
**Republic of Mozambique**
**Ministry of Land and Environment**

# REDD+ TECHNICAL ANNEX 2 - MODIFIED SUBMISSION

## RESULTS ACHIEVED BY MOZAMBIQUE FROM REDUCING EMISSIONS FROM DEFORESTATION (2017-2020)

**(Submission following the Technical Assessment preliminary findings, April 2025)**

**Maputo, May 2025**

**Technical information**

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# 1 Executive Summary

Mozambique presents this modified REDD+ Technical Annex in response to the findings of the Technical Assessment of its initial submission, covering the results for the period 2017–2020. This submission reflects Mozambique's commitment to continuous improvement, transparency, and alignment with the highest international standards for REDD+ reporting.

The Technical Assessment identified areas for methodological improvement, particularly concerning the consistency of activity data generation with the assessed FREL, the accuracy of area estimation, and the transparency and completeness of reported data.

In direct response, Mozambique has undertaken a comprehensive visual interpretation of all 48,894 sampling units from its national systematic grid, fully replicating the approach used to construct the FREL. This substantial enhancement eliminates reliance on preliminary map classifications, addresses potential biases in area estimation, and ensures full methodological consistency.

As a result of the comprehensive visual interpretation, the estimates of gross emissions reductions achieved by Mozambique from reducing deforestation during the period 2017–2020 have been revised.

# 2 Introduction

In the context of results-based payments for reducing emissions from deforestation and forest degradation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (REDD+), under the United Nations Framework on Climate Change (UNFCCC), Mozambique is submitting this Technical Annex to its 2nd Biennial Update Report (BUR).

The submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving results-based payments in accordance with the decisions 13/CP.19, paragraph 2 (UNFCCC COP19 – Warsaw, 2013a), and 14/CP.19, paragraphs 7 and 8 (UNFCCC COP19 – Warsaw, 2013b).

This submission, therefore, does not modify, revise or adjust in any way the Nationally Appropriate Mitigation Actions (NAMA) voluntarily submitted by Mozambique under the Bali Action Plan (FCCC/AWGLCA/2011/INF.1), nor does it interfere with its Nationally Determined Contribution (NDC) under the Paris Agreement of the UNFCCC.

This document presents the results achieved in reducing emissions from deforestation in Mozambique during the 2017-2020 period, and also the progress made in producing data and information to continuously improve Mozambique's submissions.

The technical annex is part of the international consultation and analysis of BURs referred to in decision 2/CP.17, annex IV, paragraph 4, the objective of which is to increase the transparency of mitigation actions and their effects through analysis by the TTE (team of technical experts) in consultation with Mozambique and through a facilitative sharing of views, resulting in a separate summary report.

# 3 Response to Technical Assessment

This modified Technical Annex has been prepared in response to the preliminary findings of the Technical Assessment (TA) of Mozambique's REDD+ results for the period 2017–2020, as communicated by the Assessment Team (AT) in April 2025. Mozambique welcomes the findings of the TA and appreciates the constructive feedback provided by the LULUCF experts, which has guided significant methodological improvements in this submission.

The main issues identified in the TA pertained primarily to the methodology for activity data generation, particularly the reliance in the initial submission on a two-stage classification process that did not fully replicate the approach adopted for the FREL, and related implications for accuracy, transparency, and uncertainty estimation.

Mozambique has addressed these areas for technical improvement as follows:

1. **Full Review of the National Systematic Sampling Grid**
    - In the original submission, Mozambique applied a two-stage approach: first, using national deforestation maps to classify stable areas; and second, conducting visual interpretation only on plots intersecting areas of mapped change.
    - In this modified submission, Mozambique has undertaken a comprehensive review of all 48,894 sampling units of the national systematic grid, through full visual interpretation, consistent with the approach adopted for the FREL.
    - This improvement ensures full methodological consistency with the FREL and responds directly to Finding ID#2 and ID#4 of the TATR.
2. **Addressing Potential Bias and underestimation of accuracy**
    - By reviewing the full grid, Mozambique eliminates potential biases introduced by the previous reliance on mapped stable areas, which may have understated deforestation and overstated results.
    - This addresses the concern raised under Findings ID#4 and ID#6, ensuring that the estimation of deforested areas is unbiased and improves the overall accuracy of the emission reductions reported.
3. **Improved Transparency and Completeness of Data**
    - Mozambique has enhanced the completeness of this submission by providing direct access to data and clear documentation of the methodologies employed.
    - Links and references to key datasets, interpretation protocols, and metadata for all sampling units are included, responding to Finding ID#5.

- The classification of each sampling unit is transparently presented, accurately reflecting the methodology applied.

**4. Further Areas of Improvement**

- Mozambique recognises the recommendation to include non-CO2 gases and soil organic carbon in future FREL and results reporting (Finding ID#3).
- While these elements remain outside the scope of this modified submission to preserve consistency with the assessed FREL, Mozambique will consider their inclusion in future updates as the monitoring system evolves.

Mozambique reiterates its commitment to transparency, methodological rigor, and continuous improvement of its national forest monitoring system and REDD+ reporting processes. The improvements introduced in this modified submission aim to fully address the recommendations of the Technical Assessment and align with best practices as set out in IPCC guidelines and good practice guidance for land-use change estimation.

As a consequence of these methodological improvements, the estimates of emission reductions achieved during the 2017–2020 period have been updated in this modified submission. The revised figures are based on the recalculated deforestation areas derived from the full visual interpretation of all sampling units. These updated results replace those from the original submission and reflect a more robust, unbiased, and transparent estimation framework that better supports credible REDD+ reporting and eligibility for results-based payments.

*Table 1. Response matrix.*

| Finding ID | Issue Identified in TATR | Response in Modified Submission |
|---|---|---|
| 1 | Methodological consistency in emission factors, pools, gases, and forest definition | Maintained consistency as per initial submission. No change required. |
| 2 | Inconsistent methodology for generating activity data compared to FREL (partial visual interpretation) | Full visual interpretation of all 48,894 points in the national systematic grid, replicating the FREL methodology fully. |
| 3 | Suggestion to include non-CO2 gases and SOC pools for future improvements | Acknowledged. Maintained consistency with the original FREL scope, but commitment to explore inclusion in future updates. |
| 4 | Potential bias in area estimates due to reliance on map classification for stable areas | Addressed through comprehensive visual assessment of all sampling units, removing reliance on preliminary map classifications and potential associated bias. |
| 5 | Lack of references/links to data for full reconstruction of results | Addressed in this modified submission because the assessment now includes all sampling units. |

| | | |
|---|---|---|
| 6 | Underestimation of uncertainty due to assumed full sample interpretation | Revised uncertainty analysis is based on the full reviewed sample, correcting potential underestimation and improving accuracy. |

# 4 Summary of information from the assessed FREL

Mozambique's Forest Reference Emission Level (FREL) for reducing emissions from national native forest for REDD+ results-based payments under UNFCCC, within a national basis resulting from an historical average from 2003 to 2013, was submitted on a voluntary basis for a technical assessment in the context of results-based payments. The FREL covers the activity "reducing emissions from native forest deforestation" which is Mozambique's most significant of five activities included in paragraph 70 of 1/CP.16 (UNFCCC COP16 – Cancun, 2010). The country is still developing the methodologies for monitoring the emissions and removals from the other REDD+ activities (forest degradation, conservation, sustainable management of forests and enhancement of forest carbon stocks).

Mozambique submitted its FREL on 10 January 2018 in accordance with decisions 12/CP.17 (UNFCCC COP17 – Durban, 2011) and 13/CP.19 (UNFCCC COP19 – Warsaw, 2013). The technical assessment took place from 19 to 23 March 2018 in Bonn, Germany, and was coordinated by the UNFCCC secretariat. As a result of the facilitative interactions with the Assessment Team (AT), Mozambique provided a modified version of its submission on 28 May 2018, which took into consideration the technical inputs of the AT. Finally, the technical assessment report was published on 20 November 2018.

In the referred FREL, Mozambique used a national forest definition, which is: lands occupying at least 1 hectare, with a canopy cover equal or greater than 30% and with trees with the potential to reach a height of 3 m at maturity (Falcão & Noa, 2016). Mozambique uses a tiered Land Use and Land Cover (LULC) classification system, which fits within the IPCC system that was used as the basis for the National Forest Inventory (NFI), activity data and mapping of LULC. However, the national system highlights the forest class, making a distinction between different types of forest existing in the country.

Mozambique's forests are categorized as a "tropical forest", and subdivided at the national level, considering level 1 as the IPCC system, level 2 that distinguishes between open and closed canopy, as well as evergreen or deciduous evergreen or deciduous forests. It also includes a class of forest plantation. At level 3, forest types are further differentiated into evergreen forests including montane forest, gallery forest, mangrove, coastal forest and Mecrusse forest.

The activity data used for the construction of the FREL in Mozambique were obtained from an annual historical analysis of land use, land use change and forestry (LULUCF) conducted by the MRV Unit for the period 2001-2016, using the tool Open Foris Collect Earth (MITADER, 2018). However, the FREL covered the period 2003 - 2013, to maintain consistency with the historical record of deforestation estimates of the country. The activity data was generated following IPCC Approach 3 for representing activity data as described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 3, Section 3.13 (Eggleston et al., 2006).

The NFI is the second sub-system within the National Forest Monitoring System (NFMS), which produces the emission factors. The forest inventory conducted in 2016-17 (MITADER, 2017b) produced the emission factors used for the FREL submitted to the UNFCCC in 2018.

For estimating emission factors and other purposes (volume, density, etc.), Mozambique aggregated fourteen forest types into five forest strata (Table 2), based on the similarity of the forest type. The aggregation was done with the purpose of harmonizing the forest strata of activity data and the emission factors from NFI.

The construction of the FREL considered equation 2.16 of the 2006 IPCC Guidelines for estimating annual change in carbon stocks in biomass on forestland converted to other land-use categories. The FREL did not consider changes in carbon stocks in forest lands remaining forest lands (degradation).

*Table 2: Mozambique forest types and aggregated strata used in NFI and FREL emission factors.*

| Initial forest type | Aggregated strata |
|---|---|
| Semi-deciduous open forest | Semi-deciduous forest |
| Semi-deciduous closed forest | |
| Miombo open forest | |
| Miombo closed forest | |
| Semi-evergreen mountain open forest | Semi-evergreen forest |
| Semi-evergreen mountain closed forest | |
| Semi-evergreen open forest | |
| Semi-evergreen closed forest | |
| Mopane open forest | Mopane forest |
| Mopane closed forest | |
| Mecrusse open forest | Mecrusse forest |
| Mecrusse closed forest | |
| Mangrove open forest | Mangrove forest |
| Mangrove closed forest | |

Based on the methodology described above, Mozambique's FREL for the period of 2003 – 2013 was assessed to be 38,956,426 $tCO_2e$ (Table 4) from an annual average of 267,029 hectares deforested (Table 3).

*Table 3: Annual deforestation per forest stratum for the FREL period.*

| Year | Annual deforestation per forest stratum (ha) | | | | | Total |
|---|---|---|---|---|---|---|
| | Semi-deciduous | Semi-evergreen | Mangrove | Mecrusse | Mopane | |
| 2003 | 192,108 | 38,633 | - | 1,755 | 1,704 | 234,198 |
| 2004 | 235,354 | 38,874 | 1,716 | - | 12,100 | 288,044 |
| 2005 | 242,940 | 74,239 | - | - | 6,754 | 323,934 |
| 2006 | 200,388 | 35,283 | - | 5,246 | 10,476 | 251,393 |
| 2007 | 192,401 | 40,605 | 1,716 | 1,709 | 3,424 | 239,854 |
| 2008 | 213,758 | 76,531 | - | - | - | 290,289 |
| 2009 | 206,592 | 60,370 | - | - | 1,669 | 268,632 |
| 2010 | 268,354 | 68,104 | 5,140 | - | 23,831 | 365,431 |
| 2011 | 190,519 | 45,389 | - | - | 11,975 | 247,884 |
| 2012 | 198,476 | 50,123 | - | - | 5,128 | 253,726 |
| 2013 | 137,050 | 33,514 | - | - | 3,373 | 173,937 |
| **Average** | 207,086 | 51,060 | 779 | 792 | 7,312 | **267,029** |

*Table 4: Annual emissions from deforestation per forest stratum for the FREL period.*

| Year | Annual emissions from deforestation per forest stratum ($tCO_2e$) | | | | | Total |
|---|---|---|---|---|---|---|
| | Semi-deciduous | Semi-evergreen | Mangrove | Mecrusse | Mopane | |
| 2003 | 25,559,439 | 7,942,668 | - | 273,615 | 142,096 | 33,917,819 |
| 2004 | 31,338,894 | 7,981,362 | 325,087 | - | 1,009,247 | 40,654,590 |
| 2005 | 32,356,914 | 15,257,126 | - | - | 566,963 | 48,181,004 |
| 2006 | 26,703,194 | 7,251,572 | - | 806,709 | 873,834 | 35,635,309 |
| 2007 | 25,608,983 | 8,343,784 | 350,931 | 262,747 | 285,589 | 34,852,034 |
| 2008 | 28,482,723 | 15,727,697 | - | - | - | 44,210,420 |
| 2009 | 27,481,558 | 12,388,883 | - | - | 139,242 | 40,009,683 |
| 2010 | 35,724,524 | 13,998,072 | 999,748 | - | 1,998,642 | 52,720,986 |
| 2011 | 25,379,684 | 9,318,237 | - | - | 1,002,489 | 35,700,409 |
| 2012 | 26,423,022 | 10,362,675 | - | - | 427,686 | 37,213,382 |
| 2013 | 18,236,643 | 6,907,066 | - | - | 281,338 | 25,425,047 |
| **Average** | 27,572,325 | 10,498,104 | 152,342 | 122,097 | 611,557 | **38,956,426** |

The REDD+ decisions under the UNFCCC value the continuous update and improvement of relevant data and information over time. Mozambique values consistency and transparency of the data submitted as

fundamental and gives the highest priority to these. On the other hand, Mozambique continues its efforts to improve the accuracy of the estimates for all carbon pools included in the FREL, and continue presenting the data in a much more transparent and verifiable manner, allowing the reconstruction of the FREL.

# 5 Results in tonnes of CO2 per year, consistent with the assessed FREL

The necessary data for the reconstruction of FREL, is publicly available, in a manner which allows its replication, as result of decision 14/CP.19 of COP-19, which determines that "the data and information used by Parties in the estimation of anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest-area changes, as appropriate to the activities referred to in decision 1/CP.16, paragraph 70, undertaken by Parties, should be transparent, and consistent over time and with the established forest reference emission levels and/or forest reference levels in accordance with decision 1/CP.16, paragraph 71(b) and (c) and chapter II of decision 12/CP.17". The activity data of deforestation is publicly available through the Deforestation Statistics Web portal (link) and the emission factors used are described in the FREL.

The emission reductions in tonnes of $CO_2e$ per year from 2017–2020 were estimated by subtracting the annual emissions from the FREL.

| **Emission reductions ($tCO_2e$) = FREL - Annual emissions from deforestation** | Equation 1 |
|---|---|

For the period 2017-2020, Mozambique reduced its emissions from deforestation by 29,824,401$tCO_2e$ (Table 5 and Figure 1)

*Table 5: Summary of information from assessed results of emission reductions from 2017 to 2020.*

| Year | FREL ($tCO_2e*yr^{-1}$) | Deforestation (ha) | Emissions from deforestation ($tCO_2e$) | Emission Reductions ($tCO_2e$) |
|---|---|---|---|---|
| 2017 | 38,956,426 | 137,679 | 19,348,288 | 19,608,137 |
| 2018 | 38,956,426 | 204,061 | 29,090,654 | 9,865,772 |
| 2019 | 38,956,426 | 273,629 | 38,605,935 | 350,491 |
| 2020 | 38,956,426 | 313,691 | 43,540,597 | 0 |
| **Total** | | **929,060** | **130,585,473** | **29,824,401** |

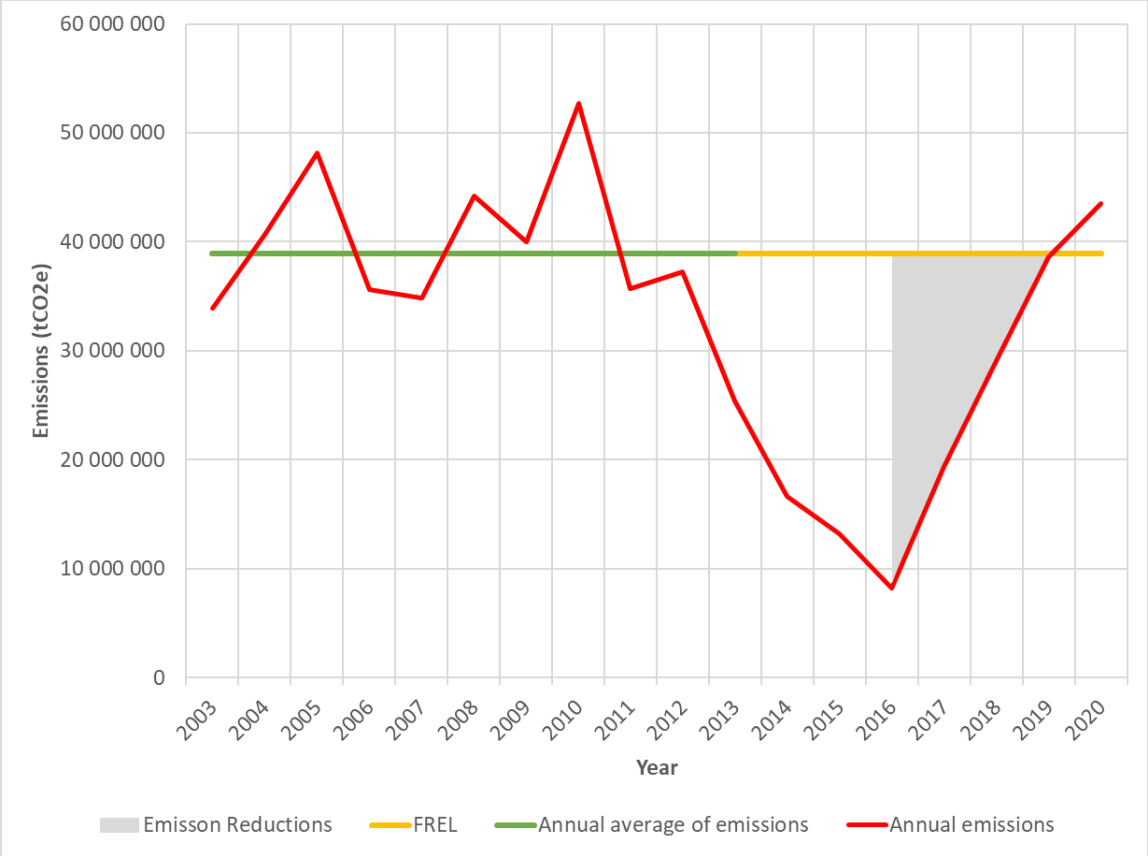


*Figure 1: Summary of annual emissions in Mozambique between 2003 and 2020, with REDD+ results achieved between 2017-2020 highlighted in gray.*

# 6 Demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed FREL

The present REDD+ results method is overall consistent with Mozambique's FREL, as it used the same national forest definition, national land use and land cover classification system (including sampling and response design), REDD+ activities, carbon pools, gases and scales.

Additionally, the methodology presented here was also used to calculate land-use and land cover change emissions in the national GHG inventory for the 2nd BUR.

## 6.1 REDD+ activities

The only REDD+ activity included in the FREL of Mozambique was deforestation. Other REDD+ activities were not included in the FREL, and so are also not monitored under this Technical Annex. In this regard,

the Technical Annex differs from the BUR, since the BUR includes other activities, namely removals from biomass growth in natural forests and emissions from forest degradation due to fuel wood removal and wildfires.

## 6.2 Carbon pools

For the monitoring of carbon emissions, Mozambique considered in the FREL the use of only 2 of the 5 carbon pools presented in section 4.2.2 of chapter 4 of the IPCC good practice guide. The two reservoirs considered were: aboveground biomass (AGB) and belowground biomass (BGB), while dead wood, litter and soil organic carbon were excluded. The same carbon pools are considered in this Technical Annex.

## 6.3 Included gases

Consistent with the FREL, only CO2 emissions are included in this Technical Annex.

## 6.4 Activity data

The Activity Data of Mozambique is derived from a systematic sampling grid of 4x4 km ("systematic grid"), comprising a total of 48,894 sampling units, subjected to a historical analysis time series of land use, land-use change and forestry (LULUCF), using *Open Foris Collect Earth*. The approach to produce all the information of Activity Data is described in Box 1. For more detailed information see the methodological description in the FREL of Mozambique (link).

For this Modified Technical Annex, the entire systematic grid was reviewed, to identify all changes in forests that occurred between 2017 and 2020. A total of **48,894 sampling units** covering the entire national territory were individually reviewed through visual interpretation of satellite imagery, consistent with the methodology adopted for the FREL construction.

This improvement responds to the findings of the Technical Assessment, which identified limitations in the initial approach that relied on a two-stage classification system combining deforestation maps and partial visual interpretation.

**Box 1. Summary Information of the approach, sample design and the source of remote sensing products used to produce national Activity Data**

Activity data have been generated following IPCC Approach 3 for representing the activity data as described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 3, Section 3.13), i.e., using spatially-explicit observations of land-use categories and land-use conversions over time, derived from sampling of geographically located points. A systematic sampling design is used by Mozambique to generate information on land use and land cover change, with a 4 x 4 km grid at national level (the same grid used to allocate the National Forest Inventory clusters from the Stratified Random Sampling design). This sampling design was used to produce the FREL, 1st BUR REDD+ Technical Annex and the present 2nd BUR REDD+ Technical Annex.

Regarding the spatial sampling unit, from each point of the 4 x 4 km grid, a 1 ha plot was overlaid, where an internal grid of 5 x 5 points (20m x 20m grid) is overlapped (with the weight coverage of 4% by each internal grid point). It is with this 1 ha plot the response design is applied, ensuring consistency with the national definition of forest.

The Tool used to perform the national Activity data calculation was OpenForis Collect Earth (www.openforis.org), which enables access to high resolution imagery in Google Earth and Bing Maps, a medium resolution imagery available through Earth Engine Explorer and Code Editor. This tool also provides a form designed to collect the land use and land cover information for each sampling unit (1 ha plot). The Earth Engine Code Editor was used to facilitate the interpretation of the vegetation types and of LULC changes (by displaying MODIS MOD13Q1 Imagery) including Sentinel-2 Imagery, Landsat 7 and 8 Time Series Imagery. The medium resolution imagery also includes products of Reflectance composites and vegetation indexes from Landsat 5 to 8.

## 6.5 Emission factors

The Emissions Factors for all terrestrial forest types were derived from the National Forest Inventory (NFI) conducted between 2015 and 2017 (MITADER, 2017b). The NFI considered four types of forest, namely Semi-deciduous forest, Mopane forest, Mecrusse forest and Semi-evergreen forest. Emission factors for mangrove forests were based on the default values of IPCC Guidelines for national greenhouse gas inventories.

Except for semi-evergreen forest, all other strata used national and regional allometric equations for estimating biomass. For semi-evergreen forest, IPCC (2003) allometric equation was used to estimate aboveground biomass and root to shoot ratio from (Mokany et al., 2006) was used to estimate belowground biomass. Other pools such as soil organic carbon (SOC) and dead organic matter (DOM and

litter) were not considered for the construction of the FREL, hence they are also not included in the monitoring of emissions.

Mozambique included post-disturbance carbon stocks for above and belowground biomass for conversions to cropland and grassland from the IPCC default values.

*Table 6: Allometric equations used for calculation of emission factors from NFI measurements in the FREL and REDD+ Technical Annex. $\hat{Y}$: Estimated tree biomass, d: tree diameter at 1.3m, h: total tree height. Species specific equations take precedence over forest type equations.*

| Forest Type | Forest species | Above-ground biomass (AGB) [kg] | Below-ground biomass (BGB) [kg] |
|---|---|---|---|
| Semi-deciduous forest | All species | $\hat{Y} = 0.0763 * d^{2.2046} * h^{0.4918}$ (Mugasha et al., 2013) | $\hat{Y} = 0.1766 * d^{1.7844} * h^{0.3434}$ (Mugasha et al., 2013) |
| Evergreen forest | All species | $\hat{Y} = \exp(-2.289 + 2.649\ln(d) - 0.021 * (\ln(d))^2)$ (Penman et al., 2003) | $\hat{Y}$ = Root-shoot ratio (=0.275) (Mokany et al., 2006) |
| Mopane forest | All species | $\hat{Y}=0.03325 * d^{1.848} * h^{1.241}$ (MITADER, 2017a) | $\hat{Y}=0.09572 * d^{1.7969} * h^{0.3797}$ (MITADER, 2017a) |
| Mecrusse forest | *Androstachys johnsonii* | $\hat{Y} = 1.1544 + 0.0398 * d^2 * H$ (Magalhães, (2015b) | $\hat{Y} = 0.0185 * d^{2.1990} * h^{0.4699}$ (Magalhães, 2015a) |
| Mecrusse forest | Other species | $\hat{Y} = 0.0763 * d^{2.2046} * h^{0.4918}$ (Mugasha et al., 2013) | $\hat{Y} = 0.1766 * d^{1.7844} * h^{0.3434}$ (Mugasha et al., 2013) |
| Any | *Millettia stuhlmannii* | $\hat{Y} = 5.7332 * d^{1.4567}$ (Mate et al., 2014) | $\hat{Y} = 0.1766 * d^{1.7844} * h^{0.3434}$ (Mugasha et al., 2013) |
| Any | *Pterocarpus angolensis* | $\hat{Y} = 0.2201 * d^{2.1574}$ (Mate et al., 2014) | $\hat{Y} = 0.1766 * d^{1.7844} * h^{0.3434}$ (Mugasha et al., 2013) |
| Any | *Afzelia quanzensis* | $\hat{Y} = 3.1256 * d^{1.5833}$ (Mate et al., 2014) | $\hat{Y} = 0.1766 * d^{1.7844} * h^{0.3434}$ (Mugasha et al., 2013) |

*Table 7: Emissions factors*

| Forest type | AGB ($t.ha^{-1}$) | BGB ($t.ha^{-1}$) | Source |
|---|---|---|---|
| Semi-deciduous forest | 62.24 (59.51 – 64.97) | 24.82 (23.88 – 25.75) | MITADER (2018), Table 20 |
| Evergreen forest | 99.89 (93.98 – 105.81) | 29.19(27.53 – 30.86) | |
| Mopane forest | 44.51 (40.65 – 48.36) | 13.89 (12.83 – 14.95) | |
| Mecrusse forest | 78.65 (73.18 – 84.12) | 20.58 (19.21 – 21.96) | |
| Mangrove | 92 | 26.68 | IPCC (2006), Table 4.5 |

## 6.6 Uncertainty estimation

The uncertainty estimation followed the same procedure as was used in the FREL. Below we provide a brief description of this methodology for activity data, emission factors and emissions uncertainty estimation.

### 6.6.1 Activity data

The assessment of the uncertainty in activity data was derived from the standard error formula for a 95% confidence interval, under the assumption that the values follow a normal distribution. Thus, the uncertainty of the estimate was expressed according to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1, Chapter 3, Section 3.13, Box 3.0A.

The standard error (SE) of the estimate of area per land-use category was calculated as follows:

$$SE_j = A_j \times \sqrt{\frac{p_j \times (1 - p_j)}{n - 1}}$$

Where:

$A_j$ is the land surface area of the land-use category *j*, in hectares;

$p_j$ is the proportion of samples in the land-use category *j*, dimensionless; and

*n* is the total number of sampling units.

The uncertainty of the estimate per land-use category was expressed using the formula:

$$Uncertainty_j = \pm\left(\frac{1.96 \times SE_j}{\mu_j}\right) \times 100\%$$

Where:

$\mu_j$ is the estimated area of land use category *j*, in hectares.

### 6.6.2 Emission factors

The uncertainties (variance, standard error, sample error, and confidence interval) associated with the above-ground and below-ground biomass, for the four classes covered by the NFI, were estimated using the approach proposed by Jayaraman (1999). Below we provide a description of the equations, which were used to calculate the uncertainties presented in the NFI report (link). The same approach was taken in the FREL.

The variance was estimated using the equations 5.27 and 5.28 proposed by Jayaraman (1999), and the standard error was estimated using the classic mathematical expression of standard deviation (square root of variance) available in all statistical books and also proposed by Jayaraman (1999).

$$V(\hat{Y}) = \frac{1}{N^2} \sum_{t=1}^{k} N_t * (N_t - n_t) \frac{{S_t}^2(y)}{n_t}$$

Where:

$${S_t}^2(y) = \sum_{j=1}^{nt} \frac{(Y_{tj} - \bar{y}_t)}{n_t - 1}$$

$$SE(\hat{Y}) = \sqrt[2]{V(\hat{Y})}$$

The relative standard error of the mean or sampling error was estimated using equation 5.29, also proposed by Jayaraman (1999), which is equal to the standard error divided by the mean and converted to percentage. The confidence interval of above-ground and below-ground biomass was estimated using the classic mathematical expression for estimating the confidence interval, also available in all statistical books.

$$RSE(\hat{Y}) = (SE(\hat{Y}) * 100)/\hat{Y}$$

$$CI(\hat{Y}) = \hat{Y} +/- SE(\hat{Y}) * t$$

Where:

V(Ŷ) is the variance of the above-ground and below-ground biomass of the population

$St^2$ is the variance of the above-ground and below-ground biomass of strata

Ŷ is the mean of the above-ground and below-ground biomass of the population

$\bar{y}_t$ is the mean of the above-ground and below-ground biomass of strata *t*

$n_t$ is the total number of the plot of strata *t*

$Y_{tj}$ is the estimated value of above-ground and below-ground biomass in plot *j* of the strata *t*

$N_t$ is the total number of the plot of the population

*N* is the total number of the population if the census were taken

SE is the standard error of the above-ground and below-ground biomass of the population

CI(Ŷ) is the confidence interval of the above-ground and below-ground biomass of the population

*t* is the value of student test, considering 95% of significance level and n-1 degrees of freedom

For mangroves, the emission factor uncertainty for AGB and BGB was taken from the IPCC (2006) default values.

### 6.6.3 Emissions

The estimation of uncertainties in CO2 equivalent emissions was carried out using the propagation error approach as described in section 3.17 of Chapter 3 of Volume 1 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. This method quantifies uncertainties associated with activity data, emission factors, and other estimation parameters in individual categories.

The propagation error equation provides two main rules for combining uncorrelated uncertainties, whether by multiplication or addition/subtraction:

**Multiplication**: When uncertain quantities are combined by multiplication, such as the product of activity data, emission factor, carbon fraction, and conversion of C stock changes to CO2 emissions, the total uncertainty is calculated using Equation 3.1, expressed in percentage terms:

$$U_{total} = \sqrt{U_1^2 + \cdots U_i^2 + \cdots U_n^2}$$

Where:

$U_{total}$ is the percentage uncertainty in the product of the quantities (half the 95 percent confidence interval divided by the total and expressed as a percentage); and

$U_i$ is the percentage uncertainties associated with each of the quantities

**Addition/Subtraction**: When uncertain quantities are combined by addition or subtraction, such as the sum of above-ground and below-ground biomass before deforestation and after deforestation, or the difference between biomass before deforestation and after deforestation, the total uncertainty is calculated using Equation 3.2, expressed in percentage terms:

$$U_{total} = \sqrt{\frac{(U_1 \times x_1)^2 + \cdots + (U_i \times x_i)^2 + \cdots + (U_n \times x_n)^2}{|x_1 + \cdots x_i + \cdots + x_n|}}$$

Where:

$U_{total}$ is the percentage uncertainty in the sum of the quantities (half the 95 percent confidence interval divided by the total (i.e., mean) and expressed as a percentage);

$x_i$ quantities to be combined; xi may be a positive or a negative number

$U_i$ is the percentage uncertainties associated with each of the quantities

*Table 8 Uncertainties of emissions from deforestation for FREL and results period.*

| Year | Uncertainty of Emissions (%) |
|---|---|
| 2003-2013 | ± 7 |
| 2014 | ± 25 |
| 2015 | ± 28 |
| 2016 | ± 35 |
| 2017 | ± 23 |
| 2018 | ± 19 |
| 2019 | ± 17 |
| 2020 | ± 16 |

# 7 Description of the National Forest Monitoring System and the institutional roles and responsibilities for measuring, reporting and verifying the results

To achieve the intended activities of the national forest monitoring system, continuous efforts are carried out by different institutions within the government of Mozambique. In 2016, Mozambique initiated the establishment of an MRV unit under the National Fund for Sustainable Development (FNDS) to carry out the monitoring, reporting and verification of national forest greenhouse gas emission.

The National Forest Monitoring System (NFMS) is being developed jointly between the National Directorate of Forest (DINAF), FNDS (through the MRV Unit) and other relevant stakeholders. The current monitoring system has three sub-systems: Satellite and land monitoring system, National forest inventory and National GHG inventory.

The first version of the NFMS document was finalized in 2021 (link) and defines the NFMS as a system which:

i. Allows for accountable reporting of REDD+ results.
ii. Allows for Monitoring the implementation and effectiveness of Policies and Measures for sustainable forest management, which include national and international purposes and beyond REDD+.
iii. Builds on a robust IT system to support data management and transparency.

*Responsibilities within the NFMS:*

DINAF - Responsible for the National Forest Inventory as a Leader, and responsible for the Quality Control and Quality Assurance of the NFI process.

FNDS/MRV - Coordinate the operations and logistics of the National Forest Inventory activities, and Production of activity data for REDD+ Activities, Production and submission of the FREL document.

IIAM - Provide technical staff for tree species identification and fieldwork support, establish permanent sampling plots.

Academic Institutions - Support in the production of the National Forest Inventory, National Forest Inventory Report, providing allometric equations for carbon estimation.

CENACARTA - Evaluation of the data production process.

# 8 Necessary information that allows for the reconstruction of the results

For REDD+ purposes, complete information means the provision of data that allows for the reconstructions of the FREL and the REDD+ results. The methodology used to calculate activity data, emission factors and FREL is described in detail in the FREL document through the link: https://redd.unfccc.int/files/moz_frel_report_final.v03_03102018.pdf, and all the data used, that allows for the reconstruction of the FREL and this REDD+ Technical Annex, are available here.

For REDD+ purposes, ensuring complete information is crucial for reconstructing the Forest Reference Emission Level (FREL) and REDD+ results. The following sections detail the methodology used to calculate activity data, emission factors, the FREL, REDD+ results, and uncertainties. The information provided in these sections ensures transparency and reproducibility of the results.

## 8.1 Estimation of activity data

The estimation of activity data adopted the weighted sum technique. This approach involved calculating the total area of each land-use category in each province of the country, directly considering the specific geographical areas and the number of sampling units allocated in each province from the systematic grid, as detailed in Table 9.

*Table 9: Total area, sampling units of the systematic grid and corresponding expansion factor for every province in Mozambique.*

| Province | Total Area (ha) | Sampling Units |
|---|---|---|
| Cabo Delgado | 8,027,338.90 | 4,872 |
| Gaza | 8,248,235.20 | 4,701 |
| Inhambane | 7,498,070.30 | 4,295 |
| Manica | 6,628,716.20 | 3,891 |
| Maputo | 2,590,492.10 | 1,455 |
| Maputo City | 38,758.80 | 25 |
| Nampula | 8,139,712.90 | 4,872 |
| Niassa | 12,648,287.90 | 7,962 |
| Sofala | 7,207,150.50 | 4,218 |
| Tete | 10,512,069.80 | 6,297 |
| Zambezia | 10,820,042.40 | 6,306 |
| **Country** | **82,358,875.00** | **48,894** |

The weighted sum ensures that the calculated areas accurately reflect the geographical and administrative dimensions of each province. This is essential to ensure the precision of estimates in studies that rely on the actual spatial distribution of land-use categories within administrative units. This approach is preferable to uniform sampling methods as it avoids distortions that could occur by applying the same ratio to all provinces, especially in smaller provinces or those with a non-homogeneous spatial distribution of sampling points.

The formula used to estimate the area for each land-use category is:

$$\mu_j = \sum_i \left( \frac{a_i}{N_i} \times n_i \right)$$

Where:

$\mu_j$ is the estimated area of land use category *j*, in hectares;

$a_i$ is the total area of province *i*, in hectares;

$N_i$ is the total number of sampling points allocated in province *I*, a numerical value; and

$n_i$ is the number of sampling points allocated in province *i* observed for land-use category *j*, a numerical value.

## 8.2 Estimation of Annual Emissions from Deforestation

Considering Equation 2.16 described in the IPCC 2006, Volume 4, Chapter 2, Section 2.20, the calculation of equivalent carbon dioxide emissions from deforestation adopted the weighted sum of estimated areas of different land use categories converted to alternative uses, multiplied by the amount of above-ground and below-ground biomass, the carbon fraction, and the conversion of C stock changes to $CO_2$ emissions factor.

The emission calculation was expressed by the following formula:

$$CO_2\ Emissions = \sum_j \left\{ \left( AGB_j + BGB_j - AGB_k - BGB_k \right) \times A_{j \to k} \right\} \times CF \times \frac{44}{12}$$

Where:

$\mu_{j \to k}$ is the estimated area of land-use category *j* converted to other land-use category *k*, in hectares. Five forest strata with conversion potential were considered, namely:

(i) Broadleaved (Semi-)deciduous including Miombo,
(ii) Broadleaved (Semi-)evergreen,
(iii) Mangrove,
(iv) Mecrusse, and
(v) Mopane;

$AGB_j$ is the above-ground biomass of land-use category *j* before deforestation, in tonnes of dry matter per hectare (tonnes d.m. $ha^{-1}$). Biomass was considered for the five forest strata mentioned above;

$BGB_j$ is the below-ground biomass of land use category *j* before deforestation, in tonnes of dry matter per hectare (tonnes d.m. $ha^{-1}$). biomass was considered for the five forest strata mentioned above;

$AGB_k$ is the above-ground biomass after deforestation land-use category *j* converted to other land-use category *k*, in tonnes of dry matter per hectare (tonnes d.m. $ha^{-1}$). Five possible conversions of each forest stratum to non-forest land uses were considered:

(i) forest stratum *j* converted to wetlands (F>A),
(ii) forest stratum *j* converted to cropland (F>C),
(iii) forest stratum *j* converted to grasslands (F>P),
(iv) forest stratum *j* converted to other lands (F>O), and
(v) forest stratum *j* converted to settlements (F>U);

$BGB_k$ is the below-ground biomass after deforestation land-use category *j* converted to other land-use category *k*, in tonnes of dry matter per hectare (tonnes d.m. $ha^{-1}$). The same five possible conversions as above were considered;

CF is Carbon fraction of dry matter, tonnes of C (tonnes d.m.)$^{-1}$. The applied value is 0.47, based on the 2006 IPCC Guidelines; and

44/12 is the conversion factor from changes in carbon stock to $CO_2$ emissions.

# 9 Description of how the elements contained in Decision 4/CP.15, paragraph 1(C) and (D), have been taken into account

## 9.1 Use of the most recent IPCC guidance and guidelines

The construction of Mozambique's FREL and the results presented in this Technical Annex are based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) for estimating the annual carbon stock change on forest land converted to non-forest land, considering the carbon stock in the biomass immediately before and immediately after a conversion. Mozambique applies the product of activity data (in hectares/year) and emission factor (in t CO2e/ha) for estimating emissions.

Mozambique considered updating the post-disturbance emission factor for cropland, which was revised in the 2019 IPCC Revised Guidelines, but this would maintain consistency with the current FREL. However, since this emission factor has increased slightly, it is conservative to maintain it at its previous value.

## 9.2 Establish, according to national circumstances and capabilities, robust and transparent national forest monitoring system

Mozambique's National Forest Monitoring System (NFMS) is still in development, and it will allow long-term forest monitoring to improve forest management in a transparent, accurate, consistent and complete, and also will provide robust and transparent information for the Agriculture, Forestry and Other Land Use (AFOLU) sector, including sustainable forestry, management of protected areas and buffer zones, agricultural expansion, and land-use planning. NFMS is being developed by the National Directorate of Forests (DINAF) in coordination with the National Fund for Sustainable Development (FNDS) and other stakeholders. Currently, the NFMS includes Satellite and land monitoring systems, NFI and GHG inventory done by the MRV unit of FNDS.

# 10 Leakage outside of the national boundary

The measurement of leakage outside of Mozambique’s boundaries is challenging to account for and quantify as little or no monitoring may occur in neighboring countries. In addition, the identification of reasons and allocation of responsibilities or liability for the leakage is very difficult. Finally, neither the National REDD+ Strategy, nor the Strategic Environmental and Social Assessment mention leakage outside the national boundary. As a result, we do not report on leakage outside the national boundary.

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# ANNEX 1: National REDD+ Strategy

The national REDD+ strategy was finalized and approved by the government in 2016 with the objective to conserve wooded areas, promote sustainable development, and to reduce deforestation by enhancing forest resilience to climate change, all with integrated approach to rural development. This strategy also aims to increase carbon stocks by reducing emissions of 170Mt$CO_2$e per year and restore 1 million hectares of forests until 2030.

The national REDD+ strategy address strategic actions to tackle deforestation and forest degradation, considering the commercial agriculture, shifting agriculture, extraction of timber products, production of firewood and charcoal, urban expansion, mining and livestock as the drivers of deforestation and forest degradation.

The national REDD+ strategy has six strategic pillars: (i) governance; (ii) sustainable agriculture; (iii) alternative sources of energy; (iv) protection of conservation areas; (v) sustainable forest management; and (vi) restoration of degraded forests and forest plantations.

The national REDD+ strategy document is available at https://www.fnds.gov.mz/index.php/pt/documentos/publicacoes/estrategia-nacional-do-redd

# ANNEX 2: Safeguards instruments

To support the implementation of the National REDD+ Strategy, a Social and Environmental Strategic Assessment (SESA), was produced. The objective of the Strategic Environmental and Social Assessment (SESA) for the REDD+ National Strategy is to integrate key environmental and social considerations in the design and actual establishment of forest development initiatives, considering a long-term perspective in which integrated rural development and improved wealth and well-being of rural communities and the country in general are based on the sustainable use of natural resources, particularly land and forests.

The SESA identifies priority environmental and social considerations to guide design, implementation and operation of forest development and investment programs. It establishes the legal, institutional and governance framework within which such programs should take place. The SESA is also anchored in long-term economic and social development objectives, and sets a strategic framework for individual forest development programs. It identifies priority environmental and social considerations that are important at national level.

With a focus on forest development and improved and sustainable forest management, more specifically the objective of the SESA is to (i) promote the harmonization of the forest, agriculture, energy and rural development specific strategies and policies in order to support the integration of sustainable resource management and use in forest and rural development planning processes; (ii) contribute to streamlining forests, agriculture, energy and rural development in the long-term integrated development planning for sustainable economic growth and poverty reduction; (iii) identify environmental, social and local economy investment opportunities, and promote environmentally sustainable and socially responsible development; and (iv) support the understanding and inclusion of priority environmental and social considerations in the preparation of forest investment programs that will stem from the country's REDD+ Strategy.

The SESA document is available at https://www.fnds.gov.mz/index.php/pt/component/edocman/sesa-for-redd-strategy-mozambique-october-30/download

# ANNEX 3: National MRV System for REDD+

Mozambique has not formalized its national monitoring system (NFMS). There is a work in progress between the DINAF and FNDS and other relevant stakeholders to formalize the NFMS. This process started in 2019, with the establishment of the NFMS Task Force, responsible for designing, developing and operationalizing the NFMS. Technical officers of DINAF and FNDS (MRV unit) were appointed as its members.

The NFMS Working Group, as a group of stakeholders related to the NFMS with its role to provide related information, inputs and advice to the development and operationalization of the NFMS. The initial members included DINAF, National Directorate of Environment (DINAB), National Directorate of Land (DINAT), FNDS, Eduardo Mondlane University (UEM), Institute of Agricultural Research of Mozambique (IIAM), FAO (Food and Agriculture Organization of the United Nations), World Bank, International Union for Conservation of Nature (IUCN) and Federation of Timber Operators (AMOMA). However, the Working Group is, by its nature, an open forum which the members can change flexibly depending on the needs and interests.

The first version of the NFMS document was finalized in 2021 (link) and defines its NFMS as a system which enables accountable reporting of REDD+ results; monitoring the implementation and effectiveness of Policies and Measures (PaMs) for sustainable forest management which include national and international purposes and beyond REDD+; and builds on robust IT system to support data management and transparency. The following principles are stated in the document as the basis of the NFMS:

- The NFMS shall be designed and operationalized under the full ownership of Ministry of Land and Environment (MTA), and in collaboration with related stakeholders;
- The NFMS should be target-driven, oriented towards specified sub-national, national and international objectives;
- The NFMS shall build on existing system as far as practical;
- The NFMS shall be developed through step-wise improvement, take into consideration the national circumstances, reflect the phased approach for the implementation of REDD+ activities, and sustainable in the long-run. The development shall be realistically feasible within the available time, financial and human resources; and
- The NFMS shall meet the international requirement under REDD+, and as appropriate, apply international and national good practices.

*Responsibilities within the NFMS:*

DINAF - Responsible for the National Forest Inventory as a Leader, and responsible for the Quality Control and Quality Assurance of the NFI process.

FNDS/MRV - Coordinate the operations and logistics of the National Forest Inventory activities, and Production of activity data for REDD+ Activities, Production and submission of the FREL document.

IIAM - Provide technical staff for tree species identification and fieldwork support, establish permanent sampling plots.

Academic Institutions - Support in the production of the National Forest Inventory, National Forest Inventory Report, providing allometric equations for carbon estimation.

CENACARTA - Evaluation of the data production process.

More information regarding the institutional arrangements can be found in section 8 on the NFMS document through the link.

The current monitoring system has three sub-systems:

- Satellite and land monitoring system
- National forest inventory
- National Greenhouse Gases (GHG) inventory

## Satellite and land monitoring system

The satellite and monitoring system is a sub-system within the NFMS that produces the activity data. The MRV Unit within FNDS is responsible for this system. It specifically generates the information on the number of hectares of deforestation within a given geographic area. This system produced information of deforestation that was used to produce the National Forest Reference Emissions Level (FREL). This information was also used to generate historical deforestation statistics by Provinces, districts (link https://fnds.gov.mz/mrv/index.php/documentos/estudos/15-anuario-ambiental-para-instituto-nacional-de-estatistica-ine/file), conservation areas and Zambézia Integrated Landscape Management Program (ZILMP) using a systematic stratified sampling.

To ensure a good quality of data the team developed and implemented Quality Assurance/Quality Control (QA/QC) processes in all production processes including the development of Standard Operating Procedures (SOPs). This ensures a high standard of quality of the data produced. To guarantee the replication of processes, the MRV unit developed a Portuguese version guideline to produce activity data, accessed through the link https://fnds.gov.mz/mrv/index.php/documentos/guioes/46-protocolo-de-monitoria-e-estimativa-de-emissoes-por-desmatamento-vjun2021/file. Data collection is conducted by a core team of professional interpreters who work permanently for FNDS and who have received adequate training in the implementation of the SOPs.

## National forest Inventory

The national forest inventory is the second sub-system within the NFMS, which produces the emission factors. They give the tonnage of carbon stored per unit hectare of forest. The tonnage of carbon per hectare varies from one type of forest to another. Mozambique has conducted four national forest inventories and the updating of NFI is carried out every 10 years. The information from these inventories were used to produce information for timber purposes. The last inventory in 2016-17 produced the emission factors used for the FREL submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2018 (report may be accessed in the following link https://redd.unfccc.int/files/moz_frel_report_final.v03_03102018.pdf).

The entity responsible for the National Forest Inventory is DINAF. The NFI report (https://fnds.gov.mz/mrv/index.php/documentos/relatorios/26-inventario-florestal-nacional/file) was produced by FNDS and DINAF. The data collection involved the IIAM, the Faculty of Agronomy and Forest Engineering (FAEF), the Department of Biological Sciences and Provincial Forest Services. The estimation of emissions also relies on the allometric equations that have been developed by Masters and PhD students and research projects from FAEF and the Department of Biological Sciences (DCB) of the UEM.

To ensure the quality of the data collected, the team followed QAQC procedures defined by the National Directorate of Forest. To maintain the processes of the national forest inventory, the MRV unit developed a practical field manual for training teams in data collection that can be accessed on the link https://fnds.gov.mz/mrv/index.php/documentos/guioes/21-manual-do-inventario-florestal/file.

The Permanent Sampling plots are another component of the National Forest Monitoring System that will improve the estimation of emissions factors and the IIAM leads the process. Currently, under the MozFIP project, a joint group of institutions that involves IIAM, FNDS, UEM and DINAF are establishing the network of Permanent Sampling plots across the country.

## National GHG inventory

The National GHG inventory for the purpose of REDD+ combines the Activity data and the emission factors to estimate the annual emissions and the FREL.

At the national level, the recent experience of GHGs inventory was with the submission of the FRELs to the UNFCCC (https://redd.unfccc.int/files/moz_frel_report_final.v03_03102018.pdf). The National Directorate of Climate Change is responsible for the communication of GHG emissions of Mozambique, as the focal point for climate change with the UNFCCC. The National Directorate of Climate Change coordinates with DINAF and FNDS on the production of such information.

At the subnational level, the MRV unit from FNDS is currently responsible for the generation of all information related to emissions from deforestation for the country. To maintain the quality standards in the production of emissions estimates from deforestation, the MRV unit has developed SOPs on how to produce the estimates.

# ANNEX 4: Land-use, land-use change matrix

| Land Use and Land Use Change<br>Reference period (Year): 2017 – 2020<br>Unit in hectares (ha)<br>Vertical: Actual Land Use<br>Horizontal: Initial Land Use | **Forest Lands** | Broadleaved (Semi-) deciduous forest including Miombo | Broadleaved (Semi-) evergreen forest | Mangrove | Mecrusse | Mopane | Forest Plantation | **Croplands** | Annual and perenial | **Grasslands** | Grasslands, Thicket, Shrubland | **Settlements** | Settlements | **Wetlands** | Aquatic or regularly flooded shrublands, herbaceous vegetation, water bodies | **Other Lands** | Bare soils, Bare rocks, Dunes | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Forest Lands** | | | | | | | | | | | | | | | | | | |
| Broadleaved (Semi-) deciduous forest including Miombo | | 22,218,066.76 | | | | | | | 770,114.21 | | 27,238.36 | | | | | | | 23,015,419.34 |
| Broadleaved (Semi-) evergreen forest | | | 6,659,412.05 | | | | | | 94,312.25 | | 15,233.33 | | | | | | | 6,768,957.63 |
| Mangrove | | | | 292,763.05 | | | | | | | | | | | | | | 292,763.05 |
| Mecrusse | | | | | 892,043.38 | | | | 3,491.53 | | | | | | | | | 895,534.92 |
| Mopane | | | | | | 2,904,141.11 | | | 16,915.87 | | | | 1,754.57 | | | | | 2,922,811.55 |
| Forest Plantation | | | | | | | 61,106.39 | | | | 1,588.58 | | | | | | | 62,694.97 |
| **Croplands** | | | | | | | | | | | | | | | | | | |
| Annual and perenial | | | | | | | | | 17,498,982.99 | | | | 23,745.10 | | | | | 17,522,728.09 |
| **Grasslands** | | | | | | | | | | | | | | | | | | |
| Grasslands, Thicket, Shrubland | | | | | | | | | 451,098.68 | | 23,717,077.15 | | 18,365.26 | | | | 1,715.83 | 24,188,256.93 |
| **Settlements** | | | | | | | | | | | | | | | | | | |
| Settlements | | | | | | | | | | | | | 468,489.29 | | | | | 468,489.29 |
| **Wetlands** | | | | | | | | | | | | | | | | | | |
| Aquatic or regularly flooded shrublands, herbaceous vegetation, water bodies | | | | | | | | | 3,297.25 | | | | | | 5,698,861.59 | | | 5,702,158.84 |
| **Other Lands** | | | | | | | | | | | | | | | | | | |
| Bare soils, Bare rocks,Dunes | | | | | | | | | | | | | | | | | 519,060.39 | 519,060.39 |
| Total | | 22,218,066.76 | 6,659,412.05 | 292,763.05 | 892,043.38 | 2,904,141.11 | 61,106.39 | | 18,838,212.78 | | 23,761,137.43 | | 512,354.23 | | 5,698,861.59 | | 520,776.23 | 82,358,875.00 |