United Nations

Framework Convention on Climate Change

FCCC/TAR/2020/COL

Distr.: General
18 February 2022

English only

Report on the technical assessment of the proposed forest reference emission level of Colombia submitted in 2020

Summary

This report covers the technical assessment of the voluntary submission of Colombia 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 Colombia covers the activity reducing emissions from deforestation, which is among the activities included in decision 1/CP.16, paragraph 70. For its submission, Colombia developed a national FREL. The FREL presented in the original submission for the reference period 2008–2017 corresponds to 123,834,903.00 (2018), 130,234,810.00 (2019), 135,882,892.00 (2020), 140,609,989.00 (2021) and 144,303,327.00 (2022) tonnes of carbon dioxide per year. As a result of the facilitative process during the technical assessment, the FREL was modified to 120,770,431.44 (2018), 127,011,963.18 (2019), 132,520,275.34 (2020), 137,130,393.50 (2021) and 140,732,334.73 (2022) tonnes of carbon dioxide per year. The assessment team notes that the data and information used by Colombia in constructing its FREL are transparent, mostly complete and mostly in 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 future technical improvement in accordance with the provisions on the scope of the technical assessment contained in the annex to decision 13/CP.19.

Abbreviations and acronyms

AT	assessment team
BUR	biennial update report
COP	Conference of the Parties
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
FREL	forest reference emission level
FRL	forest reference level
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
IPCC good practice guidance for LULUCF	*Good Practice Guidance for Land Use, Land-Use Change and Forestry*
LULUCF	land use, land-use change and forestry
NFI	national forest inventory
QC	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)
SOC	soil organic carbon
TA	technical assessment
2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

I. Introduction and summary

A. Overview

1. This report covers the TA of the voluntary submission of Colombia on its proposed FREL,[1] submitted on 6 January 2020, in accordance with decisions 12/CP.17 and 13/CP.19. The remote TA[2] took place from 8 to 12 June 2020 and was coordinated by the secretariat.[3] The TA was conducted by two LULUCF experts from the UNFCCC roster of experts[4] (hereinafter referred to as the AT): Raúl Abad Viñas (European Union) and Javier Fernández (Costa Rica). In addition, Gervais Ludovic Itsoua Madzous, an expert from the Consultative Group of Experts, participated as an observer[5] during the remote session. The TA was coordinated by Jenny Wong (secretariat).

2. In response to the invitation of the COP and in accordance with the provisions of decision 12/CP.17, paragraphs 7–15 and annex, Colombia submitted its proposed FREL on a voluntary basis. The proposed FREL is one of the elements[6] to be developed in implementing the activities referred to in decision 1/CP.16, paragraph 70. Pursuant to decision 13/CP.19, paragraphs 1–2, and decision 14/CP.19, paragraphs 7–8, the COP decided that each submission of a proposed FREL or FRL, as referred to in decision 12/CP.17, paragraph 13, shall be subject to a TA in the context of results-based payments.

3. Colombia provided its submission in Spanish. The submission is supported by a technical annex, also in Spanish, describing the model used to develop the FREL and the adjustment of Colombia's historical emissions based on its national circumstances, which enhances the clarity and transparency of the FREL.

4. The Party highlighted that it submitted its FREL on a voluntary basis with the objective of preparing a benchmark for implementing REDD+ activities in accordance with decision 1/CP.16, paragraph 70, and in the context of results-based payments in accordance with decisions 9/CP.19 and 14/CP.19 and Article 5 of the Paris Agreement.

5. The objective of the TA is to assess the degree to which the information provided by Colombia is in accordance with the guidelines for submissions of information on reference levels[7] 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 the Party for the construction and future improvement of its FREL, as appropriate.[8]

6. The TA of the FREL submitted by Colombia was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELs and/or FRLs.[9] This report on the TA was prepared by the AT following the same guidelines and procedures.

7. Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Colombia. The facilitative exchange during the TA allowed Colombia to provide clarifications and additional information, which were considered by the AT in the preparation of this report.[10] As a result of the facilitative interactions with the AT during the TA, the Party provided a modified version of its submission on 18 August 2020, which took into consideration some of the technical inputs of the AT. The modifications improved the clarity and transparency of the submitted FREL.

[1] The submission of Colombia, including a technical annex, is available at https://redd.unfccc.int/submissions.html?country=col.

[2] Owing to the circumstances related to the coronavirus disease 2019, the TAs of the FREL and FRL submissions of developing country Parties in 2020 had to be conducted remotely.

[3] As per decision 13/CP.19, annex, para. 7.

[4] As per decision 13/CP.19, annex, paras. 7 and 9.

[5] As per decision 13/CP.19, annex, para. 9.

[6] See decision 1/CP.16, para. 71(b).

[7] Decision 12/CP.17, annex.

[8] Decision 13/CP.19, annex, para. 1(a–b).

[9] Decision 13/CP.19, annex.

[10] As per decision 13/CP.19, annex, paras. 1(b), 13 and 14.

This TA report was prepared in the context of the modified FREL submission. The modified submission containing the assessed FREL, the original submission and the accompanying technical annex are available on the UNFCCC website.[11]

B. Proposed forest reference emission level

8. In decision 1/CP.16, paragraph 70, the COP 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 and in accordance with their respective capabilities and national circumstances, in the context of providing adequate and predictable support. The FREL proposed by Colombia, on a voluntary basis for a TA in the context of results-based payments, covers the activity reducing emissions from deforestation, which is one of the five activities referred to in that paragraph. Pursuant to paragraph 71(b) of the same decision, the Party developed a national FREL that covers its entire continental territory.[12] Colombia's islands, which cover an area of 52.7 km^2 (representing 0.005 per cent of the country's land area), were excluded from the construction of the FREL. For its submission, Colombia applied a stepwise approach to developing its FREL in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve their FRELs or FRLs by incorporating better data, improved methodologies and, where appropriate, additional pools.

9. The national FREL values proposed by Colombia for 2018–2022 are based on historical emissions from gross deforestation in 2008–2017 and on the projection of the expected increase in deforestation areas as an effect of the peace agreement.[13] To obtain these values, emissions from gross deforestation were projected using a logistic model, taking into consideration national forest coverage and the expected increase in deforestation rates in 2018–2022, resulting in an estimated annual increase in emissions of 32–54 per cent in 2018–2022 compared with historical average emissions of 91,652,448.54 t CO_2/year during the reference period. The adjusted FREL values presented in the modified submission, with the aim of accessing results-based payments for the REDD+ activity reducing emissions from deforestation for 2018–2022, correspond to 120,770,431.44 t CO_2 in 2018 (increase of 32 per cent compared with historical average emissions), 127,011,963.18 t CO_2 in 2019 (increase of 39 per cent), 132,520,275.34 t CO_2 in 2020 (increase of 45 per cent), 137,130,393.50 t CO_2 in 2021 (increase of 50 per cent) and 140,732,334.73 t CO_2 in 2022 (increase of 54 per cent), highlighting the magnitude of the adjustment on the historical average emissions of 91,652,448.54 t CO_2/year.[14]

10. Areas of deforestation were obtained from the national forest monitoring system, which monitors deforestation in the five biomes that make up the continental territory of Colombia (i.e. Amazon, Andes, Caribbean, Orinoquía and Pacific). Annual deforestation areas for 2008–2017[15] were estimated on the basis of a geospatial analysis of biennial forest-cover change maps for 2000–2012 and annual forest-cover change maps for 2013–2017.

11. Estimates of forest carbon stocks, which were used to develop emission factors, were derived from tree-level information collected during the first cycle of Colombia's NFI. The first NFI cycle started in 2015 and is expected to be concluded in 2022. For the FREL submission, the Party used information from 303 (20.4 per cent) of the 1,479 NFI plots planned to be measured as part of the first NFI cycle.

[11] https://redd.unfccc.int/submissions.html?country=col.

[12] The continental territory of Colombia is 1,141,748 km^2.

[13] See section 7.6 and table 12 of the modified submission for information on the peace agreement and the assumptions behind the logistic model.

[14] In its original submission, Colombia proposed a national FREL of 93,978,070.00 t CO_2 eq/year for 2008–2017. The difference between the original and the modified FREL values is due mostly to the correction of the stoichiometric ratio of carbon to CO_2 (44/12) and the consistent use of decimals in the estimates (see para. II.2(a)29 below).

[15] Colombia included lagged SOC emissions from deforestation events that occurred in 2000–2007 in the total emissions in the historical reference period (2008–2017) (see para. II.2(a)31 below).

12. The proposed FREL includes the pools above-ground biomass, below-ground biomass and SOC in mineral soils. Dead organic matter (deadwood and litter) and SOC in organic soils were excluded. Regarding GHGs, the submission includes CO_2 only.

13. The FREL proposed by Colombia is its second FREL submitted in the context of results-based payments and of applying the stepwise approach in accordance with decision 12/CP.17, paragraph 10. The previous FREL, which was subnational in scope, covering the Amazon biome only, was submitted on 8 December 2014 and subject to a TA in February 2015, resulting in a modified submission on 20 May 2015;[16] it covered the activity reducing emissions from deforestation for 2013–2017. The previous FREL value reflected in the UNFCCC Lima REDD+ information hub[17] corresponds to 51,612,072.9 t CO_2/year. The assessed FREL proposed in the 2015 modified submission was on a subnational scale (the Amazon biome only) for 2014–2017, while the latest FREL includes the five biomes that make up the continental territory of Colombia and covers 2018–2022. In addition, while the Party reflected future deforestation in the 2015 modified submission by applying an annual 10 per cent adjustment based on expert judgment, it estimated such emissions for the 2020 modified submission using a logistic model (see para. 9 above). Furthermore, the present submission includes emissions from SOC in mineral soils.

II. Data, methodologies and procedures used in constructing the proposed forest reference emission level

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

1. Information used by the Party in constructing its forest reference emission level

14. Colombia included in its FREL submission information on the activity reducing emissions from deforestation. The FREL presented in the modified submission, with the aim of accessing results-based payments for REDD+ activities for 2018–2022, was constructed on the basis of a time series of the CO_2 emissions associated with gross deforestation during the reference period 2008–2017.

15. For constructing its FREL, Colombia used both the 2006 IPCC Guidelines and the IPCC good practice guidance for LULUCF to estimate annual CO_2 emissions from deforestation. Specifically, the Party selected a default carbon fraction of 0.47 for living biomass (above-ground and below-ground biomass) from the 2006 IPCC Guidelines and adopted a default transition period of 20 years for estimating annual emissions from SOC in minerals soils. Colombia used the default models developed by Cairns et al. (1997) found in the IPCC good practice guidance for LULUCF to estimate below-ground biomass.

16. The areas of deforestation for 2000–2017 were obtained from a series of forest-cover change maps (see para. 10 above). These maps, based on the analysis of Landsat images,[18] provided information that enabled Colombia to measure deforestation biennially for 2000–2012 and annually for 2013–2017.[19] Where these data sources did not provide enough cloud-

[16] See document FCCC/TAR/2015/COL.

[17] https://redd.unfccc.int/info-hub.html.

[18] Images obtained from the Enhanced Thematic Mapper sensor on Landsat 7 and the Operational Land Imager on Landsat 8.

[19] For each reference year, the national forest monitoring system acquired the entire Landsat image catalogue and only images with less than 90 per cent cloud cover were selected.

free information, images from other sensors were used.[20] Automatic digital processing[21] was conducted on the basis of the spectral response observed in the satellite images. Multiple QC procedures were implemented by national experts in the analysis of satellite images.

17. The Party estimated forest carbon stocks per unit area and by biome. Separate estimates were made for the carbon pools above-ground biomass, below-ground biomass and SOC in mineral soils using data from the 303 NFI plots available. Colombia employed the equations in Chave et al. (2014) to estimate tree-level biomass using the following parameters: diameter at breast height, height and wood density values obtained from the Global Wood Density Database (Chave et al., 2014; Zanne et al., 2009). Below-ground biomass stocks were estimated on the basis of above-ground biomass values using equation 1 from Cairns et al. (1997). SOC reference stocks were estimated on the basis of field samples collected from the same 303 NFI plots and were subsequently analysed in a laboratory.

18. The annual FREL values were estimated using a model based on a logistic function that employed two main parameters: (1) the total forest area that is susceptible to deforestation (parameter *k*) and (2) the deforestation rate observed for 2016–2017 (parameter *b*). Parameter *k* includes all forest areas except inaccessible forests (determined on the basis of distance to roads and/or steepness of slopes), forests in public or private areas under special management and a set-aside of the minimal forest area by biome, with the aim of preventing the model from assuming that all forests are subject to deforestation. Parameter *b* is based on the deforestation rate observed in 2016–2017 and represents the pivotal point in the logistic curve. Further, Colombia used the lower end of the model's confidence interval for 2018–2022 when adjusting the average historical emissions. The upward adjustment was 32–54 per cent for 2018–2022 (see para. 9 above).

19. The Party conducted an uncertainty assessment related to historical emissions from gross deforestation in 2008–2017. Total propagated uncertainty was estimated at 22.7 per cent and included (1) the error associated with mapping deforestation, assumed to be 9 per cent for all biomes, and (2) biome-level variances for above-ground biomass, below-ground biomass and SOC stock estimates from the 303 NFI plots available. The two uncertainty measures were reported separately. For 2018–2022, Colombia submitted information on the statistical errors associated with the logistic model, which ranged from 8.3 to 54.5 per cent depending on the biome, with the national average reported at 18.7 per cent. Propagated uncertainty was not reported for the FREL values estimated for 2018–2022.

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

(a) Methodological information, including description of data sets, approaches and methods

20. The AT commends Colombia for transitioning from a subnational FREL covering the Amazon biome to a national FREL that includes the five biomes making up the country's continental territory. However, the AT noted that Colombia's islands (accounting for 52.7 km^2) were excluded from the submission. During the TA, the Party explained that these islands are considered as a separate, insular biome and hence were not included in the current FREL. The AT notes that these islands represent less than 0.005 per cent of the continental territory and thus do not have a significant impact on the estimation of emissions from deforestation at the national level.

21. The FREL submitted by Colombia is based on activity data and forest carbon stocks estimated at the biome level. This stratification by biome reduces variability and increases

[20] Specifically, the China–Brazil Earth Resources Satellite; the RapidEye satellite; the high-resolution imaging satellite Sentinel-2, which can be used to map changes in land cover and monitor the world's forests; and the Advanced Spaceborne Thermal Emission and Reflection Radiometer on board the Terra satellite of the National Aeronautics and Space Administration provide broad spectral and high-resolution coverage for surface mapping and monitoring of dynamic conditions and temporal changes.

[21] Colombia carried out a principal component analysis to classify the pixels of the images as (1) stable forest, (2) stable non-forest, (3) deforestation, (4) regeneration or (5) no information.

the accuracy of the activity data and forest carbon stock estimates. The AT noted that the Party included a description of each of the five biomes, including their altitudinal and geographical ranges, but did not include information on the specific floristic compositions or internal variability of carbon stocks in vegetation and soils for each biome. During the TA, Colombia stated that each biome has a specific geomorphological origin, resulting in the assumption that the intrabiome variability of wood density, forest growth and tree allometry is low. The Party indicated that it plans to conduct a further analysis of NFI data to determine whether additional levels of stratification are needed. The AT commends the Party for its current and planned efforts and considers that further stratification could reduce the uncertainty of the FREL. For example, the 2006 IPCC Guidelines (vol. 4, chap. 3, table 3.1) suggest considering climate, soil, biomass (ecological zone) and management practices for stratification. In addition, improving the current stratification approach could prevent systematic errors arising from the misrepresentation of forest carbon stocks by assuming all forest types to be homogeneous within specific biomes (2006 IPCC Guidelines, vol. 1, chap. 3, section 3.1.5). Furthermore, the AT expressed its concern that specific forest types could be disproportionately affected by deforestation within a biome, resulting in systematic errors. The AT considers this an area for future technical improvement.

22. Colombia defined deforestation as the direct or induced conversion of forest cover to another land-cover type in a "determined time frame". During the TA, the AT sought clarification on the time frame covered by the definition. The Party clarified that deforestation is measured using biennial and annual maps across the time series (see para. 10 above), which is why a specific time frame is not given in the definition; instead, use of a flexible time frame enables the Party to accommodate the annual and biennial monitoring periods that are used for measurement and reporting under Colombia's national forest monitoring system. In addition, the Party clarified that, since its definition is based on land-cover change rather than land-use change, a time threshold is not attached to the definition; deforestation occurs once land-cover change is detected. The AT considers that the Party may wish to include a reference to the methodology employed and/or to the period(s) of time used to identify deforestation, which could enhance the transparency of the definition. The AT considers this an area for future technical improvement.

23. The AT noted that, under the gross deforestation approach applied by Colombia, any temporarily unstocked forest areas (e.g. temporary losses of forest cover due to management practices) would be classified as deforestation. During the TA, Colombia explained that forest plantations are not classified as forest, so their rotation cycles are not reflected as deforestation, and selective logging is the only silvicultural regime applied that does not lead to clear-cuts (i.e. removal of the entire forest cover). The AT notes that this considerably reduces the probability of temporarily unstocked forest areas being classified as deforestation and commends the Party for providing this information, also noting that the additional data collected through the NFI will provide further information on management practices that could result in a temporary loss of forest cover.

24. Colombia conducted QC procedures at the pixel level to prevent areas from being classified as deforestation more than once, which can happen if a forest quickly regrows after a deforestation event within the historical reference period. These procedures included a consistency check going back six years prior to the deforestation event. The AT noted that the historical reference period covers 10 years, which means it is possible for a pixel to be marked as deforestation more than once. During the TA, Colombia confirmed that a deforestation area of 500 ha was double counted, but that this represents less than 0.005 per cent of total deforestation in the historical reference period. The AT commends the Party for its efforts to reduce the likelihood of double counting; however, it considers that the QC procedures should encompass the entire time series and thus considers this an area for future technical improvement. At the same time, the AT notes that the magnitude of the double counting reported by Colombia does not significantly affect the proposed FREL values.

25. The AT noted that the gross deforestation approach adopted by Colombia does not include information on final land use, but that this information was included for 2013–2014 in the latest national GHG inventory included in the Party's second BUR (2018).[22] During

[22] Available at https://unfccc.int/documents/194659.

the TA, the Party explained that this information was not used in constructing the FREL since it was not available for the entire time series, but stated that it is working to produce these data. The AT commends Colombia for the ongoing efforts to collect field data as part of the current NFI cycle. Further, the AT considers that the gross deforestation approach for land representation is not in line with IPCC guidance since IPCC methods and equations require data on all six land-use categories. The AT notes that this approach leads to the overestimation of emissions from living biomass and SOC in mineral soils because carbon stocks in final land use are not considered (see para. 30 below). During the technical exchanges, Colombia explained that it was not possible to include post-deforestation carbon stocks owing to lack of data, and that using IPCC default values would have compromised the accuracy of the FREL values. The AT commends Colombia for its ongoing efforts to improve land representation and considers that obtaining information on final land use after deforestation would increase the accuracy of FREL values and improve consistency between the FREL and the national GHG inventory. The AT identifies this an area for future technical improvement.

26. The Party used data from the 303 NFI plots established between 2015 and 2018 to estimate forest carbon stocks for 2000–2017 (see para. 17 above). The AT noted that the temporal and spatial representativeness of such data could be poor because natural disturbance and anthropogenic impacts in forests do not remain constant over time or in space. In particular, large-scale infrequent disturbances (e.g. El Niño) may affect forest carbon stocks during specific years in the time series, which could in turn affect estimated trends in emissions (especially since some years, such as 2000–2014, were not sampled). During the TA, Colombia provided updated information on progress in implementing the NFI, including the goal to establish permanent sampling plots on 3 per cent of the NFI plots, enabling monitoring of longer-term forest dynamics. The AT commends Colombia for its efforts to conclude the current phase of the NFI and to monitor forests on a continuous basis, which would identify large-scale infrequent disturbances affecting long-term forest carbon stocks. The AT considers this an area for future technical improvement.

27. For estimating below-ground biomass, Colombia applied the default models by Cairns et al. (1997) as suggested in the IPCC good practice guidance for LULUCF rather than following the guidance in the 2006 IPCC Guidelines to use the Mokany, Raison and Prokushkin (2006) model. The Party clarified that the root-to-shoot ratios in Cairns et al. (1997) were found to be more accurate, as above-ground biomass could be used as a predictor variable, and that the output root-to-shoot ratios were consistent with those presented by Mokany, Raison and Prokushkin (2006). The AT welcomes this explanation and considers the approach used by Colombia to be in line with IPCC guidance.

28. To assess the completeness[23] of the FREL, the AT sought clarification from Colombia regarding the estimation of forest carbon stocks from NFI data. Specifically, the AT requested the tree-level data necessary for reconstructing the estimated forest carbon stocks of above-ground and below-ground biomass and SOC in mineral soils by biome. The Party provided several spreadsheets, which increased the understanding of the AT of the estimates, including cluster-level carbon stocks. Conversely, tree-level data were not shared for confidentiality reasons, in line with Colombia's information management policy. The AT was therefore not able to fully reconstruct the estimates of forest carbon stocks used in constructing the FREL. In the absence of this information, the AT compared the carbon stock estimates used by Colombia against the default values in the 2006 IPCC Guidelines and values provided by other Parties in similar ecoregions and found them to be within the expected ranges. The AT considers that the Party providing tree-level data could increase the completeness and transparency of future submissions and considers this an area for future technical improvement.

29. In attempting to reconstruct the FREL, the AT used the data provided by Colombia in its original submission and found minor differences between the FREL values in the submission and those derived from its own calculations. Colombia explained that these differences are due to a different number of decimal points being used in the spreadsheets. The AT noted that the Party used 3.67 as a simple representation of the 44/12 stoichiometric

[23] 'Complete' here means the provision of information that allows for the reconstruction of the FREL.

ratio of carbon to CO_2, which resulted in differences. In its modified submission, Colombia used the 44/12 stoichiometric ratio and harmonized the number of decimal points, thus addressing these remaining differences. The AT commends the Party for these improvements, which allowed it to reproduce the calculations leading to the FREL values and increased the overall transparency of the submission.

30. As part of the stepwise approach referenced in decision 12/CP.17, paragraph 10, the Party included CO_2 emissions from SOC stock changes in mineral soils following deforestation (emissions from SOC in organic soils were excluded; see para. 42 below). The AT noted that Colombia assumed SOC stocks to be zero after deforestation under its gross deforestation approach owing to lack of data on SOC stocks on non-forest land. The AT commends Colombia for its efforts to include emissions from SOC but notes that the Party was not able to apply equation 2.25 of the 2006 IPCC Guidelines (vol. 4, chap. 2) because of the missing information on SOC stocks in final land use. As a result, the AT considers that the treatment of SOC is not consistent with IPCC guidance as the Party does not have the information needed to apply the appropriate equations, thus affecting the accuracy of the FREL and resulting in the overestimation of emissions from deforestation. As such, the AT considers this an important area for future technical improvement.

31. Colombia assumed that emissions from SOC in mineral soils occur for 20 years following a deforestation event, in line with the default IPCC assumption. In response to a question from the AT, the Party clarified that its historical reference period (2008–2017) included lagged SOC emissions from deforestation events that occurred in 2000–2007. The Party further clarified that it started accounting for lagged SOC emissions in 2000 because this is the first year for which there is reliable information on deforestation areas. Emissions from the living biomass pools were considered for 2008–2017, while SOC emissions, including lagged emissions, were considered for 2000–2017, thus including SOC emissions from deforestation events that happened prior to the selected historical reference period. The AT considers that this results in emissions from SOC being treated and reported inconsistently with emissions from the living biomass pools. The AT considers ensuring consistent treatment of all carbon pools during the historical reference period to be an important area for future technical improvement.

32. The logistic model developed to predict emissions for 2018–2022 is based on deforestation rates observed in 2016–2017 (parameter *b* of the model). As a result of the technical exchanges, Colombia explained that selecting 2016–2017 as the inflection point of the logistic model was a national decision based on expert judgment. Furthermore, the Party explained that updated information on deforestation is now available, which enhances understanding of the trends in national deforestation rates following the peace agreement. The AT notes that this clarification differs from the rationale provided by Colombia in its 2015 modified FREL submission and from the Party's explanation, included in the 2020 modified submission (section 7.6.1), that the expectation of the peace agreement resulted in increased deforestation rates since 2013. The Party also clarified that, although the model used for the current FREL takes into account the entire historical time series (including deforestation observed during the peace negotiations), the observed trend in deforestation at the conclusion of the negotiations, when the peace agreement was ratified, was used as an inflection point which defined a new deforestation trend for the country. Thus, the AT is of the view that the Party may wish to consider when the effects of the peace agreement began to inform the projection of the FREL values in order to produce the most accurate estimates, and considers this an important area for future technical improvement.

33. The AT noted that, according to figure 10 in the modified submission and the information in the technical annex, the estimates produced by the logistic model are closely aligned with the deforestation rates observed in 2016–2017 as these two years served as the inflection point of the logistic function (parameter *b*). However, the model does not appear to accurately predict the observed deforested areas for 2008–2015. During the technical exchanges, the Party explained that the model was developed to predict future deforestation rates, and as such the model should not be expected to accurately predict the observed deforestation during the historical reference period. The AT acknowledges Colombia's challenges in predicting future emissions but considers that it may wish to assess whether the lack of fit between predicted and observed deforestation estimates for 2008–2015 could

imply inadequacies in model performance and whether this could impact projections of emissions from deforestation for 2018–2022. The AT considers enhancing the performance of the logistic model to be an area for future technical improvement.

34. Colombia used the lower end of the model's confidence interval to adjust the annual areas of deforestation (see para. 18 above), which is considered by the Party to be a conservative approach to projecting future deforestation areas. During the technical exchanges, Colombia explained that this measure was adopted to address the uncertainty of the model. The AT notes that, in this case, conservativeness directly affects accuracy, which is a key principle in the 2006 IPCC Guidelines. In accordance with the best practice in the 2006 IPCC Guidelines, the AT is of the view that the Party (1) should avoid using the lower end of the confidence interval in order to achieve accurate annual estimates, as far as possible, and (2) may use the confidence interval to estimate overall propagated uncertainty for each year of the FREL period (see para. 19 above). The AT considers this an area for future technical improvement.

35. The AT noted that, unlike in the original submission, the uncertainty assessment in the modified submission took into account SOC estimates (see table 13 in the modified submission). The AT commends Colombia for improving its uncertainty assessment and notes that the inclusion of SOC estimates in the assessment increased total uncertainty to 22.7 per cent (compared with 20.4 per cent when considering above-ground and below-ground biomass only). However, the AT notes that this uncertainty assessment was applied to historical emissions (2008–2017) only, and not to the adjusted FREL values (2018–2022), as the assessment does not consider the statistical error associated with the logistic model (see paras. 19 and 34 above and table 13 in the modified submission). In addition, during the TA, the AT highlighted other potential sources of systematic error (bias) that could occur when computing the final uncertainty value: (1) the effect of using biennial versus annual maps across the deforestation time series; (2) areas covered by clouds for which there is no land-use information; (3) the contribution of the deforestation area of 500 ha that was double counted to total deforestation estimates; (4) partial temporal and spatial representativeness in the data from the NFI; (5) the assumption of zero post-deforestation carbon stocks; and (6) the intrabiome variability of forest types and deforestation trends. The AT is of the view that Colombia may wish to consider these other sources of uncertainty as part of its efforts to improve the uncertainty assessment and considers this an area for future technical improvement.

36. The FREL proposed by the Party is its second FREL submitted in the context of applying the stepwise approach in accordance with decision 12/CP.17, paragraph 10. The previous FREL submission was subject to a TA in 2015.[24] In its most recent submission, Colombia described the changes from previously submitted information in accordance with decision 12/CP.17, annex, paragraph (b). The Party described the following changes:

(a) Transition from subnational to national coverage;

(b) Inclusion of emissions from SOC in mineral soils;

(c) Implementation of a new adjustment method based on a logistic model of deforestation that employs quantitative information, such as historical areas of deforestation and areas that may undergo future deforestation;

(d) Selection of a new value for total living biomass (above-ground and below-ground) in the Amazon biome (148.1 t carbon/ha), which is 4 per cent lower than the value used for the previous FREL (154.3 t carbon/ha).

(b) Description of relevant policies and plans, as appropriate

37. Colombia included a brief description of its national REDD+ strategy in the modified submission (section 2.1). Specifically, the Party included information on the main objectives of its national strategy, including four targets to be achieved by 2030: (1) achieving zero net deforestation; (2) improving quality of life in forest-dependent communities; (3)

[24] See document FCCC/TAR/2015/COL.

strengthening governance for ethnic groups, local communities and forest-dependent communities; and (4) reducing emissions from deforestation by 32.4 Mt CO_2 eq. The AT commends Colombia for providing this information.

3. Pools, gases and activities included in constructing the forest reference emission level

38. According to decision 12/CP.17, annex, paragraph (c), reasons for omitting a pool or activity in constructing the FREL should be provided, noting that significant pools and activities should not be excluded.

39. The pools included in the Party's FREL are living biomass (above-ground and below-ground) and SOC in mineral soils. Deadwood and litter were excluded, as well as emissions from organic soils. With regard to GHGs, Colombia considered CO_2 emissions from deforestation only. Non-CO_2 emissions were not reported.

40. With regard to emissions and removals from other REDD+ activities, such as reducing emissions from forest degradation and sustainable management of forests, the AT requested clarification of the reasons for not including these activities based on their potential significance. In response Colombia explained that it is in the process of developing accurate estimates of emissions from forest degradation. The AT commends Colombia for these efforts and for the information provided on emissions from forest degradation. The AT notes that the Party may also wish to assess methodological options, as outlined in the 2006 IPCC Guidelines, for including CO_2 emissions and removals from forest land remaining forest land. The AT considers this an important area for future technical improvement, considering that 33.5–42.0 per cent of the merchantable wood in use in Colombia is sourced from illegal logging, with 9 Mt fuelwood removed from standing forests each year (see section 2 of the modified submission).

41. With regard to emissions and removals from land converted to forest land (under the activity enhancement of forest carbon stocks), the AT requested clarification of the reasons for omitting the activity based on its potential significance. During the technical exchanges, Colombia informed the AT that this category represented 2.8 per cent of the total agriculture, forestry and other land use sector as included in the latest GHG inventory estimates for 2014. The AT acknowledges the justification for the omission of this category based on its significance provided by Colombia and considers that the Party may wish to (1) assess the contribution of this activity in relation to the forest-related emissions and removals included in the FREL and (2) assess the inclusion of this activity in future FREL submissions if its significance increases compared with total forest-related emissions and removals.

42. The AT noted that Colombia excluded emissions from SOC in organic soils. During the TA, Colombia explained that it is working to improve its methods for identifying specific forest types within biomes (see para. 21 above), including forests on organic soils. The Party confirmed the presence of organic soils in the country, stating that they encompass an area of 579,511.00 ha, of which 355,887.00 ha is forest (according to data for 2017 from the national soil map). In response to a question from the AT, the Party provided a preliminary estimate of emissions from deforestation on organic soils of 2.61 per cent of the total emissions from deforestation. The AT considers this an area for future technical improvement as the contribution of emissions from deforestation on organic soils could be significant.

43. Colombia did not include emissions from dead organic matter (deadwood and litter). In response to a question from the AT, the Party explained that data on deadwood and litter carbon stocks are derived from the same 303 NFI plots used for estimating living biomass and SOC stocks. However, the data on dead organic matter are not considered to be fully representative of national circumstances, considering the current sample size. The AT is of the view that, if Colombia considers that the NFI data on dead organic matter are not representative of national circumstances, then this assumption should equally apply to the estimates of living biomass and SOC, which were obtained through the same NFI samples. Further, during the TA, the AT suggested using default tier 1 values from the 2006 IPCC Guidelines as an interim measure instead of excluding these pools as this could affect the accuracy of the FREL values. The AT notes that the Party did not provide a justification for the omission of dead organic matter based on the significance of this pool and considers this

an area for future technical improvement. The AT commends Colombia for its efforts to complete the NFI by 2022.

44. The Party did not include non-CO_2 emissions in constructing its FREL. The AT notes that the submission (section 2) describes slash and burn as a common practice for clearing forests and opening new pasture areas. Further, the AT notes that non-CO_2 emissions associated with deforestation were considered in the national GHG inventory included in the second BUR. In response, Colombia stated that non-CO_2 emissions from biomass burning accounted for 2 per cent of the total emissions associated with deforestation in 2014. The AT welcomes this justification and considers this an area for future technical improvement so as to maintain consistency with the national GHG inventory and accurately reflect the total emissions associated with deforestation. In addition, the AT commends Colombia for its efforts to improve its national forest monitoring system, which will enable tracking of areas affected by fires and their potential inclusion in future FREL submissions.

45. The AT acknowledges that Colombia included the most significant activity, reducing emissions from deforestation, of the five activities identified in decision 1/CP.16, paragraph 70, in accordance with its national capabilities and circumstances. The AT notes that other activities could also be significant, in particular reducing emissions from forest degradation. The AT considers including significant pools, gases and activities as an important area for future technical improvement in accordance with decision 13/CP.19, annex, paragraph 2(f), and in the context of the stepwise approach referred to in decision 12/CP.17, paragraph 10.

46. The AT acknowledges the Party's intention to improve land representation for future FRELs, including by identifying post-deforestation land uses, and to complete the first cycle of the NFI by 2022. These improvements, as part of the stepwise approach in accordance with decision 12/CP.17, paragraph 10, will serve as the basis for including additional activities and carbon pools in future FREL/FRL submissions.

4. Definition of forest

47. The Party provided in its submission the definition of forest used in constructing its FREL, namely land mainly covered by trees and possibly containing shrubs, palms, *Guadua*, grass and vines, on which tree cover predominates with at least 30 per cent canopy cover, height (in situ) of 5 m or more and a minimum area of 1 ha. Tree cover of commercial forest plantations, palm crops and planted trees for agricultural production are excluded. In response to a question from the AT, Colombia explained that this definition includes the same thresholds as the definition used for the LULUCF sector in the national GHG inventory, but that some forest classes and forest areas are excluded from the FREL. During the TA, in line with decision 13/CP.19, annex, paragraph 2(g), Colombia explained that the definition used for the FREL is a subset of the definition used for the national GHG inventory. For the national GHG inventory, the forest definition includes natural forests, forest plantations and shrublands, as defined by Colombian law. However, for constructing the FREL, plantations and shrublands were excluded from the forest definition. The AT welcomes this clarification and, with regard to the differences between the definitions highlighted by the Party, notes that Colombia may wish to assess whether the definitions could be harmonized in order to avoid different information and deforestation estimates being reported across future national reports. The AT considers this an area for future technical improvement.

48. In accordance with decision 12/CP.17, annex, paragraph (d), Parties are required to explain any differences between the forest definition used for the FREL and forest definitions used for other international reporting. The AT notes that the forest definition used by Colombia for its reporting to the Food and Agriculture Organization of the United Nations for the Global Forest Resources Assessment 2015 is the same as the one used in constructing the FREL.

49. With regard to woody crops that could be classified as forests on the basis of satellite imagery, the AT requested information on how tree crops (e.g. palms, cocoa, rubber trees and forest plantations) were identified and effectively excluded. Specifically, the AT requested some images to further understand how these classes of woody crops were distinguished from each other and from forests. In response, the Party provided two images that showed how these areas are delineated. The AT commends Colombia for providing this

information, which enhanced the transparency of the submission, and notes that including this information in future submissions could help to increase the clarity of the methods used.

III. Conclusions

50. The information used by Colombia in constructing its FREL for reducing emissions from deforestation is transparent, mostly complete and mostly in accordance with the guidelines for submissions of information on reference levels.

51. The FREL presented in the submission is Colombia's second FREL and is national in scope. The previous FREL was submitted on 8 December 2014 and was subject to a TA in 2015; it covered the activity reducing emissions from deforestation for 2013–2016, but its coverage was subnational.

52. The FREL presented in the modified submission, based on the historical emissions during the reference period 2008–2017, corresponds to 120,770,431.44 (2018), 127,011,963.18 (2019), 132,520,275.34 (2020), 137,130,393.50 (2021) and 140,732,334.73 (2022) t CO_2/year.

53. The AT acknowledges that Colombia included in its national FREL the most significant activity, the most important forest biomes and the most significant pools in terms of emissions from forests. The AT commends the Party for providing information on its ongoing work to develop FRELs for other activities, carbon pools and GHGs as a step towards gradually improving its FREL.

54. As a result of the facilitative interactions with the AT during the TA, Colombia provided a modified submission that took into consideration some of the technical input of the AT. The AT notes that the transparency of the information provided was significantly improved in the modified FREL submission and commends Colombia on its efforts.

55. The AT notes that, overall, the FREL does not maintain consistency with the national GHG inventory included in Colombia's second BUR.[25] The Party used a slightly different forest definition (see para. 47 above), leading to different estimates of forest, deforestation areas and deforestation emissions per unit of area. Further, the national GHG inventory covers all six IPCC land-use categories, while a forest/non-forest approach to estimating gross deforestation was followed for the FREL. The Party identified the following differences between its proposed FREL and national GHG inventory (see section 9.1 of the modified submission): (1) the gain–loss method was employed for the GHG inventory, whereas a gross deforestation approach was followed for the FREL; (2) lagged SOC emissions are considered in the GHG inventory since 1990 and for the FREL since 2000; and (3) deadwood is included in the GHG inventory but excluded from the FREL. The AT considers maintaining consistency between the FREL and the national GHG inventory to be an area for future technical improvement.

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

(a) Considering including Colombia's islands biome in the FREL, if practicable (see para. 20 above);

(b) Finalizing the first cycle of the NFI in order to derive data that can be used to improve the estimation of forest carbon stocks in all carbon pools and considering establishing permanent sampling plots to monitor forest disturbance (see paras. 21 and 26 above);

(c) Introducing additional stratification of the biomes with a view to increasing the accuracy of estimates by addressing intrabiome variability (see para. 21 above);

(d) Clarifying the definition of deforestation by describing how it relates to the methods for identifying deforestation areas (see para. 22 above);

[25] In reference to the scope of the TA, as per decision 13/CP.19, annex, para. 2(a).

(e) Continuing efforts to identify any temporarily unstocked forest lands that could be classified as deforestation (see para. 23 above);

(f) Expanding the QC procedures to cover the entire historical reference period and not just the six years prior to the events in order to avoid double counting deforestation events (see para. 24 above);

(g) Monitoring land use after deforestation to enable implementation of IPCC methods and equations for living biomass and SOC (see paras. 25 and 30 above);

(h) Enhancing the completeness of future FRELs by making available the tree-level data from the NFI (see para. 28 above);

(i) Adopting a consistent approach to the treatment of different carbon pools by ensuring a consistent historical reference period when measuring these pools (see para. 31 above);

(j) Considering when the effects of the peace agreement began to inform the projection of the FREL values in order to produce the most accurate estimates of future deforestation areas (see para. 32 above);

(k) Enhancing the performance of the logistic model for estimating the FREL values (see para. 33 above);

(l) Avoiding using the lower end of the logistic model's confidence interval in order to produce the most accurate FREL values possible and, as far as practicable, estimating overall propagated uncertainty related to the FREL values (see para. 34 above);

(m) Including in the uncertainty assessment other potential sources of error and bias (see para. 35 above);

(n) Enhancing the consistency of the forest definition used for the FREL with the forest definition applied for the national GHG inventory (see para. 47 above);

(o) Including information on the classification of tree crops and how these are distinguished from forests (see para. 49 above);

(p) Enhancing the consistency of the FREL with the national GHG inventory (see para. 55 above).

57. Pursuant to decision 13/CP.19, annex, paragraph 2(f), in assessing the activities, pools and gases included in the FREL, the AT noted that some of the activities, pools and gases excluded by Colombia could be significant in the context of the FREL. Pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following additional areas for future technical improvement regarding the exclusion of activities, pools and gases from the FREL:

(a) Assessing whether REDD+ activities occurring on forest land remaining forest land are significant (see para. 40 above);

(b) Assessing whether REDD+ activities occurring on land converted to forest land are significant in relation to forest-related emissions and removals (see para. 41 above);

(c) Assessing the significance of CO_2 and non-CO_2 emissions from organic soils under forest land, as these could be highly significant (see para. 42 above);

(d) Continuing collecting data through the NFI and considering including dead organic matter (see para. 43 above);

(e) Considering including non-CO_2 gases so as to maintain consistency with the national GHG inventory (see para. 44 above).

58. The AT acknowledges and welcomes the Party's intention to:

(a) Improve the consistency of the FREL with the national GHG inventory;

(b) Continue efforts to include dead organic matter and non-CO_2 emissions from biomass burning;

(c) Continue to investigate and understand the impacts of the peace agreement and the coronavirus disease 2019 on national land-use dynamics;

(d) Continue with the areas of capacity-building identified in section 10.1 of the modified submission.

59. In conclusion, the AT commends Colombia for showing strong commitment to continuously improving its FREL estimates in line with the stepwise approach. A number of areas for the future technical improvement of the Party's FREL have been identified in this report. At the same time, the AT acknowledges that such improvements are subject to national capabilities and policies and notes the importance of providing adequate and predictable support.[26] The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Colombia.

60. The table contained in annex I summarizes the main features of Colombia's proposed FREL.

[26] As per decisions 13/CP.19, annex, para. 1(b), and 12/CP.17, para. 10.

Annex I

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

Main features of the FREL		*Remarks*
Proposed FREL values (t CO_2/year)	120 770 431.44 in 2018 127 011 963.18 in 2019 132 520 275.34 in 2020 137 130 393.50 in 2021 140 732 334.73 in 2022	Values were projected using a logistic model on the basis of expected deforestation levels following the entry into force of the peace agreement (see para. 9 of this document)
Type and reference period of FREL	FREL = historical emissions from gross deforestation in 2008–2017 and an adjustment based on the projection of the expected increase in deforestation rates in 2018–2022	Lagged SOC emissions from deforestation events that occurred in 2000–2007 were included in the reference period 2008–2017 (see paras. 9 and 31 of this document)
Application of adjustment for national circumstances	Yes	Colombia expects deforestation to continue to increase as a result of the peace agreement (see paras. 9 and 18 of this document)
National/subnational	National	The Party constructed a national FREL but excluded its islands, which account for a total area of 52.7 km^2 or less than 0.005 per cent of its territory (see para. 20 of this document)
Activity included	Reducing emissions from deforestation	See paragraphs 9 and 14 of this document
Pools included	Above-ground biomass Below-ground biomass SOC in mineral soils	Dead organic matter and SOC in organic soils were excluded, but the Party did not provide a justification for this based on significance (see paras. 12 and 43 of this document)
Gas included	CO_2	Non-CO_2 emissions were excluded (see paras. 12 and 44 of this document)
Forest definition	Included	See paragraph 47 of this document
Consistency with latest national GHG inventory	Some methods used for estimating the FREL are not consistent with those used for the latest GHG inventory (2014)	Differences between the FREL and the national GHG inventory are explained in paragraphs 25, 44, 47 and 55 of this document

Main features of the FREL		*Remarks*
Description of relevant policies and plans	Included	The Party described its national REDD+ strategy, including specific goals and targets (see para. 37 of this document)
Description of assumptions on future changes to domestic policies, if included in the construction of the FREL	Included	Colombia applied an adjustment based on national circumstances and the peace agreement (see paras. 9 and 18 of this document)
Description of changes to previous FREL	Included	Colombia described the key changes from the previous FREL, which include transitioning to a national FREL and incorporating SOC emissions (see para. 13 of this document)
Identification of future technical improvements	Included	Several areas for future technical improvement were identified (see paras. 56–57 of this document)

Annex II

Documents and information used during the technical assessment

A. Reference documents

First and second FREL submissions (original and modified versions) of Colombia. Available at https://redd.unfccc.int/submissions.html?country=col.

"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/sites/default/files/resource/docs/2013/cop19/eng/10a01.pdf#page=36.

"Guidelines for submissions of information on reference levels". Annex to decision 12/CP.17. Available at https://unfccc.int/sites/default/files/resource/docs/2011/cop17/eng/09a02.pdf#page=19.

IPCC. 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. J Penman, M Gytarsky, T Hiraishi, 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.

B. Other documents

The following references have been reproduced as received from the Party:

Cairns M, Brown S, Helmer E, et al. 1997. Root biomass allocation in the world's upland forests. *Oecologia*. 111(1): pp.1–11. Available at https://doi.org/10.1007/s004420050201.

Chave J, Réjou-Méchain M, Búrquez A, et al. 2014. Improved allometric models to estimate the aboveground biomass of tropical trees. *Global Change Biology*. 20(10): pp.3177–3190. Available at https://doi.org/10.1111/gcb.12629.

Galindo G, Espejo OJ, Rubiano JC, Vergara LK and Cabrera E. 2014. Protocolo de Procesamiento Digital de Imágenes para la Cuantificación de la Deforestación en Colombia, V 2.0. Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM. Bogotá D.C., Colombia.

Mokany K, Raison RJ and Prokushkin A. 2006. Critical analysis of root:shoot ratios in terrestrial biomes. *Global Change Biology*. 12(1): pp.84–96. Available at https://doi.org/10.1111/j.1365-2486.2005.001043.x.

Zanne AE, Lopez-Gonzalez G, Coomes DA, et al. 2009. Data from: Towards a worldwide wood economics spectrum. Dataset in the Dryad digital repository. Available at https://doi.org/10.5061/dryad.234.

The following additional data and information were provided by the Party for the TA:

Brief step-by-step description of the methodology to estimate biomass stocks by biome from the National Forest Inventory plots, including the application of expansion factors.

Excel spreadsheet containing information on the biomass and soil organic carbon stocks per biome, the expansion factors used, and the lagged emissions from SOC by year for 2001–2022, the estimation of the FREL values for 2018–2022 and the application of the adjustment based on the logistic model.

Excel spreadsheet with accessible and non-accessible forest and non-forest areas, as well as areas without information by biome.

Excel spreadsheet with projected annual deforestation areas by biome for 2018–2022.

Excel spreadsheet containing information on areas without land use information associated with biennial and annual maps in the time-series 2000–2017, by biome and at the national level.

Excel spreadsheet containing the number of National Forest Inventory plots by biome for the estimation of carbon stocks by pool, their confidence intervals and sampling errors.

Excel spreadsheet containing the total available "deforestable" areas in Colombia by biome, and additional information on parameters "*a*", "*b*", "*k*" and "*t*" of the logistic model, the confidence interval of the logistic model by year and the cumulative deforestation areas over the time-series.

Additional description describing the estimation of parameter "*b*" in the logistic model.

Additional information on the equations and parameters of the logistic model, including three equations derived from the logistic model.

Satellite image showing the visual classification of natural and planted forest types.

Satellite image showing the visual classification of natural and planted forest types.

Updated annex describing the construction of the logistic model and national circumstances leading to the adjustment of the FREL values for 2018–2022.

Updated graph showing the adjusted parameter *k* of the logistic model.