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## Report of the technical assessment of the proposed forest reference emission level of Brazil submitted in 2017

### *Summary*

This report covers the technical assessment of the submission of Brazil, on a voluntary basis, on its proposed forest reference emission level (FREL), in accordance with decision 13/CP.19 and in the context of results-based payments. The FREL proposed by Brazil covers the activity “reducing emissions from deforestation”, which is among the activities included in decision 1/CP.16, paragraph 70. In its submission, Brazil has developed a subnational FREL for the Cerrado biome, with the aim of transitioning to a national FREL and/or forest reference level in the future. The FREL presented in the original submission for the reference period 2000–2010 corresponds to 326,672,509 tonnes of carbon dioxide equivalent per year (t CO<sub>2</sub> eq/year). As a result of the facilitative process during the technical assessment, Brazil submitted a modified estimate of the FREL of 335,540,289 t CO<sub>2</sub> eq/year. The assessment team notes that the data and information used by Brazil in constructing its FREL are transparent, complete and in overall accordance with the guidelines contained in the annex to decision 12/CP.17. This report contains the assessed FREL and a few areas identified by the assessment team for further technical improvement, according to the scope of the technical assessment in the annex to decision 13/CP.19.

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## I. Introduction and summary

### A. Overview

1. This report covers the technical assessment (TA) of the submission of Brazil on its proposed forest reference emission level (FREL)<sup>1</sup> for the Cerrado biome, submitted on 6 January 2017 in accordance with decisions 12/CP.17 and 13/CP.19. The TA took place (as a centralized activity) from 13 to 17 March 2017 in Bonn, Germany, and was coordinated by the UNFCCC secretariat.<sup>2</sup> The TA was conducted by two land use, land-use change and forestry experts from the UNFCCC roster of experts<sup>3</sup> (hereinafter referred to as the assessment team (AT)): Mr. Mattias Lundblad (Sweden) and Ms. Elizabeth Philip (Malaysia). In addition, Mr. Brian Mantlana, an expert from the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention, participated as an observer<sup>4</sup> during the centralized activity in Bonn. The TA was coordinated by Mr. Dirk Nemitz (UNFCCC secretariat).

2. In response to the invitation by the Conference of the Parties (COP) and in accordance with the provisions of decision 12/CP.17, paragraphs 7–15, and its annex, Brazil submitted, on a voluntary basis, its proposed FREL. The proposed FREL is one of the elements<sup>5</sup> to be developed in the implementation of the activities referred to in decision 1/CP.16, paragraph 70. The COP decided that each submission of a proposed FREL and/or forest reference level (FRL), as referred to in decision 12/CP.17, paragraph 13, shall be subject to a TA in the context of results-based payments, pursuant to decision 13/CP.19, paragraphs 1 and 2, and decision 14/CP.19, paragraphs 7 and 8.

3. Brazil underlined that the submission of a FREL and/or FRL does not modify, revise or adjust in any way the nationally appropriate mitigation actions being undertaken by the Party under the Bali Action Plan,<sup>6</sup> and does not interfere with the nationally determined contribution submitted by Brazil to the UNFCCC under the Paris Agreement.

4. The objective of the TA was to assess the degree to which information provided by Brazil was in accordance with the guidelines for submissions of information on FRELS/FRLs<sup>7</sup> and to offer a facilitative, non-intrusive, technical exchange of information on the construction of the FREL, with a view to supporting the capacity of Brazil for the construction and future improvement of its FRELS/FRLs, as appropriate.<sup>8</sup>

5. The TA of the FREL submitted by Brazil was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELS and/or FRLs as contained in the annex to decision 13/CP.19. This report on the TA was prepared by the AT following the guidelines and procedures contained in the same decision.

6. As a result of the facilitative interactions with the AT during the TA, Brazil submitted a modified version of its subnational FREL for the Cerrado biome on 23 May 2017, which took into consideration the technical inputs of the AT and included emissions of greenhouse gases (GHGs) other than carbon dioxide (CO<sub>2</sub>) from fire following deforestation. This TA report was prepared in the context of the modified FREL submission. The modified submission, which contains the assessed FREL, and the original submission are available on the UNFCCC website.<sup>9</sup>

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<sup>1</sup> The submission of Brazil is available at <http://unfccc.int/8414>.

<sup>2</sup> Decision 13/CP.19, annex, paragraph 7.

<sup>3</sup> Decision 13/CP.19, annex, paragraphs 7 and 9.

<sup>4</sup> Decision 13/CP.19, annex, paragraph 9.

<sup>5</sup> Decision 1/CP.16, paragraph 71(b).

<sup>6</sup> See document FCCC/AWGLCA/2011/INF.1.

<sup>7</sup> Decision 12/CP.17, annex.

<sup>8</sup> Decision 13/CP.19, annex, paragraph 1(a) and (b).

<sup>9</sup> <http://unfccc.int/8414>.

## B. Proposed forest reference emission level

7. The FREL for the Cerrado biome proposed by Brazil is the annual average of the CO<sub>2</sub> emissions associated with “gross deforestation” and non-CO<sub>2</sub> emissions from fire following deforestation. Deforestation is defined as the conversion of natural areas with forest formations to other land uses for the historical reference period 2000–2010. The FREL includes only gross emissions from deforestation associated with clear-cuts and excludes any subsequent emissions and removals from the deforested areas. The year 2000 was used as the reference year for identification of the deforested areas, which was done by analysis of Landsat-5 satellite images. The information on activity data used in constructing the FREL was extracted from a historical time series of land-use maps for the periods 2000–2002, 2002–2004, 2004–2006, 2006–2008 and 2008–2010. The information on emission factors was obtained from various scientific publications, the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) and the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines). The time series for the period 2000–2010, used to estimate the FREL, are presented in table 2 of the submission. The resulting gross deforestation in the Cerrado biome for the period 2000–2010, representing the Cerrado biome FREL, corresponds to 335,540,289 tonnes of carbon dioxide equivalent per year.

8. In decision 1/CP.16, paragraph 70, the COP encourages developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances, in the context of the provision of adequate and predictable support. The FREL for the Cerrado biome proposed by Brazil, on a voluntary basis, for a TA in the context of results-based payments, covers “reducing emissions from deforestation”, which is one of the five activities included in decision 1/CP.16, paragraph 70. Pursuant to paragraph 71(b) of the same decision, Brazil has developed a subnational FREL for the Cerrado biome with the aim of transitioning to a national FREL, which would incorporate all biomes in the country, by 2020. In its submission, Brazil applies a stepwise approach to its development of the FREL, in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools.

9. The proposed FREL includes the above-ground biomass, below-ground biomass, litter and deadwood pools. The soil organic carbon pool was not included. Regarding GHGs, the submission includes CO<sub>2</sub> as well as methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) from fire following deforestation.

## II. Data, methodologies and procedures used in the construction of the proposed forest reference emission level

### How each element in the annex to decision 12/CP.17 was taken into account in the construction of the forest reference emission level

#### 1. Information that was used by the Party in the construction of the forest reference emission level

10. For the construction of the FREL for the Cerrado biome, Brazil used the methodologies in the IPCC good practice guidance for LULUCF and in the 2006 IPCC Guidelines as the basis for estimating changes in carbon stocks in forest land converted to other land-use categories. Accordingly, the gross emissions from deforestation were estimated from the year 2000 onwards by combining activity data (i.e. the area of annual gross deforestation) with the appropriate emission factors (i.e. CO<sub>2</sub> emissions associated with the corresponding forest type). Non-CO<sub>2</sub> emissions from fire following deforestation were estimated using the 2006 IPCC Guidelines and with the above-mentioned CO<sub>2</sub> emissions as the basis for calculating the amount of fuel burned.

11. The Cerrado biome covers an area of 203,644,800 ha (about 24 per cent of the national territory). According to Brazil's definition of forest (see para. 30 below), 65 per cent of the Cerrado biome is considered forest.

12. The activity data used to establish a time series of annual deforestation consist of forest formations converted to other land uses as detected using subsequent Landsat-5 images in a wall-to-wall analysis. Deforestation polygons were identified and mapped in the entire biome at a scale of 1:75,000 and with spatial resolution of about 1 ha. The reference period considered was 2000–2010, with 2000 being the reference year. The FREL was calculated as the average emissions from deforested areas for the period 2000–2010. The presence of clouds is known to affect the quality of the analysis but for the Cerrado biome the total area under cloud cover was quite small in all the periods considered. The overlaying of deforestation polygons with a vegetation cover map provided by the Brazilian Institute of Geography and Statistics (2004) allowed for the identification of the forest physiognomy affected by deforestation for each polygon. All deforested areas were assumed to be burned following deforestation. The resulting shapefiles are available through Info Hub Brazil, which is maintained by the Ministry of the Environment.<sup>10</sup> The sum of the areas of all the deforestation polygons within a given geographic extension is referred to as deforestation increment.

13. The average annual area of deforestation for the reference period (2000–2010) used in the construction of the FREL was 1,459,379 ha. The AT notes that Brazil applied a narrow approach in the construction of its FREL in that only forest formation areas converted to other lands were considered as deforestation. Conversion of non-forest areas such as grassland and savannah was not considered as deforestation. Brazil also indicated in the submission that Brazil's third national GHG inventory considered a mapping area for deforestation of 6 ha as the minimum, which resulted in a difference in the estimate of deforested area in that submission and the FREL of 8.0 per cent.

14. Most of the emission factors used were country-specific (tier 2) and based on carbon stocks presented per phytophysiology, representing 23 forest types. The emission factors were further differentiated per state for some phytophysiologies. The carbon stocks were derived from the literature, as referenced in table 9 of the submission, and from the IPCC good practice guidance for LULUCF and the 2006 IPCC Guidelines. Data on carbon stocks in above-ground biomass were obtained from published scientific reports while some of the data for below-ground biomass and most of the data on carbon stocks in litter and deadwood pools were obtained using root-to-shoot ratios and the relationship between living biomass and litter and deadwood, respectively. Most of the ratios and relationships used were from the IPCC good practice guidance and the 2006 IPCC Guidelines. The loss of carbon was calculated using the sum of carbon stocks from relevant pools for each physiognomy, which was assumed to instantly oxidize; that is, no subsequent CO<sub>2</sub> emissions or removals after the deforestation event were considered. The total amount of carbon for the different forest types ranged from 15.2 to 225.1 t carbon (C)/ha; the average was 101.7 t C/ha and the area weighted average was 83.6 t C/ha. These values are within the range reported for the corresponding vegetation types in the 2006 IPCC Guidelines.

15. Annual emissions from deforestation were estimated using the area of each deforestation polygon under a certain forest type multiplied by the emission factor (i.e. carbon density in t C/ha) of the corresponding forest type and by 44/12 (to convert carbon into CO<sub>2</sub>). Finally, emissions from all the deforested areas were summed and divided by two, because each area estimate covered a two-year period.

16. Non-CO<sub>2</sub> emissions from fire following deforestation were calculated in accordance with the methodology in the 2006 IPCC Guidelines, assuming that all forest conversions led to a post-conversion fire. The mass of fuel available for combustion was calculated from the carbon stock values presented for above-ground biomass, litter and deadwood converted to dry mass.

<sup>10</sup> <http://redd.mma.gov.br/en/infohub>.

## 2. Transparency, completeness, consistency and accuracy of the information used in the construction of the forest reference emission level

### Methodological information, including description of data sets, approaches and methods

17. The activity data used in the construction of the FREL were derived from the interpretation of Landsat-5 images for five two-year periods between 2000 and 2010 (see paras. 7 and 12 above). Emission factors were derived from information in scientific publications and default IPCC values (see para. 14 above). The AT commends Brazil for the effort it made to provide detailed information on deforested areas and emission factors by forest type through Info Hub Brazil.

18. Brazil is currently working on its first national forest inventory, which has been gradually implemented since 2005 and for which sampling points are distributed systematically throughout the country according to a grid established by the Brazilian Forest Service of the Brazilian Ministry of the Environment. While the emission factors used for the construction of the FREL are already of acceptable accuracy, the AT notes the possibility for Brazil to validate and improve the emission factors when data from the national forest inventory become available.

19. The AT notes that the reference period for deforestation reported in the submission and in Brazil's Action Plan for the Prevention and Control of Deforestation and Forest Fires in the Cerrado are different. Brazil clarified that new and better quality satellite images and a change to the minimum mapping unit became available in 2016. The use of this better information resulted in the estimated total area of deforestation presented in Brazil's third national communication having a difference of 8.0 per cent compared with the FREL.

20. The AT also notes that while Brazil conducted a wall-to-wall analysis of the entire Cerrado biome to estimate the total deforested area for the period 2000–2010 on a biennial basis, the Party did not consider subsequent removals from the deforested areas. During the exchange with the AT, Brazil explained that estimating these removals following deforestation is complex. Information on land-use change in the Cerrado biome is obtained through the Brazilian Biomes Environmental Monitoring Program, which adds to the understanding of these dynamics. The AT acknowledges that Brazil is pursuing a better understanding of the challenge, with a view to including net deforestation in a future submission.

21. Brazil indicated in its modified submission that forest fires occur frequently in the Cerrado biome; for example, they affected 2,846,980 ha of forest formation area in the Cerrado biome in 2010. The AT considers this to be a potentially significant source of emissions and identified the inclusion in the FREL of forest degradation caused by fire as an area for technical improvement.

22. The AT commends Brazil for providing information on sources of uncertainties related to data and carbon stock assessment as well as some qualitative information on the sources of uncertainty in activity data. In its submission, the Party included a box with quantitative estimates of uncertainties associated with the mapping of land use and land cover based on those identified in the third national inventory. However, the submission does not contain quantitative information on uncertainties of emission factors and activity data used for constructing the FREL or an estimate of the total uncertainty of the FREL itself. The AT considers this to be an area for future improvement of the FREL.

### Description of relevant policies and plans, as appropriate

23. As the proposed FREL is based entirely on historical data, no assumptions about future changes to domestic policies have been included in the FREL submission. The AT commends Brazil for including supplementary information in annexes to the submission; for example, on the Brazilian National Policy on Climate Change, which advises that the rate of deforestation in the Cerrado biome should be reduced by 40 per cent from the average annual deforestation observed from 2002 to 2008. The policy outlines an Action Plan for the Prevention and Control of Deforestation and Forest Fires in the Cerrado and is in its third phase of implementation.

### 3. Pools, gases and activities included in the construction of the forest reference emission level

24. According to decision 12/CP.17, annex, subparagraph (c), the reasons for omitting a pool and/or activity from the construction of the FREL should be provided, noting that significant pools and/or activities should not be excluded.

25. The pools included in the FREL for the Cerrado biome include the above-ground biomass, below-ground biomass, litter and deadwood pools. The soil organic carbon pool was not included.

26. During conversion of forest lands to other land uses, changes in the soil organic carbon pool may be significant. However, as the FREL for the Cerrado biome includes only gross emissions from deforestation, only the changes in soil organic carbon due to the conversion would have been included, regardless of subsequent land use. In its submission, Brazil noted that the available literature indicates the conversion of forest formations in the Cerrado biome can result in either carbon emissions or carbon removals from soil, but also that there is robust evidence to support the potential for management practices to recover soil carbon stocks in pasture or agriculture, thereby balancing out the carbon losses due to the oxidation of organic matter in the soil at the time of conversion. Brazil reported that soil in the Cerrado biome has the potential to be either a source or a sink of CO<sub>2</sub>. However, the collection of data related to management practices for the Cerrado biome is not yet well established and a better understanding of their impacts on soil emissions or removals is necessary. The AT considers that Brazil justified the exclusion of the soil organic carbon pool in the FREL for the Cerrado biome adequately, and suggests that the Party explore the possibility of including this pool in future FREL submissions.

27. Brazil noted in its submission that organic soils may hold about 70 per cent of the carbon in a forest stand of the Cerrado biome. During the facilitative exchange, the AT asked for clarification on the extent of organic soils in the biome. Brazil responded that about 1.6 per cent of the Cerrado biome is considered to have organic soils, mainly in grasslands, which implies that deforestation does not occur on organic soils.

28. Following the exchange with the AT, Brazil included in its modified submission emissions of N<sub>2</sub>O and CH<sub>4</sub> from fire following deforestation in the FREL. The AT considers the assumption that all deforested areas will be burned reasonable in the absence of a no burning policy.

29. The AT acknowledges that Brazil included the most significant activity (“reducing emissions from deforestation”) of the five activities identified in decision 1/CP.16, paragraph 70, in accordance with national capabilities and circumstances. During the TA, Brazil informed the AT that forest degradation may be included in the future FREL, perhaps by 2020, when Brazil plans to submit a national FREL. Brazil is already conducting discussions with experts from the academic and research community as well as with non-governmental organizations through Brazil’s Technical Working Group on REDD-plus to define forest degradation, which may vary significantly from one biome to another. The AT commends Brazil for these efforts and looks forward to the inclusion of forest degradation in the FREL by 2020.

### 4. Definition of forest

30. Brazil provided in its modified submission the definition of forest used in the construction of its FREL. This definition is the same as the one that the Party uses in its national GHG inventory and its forest resources assessment for the Food and Agriculture Organization of the United Nations; that is, minimum area of 0.5 ha, height of 5 m or more and at least 10 per cent canopy cover.

## III. Conclusions

31. The information used by Brazil in constructing its FREL for the Cerrado biome for deforestation is transparent, complete and in overall accordance with the guidelines for

submission of information on FRELs/FRLs (as contained in the annex to decision 12/CP.17).

32. The AT acknowledges that Brazil is continuing the development of its FREL in this submission for the Cerrado biome, which covers about 24 per cent of the national territory, and together with the previous FREL for the Amazonia biome,<sup>11</sup> 73 per cent of the national territory is covered. In doing so, the AT considers that Brazil followed decision 1/CP.16, paragraph 70, on activities undertaken, and paragraph 71(b), on elaboration of subnational FRELs as an interim measure, and decision 12/CP.17, paragraph 10, on implementing a stepwise approach. During the exchange of information, Brazil provided information on the ongoing work on the inclusion of forest degradation in the FREL.

33. As a result of the facilitative interactions with the AT during the TA, Brazil submitted a modified submission, which took into consideration the technical inputs of the AT. The AT notes that Brazil included non-CO<sub>2</sub> gases, which contributed to an increase in the accuracy of the FREL and to its improved consistency with the third national communication.

34. The AT notes that, overall, the FREL maintains consistency, in terms of sources for the activity data and the emission factors, with the GHG inventory included in Brazil's third national communication.

35. Pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following areas for future technical improvement:

- (a) Estimate emissions from net deforestation (see para. 20 above);
- (b) Include emissions from forest degradation by forest fires (see para. 21 above);
- (c) Quantify uncertainties associated with the FREL (see para. 22 above);
- (d) Explore the possibility of including the soil organic carbon pool (see para. 26 above).

36. The AT acknowledges and welcomes the intention expressed by Brazil to:

- (a) Continually improve the estimates of emissions and removals as part of the stepwise approach adopted for REDD-plus;
- (b) Improve the emission factors when data from the national forest inventory become available;
- (c) Enhance understanding of the land-use change dynamics to estimate net deforestation;
- (d) Enhance understanding of the definition of forest degradation, and include emissions from degradation;
- (e) Extend the FREL to other biomes in an effort to move towards a national FREL.

37. In conclusion, the AT commends Brazil for showing a strong commitment to the continuous improvement of its FREL estimates in line with the stepwise approach. Areas for future technical improvement of Brazil's FREL have been identified in this report. The AT acknowledges that such improvements are subject to national capabilities and policies, and notes the importance of adequate and predictable support.<sup>12</sup> The AT also acknowledges that the assessment process was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Brazil.

38. The table contained in the annex summarizes the main characteristics of Brazil's proposed FREL.

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<sup>11</sup> See document FCCC/TAR/2014/BRA.

<sup>12</sup> Decision 13/CP.19, annex, paragraph 1(b), and decision 12/CP.17, paragraph 10.



## Annex

## Summary of main features of the proposed forest reference emission level based on information provided by the Party

<i>Main features of the FREL</i>		<i>Remarks</i>
Proposed FREL (in t CO <sub>2</sub> eq/year)	335 540 289	See paragraph 7 of this document
Type and duration of FREL	FREL = historical emissions 2000–2010	See paragraph 7 of this document
Adjustment for national circumstances	No	
National/subnational <sup>a</sup>	Subnational	See paragraphs 7 and 11 of this document
Activities included <sup>b</sup>	Deforestation	See paragraph 8 of this document
Pools included <sup>b</sup>	AB, BB, DW, L	See paragraph 25 of this document
Gases included	CO <sub>2</sub> , N <sub>2</sub> O, CH <sub>4</sub>	See paragraph 28 of this document
Forest definition <sup>c</sup>	Included	See paragraph 30 of this document
Relationship with latest GHG inventory	Methods used for FREL are consistent with latest GHG inventory (2010)	
Description of relevant policies and plans <sup>d</sup>	Included	See paragraph 23 of this document
Description of assumptions on future changes in policies <sup>d</sup>	Not applicable	
Descriptions of changes to previous FREL	Not applicable	
Future improvements identified	Not applicable	Several areas for future technical improvements were identified (see para. 35 of this document)

*Abbreviations:* AB = above-ground biomass, BB = below-ground biomass, DW = deadwood, FREL = forest reference emission level, GHG = greenhouse gas, L = litter, t CO<sub>2</sub> eq/year = tonnes of carbon dioxide equivalent per year.

<sup>a</sup> If subnational, comments should include information on the treatment of displacement of emissions.

<sup>b</sup> In the case of omitted pools or activities, comments should include the justification provided by the country.

<sup>c</sup> The forest definition should be summarized, and it should be stated if it differs from the definition used in the GHG inventory or in reporting to other international organizations.

<sup>d</sup> May be relevant to the description of national circumstances, which is required in the case of adjustment.