TECHNICAL ANNEX I: RESULTS ACHIEVED BY BRAZIL FROM REDUCING EMISSIONS FROM DEFORESTATION IN THE AMAZON BIOME FOR REDD+ RESULTS-BASED PAYMENTS

1. INTRODUCTION

Brazil welcomes the opportunity to submit a Technical Annex to its Fourth Biennial Update Report (BUR) 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).

Brazil notes that the submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving results-based payments for its REDD+ actions, pursuant to decisions 13/CP.19, paragraph 2, and 14/CP.19, paragraphs 7 and 8.

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

This submission was developed by the Brazilian government and presents the results achieved in reducing emissions from deforestation in the Amazon biome in the 2018-2019 period, and also the progress made in producing data and information to continuously improve Brazil's submissions.

2. SUMMARY INFORMATION FROM THE ASSESSED FOREST REFERENCE EMISSION LEVEL FOR REDUCING EMISSIONS FROM DEFORESTATION IN THE AMAZON BIOME

Brazil´s second forest reference emission level for reducing emissions from deforestation in the Amazon biome for REDD+ results-based payments under UNFCCC from 2016 to 2020, hence forth referred to as FREL C, was submitted on a voluntary basis for a technical assessment in the context of results-based payments and covers the activity "reducing emissions from deforestation" in the Amazon biome, Brazil's most significant of the five activities included in paragraph 70 of decision 1/CP.16.

Brazil submitted its FREL C on 15 January 2018 in accordance with decisions 12/CP.17 and 13/CP.19. The technical assessment took place (as a centralized activity) from 19 to 23 March 2018 in Bonn. As a result of the facilitative interactions with the assessment team (AT), Brazil 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 12 July 2019.

Therefore, Brazil's second FREL submission for the Amazon biome (FREL C) presents all emission estimates from deforestation in the period 1996-2015 re-estimated based on the updated adjusted increments from deforestation in the period 1996-2010, using deforestation data from the period 2011-2015. The third BUR included a Technical Annex with the emission reduction results achieved in the Amazon biome in the period 2016-2017, based on FREL C, estimated as the mean of the annual CO_2 emissions from gross deforestation from the period 1996-2015.

The submission of FREL C maintains close resemblance with the construction of both FREL A and FREL B, and is considered to be an update of the first submission for the Amazon biome, which is consistent with Decision 12/CP.17. Nonetheless, the second submission considers suggested improvements from the

technical assessment of the first FREL and includes new text to continuously improve the transparency and clarity of the submission.

Brazil recalls paragraphs 11 and 10 of Decision 12/CP.17 (FCCC/CP/2011/9/Add.2) that respectively indicate that a subnational FREL may be developed as an interim measure, while transitioning to a national FREL; and that a step-wise approach to a national FREL may be useful, enabling Parties to improve the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools. Although the FREL C includes only CO_2 emissions from gross deforestation in the Amazon biome, Brazil is implementing the National REDD+ Strategy and is carrying out concrete efforts to transition to a national FREL.

The construction of the FREL C was based on the National Institute for Space Research's (INPE, for the Portuguese acronym) historical time series for gross deforestation in the Legal Amazonia using Landsat-class satellite data on an annual, wall-to-wall basis since 1988. This time series is considered to be the most reliable source of the areas annually deforested, due to its consistency through time, transparency, verifiability, and low uncertainty. Due to the characteristics of the time series data (e.g., annual wall-to-wall assessments, adjustment for different dates between annual assessments), the use of these data (instead of data from the II and III National Inventories that provide average estimates for an 8-year period and are based on a more coarse work scale) is considered to be the most accurate for the purposes of the FREL construction for the Amazon biome.

The emissions from deforestation for the period 1996-2015 were estimated through the combination of activity data (i.e. the area of annual gross deforestation per forest type considered) with the appropriate emission factor (i.e. carbon stocks associated with carbon pools of the forest types considered). The FREL Amazonia considers the following carbon pools: living biomass (above and below-ground biomass) and litter, consistent with the first submission for the Amazon biome. Dead wood and soil organic carbon (for mineral and organic soils) were not included, as they are not considered to be significant sources, following the Second National Greenhouse Gas Inventory, the most recent inventory at the time of the FREL Amazonia submission. As per the gases included in the submission, only CO_2 was considered.

FREL C includes only the activity "Reducing Emissions from Deforestation" in the Amazonia biome, which comprises approximately 4,197,000 km^2, using PRODES data as a basis. In accordance with the technical assessment of the previous FREL for the Amazon biome, Brazil understands the importance of better understanding forest degradation and its linkages with deforestation. Brazil is carrying out efforts to include emissions from forest degradation in its national submission.

Regarding the emission factors, the carbon stock in aboveground biomass was estimated for the different forest typologies considered using a country-specific allometric equation (tier 3) and data collected in sampled plots by the RADAMBRASIL Project (circumference at breast height – CBH). The estimates were adjusted to include carbon in belowground biomass, litter, biomass in palms and lianas, as well as in the biomass of trees with CBH below 100 cm[1] and were extrapolated to the entire territory of the biome following defined rules. Hence, a Carbon Map for the Amazona biome was created for the 22 types of forest physiognomies[2].

The FREL C uses the IPCC methodology as a basis for estimating changes in carbon stocks in forest land converted to other land-use categories as described in the GPG LULUCF (IPCC, 2003). For any land-use conversion occurring in a given year, GPG LULUCF considers both the carbon stocks in the biomass immediately before and immediately after the conversion. Brazil assumed that the biomass immediately

[1] RADAMBRASIL project collected data on trees with circumference at breast height (CHB) greater than 100 cm.

[2] Details about the Carbon Map are included in section b (Transparent, complete, consistent and accurate information used in the construction of the Forest Reference Emission Level) of the original FREL submission.

after the conversion to other land-use category was zero and did not consider any CO_2 removals after the conversion (that is, only gross emissions from deforestation were considered).

The emission factors in the FREL C are defined as the carbon densities in living biomass (above and below-ground biomass) and litter, consistent with those adopted in the construction of both FREL A and FREL B (i.e., based on the carbon map data from the II National GHG Inventory). The application of the carbon map developed for the III National GHG Inventory resulted in an insignificant difference (0.22 per cent) relative to the carbon map of the II National GHG Inventory, maintained the same carbon pools (living biomass and litter).

The annual emissions from gross deforestation were estimated from the annual deforestation increments[3], adjusted to include potential deforested areas under clouds, as detailed in **Section 4** herein and in the assessed FREL C Amazonia. The areas of the deforestation polygons for a given forest typology were multiplied by the corresponding emission factors (total carbon[4], in tonnes of carbon per unit of area (tC ha^{-1}) and subsequently by 44/12, to convert tonnes of carbon to tonnes of CO_2 (tCO_2 ha^{-1}). Then, for each year considered, the CO_2 estimates associated with each polygon were summed up.

Following the approach established in the first FREL submission, of a dynamic FREL[5], the FREL C for results-based payments for emission reductions from deforestation in the period from 2016 to 2020 is the mean of the annual CO_2 emissions associated with the adjusted gross deforestation from 1996 to 2015 (refer to Figure 1 and Table 1).

As in the first submission (for FREL A and FREL B), Brazil's FREL C does not include assumptions on potential future changes to domestic policies.

[3] Increment of deforestation refers to the sum of the area of all observed deforestation polygons within a certain geographic area. In the FREL C submission and also in this Technical Annex, increment of deforestation refers to the sum of observed deforested area in each Landsat scene that covers the biome. The increment of deforestation may underestimate the total area deforested (and corresponding emissions), since it does not include potential deforestation in cloud covered areas.

[4] Total carbon refers to the sum of the carbon in aboveground biomass, belowground biomass and litter.

[5] See page 24 of the Brazil's first submission of a FREL for the Amazonia biome (https://goo.gl/p4YP3T)

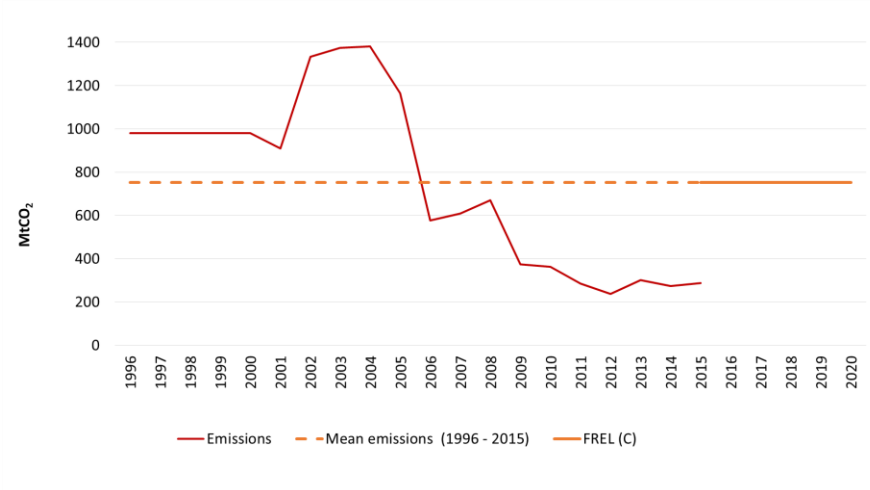

FIGURE 1: PICTORIAL REPRESENTATION OF BRAZIL'S FREL C (751,780,503.37 TCO_2).

TABLE 1: ADJUSTED INCREMENTS OF DEFORESTATION (IN HA) AND CORRESPONDING ADJUSTED CO_2 EMISSIONS (IN TCO_2) FOR THE PERIOD 1996-2015 USED IN THE CONSTRUCTION OF FREL C (IN TCO_2).

Year	(A) ANNUAL ADJUSTED INCREMENT FROM DEFORESTATION (ha)	(B) ANNUAL ADJUSTED CO_2 EMISSIONS FROM DEFORESTATION USING DATA FROM 2011-2015 (tCO_2)
1996	1,874,013.33	979,523,618.48
1997	1,874,013.33	979,523,618.48
1998	1,874,013.33	979,523,618.48
1999	1,874,013.33	979,523,618.48
2000	1,874,013.62	979,523,849.37
2001	1,949,331.97	908,964,575.38
2002	2,466,605.01	1,334,458,298.72
2003	2,558,847.66	1,375,224,078.19
2004	2,479,431.66	1,380,142,199.34
2005	2,176,233.21	1,163,879,134.73
2006	1,033,687.21	576,136,731.11
2007	1,088,545.83	609,101,478.18
2008	1,237,179.07	669,215,058.08
2009	608,154.57	373,066,456.69
2010	610,642.15	362,507,086.87
2011	501,406.41	285,507,794.61
2012	425,499.51	236,684,154.44
2013	537,857.10	301,847,850.91
2014	490,851.45	273,591,600.59
2015	524,055.95	287,665,246.39
AVERAGE 1996-2015	**1,402,919.78**	**751,780,503.37 (FREL C)**

The REDD+ decisions under the UNFCCC value the continuous update and improvement of relevant data and information over time. Brazil values consistency and transparency of the data submitted as fundamental and gives the highest priority to these. Nonetheless, Brazil continues its efforts to improve the accuracy of the estimates for all carbon pools included in the FREL. Brazil's data is presented in a transparent and verifiable manner, allowing the reconstruction of the FREL C.

3. RESULTS IN TONNES OF CO_2 PER YEAR, CONSISTENT WITH THE ASSESSED FOREST REFERENCE EMISSION LEVEL FOR THE AMAZON BIOME

Decision 14/ CP.19, paragraph 3, "decides 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 section II of decision 12/CP.17".

CO_2 emissions from gross deforestation in the Amazon biome in the period from 1996 to 2015, used in the construction of the FREL C, were estimated using the methodology presented in the previous section. For this Technical Annex, the increments of deforestation (2018 to 2019) were adjusted until 2015 to avoid over or under-estimating the emissions from deforestation, due to the non-observation of potential deforestation polygons in areas covered by clouds. The cloud adjustment was performed only for the 4 years prior to the most recent increment of deforestation, since it has been the period with the largest variations (see FREL C, Table 1).

The annual REDD+ results for the period from 2018 to 2019 were calculated by subtracting the mean annual CO_2 emissions (calculated from the adjusted deforestation increments) from the forest reference emission level for the period from 1996 to 2015 (see FREL C in **Figure 1** = 751,780,503.37 tCO_2).

Hence, for year t in the period from 2018 to 2019, the emission reduction from deforestation was estimated as follows:

REDD+ (*t*) = FREL C (1996-2015) – Gross emissions from deforestation at year *t*; (tCO_2)

For example, the emission reduction from deforestation for year 2018 is equal to:

751,780,503.37 tCO_2 – 406,351,768.88 tCO_2 = 345,428,734.49 tCO_2

The total emission reduction from gross deforestation in the Amazon biome, from 2018 to 2019, was equal to the sum of the emission reduction results achieved for each year in the period, i.e., **518,967,155.03 tCO_2 (Figure 2 and Table 2)**.

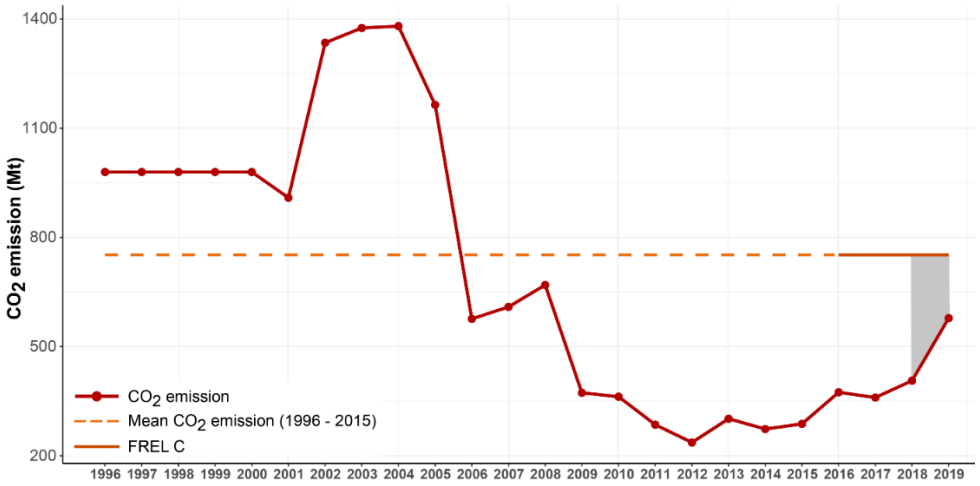

FIGURE 2: REDD+ RESULTS FROM 2018 TO 2019 CALCULATED BASED ON THE FREL C SUBMITTED TO THE UNFCCC IN 2018 AND ASSESSED BY TECHNICAL EXPERTS.

TABLE 2: ANNUAL EMISSIONS FROM DEFORESTATION (tCO_2/YR) FROM 1996 TO 2019; FOREST REFERENCE EMISSION LEVEL USED TO ESTIMATE THE EMISSION REDUCTION RESULTS IN THE PERIODS OF 2016-2020 AND REDD+ RESULTS ACHIEVED (tCO_2).

Year	Annual emissions from deforestation (tCO_2/yr)	Annual adjusted CO_2 emissions (2018-2019) until 2015	FREL C (tCO_2)	Annual REDD+ results 2016 e 2017 (tCO_2/yr)
1996	979,523,618.48			
1997	979,523,618.48			
1998	979,523,618.48			
1999	979,523,618.48			
2000	979,523,849.37			
2001	908,964,575.38			
2002	1,334,458,298.72			
2003	1,375,224,078.19			
2004	1,380,142,199.34			
2005	1,163,879,134.73			
2006	576,136,731.11			
2007	609,101,478.18			
2008	669,215,058.08			
2009	373,066,456.69			
2010	362,507,086.87			
2011	**285,507,794.61**			
2012	**236,684,154.44**			
2013	**301,847,850.91**			
2014	**273,591,600.59**			
2015	**287,665,246.39**	**319,244,077.30**		
2016		**374,740,219.83**		
2017		**362,678,365.23**		
2018		**406,351,768.88**	**751,780,503.37**	**345,428,734.49**
2019		**578,242,082.83**	**751,780,503.37**	**173,538,420.54**
Total emission reductions result (2018-2019)				**518,967,155.03 tCO_2**

4. DEMONSTRATION THAT THE METHODOLOGIES USED TO PRODUCE THE RESULTS ARE CONSISTENT WITH THOSE USED TO ESTABLISH THE ASSESSED FOREST REFERENCE EMISSION LEVEL

The methodology, data sets and information used in the calculation of the results presented in this Technical Annex are the same as the ones used in Brazil's FREL C, as demonstrated in the following items: (4.1) activity data; (4.2) emission factors; (4.3) carbon pools; (4.4) Non-CO_2 gases; and (4.5) REDD+ activities.

4.1 ACTIVITY DATA

The area of each deforestation polygon with a certain forest physiognomy is the data needed to estimate the emissions from deforestation[6], following the IPCC good practice guidance for LULUCF (IPCC, 2003).

Similar to the way the FREL C was calculated, the activity data used here to generate the results are derived from PRODES, adapted to include only deforestation within the geographical boundaries of the Amazon biome. The minimum mapping area of 6.25 hectares was maintained (see **Box A.1**, page 77 of the FREL C for further information).

In the construction of FREL C, the increments of deforestation were adjusted to avoid over or under-estimating the emissions from deforestation for any given year, due to the non-observation of potential deforestation polygons in areas covered by clouds (see **Box 3**, page 18 of the FREL C for details). The same Vegetation Map used to identify the forest physiognomies associated with the deforestation polygons was used to identify the forest physiognomies affected by deforestation in the results presented in this Technical Annex.

4.2 EMISSION FACTORS

Although Brazil has submitted to the UNFCCC, in March 2016, its Third National Greenhouse Gas Inventory, with a new Carbon Map for the Amazon biome, the results here presented were calculated using the same Carbon Map included in Second National Greenhouse Gas Inventory to ensure consistency between the **FREL C** and the results.

4.3 CARBONS POOLS

The FREL C includes the following carbon pools: above and below-ground biomass and litter. The Carbon Map of the Second National GHG Inventory mentioned in **Section 4.2** includes the carbon in the biomass of these three pools. The results presented in this Technical Annex maintain the same pools. Considerations regarding the dead wood pool are presented in **Box 1** below.

BOX 1 – THE TREATMENT OF DEAD WOOD IN FREL C

Paragraph 28 of the technical evaluation of the FREL submitted by Brazil to the UNFCCC (FCCC/TAR/2014/BRA) indicated the treatment of the emissions from dead wood as an area for future improvement of the FREL. Although the results presented in this submission do not include emissions from this pool, in order to ensure consistency with the construction of both FREL A and FREL B, the III National GHG Inventory includes this pool in the carbon map for the Amazonia biome there proposed.

[6] *In most first order approximations, the "activity data" are in terms of area of land use or land use change. The generic guidance is to multiply the activity data by a carbon stock coefficient or "emission factor" to provide the source/or sink estimates. (IPCC, 2003, section 3.1.4, page 3.15).*

4.4 NON-CO_2 GASES

The FREL C includes only CO_2 emissions from gross deforestation in the Amazon biome. However, the III National Inventory includes estimates of non-CO_2 emissions from biomass burning resulting from deforestation in the Amazon biome. **Box 2** presents some considerations regarding the treatment of non-CO_2 gases.

BOX 2 – CONSIDERATION REGARDING NON-CO_2 GASES

Paragraph 29 of the technical evaluation report of the FREL submitted by Brazil to the UNFCCC indicates the treatment of emissions of non-CO_2 gases as an area for future technical improvement of the FREL. An analysis of the impact of non-CO_2 emissions of carbon monoxide (CO), methane (CH_4), nitrous oxide (N_2O) and NO_x for year 2010, included in the III National GHG Inventory indicates the following emissions: 8,400 Gg; 549 Gg; 16 Gg; and 129 Gg, respectively.

Non-CO_2 emissions from deforestation in the Amazonia biome are not available for other years and hence; recalculation of the emission estimates to include non-CO_2 emissions would not be possible, nor would it be consistent with FREL A and FREL B. Estimation of emissions from fire resulting from deforestation is expected to be improved in the next national inventories, and if it is possible, non-CO_2 emissions from fire will be included in the national FREL, if the consistency of the time-series can be assured and if deemed relevant.

4.5 REDD+ ACTIVITIES

The FREL Amazonia was constructed targeting emissions from gross deforestation and, hence, does not include emissions resulting from other REDD+ activities.

The results presented in this Technical Annex are consistent with the assessed FREL C Amazonia.

Brazil is carrying out internal discussions regarding the treatment of forest degradation and how its associated emissions can be included in future submissions. **Annex III (page 93) and BOX A.4 in the FREL C submission** provide some considerations regarding the treatment of forest degradation.

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

5.1 ARRANGEMENT OF BRAZIL'S NATIONAL FOREST MONITORING SYSTEM

Due to Brazil's extensive coverage of native vegetation and the dynamics of land use and occupation, the Brazilian Government has been implementing a series of systems to monitor these phenomena over the years. These systems, each with its own characteristics and purposes, make up a robust arrangement for monitoring and implementation of actions in the LULUCF sector. Figure 3 below presents the main systems that make up this arrangement.

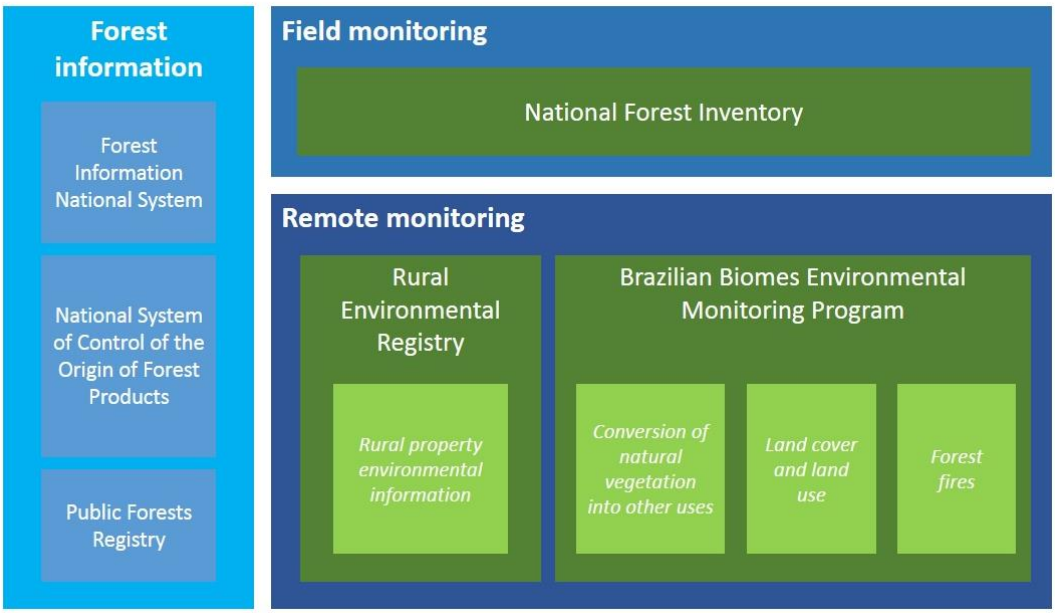

FIGURE 3: IMPLEMENTATION ARRANGEMENT OF THE NATIONAL FOREST MONITORING SYSTEM.

As per Section 6 of the BUR, the systems presented above provide contributions to the implementation and monitoring of LULUCF's NAMAs, as well as the MRV process of REDD+ results, in addition to those intended to provide and organize forest information[7]. **Further to what has been described in section 6 of the BUR, additional information is presented below about the initiatives that provide inputs directly related to the MRV of REDD+.**

5.1.1 BRAZILIAN BIOMES ENVIRONMENTAL MONITORING PROGRAM (PMABB)

The Ministry of the Environment established the Brazilian Biomes Environmental Monitoring Program for the monitoring of deforestation, land cover and land use, selective logging, forest fires and recovery of native vegetation, through MMA Ordinance no. 365, of November 27, 2015.

With the development of geoprocessing and remote sensing technologies, Brazil has become a benchmark in the development and deployment of land cover and land-use monitoring systems. The resulting knowledge on the dynamics of land-use change has been a key element for curbing deforestation in the Amazon.

Research and innovation in the field of remote sensing have helped the mapping of land cover and land-use change dynamics at local, regional, and national levels. This has been essential for better understanding the spatial aspects related to the expansion, retraction, transition, intensification, conversion and diversification of the Brazilian agricultural production. Understanding the dynamics of land-use is important not only for assessing the condition of different ecosystems, but also for estimating the impacts caused by

[7] *For further information:*
National Forest Information System: http://snif.florestal.gov.br/pt-br/
National System for the Control of the Origin of Forest Products: http://www.ibama.gov.br/
Public Forest Register: http://www.florestal.gov.br/cadastro-nacional-de-florestas-publicas

different human activities on biodiversity and climate change. Information on deforestation and forest degradation are fundamental for the implementation of Brazil's National REDD+ Strategy.

Different land use and cover data are available at Terra Brasilis[8] platform, information on forest fires are available at Queimadas[9], and more information about land use are available at TerraClass Cerrado and TerraClass Amazônia[10].

5.1.2 AMAZONIA DEFORESTATION SATELLITE MONITORING PROJECT – PRODES

PRODES is part of a larger program (Amazonia Program) developed at the National Institute for Space Research (INPE) to monitor gross deforestation in areas of primary (natural) forest in the Legal Amazonia through use of satellite imagery, starting its time series in 1988.

Deforestation is associated with clear-cut activities, normally related to the conversion of forest areas to other land-use categories. Since the Brazilian Forestry Code provides for the authorized suppression of forests, from the beginning PRODES focused only on identifying the polygons of forest suppression, without any qualification as to the legality of the process. Gross deforestation is annually estimated through a complete wall to wall analysis that involves approximately 215 Landsat scenes, with minimum mapping area equal to 6.25 hectares. It uses satellite imagery to identify new deforestation polygons every year in areas of primary forest, aided by additional Landsat class data (CBERS/CCD, Resourcesat/LISS3 and DMC) to reduce areas that are not observed due to the presence of cloud cover.

Since 2003, INPE began to publish the annual rate of deforestation online, together with all the satellite imagery used and the maps with the observed deforestation polygons, ensuring complete transparency of the deforestation estimates and public online access (http://www.obt.inpe.br/prodes/index.php). Approximately 215 Landsat 5/7/8 scenes (or similar data, as for instance, from CBERS/CCD, Resourcesat/LISS3 and DMC) are annually available and each scene is accompanied by the respective mapping of the observed deforestation in that year and previous ones.

INPE continuously improves its tools to better manage large-scale projects such as PRODES. Its latest development, the TerraAmazon, is a system that manages the entire workflow of PRODES, annually storing approximately 600 images (e.g., Landsat, CBERS, DMC, Resourcesat). It performs geo-referencing, pre-processing and enhancement of images for subsequent analysis in a multi-task, multi-processing environment. The database stores and manages approximately 4 million polygons.

PRODES, which for decades has generated reliable deforestation data for Amazonia, is key in the context of expanding land cover monitoring to the other Brazilian biomes. The Project, open coded and evaluated by national and international experts, ensures the quality of the data used by Brazil on its REDD+ submissions.

[8] *Terra Brasilis: http://terrabrasilis.info/composer/DETER-B*

[9] *INPE's webpage about forest fires: www.inpe.br/queimadas*

[10] *TerraClass Cerrado: http://www.dpi.inpe.br/tccerrado/ and TerraClass Amazônia: http://www.inpe.br/cra/projetos_pesquisas/dados_terraclass.php*

5.2 ROLES AND RESPONSIBILITIES FOR MEASURING, REPORTING AND VERIFYING (MRV) REDD+ RESULTS

The measuring, reporting and verifying process for REDD+ results in Brazil are presented in Figure 4 below.

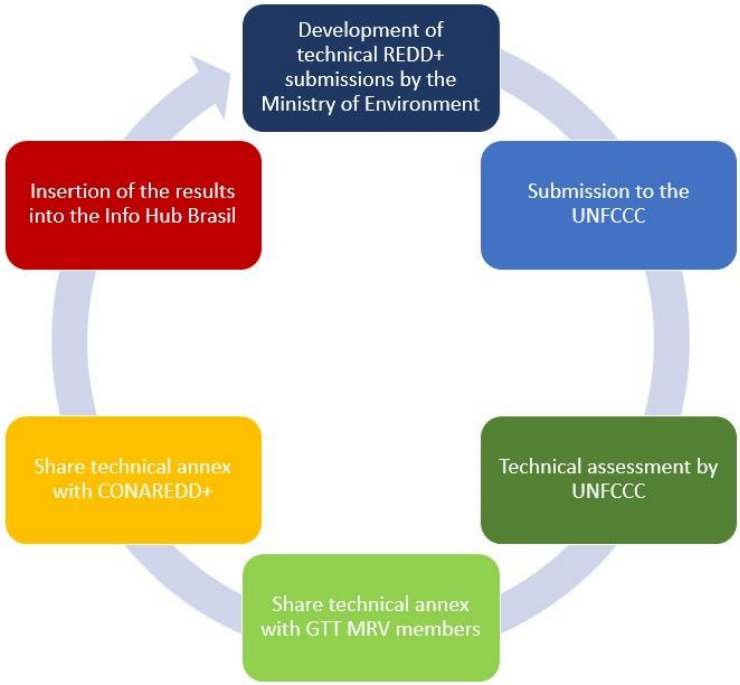

FIGURE 4: MRV FOR REDD+ IN BRAZIL.

Table 3 presents the mapping of the institutions responsible for measuring, reporting and verifying (MRV) REDD+ results.

TABLE 3: ROLE AND INSTITUTIONAL RESPONSIBILITIES FOR REDD+ MRV IN BRAZIL.

MRV	INSTRUMENT	RESPONSIBLE INSTITUTION	ROLE	ADDITIONAL INFORMATION
MEASURING	Technical Work Group on Measurement, Report and Verification (GTT MRV)	*Institution contracted to do the mapping and generating the results estimates*	Map the deforestation polygons in the Amazon biome, consistent with the methodologies used in the assessed FREL Amazonia; estimate the annual emissions, ensure consistency with the Second National GHG Inventory	http://inpe.br
		INPE/MCTI	Carry out the quality control and quality assurance of the products generated by the contracted institution.	http://www.obt.inpe.br/prodes/index.php
	Executive Secretariat of the National REDD+ Committee (CONAREDD+)	MMA	Carry out quality control of the emission estimates produced by the contracted institution. Develop the submissions to the UNFCCC under the guidance of the GTT MRV. Verify consistency with the FREL.	http://redd.mma.gov.br/en/the-national-redd-committee

MRV	INSTRUMENT	RESPONSIBLE INSTITUTION	ROLE	ADDITIONAL INFORMATION
REPORTING	Presidency of CONAREDD+ Focal point to the UNFCCC	MMA MRE	Forward the REDD+ submission to the UNFCCC.	http://redd.mma.gov.br/en/the-national-redd-committee
	Info Hub Brasil	MMA	Compile and make available documentation needed for the recognition of the REDD+ results until its verification by the ICA and insertion in the Lima REDD+ Information Hub.	http://redd.mma.gov.br/en/infohub
VERIFYING	International Consultation and Analysis	UNFCCC	Verify the submission by Parties, indicating experts in Land use and Forestry (LULUCF) to evaluate the FREL submissions and technical annexes.	http://unfccc.int/methods/redd/redd_web_platform/items/4531.php
		MMA	Provide the clarification information requested by the experts in charge of the technical evaluation and verification of the consistency of results. Exchange with the experts indicated by the UNFCCC for the technical evaluation of the submission of the FREL and results.	

6. NECESSARY INFORMATION THAT ALLOWS FOR THE RECONSTRUCTION OF THE RESULTS

For REDD+ purposes, **complete** information means the provision of data that allows for the reconstruction of the FREL and the REDD+ results.

The links to the database and the information that allows for the reconstruction of the results are listed in **Section b.1 of the FREL C**. These data are described below and can also be accessed at: http://redd.mma.gov.br/pt/frel-c

1. **Satellite imagery** used in the identification of deforestation polygons in the Amazon biome, from 2001 to 2019. The images (approximately 220 per year) are made publicly available by INPE.
2. **Accumulated deforestation polygons until 1997** (inclusive) presented in a map hereinafter referred to as the digital base map (for more details, see Annex I.1 of the FREL C).
3. **Accumulated deforestation polygons for years 1998, 1999 and 2000** are presented in the digital base map.
4. **Annual deforestation polygons** (annual maps) for the period from 2001 to 2019.
5. Deforestation polygons by forest type attributes and RADAMBRASIL volume for the period 2001-2015.
6. **Map with the carbon stocks for the different types of forest in the Amazon biome** (Carbon Map), consistent with FREL C.
7. **Information regarding deforestation under cloud cover and calculation of the adjusted deforestation increment**.

IMPORTANT NOTE 1: All the maps listed under (2), (3) and (4) above are available in shapefile format (.shp), ready to be incorporated in a Geographical Information System for analysis. All the satellite images cited in (1) above are available in full resolution in format GeoTIFF at INPE's site. Any specific deforestation polygon can be verified using the corresponding satellite image.

IMPORTANT NOTE 2: The maps cited in (2), (3) and (4) above are a subset of the maps produced by INPE for PRODES (for more information access http://www.obt.inpe.br/prodes/index.php and refer only to the Amazon biome, object of this submission. The information in (2) and (3) above is available as a single file.

7. DESCRIPTION OF HOW THE ELEMENTS CONTAINED IN DECISION 4/ CP.15, PARAGRAPH 1(C) AND (D), HAVE BEEN TAKEN INTO ACCOUNT

7.1 USE OF THE MOST RECENT IPCC GUIDANCE AND GUIDELINES

The FREL C and the respective Technical Annex use the methodologies described in the IPCC Good Practice Guidance for LULUCF (IPCC, 2003) as a basis for estimating the changes in carbon stock in forested areas converted to other land uses. For any conversion occurring at a given year, the IPCC considers the carbon stock in the biomass immediately before and immediately after the conversion. Brazil only considers the loss of the carbon stock in the biomass present immediately before the conversion (gross emissions). Brazil applies the basic method for estimating emissions suggested by IPCC, i.e., emissions estimated as the product of activity data and emission factor.

7.2 ESTABLISH, ACCORDING TO NATIONAL CIRCUMSTANCES AND CAPABILITIES, ROBUST AND TRANSPARENT NATIONAL FOREST MONITORING SYSTEMS

The activity data used in the construction of all FREL and Technical Annexes submissions originated from PRODES historical time series, which is one of the products under the Brazilian Biomes Environmental Monitoring Program. In a near future, as described in Section 5.1, the harmonization of land use/cover monitoring initiatives will allow the regular production of emission data from deforestation in the remaining biomes (Caatinga, Atlantic Forest, Pantanal and Pampas)). Field data will also be available through the National Forest Inventory that will certainty enhance the quality of the forest carbon estimates. Both initiatives are of great importance to the advancement of the forest agenda in Brazil and are instrumental for the establishment of robust and transparent forest monitoring systems at the national level.