER Program

Table 54: Status of progress actions and interventions under the ER Program

Intervention	Type of intervention (Sector)	Status of Key Actions and Interventions
Zambia Integrated Forest Landscape Project January 2018 – February 2024	1.1 Land use planning	• Nine (9) District Integrated Development Plans were developed and approved by the Ministry of Local Government and Rural Development • Twenty-two (22) participatory land use plans were developed and approved in 14 districts of the EP
	1.2 Enabling Environment for Emissions Reduction Framework	• Emissions reference level for the EP was established • Strategic Environmental & Social Assessment Document was developed • MRV system was developed to Monitor, Verify and Report emissions from the AFOLU sector • Benefit Sharing Plan developed and agreed on. • Emissions Reduction Program Document was developed and validated by the External Auditors, SCS Global.
	2. Climate Smart Agriculture	❖ Strengthened agricultural extension services through the training of 338 extension officers. ❖ Established 478 Farmer Field Schools ❖ Recruited and trained 10755 Lead Farmers who in turn each recruited 10 follower farmers ❖ Brought 162, 334 hectares of agriculture land area under climate smart agriculture ❖ 73,052 farmers adopted climate smart agriculture ❖ Established 21 Farmer Led Irrigation Schemes, each measuring 5ha giving a total of 1050ha of agricultural land brought under irrigation ❖ Conducted the soil fertility mapping for the entire EP.

		❖ Raised and distributed about 5million agroforestry seedlings to farmers. ❖ 30 Agriculture related subgrants provided to communities as alternative livelihood option ❖ 15,122.1 hectares of cashew planted across the province
	3 Sustainable Forest Management	• Twenty-nine (25 males and 4 females) government staff and 543 community members (320 males and 223 females) of the 27 established Community Forestry Management Group (CFMGs) were trained in the CFM process as Trainer of Trainers (ToT). • 28 Community Forest Management groups were established • 72, 752 hectares of forest land area was brought under sustainable management practices • Developed management plans for 25 Forest Reserves covering 256,571 ha. • Supported fire management activities in 25 Forest Reserves and 27 CFMGs • Boundary demarcation and clearing in 12 Forest Reserves covering a perimeter of 1,127.77 Km • 42 Forestry related subgrants provided to communities as alternative livelihood options • 5,000 beehives distributed to community forest management groups • 4 nursery shelters, 2 office blocks, 4 ranger housing units constructed to enhance forest protection in Kaluwe (2 houses), Masupe (1 house) and Msipazi Local Forest (1 house) • 27 CFMGs and 21 Forest Reserves supported to implement fire management and suppression activities • 2 tractors, 3 Toyota Landcruiser vehicles, 1 truck and trailer, 2-disc harrows, 2 ploughs, 20 wheelbarrows, 150 shovels, 150 spades, 450 pairs of gumboots, 65 slashers, 9 Jacto sprayers and 97 protective wear procured and distributed to support sustainable forest management activities. • 599 Honorary Forest Officers (HFOs) were recruited and trained to enhance forest protection • 114.1 hectares of exotic plantations established
	4. Wildlife Management	❖ Supported the development of the General Management Plan (GMP) for Luambe National Parks and Lumimba Game Management Area ❖ Consistently supported law enforcement activities in Luambe and Lukusuzi National Parks on a quarterly basis. Cumulatively, a total of 15,504 field patrols were

		undertaken resulting into 1,248 arrests and recoveries of wildlife trophies. Notable among the recoveries made were; 15 pangolins, 219 assorted guns, 265 wire snares and 239.5 kgs of ivory. ❖ Supported the development and implementation of fire management plans for Lukusuzi & Luambe National Parks ❖ Supported the creation of loop roads in Luambe (25Km) and Lukusuzi (50Km) National Parks. ❖ Supported the relocation of 200 illegal settlers from Lukusuzi National Parks and integrated them in Kazembe Chiefdom. ❖ Supported the boundary clearing and beaconing around the Lukusuzi and Luambe National Parks. In Lukusuzi the total length of the surveyed and cleared boundary line was 75.1 km while for Luambe it covered 328 square kilometers. ❖ Two (2) Automated Meteorological Weather Stations were procured and installed at Chipuka and Chikomeni Camp in Luambe and Lukusuzi National Parks respectively forming part of Meteorological Department weather stations network ❖ Two (2) Wildlife Ranger Camps were established in Kalindi and Roan Camps to enhance law enforcement activities in the 2 National Parks. ❖ Five Community Resource Boards (CRBs) were formed with support from the Project. ❖ Nine 9 wildlife subgrants provided to community groups as alternative livelihood option. ❖ Forestry Department ceased issuing Forest Concession Licenses in Areas under Community Forest Management.
	Improved cookstoves	❖ Trained 157 community members in the construction of fixed mud stoves ❖ Distributed 156 improved institution cookstoves to 20 boarding schools and 3 prisons ❖ Supported the construction of 4,185 improved fixed mud stoves
EPJSLP September 2024 – October 2030	Current ongoing activities under CSA, forest management and improved cookstoves	❖ Emissions Reduction Purchase Agreement (ERPA) was Signed with ISFL through the World Bank. ❖ Forest Carbon Stock Management Permit was issued to the EPJSLP by the Director of Forestry. ❖ 55 Chiefdoms Emissions Reduction Performance Agreements were signed. **Current ongoing activities**

		❖ Maintain the 162,000 hectares of agriculture land under climate smart agriculture ❖ Bring additional 80,000ha of agriculture land area under CSA ❖ Maintain 72,000 of community forest land area under sustainable management practices ❖ Establishment of 200 additional Farmer Field Schools ❖ Establishment of 30 new CFMGs ❖ Bring 335,000 hectares of forest land area under sustainable management practices ❖ Promotion of improved cookstoves in 30 CFMGs
Community Markets for Conservation (COMACO)	**Sustainable Landscape Management Project**	• 236,117 ha of forest land under community conservation • 229,939 farmers have signed a conservation pledge and joined 13,013 farmer producer groups from 103 local cooperatives. • 37,939,119 *Gliricidia Sepium* trees planted on-farm for improved soil fertility and crop yield. • 97,463 fuel efficient cook stoves installed – contributing to the annual saving of 32 trees per household or a total of 3,118,816 trees from all the stoves installed in 2021. • A total of 3,118,816 trees are planted in 2022. • 35,957 beehives were installed in community forests areas. • 55 chiefdom-level conservation tasks forces enforcing local conservations plans. • 103 cooperatives providing farmer extension services at varying stages of proficiency in 84 chiefdoms across three provinces (Eastern, Central and Muchinga). • Cooperative federation formed in Eastern Province representing 55 chiefdom level cooperatives. • 1,801 reformed wildlife poachers transitioned to farming and other alternative livelihoods. • 80,623 snares and 1,996 firearms surrendered, previously used to kill wildlife. • 55 reformed poachers contracted by cooperatives to blast chili, not bullets, to guard crops from elephants' attacks in the valley areas of Chama and Lundazi.
Biocarbon Partners (BCP)	**Luangwa Community Forest Project (LCFP).** The LCPF is a BCP flagship REDD+ initiative, launched in 2014 and works on communal lands within Game Management Areas (GMAs) and in selected	• 840 Lead Farmers trained in CSA. • 1,756 *Faidherbia Albida* trees have been planted since inception. • 938.5 Hectares of farmland under CSA. • 60 BCP supported Community Scouts trained. • 774,612 Total Hectares of Forest Protected. • 49,379 Households Benefiting from Forest Carbon Revenues.

	private game ranches, blending forest conservation with community development and carbon finance mechanisms to create a holistic sustainable model. LCPF operates on 1.2 million hectares of land across 12 Chiefdoms in Eastern Province with a social impact over 200,000 beneficiaries. The LCFP leverages the REDD+ framework to generate carbon credits by reducing deforestation and forest degradation while simultaneously improving local livelihoods.	• 619,699,048 estimated trees protected. • 232,530 community beneficiaries. • 650 community livelihood impact projects implemented since inception. • ZMW 22O% increase in annual household income since inception. • 2000 indirect income earning opportunities created. • 136 education related projects from inception. • 37 education related projects since inception. • 15 health related projects since inception.
World Vision Zambia Project – World Vision Zambia 1 July 2022 – 30 June 2027	**Zambia Sustainable Land Regeneration** The project aims at addressing deforestation and land degradation crisis in Zambia through the restoration of 150,000 hectares of forest land across three districts (Katete and Sinda) in an inclusive manner using the Farmer Managed Natural Regeneration (FMNR) concept.	❖ 11,168 hectares of individual FMNR sites were established in Sinda (8,083ha) and Katete (3,085ha) Districts. ❖ 26,774 hectares of communal FMNR sites were established in Katete (7,924ha) and Sinda (18,850ha) Districts. ❖ 7,966 participants trained in FMNR (i.e., 4063 Female, 3,903 Male, of these 478 are persons with disability (PWDs)). ❖ Formed two (2) Technical Working Groups (TWGs) who are leading the formation of Community Forest Management Groups (CFMGs) each in Sinda and Katete through the various processes of CFMG formation. ❖ Six (6) media personnel trained in FMNR for social marketing. FMNR programmes are being aired on Mphangwe Radio and Breeze FM in Eastern Province. ❖ 1,300 traditional leaders engaged in the formation of community By-laws. ❖ 1,679 (760 Female, 919 Male, of which 6 are persons with disability (PWDs) traditional leaders trained in Gender Equality Disability and Social Inclusion (GEDSI). ❖ 60 Satellite Disaster Management Committees (SDMCs) formed. 30 in Sinda and 30 in Katete.