

BRAZIL'S REFERENCE LEVEL SUBMISSION TO THE UNFCCC: A SUMMARY/ANALYSIS NOTE

Brazil's REL at a Glance: Key Characteristics

- **Forest Definition:** The submission provides the following definition it uses for FRA reporting but does not specify if this exact definition was applied for the REL development or if it had been adapted in any way:

“Forest is defined as land spanning more than 0.5 hectare with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. Land not classified as “Forest” spanning more than 0.5 hectare; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent are classified as “Other Wooded Land”.

- **Scale:** sub-national, covering Amazonia only.
- **Scope (Activities and Pools):** gross deforestation; aboveground biomass (AGB), belowground biomass (BGB), deadwood, and litter are the included IPCC carbon pools.
- **Data/Methodologies:**
 - For activity data on gross deforestation: Approach 3, using PRODES data
 - For carbon density/hectare (or emission factors): Tier 2, using RADAMBRASIL.
- **Timeframe:** a dynamic mean of the CO₂ emissions associated with gross deforestation since 1996, updated every five years, using the best available historical data and consistent with the most recent National GHG Inventory submitted by Brazil to the UNFCCC at the time of the construction of the FREL.
- **Accuracy:** limited quantitative uncertainty analysis is provided. Activity data, water and carbon content uncertainty estimates are included but other potential sources are only listed and no accumulated uncertainty estimate is presented.
- **Adjustments:** does not include assumptions on potential future changes to domestic policies but applies a rolling average meant to reflect the effects of policies and plans implemented in the Amazonia biome to reflect policy developments over time.

I. Summary and Analysis by Technical Element

A. FOREST DEFINITION

Summary

The forest definition that Brazil uses to report to FAO Global Forest Resources Assessment (FRA) is as follows:

“Forest is defined as land spanning more than 0.5 hectare with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. Land not classified as “Forest” spanning more than 0.5 hectare; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent are classified as “Other Wooded Land”.

The submission states that this definition is the broadly applicable forest definition in Brazil, however it does not provide a straightforward explanation of the exact definition applied for the REL submission. It is not necessarily the same as the FRA definition, though the submission does state that the boundaries of non-forest/forest are based on the definition applied in the FRA report.

Analysis

- The submission explains that there is a difference in terms of how the forest types are aggregated between the FRA definition and the categorization used by RADAMBRASIL, so this may imply a variation in definition. This does not appear entirely transparent and could be improved.
- It would also benefit from the inclusion of the definition used for the GHG inventory reporting. Although it is not explicitly required to provide it in the submission, it needs to be justified if there is a difference between the definitions used in the GHG inventory reporting and the FREL submission. This cannot be easily evaluated without providing those definitions together in the submission. Below the forest definition as applied by Brazil in its last National Communication (2010) is provided:

Forest land comprises areas with the following characteristics:

- a) minimum tree crown coverage: 10 percent*
- b) minimum area: 0.5 hectare*
- c) minimum tree height: 5 meters*

This is consistent with the FRA definition. Though it raises no additional issues of inconsistency, it should again be included here for full transparency.

- The FREL for Amazonia contains both managed and unmanaged lands in the deforestation assessment. In other words, if there is a clear cut on unmanaged land identified it enters into the total managed forest land database. This is consistent with IPCC guidance.

B. GEOGRAPHIC SCALE

Summary

- It is a sub-national reference level (covering Amazonia).
- A prioritisation of emissions by biome is provided. 50.8% of emissions from the Amazon biome and 18.9% from the Cerrado biome (of the 78% of total LULUCF sector emissions contributing to total national GHG emissions across all IPCC sectors).
- The submission also mentions that the national FREL to be submitted by Brazil in the future will be calculated as the sum of the FRELs constructed for each of the six biomes in the national territory. This will allow the country to assess and evaluate the effect of the implementation of policies and measures developed at the biome level.
- Brazil explains that it plans to expand its monitoring approach and future REL submission to include the Cerrado. A system for annual monitoring and early warnings is being developed to allow for this.
- Emissions from forest degradation in the Amazonia biome from 2007-2010 inclusive correspond to approximately 14.6% of the emissions from deforestation.

Analysis

In regards to scale of the submitted REL, this is consistent with the UNFCCC guidelines for RELs which recognize that a subnational REL, representing less than the total national territory of forest area, may be elaborated as an interim measure. The submission seems to be sufficiently transparent in terms of explaining what has been included versus excluded. The prioritisation of emissions by biome sufficiently justifies the subnational scale being applied as an interim stage.

C. SCOPE: ACTIVITIES AND POOLS

Summary

According to the UNFCCC guidelines, the REDD+ REL/RL technical assessment will include an assessment of the following:

“...(f) Pools and gases, and activities included in the forest reference emission level and/or forest reference level, and justification of why omitted pools and/or activities were deemed not significant.”

Inclusion of REDD+ Activities in the REL/RL

- The FREL focuses on gross deforestation.
- The assessment of deforestation is limited to areas of primary forest.
- A justification is offered for the omission of all other REDD+ activities at this time, including the lack of data, such as insufficient time-series to assess forest degradation. Progress on the potential to include other REDD+ activities (i.e. degradation) in the future is detailed in the annex of the submission.
- On degradation, this will be an included activity when there is improved data for the Cerrado. However, currently there is high uncertainty and high degree of variability when it comes to data on degradation in the Cerrado. It explains that degradation is not included at this time because the time series of data is still too short to fully understand the forest degradation process in Brazil.

Inclusion of Pools and Gases

- The five IPCC carbon pools are aboveground biomass (AGB), belowground biomass (BGB), deadwood, litter and soil organic carbon (SOC). Brazil has included three of those five pools: AGB, BGB and litter.
- A justification for the exclusion of soil organic carbon is provided. The submission cites various studies demonstrating variation in increases versus decreases in the soil organic carbon pool following deforestation. This is related to the role that management practices following the deforestation event play. Brazil indicates that more studies are needed to determine with more certainty how significant the changes in SOC are, following conversion of forest land.

Analysis

Activities:

- A REDD+ country should prioritize the inclusion of REDD+ activities, pools and gases, based on the significance of the associated emissions. “Significance” is determined by the IPCC as being 25-30%. So any significant activities should be included. There is no hierarchy other than being significant or not.
- Deforestation is clearly the most significant activity in Brazil, however the submission provides no fully transparent demonstration that the other REDD+ activities are not “significant” (i.e. 25-30% of total forest emissions). Brazil provides only a qualitative justification that these other activities are not expected to be significant.
- Based on the data Brazil has available, it could likely improve its demonstration that it has not excluded any significant activities. This is not, however, explicitly required according to the UNFCCC Durban guidance on FRELs.
- It will be interesting to see how the technical assessment team responds to the lack of quantitative assessment of the insignificance of excluded activities.

Pools/Gases:

- In terms of pools, there is no justification for the exclusion of deadwood – this is a gap and needs to be included to be fully consistent with the relevant part of the guidelines for REL submissions

D. DATA/METHODOLOGIES

Summary

Activity Data

Brazil is using PRODES, which uses satellite imagery to identify new deforestation increments every year.

- Using PRODES, gross deforestation of primary forest areas is assessed annually, on a wall-to-wall basis, encompassing the analysis of approximately 230 Landsat images. The minimum mapping unit is 6.25 hectares.
- For the early years in the time series (1996 – 2000), annual data are apparently not available through PRODES. Rather, aggregated data from a digital base map is used. At the time PRODES started, deforestation increments for years 1998-2000 were lumped into a single digital database, so that there is a 1997 base map representing these years, with no discrimination of the specific year when deforestation occurred. From year 2000 onwards, however, annual deforestation increments were assessed on an annual basis and added to the PRODES digital database. In the submission, it is reported that INPE has submitted a project proposal to the Amazon Fund to expand digital PRODES to years before 2001, which, if approved, will lead to more precise estimates.

Emission Factors

- A radar campaign referred to as RADAMBRASIL was conducted between 1970 - 1985 to develop the vegetation map, but with field inventory plots.
- Emission factors are derived from 2292 Radar samples which were calibrated based on allometric equations for the Amazon.
- The allometric equation used was developed by Higuchi (1998) from the National Institute for Amazonia Research (INPA, Instituto Nacional de Pesquisas da Amazônia from MCTI, to estimate the aboveground fresh biomass of trees from distinct forest types (or physiognomies) in the Amazonia biome. Data from a scientific literature review was also applied when necessary (see below).

- These allometric equations were developed through destructive samples of 315 trees. The allometric equations used do not include wood density.
- Two different sampling approaches were applied in the field plots (i.e. where actual measurements took place), depending on forest type:
 - Rainforests: transects of 20 x 50 meters (1 hectare)
 - Other forest types: 20x250 meters (0.5 hectare)
- Only large trees were measured. Circumference at breast height (CBH) was taken for all trees with CBH > 100cm, while a 'correction' was made to include an estimate for trees <CBH 100 cm.
- Of the 22 vegetation typologies, 9 actually had representative RADAMBRASIL data to serve as the source of data. This resulted in 84% of the carbon (C) density of the forest types defined for the Amazonia biome being estimated using the RADAMBRASIL sample data, with 16% derived from the literature review.
- The submission presents a set of steps and rules to estimate the emission factors.
- In terms of the extrapolation rules applied, the method was straightforward when there were corresponding RADAMBRASIL sample plots for a specific volume. In these cases, the C density for that forest type was calculated as the average of the average carbon density associated with sample plots. However, if no corresponding plots were available for a given volume, then the C density was calculated as the weighted average of the average C density for each sample plot in the neighboring volume(s). If no corresponding plots nor plots for the neighboring plots were available, then the average C stock was calculated from the second order neighbour.
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Analysis

Activity Data:

- By using PRODES, Brazil is applying an Approach 3 methodology, in terms of IPCC approaches for representation of land. The PRODES method and results have been scrutinised internationally through peer-reviewed scientific literature. According to the submission, INPE ensures that a consistent approach is used to identify new deforestation increments every year. This includes maintaining the same definition, minimum assessed area, similar spatial resolution, same forest/non-forest boundaries, and similar methodological approach. The submission provides complete information about the PRODES data and it is transparent in that all satellite images can be accessed on the web, in a format ready to be incorporated into a geographical database for analysis, allowing a technical assessment team to reconstruct the REL. We have no technical criticism of the use of this dataset to provide the activity data for estimating GHG emissions from gross deforestation in Brazil.

Emission Factors:

- Because the carbon densities are derived using country-specific data, this approach would be characterized as Tier 2 according to IPCC.
- In terms of the use of RADAMBRASIL as the basis for the carbon density estimates, the method used can be considered somewhat outdated (both in terms of data used, old field inventory plots, and in the method itself). This is perhaps the weakest link in Brazil's submission.
- There are gaps in the RADAMBRASIL data set which are recognized in the submission. A literature review was conducted to fill in carbon estimate gaps where RADAMBRASIL was not used to sample certain forest physiognomies.
- A specific technical critique we offer here is on the use of allometric equations that do not include wood density. Newer allometric equations exist which include wood density and there is a strong case that these lead to more accurate estimates.

E. TIMEFRAME

Summary

- The forest reference emission level proposed by Brazil is a dynamic mean of the CO₂ emissions associated with gross deforestation since 1996, updated every five years, using the best available historical data and consistent with the most recent National GHG Inventory submitted by Brazil to the UNFCCC at the time of the construction of the FREL. This dynamic construct is meant to reflect the effects of policies and plans implemented in the Amazonia biome, as well as improvements in data quality and availability.
 - For results in the period from 2006 to 2010, inclusive, the FREL is equal to the mean annual CO₂ emissions associated with gross deforestation from the period 1996 to 2005, inclusive.
 - For results in the period from 2011 to 2015, inclusive, the FREL is equal to the mean annual CO₂ emissions associated with gross deforestation from 1996 to 2010, inclusive.
 - For results in the period from 2016 to 2020, the FREL is equal to the mean annual CO₂ emissions associated with gross deforestation from 1996 to 2015, inclusive.

Analysis

- The timeframe for Brazil's REL is reset over time in order to reflect the effects of policies and plans implemented in the Amazonia biome, as well as improvements in data quality and availability.
- Given that the Durban guidance does not specify guidance in regards to this type of "rolling average" approach, there does not appear to be any basis to offer technical criticism of this approach. It is clearly explained why this type of approach is being applied and the years of data being used in the REL for results achieved in each time period is transparently presented.

F. UNCERTAINTY

Summary

- Brazil did not present an overall uncertainty range or an accuracy assessment. The REL guidelines do not specifically request an uncertainty assessment, however the reviewer is requested to assess both the accuracy as well as transparency.
- Brazil states that the accuracy of the PRODES activity data is 5%, according to expert judgement. It also provides further qualitative assessment that given the consistent team that works on the PRODES data over time and their rigorous QA/QC procedures, this adds to the accuracy of the activity data.
- For the emission factor data, the uncertainties around the water and carbon content in fresh and dry biomass are provided as these had already been estimated by Silva (2007):
 - The 95 per cent confidence interval for the average percent water content is 41.6 ± 2.8 .
 - The 95 per cent confidence interval for the average 787 percent carbon content is 48.5 ± 0.9 .
- There is no uncertainty range provided around the weighted average carbon stock estimate of 151.6tC ha⁻¹.
- Brazil lists other potential sources of uncertainty associated with the C map, including:
 - (1) data collection, sampling design;
 - (2) allometric equations;
 - (3) aggregated forest type;
 - (4) rules used to estimate the carbon density of the forest types per RADAMBRASIL volume.

Brazil states that it is difficult to associate uncertainties to most of these elements. The submission suggests that in the future, an approach that can provide an estimate of the uncertainty associated with the carbon map used by Brazil is to assess the differences in estimates of emissions from deforestation by comparing it to emissions associated with other carbon maps available in the literature. Work is underway to assess and to minimize uncertainties and this process will contribute to improving the data for future submissions.

Analysis

Though Brazil provides limited quantitative assessment of the associated uncertainties with the CO₂ estimates for the REL construction, it does indicate a plan to improve this in the future. In the meantime, Brazil could have likely improved the assessment here by providing expert judgement for all identified sources of uncertainty listed in the submission, as they have done for the PRODES data. We expect that the accumulated errors of the average carbon stock calculation might imply a confidence interval of approximately $\pm 75\text{tC ha}^{-1}$ ($151.6 \pm 75\text{tC ha}^{-1}$), or even higher, so it is an important area that the technical assessment team could possibly flag, and it will be interesting to note their response on this issue.

G. ADJUSTMENTS

Summary & analysis

- Brazil's forest reference emission level does not include assumptions on potential future changes to domestic policies. The rolling average approach, however, is meant to reflect the effects of policies and plans implemented in the Amazonia biome.
- Given that there are no specific adjustments in the construction there is no technical analysis on this component in this note.

II. General Technical Assessment

Generally, the structure of the submission appears consistent with the guidelines for REDD+ REL/RL submission of information and FREL in Annex to decision 12/CP.17. The submission addresses all key elements to be included, according to those guidelines. The 4 main elements requested by the guidelines are:

1. Includes information used, in a comprehensive and transparent way
2. Transparent, complete, consistent and accurate information including methodological information;
3. Pools, gases and activities which have been included in the FREL
4. The definition of forest used

According to these four elements, the following is a brief summary of the technical analysis on specific technical aspects of Brazil's proposed FREL, already included above, throughout the note.

1. Includes information used, in a comprehensive and transparent way

The submission describes, in a comprehensive and transparent way, all of the information that had been used to construct the FREL.

2. Transparent, complete, consistent and accurate information including methodological information

Generally, the submission explains in a complete and consistent way, the methodological approach and information. The PRODES method and results are described thoroughly. According to the submission, INPE ensures that a consistent approach is used to identify new deforestation increments every year. This includes maintaining the same definition, minimum assessed area, similar spatial resolution, same forest/non-forest boundaries, and similar methodological approach. The submission provides complete information about the PRODES data and it is transparent in that all satellite images can be accessed on the web, in a format ready to be incorporated into a geographical database for analysis, allowing a technical assessment team to reconstruct the REL.

Though the use of RADAMBRASIL is described in a transparent way, it is expected that some technical comments could be raised by a technical assessment team. In terms of the use of RADAMBRASIL as the basis for the carbon density estimates, the method used can be considered somewhat outdated (both in terms of data used, old field inventory plots, and in the method itself). There are gaps in the RADAMBRASIL data set which are recognized in the submission. A literature review was conducted to fill in carbon estimate gaps where RADAMBRASIL was not used to sample certain forest physiognomies.

A final technical critique on the approach for applying RADAMBRASIL to develop the emission factor data is on the use of allometric equations that do not include wood density. Newer allometric equations exist which include wood density and there is a strong case that these lead to more accurate estimates.

In terms of accuracy of the information, Brazil provides only limited quantitative assessment of the associated uncertainties with the CO₂ estimates for the REL construction. The submission does, however, indicate a plan to improve this in the future. In the meantime, they still could have improved the assessment here by providing expert judgement for all identified sources of uncertainty listed in the submission, as they have done for the PRODES data. It's expected that the accumulated errors of the average carbon stock calculation might imply a confidence interval of approximately +/- 75tC ha⁻¹ (151.6+/-75tC ha⁻¹), or even higher, so it is an important area that the technical assessment team may flag.

3. Pools, gases and activities which have been included in the FREL

On this point, Brazil could improve its demonstration that it is not excluding any significant activities. Deforestation is clearly the most significant activity, however the submission provides no fully transparent demonstration that the other REDD+ activities are not "significant" (i.e. 25-30% of total forest emissions). Brazil only provides a qualitative justification that these other activities are not expected to be significant. Hence, an improvement that could be recommended by the TA team is the incorporation of some degree of quantitative assessment of the significance of other activities. In terms of pools, there is no justification for the exclusion of deadwood – this is a clear gap that would need to be addressed to be consistent with the Durban guidance on RELs.

Relevant to the scope of pools, gases and activities included in the FREL, there is the issue of potential for displacement of emissions. Displacement, or leakage, is not required specifically in the context of the REL submission. This should be addressed in the design of the National REDD+ strategy, the NFMS and minimized as part of addressing and respecting the safeguard related to displacement. Displacement of emissions is recognized as an issue in the submission. It indicates in the technical annex of the submission that the available data analysis does not indicate a relationship between the reduction of deforestation in the Amazonia biome with an increase in vegetation loss from the Cerrado. However, it does not specify the source of this data analysis nor does it provide the supporting data.

4. The definition of forest used

The submission explains that there is a difference in terms of how the forest types are aggregated between the FRA definition and the categorization used by RADAMBRASIL, so this may imply a variation in definition. It may be viewed that this is not entirely transparent and could be improved. It also appears that the submission would benefit from the inclusion of the definition used for the GHG inventory reporting. Although it is not explicitly required to provide it in the submission, it needs to be justified if there is a difference between the definitions used in the GHG inventory reporting and the FREL submission. This cannot be easily evaluated without providing those definitions together in the submission. Below we provide the forest definition as applied by Brazil in its last National Communication (2010):

Forest land comprises areas with the following characteristics: a) minimum tree crown coverage: 10 percent; b) minimum area: 0.5 hectare; c) minimum tree height: 5 meters. This is consistent with the FRA definition. Though it raises no additional issues of inconsistency, it should again be included here for full transparency.