



Second technical report on the technical analysis of the technical annex to the third biennial update report of Brazil submitted in accordance with decision 14/CP.19, paragraph 7, on 2 March 2019

Summary

This technical report covers the technical analysis of the technical annex submitted on a voluntary basis, in the context of results-based payments, by Brazil on 2 March 2019 through its third biennial update report in accordance with decision 14/CP.19. The technical annex provides data and information on the activity reducing emissions from deforestation, which is an activity included in decision 1/CP.16, paragraph 70, and covers the same subnational territorial forest area as the assessed forest reference emission level (FREL) for the Cerrado biome proposed by Brazil in its modified FREL submission of 23 May 2017.

Brazil reported the results of the implementation of this activity for 2011–2017, which amount to 1,237,996,004 tonnes of carbon dioxide equivalent and were measured against the assessed FREL of 335,540,289 tonnes of carbon dioxide equivalent per year for 2000–2010 for the Cerrado biome.

The data and information provided in the technical annex are in accordance with the guidelines contained in the annex to decision 14/CP.19. The technical analysis concluded that the data and information provided by Brazil in the technical annex are transparent and consistent with the assessed FREL established in accordance with decision 1/CP.16, paragraph 71(b), and decision 12/CP.17, section II. This report contains the findings from the technical analysis and a few areas identified for capacity-building and future technical improvement in accordance with decision 14/CP.19, paragraph 14.



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Abbreviations and acronyms

AD	activity data
BUR	biennial update report
CH ₄	methane
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
EF	emission factor
FREL	forest reference emission level
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
MMU	minimum mapping unit
MRV	measurement, reporting and verification
NC	national communication
NFI	national forest inventory
NFMS	national forest monitoring system
N ₂ O	nitrous oxide
PMABB	Brazilian Biomes Environmental Monitoring Program
QA/QC	quality assurance/quality control
REDD+	reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
TA	technical analysis
TTE	team of technical experts
2006 IPCC Guidelines	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>

I. Introduction

A. Introduction

1. This technical report covers the TA of the technical annex provided by Brazil on 2 March 2019 in accordance with decision 14/CP.19, paragraph 7, included in the third BUR of Brazil,¹ which was submitted in accordance with decision 2/CP.17, paragraph 41(a), and annex III, paragraph 19. In the technical annex, Brazil provided the data and information used for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest area changes resulting from the implementation of REDD+ activities. The submission of the technical annex is voluntary and in the context of results-based payments in accordance with decision 14/CP.19, paragraph 8. The TA was coordinated by Jenny Wong (secretariat).

2. In this context, Brazil underlined that the submission of the technical annex through its third BUR does not modify, revise or adjust in any way the nationally appropriate mitigation actions voluntarily submitted by Brazil under the Bali Action Plan² or its nationally determined contribution under the Paris Agreement.

3. The TA of 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 in consultation with Brazil and through a facilitative sharing of views, resulting in a separate summary report.³

4. Brazil made its first FREL submission for the Cerrado biome, in accordance with decision 12/CP.17, on 6 January 2017, which was subject to a technical assessment following the guidance provided in decision 13/CP.19 and its annex. Following technical inputs from the assessment team, Brazil provided a modified submission on 23 May 2017.⁴ The assessed FREL, as contained in the modified submission, was included as one of the elements of the technical annex to its third BUR in accordance with the guidelines contained in the annex to decision 14/CP.19. The findings from the technical assessment of the FREL are included in a separate report.⁵

B. Process overview

5. The TA of the third BUR of Brazil took place from 2 to 6 September 2019 in Bonn and was undertaken by the following TTE drawn from the UNFCCC roster of experts on the basis of the criteria defined in decision 20/CP.19, annex, paragraphs 2–6: Ruleta Camacho Thomas (Antigua and Barbuda), Ana-Maria Danila (European Union), Andres B. Espejo (Spain), Mahendra Kumar (Fiji), Julius Madzore (Zimbabwe), Neranda Maurice-George (Saint Lucia), Engin Mert (Turkey), José María Michel Fuentes (Mexico), Elizabeth Philip (Malaysia), Verica Taseska Gjorgievska (North Macedonia) and Harry Vreuls (Netherlands). Mr. Espejo and Mr. Michel Fuentes were the LULUCF experts who undertook the TA of the technical annex in accordance with decision 14/CP.19, paragraphs 10–13.

6. The TA of the technical annex provided by Brazil was undertaken in accordance with the procedures contained in decisions 2/CP.17, 14/CP.19 and 20/CP.19. This technical report on the TA was prepared by the LULUCF experts in the TTE in accordance with decision 14/CP.19, paragraph 14.

7. During the TA and subsequent exchanges, the LULUCF experts and Brazil engaged in technical discussions, and Brazil provided clarifications in response to the questions raised by the LULUCF experts, in order to reach a common understanding on the identification of

¹ Available at <https://unfccc.int/BURs>.

² Decision 1/CP.13.

³ FCCC/SBI/ICA/2019/TASR.3/BRA. Available at <https://unfccc.int/documents/230931>.

⁴ The original and modified submissions are available at <https://redd.unfccc.int/submissions.html?country=BR>.

⁵ FCCC/TAR/2017/BRA, published on 31 August 2017.

the capacity-building needs of the Party and areas for technical improvement. As a result of the facilitative interactions with the LULUCF experts during the TA, Brazil submitted a modified version of its technical annex on 4 October 2019 that took into consideration the technical input from the experts.⁶

8. Following the TA of the technical annex, the LULUCF experts prepared and shared the draft technical report with Brazil for its review and comments. This technical report on the TA of the technical annex was prepared in the context of the modified technical annex submission. The LULUCF experts responded to the Party's comments and incorporated them into and finalized this technical report in consultation with Brazil.

C. Summary of results

9. In decision 1/CP.16, paragraph 70, the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities, as deemed appropriate by each Party in accordance with its respective capabilities and national circumstances. In the context of results-based payments and in line with decision 12/CP.17, Brazil, on a voluntary basis, proposed a subnational FREL covering the activity reducing emissions from deforestation for the purpose of a technical assessment in accordance with decision 13/CP.19 and its annex. The activity is being implemented in Brazil's Cerrado biome, which covers an area of 2,036,448 km², comprising up to 24 per cent of the national territory. The assessed FREL of the Cerrado biome is 335,540,289 t CO₂ eq per year.

10. The Party's FREL is based on its annual average historical CO₂ emissions associated with the activity reducing emissions from deforestation for the historical reference period of 2000–2010. Brazil reported the results of the implementation of this activity, calculated against the FREL, which amount to emission reductions of 1,237,996,004 t CO₂ eq for 2011–2017.

II. Technical analysis of the information reported in the technical annex to the third biennial update report

A. Technical annex

11. For the technical annex to the third BUR submitted by Brazil, see annex I.⁷

B. Technical analysis

12. The scope of the TA is outlined in decision 14/CP.19, paragraph 11, according to which the TTE shall analyse the extent to which:

(a) There is consistency in the methodologies, definitions, comprehensiveness and information provided between the assessed FREL and the results of the implementation of REDD+ activities;

(b) The data and information provided in the technical annex are transparent, consistent, complete and accurate;

(c) The data and information provided in the technical annex are consistent with the guidelines referred to in decision 14/CP.19, paragraph 9;

(d) The results are accurate, to the extent possible.

13. The remainder of this chapter presents the results of the TA of the technical annex to the BUR according to the scope outlined in paragraph 12 above.

⁶ The modified technical annex is available at <https://unfccc.int/BURS>.

⁷ In accordance with decision 14/CP.19, para. 14(a).

1. Consistency in the methodologies, definitions, comprehensiveness and information provided between the assessed reference level and the results in the technical annex

14. In accordance with decision 14/CP.19, paragraph 3, the data and information used by Parties for estimating anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest area changes related to REDD+ activities undertaken by them should be transparent and consistent over time and with their established FREL or forest reference level in accordance with decision 1/CP.16, paragraph 71(b–c), and decision 12/CP.17, section II.

15. The LULUCF experts noted that Brazil ensured consistency between its FREL and its estimation of the results of the implementation of the activity reducing emissions from deforestation in 2011–2017 by:

(a) Using consistent methodologies and data to generate AD on gross deforestation under the PMABB, applying similar protocols to detect areas of deforestation with the same MMU of 1 ha each year and adopting a wall-to-wall approach with 1:75,000 resolution and visual interpretation;

(b) Using consistent methodologies and data to generate EFs, in particular using the same stratifications based on 23 physiognomic classes to generate the same EFs for each of the forest physiognomic classes and applying the same vegetation map to assign forest physiognomy to deforested polygons;

(c) Using the same assumptions to estimate changes in carbon stocks and emissions;

(d) Including the same four carbon pools: above-ground biomass, below-ground biomass, deadwood and litter;

(e) Including the same gases: CO₂, CH₄ and N₂O;

(f) Covering the same area: the Cerrado biome;

(g) Using the same global warming potentials (i.e. 21 for CH₄ and 310 for N₂O), combustion factor (0.435) and EFs (i.e. 6.8 for CH₄ and 0.2 for N₂O) for estimating non-CO₂ emissions;

(h) Using the same carbon fraction of 0.47 for all pools considered;

(i) Using the same forest definition as that used in constructing its FREL.

16. Although consistent methodologies and data were used to generate AD, two minor aspects were noted: the length of the forest cover change subperiods applied, namely using biennial subperiods for 2000–2012 but annual subperiods for 2013–2017; and the sensors from which the satellite imagery is sourced, namely Landsat 5 Thematic Mapper and Landsat 7 Enhanced Thematic Mapper for the reference period and Landsat 8 Operational Land Imager and Resourcesat-1 Linear Imaging Self-Scanning Sensor-III for the results period. Regarding the length of subperiods, the LULUCF experts consider that more frequent monitoring will enable better detection of deforestation. Regarding the changes in satellite imagery source, the LULUCF experts consider that this will lead to better detection of deforestation, as the sensors used in the results period possess enhanced capabilities owing to the better signal-to-noise ratio of Landsat 8 Operational Land Imager and the higher spatial resolution of Resourcesat-1 Linear Imaging Self-Scanning Sensor-III. The LULUCF experts consider that these two aspects will not result in an overestimation of the reported emission reductions. In fact, these differences might result in more conservative estimates of emission reductions, as they would lead to better detection of deforestation in the reporting period (i.e. being able to detect higher emissions as they occur). In addition, owing to the incremental approach for mapping deforestation adopted by Brazil (i.e. mapping that focuses on areas not masked out as deforested in previous periods), some deforestation events not identified in the reference period might subsequently be identified in the reporting period.

17. In view of the above, the LULUCF experts concluded that the results presented of the implementation of the activity reducing emissions from deforestation are consistent with the assessed FREL. The LULUCF experts commend Brazil for ensuring the full consistency of the data and methodologies described in the FREL submission for 2011–2020 constructed on

the basis of historical data for 2000–2010 and in the technical annex with the results of the implementation of the activity reducing emissions from deforestation for 2011–2017.

2. Transparency, consistency, completeness and accuracy of the data and information provided in the technical annex

18. The LULUCF experts noted that, as part of the TA process, Brazil provided additional information, in particular the publications and references used to develop the EFs, details of deforestation detection procedures, shapefiles of the boundaries of the Cerrado biome, details of the monitoring system and its capacity to address displacement, and information related to uncertainty analysis. Brazil also provided all data (e.g. deforestation maps and spreadsheets) that are stored in a repository that is publicly available⁸ to all stakeholders interested in reconstructing the annual or biennial estimations of GHG emissions from deforestation. However, the LULUCF experts note that the repository contains files that might be outdated and that are inconsistent with the data used in the submission. For example, areas of deforestation between 2011 and 2015 provided in the shapefiles are not consistent with areas of deforestation provided in the calculation spreadsheets. The LULUCF experts commend Brazil for its efforts to increase the transparency and ensure the completeness⁹ of the data and information provided, allowing for the reconstruction of the results. They identify the management of the data in the repository as an area for future improvement that would contribute to the institutional memory necessary for future processes.

19. The LULUCF experts checked the internal consistency of the submission. During the TA process, they identified differences between the results reported in the submission and the calculations relating to the estimation of non-CO₂ emissions. In its clarification of these issues, Brazil shared with the experts the *Simple guide to the reconstruction of the emissions from deforestation in the Cerrado biome for the period between 2010 and 2017*.¹⁰ The guide contains several explanations that helped the experts to navigate the calculation spreadsheet, but it does not provide detailed information on the different steps taken from data collection to data integration. The LULUCF experts note that the provision of flowcharts showing the calculation steps and the procedures for data integration (e.g. how the EFs were assigned to the deforestation polygons for each forest type and whether the assignments were undertaken manually or automatically) would enhance the completeness of future submissions.

20. The LULUCF experts confirmed the consistency between classification systems used for estimating AD and EFs in the construction of the FREL and in the estimation of results. Both processes employed the same classification system for the 23 physiognomic classes by attributing the different sources of EFs to the respective physiognomic class. The LULUCF experts note that the EFs applied were derived from local studies, listed in Brazil's NC3 (2016).¹¹ Brazil's Working Group of Technical Experts on REDD+ (2018) confirmed that these locally derived EFs would be replaced by more representative values in future submissions once the NFI is finalized.

21. According to decision 12/CP.17, paragraph 8, the FREL shall be established taking into account decision 4/CP.15, paragraph 7, and maintaining consistency with the anthropogenic forest-related GHG emissions by sources and removals by sinks reported in the Party's GHG inventory. The team assessing Brazil's FREL noted that, overall, the Party maintained consistency in terms of sources of AD and EFs with the GHG inventory included in its NC3.¹² The LULUCF experts noted that this is also true for the estimated results. However, the LULUCF experts also noted that the technical assessment report on the FREL identified a difference regarding the MMU used in the national GHG inventory in the NC3 and that used in the FREL; namely, 6 and 1 ha, respectively. It was noted that this resulted in

⁸ Instructions for accessing the data found in the repository are available (in Portuguese) at <http://redd.mma.gov.br/pt/component/content/article/94-assuntos/information-hub/756-instrucoes-para-acessar-os-dados-e-informacoes-do-frel-cerrado?Itemid=0>.

⁹ "Complete" here means the provision of the information necessary for the reconstruction of the results.

¹⁰ Available in the repository. See footnote 8 above.

¹¹ The local studies are available in the repository (see footnote 8 above) and are also listed in Brazil's NC3, vol. III, appendix I, available at <https://unfccc.int/documents/66129>.

¹² See document FCCC/TAR/2017/BRA. Brazil's NC3 is available at <https://unfccc.int/documents/66129>.

a difference of 8.0 per cent in the estimates of deforested areas reported in the NC3 and the FREL. Although this constitutes a minor difference, the LULUCF experts note that Brazil should continue reporting the difference regarding the MMU applied in future submissions, if applicable.

22. In response to a question from the LULUCF experts regarding the uncertainty analysis, Brazil provided additional information on uncertainties as contained in the reference report on the LULUCF sector of its third national GHG inventory (Ministry of Science, Technology and Innovation, 2015). This report provides information on the sources of uncertainties and an accuracy assessment conducted on a land-use/land-cover map. Brazil also provided a study (Meira et al., 2019) that showed the results of the accuracy assessment of deforestation for 2016–2017 in the region of Matopiba. The reported user accuracy level of 99.1 per cent is considered to be very high and the level of errors of commission is low. Moreover, Brazil identified a quantified analysis of uncertainties for EFs and emission reductions as an area for technical improvement. The LULUCF experts commend Brazil for sharing information on sources of uncertainty related to AD, EFs and estimation of GHG emissions, and some qualitative information on the sources of uncertainty in AD. The LULUCF experts confirmed that AD are generated using robust protocols that include QA/QC procedures, such as standard operating procedures, training provisions and QA conducted by senior geographic information system professionals of Brazil's National Institute for Space Research, as described in Maurano et al. (2019) and de Brito et al. (2018). However, the LULUCF experts noted that no full-scale accuracy assessment identifying any classification errors (i.e. errors of commission and omission) had been conducted on the deforestation maps. Such an assessment would be useful for better understanding the correct implementation of the mapping and labelling protocols and for informing future efforts to improve the deforestation monitoring system.

23. The LULUCF experts concluded that Brazil provided the necessary information to allow for the reconstruction of the results of the implementation of the activity reducing emissions from deforestation. The data and information provided in the technical annex are considered to be transparent, consistent, complete and accurate to the extent possible.

3. Consistency with the guidelines on elements to be included in the technical annex

24. Brazil provided data and information on all the required elements in accordance with the guidelines contained in the annex to decision 14/CP.19, namely summary information from the final report containing the assessed FREL; results in t CO₂ eq per year, consistent with the assessed FREL; a demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed FREL (as outlined in chap. II.B.1 above); a description of forest monitoring systems and the institutional roles and responsibilities in the MRV of the results; the information necessary for the reconstruction of the results (as outlined in chap. II.B.2 above); and a description of how the elements contained in decision 4/CP.15, paragraph 1(c–d), have been taken into account.

25. In its submission, Brazil provided a summary table with the results of the implementation of the activity reducing emissions from deforestation for 2011–2017, consistent with the assessed FREL and allowing for the reconstruction of the results. The emission reductions achieved are listed in table 2 of the technical annex and amount to 1,237,996,004 t CO₂ eq for the seven years covered.

26. The LULUCF experts noted that Brazil provided a description of the NFMS and a summary of the institutional roles and responsibilities for the MRV of the results in the technical annex, together with weblinks for accessing further information. The roles and responsibilities of the agencies and institutions involved in MRV were transparently explained. During the consultation process, Brazil explained that the same institution that produced the estimates of AD for the reference period also produced the estimates for the results period. The LULUCF experts commend Brazil for sharing this information.

27. The forest monitoring system used is a subnational system covering the Cerrado and Amazonia biomes. In accordance with decision 4/CP.15, paragraph 1(d)(i), the monitoring system should use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating emissions and removals. The remote sensing system has been

developed as part of the PMABB and provides data and information for generating the maps and annual estimates of deforestation for the Cerrado biome, on the basis of similar methodologies used and proven effective for the Amazonia biome. However, for the Cerrado biome, Brazil has implemented improvements such as using a reduced MMU (1 ha instead of 6.25 ha), which provides more accurate estimates. Regarding the availability of a ground-based inventory, Brazil currently relies on metadata analyses from various studies that are based on ground-based forest inventories in the Cerrado biome while it works towards an NFI.

28. According to decision 11/CP.19, paragraph 4(b), the NFMS should enable the assessment of different types of forest in the country, including natural forest. During the consultation process, Brazil explained that, under the PMABB, the subnational forest monitoring system is progressively being scaled up to an NFMS that covers all other biomes (i.e. Amazonia, Atlantic Forest, Caatinga, Pantanal and Pampas) of Brazil.

29. According to decision 1/CP.16, paragraph 71(c), footnote 7, subnational monitoring and reporting should include monitoring and reporting emission displacement at the national level, if appropriate, and reporting on how the displacement of emissions is being addressed and on the means to integrate subnational monitoring systems into a national monitoring system. Brazil clarified that it is currently expanding the coverage of its deforestation monitoring system to include its remaining biomes, namely Atlantic Forest, Caatinga, Pantanal and Pampas, and that this process will ultimately lead to an NFMS that will provide the necessary annual data for quantitative comparisons so that it can assess whether any displacement of emissions is taking place at the national level. Brazil also clarified that these data will be included in future REDD+ related submissions, such as the upcoming national FREL. The LULUCF experts sought clarification as to whether an assessment of the displacement of emissions had been conducted between the Cerrado and Amazonia biomes. Brazil responded that it has not conducted such an assessment, as it would require complex analysis in the light of the different policies for, and circumstances of, the two biomes, and highlighted that data are not available for the whole country. The LULUCF experts commend Brazil for its future plans to report on whether the displacement of emissions occurs.

30. The LULUCF experts were able to confirm that, according to existing literature (e.g. Carvalho et al., 2019; Moffette and Gibbs, 2019), the main risk of displacement of emissions in Brazil could be from the Amazonia to the Cerrado biome as a result of the soy moratorium in 2006 and the zero-deforestation cattle agreements in 2009. On the basis of the available information, the LULUCF experts noted that, so far, there is no evidence of displacement of emissions to and from the Amazonia biome.

31. Brazil provided a description of how IPCC guidance and guidelines were taken into account in accordance with decision 4/CP.15, paragraph 1(c). For the estimation of emissions in the Cerrado biome, Brazil used the methodology provided in the IPCC *Good Practice Guidance for Land Use, Land-Use Change and Forestry* for estimating changes in carbon stocks in natural forest land converted to other land-use categories, and used the 2006 IPCC Guidelines for estimating the non-CO₂ emissions from fires resulting from deforestation and for sourcing values for certain parameters (e.g. carbon fractions and root-to-shoot ratios for certain physiognomic classes). The LULUCF experts noted that Brazil used 0.47 as the carbon fraction for litter, whereas the 2006 IPCC Guidelines (vol. 4, chap. 2) provide a default value of 0.37 t carbon/t dry matter. Brazil responded that the value of 0.47 was used in accordance with the 2006 IPCC Guidelines (vol. 4, table 4.3), which the experts note is the value for above-ground forest biomass. The experts further note that the Party may wish to consider using the value of 0.37, or country-specific data instead, in the next national GHG inventory and future REDD+ submissions. However, the LULUCF experts confirm that the impact of this discrepancy on overall emissions is not significant because it represents less than 1 per cent of total emission reductions.

32. Brazil included in its FREL and estimation of results the most significant pools and non-CO₂ GHGs. Overall, the exclusion of the soil organic carbon pool was adequately justified in the FREL and its inclusion was identified in the technical assessment report as a future technical improvement.

4. Accuracy of the results proposed in the technical annex

33. The LULUCF experts noted that the Party's estimation of the results of the implementation of the activity reducing emissions from deforestation in the Cerrado biome was undertaken using a transparent and consistent approach. The LULUCF experts commend Brazil for its significant long-term efforts to build up a robust NFMS that is capable of providing transparent and accurate estimates of emissions from deforestation.

34. Both the established FREL and the results obtained in 2011–2017 from the implementation of the activity are based on the assumptions that all carbon from all carbon pools is lost in the year of the deforestation event, that there are no removals from the post-deforestation land use (gross emissions), that once a land is deforested it is masked out and cannot be deforested again (gross deforestation) and, for estimating non-CO₂ emissions, that all deforested land is also burned.

35. With reference to paragraph 16 above, Brazil implemented some improvements to methods used for mapping deforestation, including moving from biennial to annual mapping and using enhanced satellite sensors that would improve the accuracy of the reported estimates of deforestation and results. The LULUCF experts consider that these two improvements will not have a substantial impact on the accuracy of the estimated emissions.

36. Regarding the AD, the LULUCF experts checked the deforestation maps against reference data for 30 polygons of deforestation for 2016–2017 and confirmed that the accuracy of the AD was acceptable. Moreover, the LULUCF experts confirmed that the descending trends and the reduction in deforestation are consistent with Noojipady et al. (2017). However, as mentioned in paragraph 18 above, there were some inconsistencies between the databases of the shapefiles of deforestation that were provided and the calculation spreadsheets for certain years. Hence, the LULUCF experts were not able to reconstruct the AD fully for these years.

37. Regarding the EFs, the LULUCF experts checked the calculation spreadsheets provided by Brazil and confirmed that the EFs were assigned correctly to each physiognomic class. In addition, Brazil was consistent in its use of the same EFs for both the construction of the FREL and results. As mentioned in paragraph 20 above, EFs were derived from local studies and could be improved in future FREL submissions by using more representative estimates from the upcoming NFI.

38. In response to a question from the LULUCF experts regarding the implementation of QA/QC procedures for the estimation of GHG emissions and the reduction of such emissions, Brazil clarified that emission estimates are subject to QA/QC procedures implemented by experienced members of the Working Group of Technical Experts on REDD+, composed of LULUCF professionals involved in the preparation of the national GHG inventory (see also para. 22 above). The LULUCF experts commend Brazil for these robust QA/QC procedures.

39. As mentioned in paragraph 22 above, Brazil provided some information related to the analysis of uncertainty. Although the national GHG inventory of the NC3 includes a description of the sources of uncertainty, the LULUCF experts note that the submission on REDD+ results does not contain comprehensive qualitative and quantitative information on the uncertainties of EFs and AD used for constructing the GHG estimates or an estimate of the total uncertainty of GHG emissions. The LULUCF experts consider uncertainty analysis as an essential tool for identifying major sources of uncertainty (i.e. the contribution of each source category to total levels of uncertainty) and for identifying areas for future improvement and improvement of estimates. The LULUCF experts note this as an area for future technical improvement. Brazil agreed that a quantified analysis of uncertainties for EFs and emission reductions achieved is an area for technical improvement. Despite this, and given the assumptions used, the LULUCF experts concluded that the results are accurate to the extent possible.

C. Areas identified for technical improvement

40. The LULUCF experts concluded that the following areas for technical improvement identified in the report on the technical assessment of Brazil's FREL¹³ also apply to the provision of information on the results of the implementation of the activity reducing emissions from deforestation:

- (a) Estimating emissions from net deforestation;
- (b) Including emissions from forest degradation by forest fires;
- (c) Quantifying uncertainties associated with the FREL and estimated results;
- (d) Exploring the possibility of including the soil organic carbon pool.

41. Furthermore, the LULUCF experts noted that Brazil could consider:

- (a) Improving the data management in its repository (see para. 18 above);
- (b) Providing more information on the integration process (see para. 19 above);
- (c) Using field information from the NFI to develop updated EFs (see para. 20 above);
- (d) Conducting a full-scale accuracy assessment of the deforestation map (see para. 22 above);
- (e) Using the carbon fraction of 0.37 t carbon/t dry matter or country-specific data for litter, as provided in the 2006 IPCC Guidelines (vol. 4, chap. 2) (see para. 31 above).

42. Brazil noted the following areas that it had identified for technical improvement for future REDD+ related submissions:

- (a) Reporting on the displacement of emissions (see paras. 29–30 above);
- (b) Quantifying uncertainties of EFs and GHG emissions (see para. 39 above).

D. Comments and responses of the Party

43. During the consultation process, Brazil noted a number of areas of capacity-building needs. Addressing those needs could potentially enable Brazil to improve its data and methodologies, and include additional activities and gases in future FREL submissions. After exchanges with the LULUCF experts, Brazil identified the need to ensure adequate training of the broader Brazilian LULUCF expert community on MRV-related processes.

III. Conclusions

44. The LULUCF experts conclude that Brazil reported the results of the implementation of the activity reducing emissions from deforestation, and followed a subnational approach covering the country's Cerrado biome, which represents up to 24 per cent of the national territory. The results include estimates of emissions of CO₂, CH₄ and N₂O from four carbon pools (above-ground biomass, below-ground biomass, deadwood and litter) from deforestation identified as clear-cuts of an MMU of 1 ha for 2011–2017. The results of the activity were reported using methodologies, definitions, assumptions and information consistent with those used for constructing the assessed FREL.

45. The LULUCF experts consider the data and information provided in the technical annex to be transparent, consistent, complete and accurate.

46. The LULUCF experts found that the data and information provided in the technical annex are consistent with the guidelines referred to in decision 14/CP.19, paragraph 11.

47. The results are accurate to the extent possible, based on the assumptions used. The LULUCF experts note that Brazil has initiated a number of programmes for assessing

¹³ FCCC/TAR/2018/BRA, para. 35.

possible displacement of emissions while taking steps to implement an NFMS (see para. 29 above). In addition, they note that, on the basis of the information available, there is no evidence of displacement of emissions to the Amazonia biome (see para. 30 above).

48. In conclusion, the LULUCF experts commend Brazil for showing a strong commitment to the continuous improvement of the data and information used for calculating the results, in line with the stepwise approach, which are consistent with those used to establish its assessed FREL. Some areas for future technical improvement and capacity-building needs identified by Brazil have been identified in this report. At the same time, the LULUCF experts acknowledge that such improvements are subject to national capabilities and circumstances, and note the importance of adequate and predictable support.¹⁴ The LULUCF experts also acknowledge that the TA process was an opportunity for a facilitative and constructive technical exchange of views and information with Brazil.¹⁵

¹⁴ In accordance with decision 2/CP.17, para. 57.

¹⁵ In accordance with decision 14/CP.19, paras. 12–13.

Annex I

Technical annex to the biennial update report

Owing to the complexity and length of the submitted technical annex to the BUR, and in order to maintain the original formatting, the technical annex is not reproduced here. It is available on the UNFCCC website at <https://unfccc.int/BURs>.

Annex II

Summary of the main features of the proposed results of the implementation of the activities referred to in decision 1/CP.16, paragraph 70, based on information provided by Brazil

	<i>Key elements</i>	<i>Remarks</i>
Results reported	1 237 996 004 t CO ₂ eq	See paragraph 10 of this document
Results period	2011–2017	See paragraph 10 of this document
Assessed FREL	335 540 289 t CO ₂ eq/year	See paragraph 9 of this document
Reference period	2000–2010	See paragraph 10 of this document
National/subnational	Subnational	Cerrado biome covering 2,036,448 km ² (up to 24 per cent of national territory). See paragraph 9 of this document
Activity included	Reducing emissions from deforestation	See paragraph 10 of this document
Pools included	Above-ground biomass Below-ground biomass Deadwood Litter	See paragraphs 15(d) and 32 of this document Exploring the inclusion of soil organic carbon is identified as an area for future improvement (see para. 40(d) of this document)
Gases included	CO ₂ , CH ₄ , N ₂ O	See paragraph 15(e) of this document Non-CO ₂ emissions only pertain to emissions from fires occurring at the time of deforestation. Non-CO ₂ emissions from forest fires are not included
Consistency between assessed FREL and the results	Methods, definitions and information used for the assessed FREL are consistent with the results	See paragraphs 15–17 of this document Consistency between the assessed FREL and the results was maintained
Description of NFMS and institutional roles	Included	See paragraphs 26–28 of this document
Identification of future technical improvements	Included	Several areas for future technical improvement were identified. See paragraphs 40–42 of this document

Annex III

Documents and information used during the technical analysis

A. Reference documents

Carvalho W, Mustin K, Hilário R, et al. 2019. Deforestation control in the Brazilian Amazon: A conservation struggle being lost as agreements and regulations are subverted and bypassed. *Perspectives in Ecology and Conservation*. 17(3): pp.122–130. Available at <https://doi.org/10.1016/j.pecon.2019.06.002>.

De Brito A, de Morrison Valeriano D, Ferri C, et al. 2018. *Monitoramento da cobertura natural do Cerrado por satélite: Metodologia da detecção do desmatamento no bioma Cerrado, mapeamento de Areas Antropizadas com imagens de média resolução espacial*. São José dos Campos/SP: Fundação de Ciência, Aplicações e Tecnologias Espaciais – Funcate. Available at http://www.dpi.inpe.br/fipcerrado/report_funcate_metodologia_mapeamento_bioma_cerrado.pdf.

Grupo de Trabalho Técnico sobre REDD+ [Working Group of Technical Experts on REDD+]. 2018. Inicia preparação do FREL Nacional. In: *IX Reunião, 22–23 August 2018*. Brasília: Ministério do Meio Ambiente. Available at <http://redd.mma.gov.br/pt/component/content/article/106-central-de-conteudos/noticias-principais/1006-gtt-redd-inicia-preparacao-do-frel-nacional?Itemid=0>.

“Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels”. Annex to decision 13/CP.19. Available at <https://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf>.

“Guidelines for elements to be included in the technical annex referred to in decision 14/CP.19, paragraph 7”. Annex to decision 14/CP.19. Available at <https://unfccc.int/resource/docs/2013/cop19/eng/10a01.pdf>.

“Guidelines for submissions of information on reference levels”. Annex to decision 12/CP.17. Available at <https://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf>.

IPCC. 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. J Penman, M Gytarsky, T Hiraiishi, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html>.

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl>.

Maurano L, Aparecido de Almeida C and Meira M. 2019. Monitoramento do desmatamento do Cerrado Brasileiro por satélite - Prodes Cerrado. In: *Anais do XIX Simposio Brasileiro de Sensoriamento Remoto, 14–17 April 2019*. São José dos Campos: Instituto Nacional de Pesquisas Espaciais. ISBN 978-85-17-00097-3.

Meira M, Maurano L, Aparecido de Almeida C, et al. 2019. Avaliação da acurácia temática do mapeamento de desmatamento no bioma cerrado na região do Matopiba. In: *Anais do XIX Simposio Brasileiro de Sensoriamento Remoto, 14–17 April 2019*. São José dos Campos: Instituto Nacional de Pesquisas Espaciais. ISBN 978-85-17-00097-3.

Ministério da Ciência, Tecnologia e Inovação [Ministry of Science, Technology and Innovation]. 2015. *Terceiro Inventário Brasileiro de Emissões e Remoções Antrópicas de Gases de Efeito Estufa: Relatórios de Referência Setor Uso da Terra, Mudança do Uso da Terra e Florestas (Reference report on the LULUCF Sector of the Third National GHG Inventory of Brazil)*. Brasília: Ministério da Ciência, Tecnologia e Inovação. Available at https://sirene.mctic.gov.br/portal/export/sites/sirene/backend/galeria/arquivos/2018/10/11/R_R_LULUCF_Mudanca_de_Uso_e_Floresta.pdf.

Moffette F and Gibbs H. 2018. *Agricultural Displacement and Deforestation Leakage in the Brazilian Legal Amazon*. Madison, Wisconsin: University of Wisconsin-Madison. Available at <https://www.semanticscholar.org/paper/Agricultural-Displacement-and-Deforestation-Leakage-Moffette-Gibbs/d72be96e9cf2e37893f7b10744eab73864256cb7>.

Noojipady P, Morton CD, Macedo NM, et al. 2017. Forest carbon emissions from cropland expansion in the Brazilian Cerrado biome. *Environmental Research Letters*. 12(2): pp.1–11. Available at <https://doi.org/10.1088/1748-9326/aa5986>.

Original and modified FREL submissions of Brazil for the Cerrado biome. Available at <https://redd.unfccc.int/submissions.html?country=bra>.

Report on the TA of the proposed FREL of Brazil submitted in 2017. FCCC/TAR/2017/BRA. Available at <https://unfccc.int/documents/28219>.

B. Additional information provided by the Party

The following documents¹ were provided by the Party in response to requests for clarification or additional information during the TA:

Brazil. 2018. Simple guide to the reconstruction of the emissions from deforestation in the Cerrado biome for the period between 2010 and 2017.

Brazil. 2018. Methodology for the detection of deforestation in the Cerrado biome.

List of satellite imagery used for mapping deforestation in 2012–2015.

Presentation on “Mapping deforestation in Cerrado for the construction of the FREL for the biome” by Valeriano, D. (2016).

Shapefile with the limits of the Cerrado biome.

Shapefiles of deforestation for years in the period 2012–2017.

¹ Reproduced as received from the Party.