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Report on the technical assessment of the proposed forest reference emission level of Suriname submitted in 2021

Summary

This report covers the technical assessment of the voluntary submission of Suriname 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 Suriname covers the activities reducing emissions from deforestation and reducing emissions from forest degradation, which are among the activities included in decision 1/CP.16, paragraph 70.

For its submission, Suriname developed a national FREL. The FREL presented in the original submission, for the results period 2020–2024, corresponds to 15,238,428 tonnes of carbon dioxide equivalent (t CO_2 eq) for 2020, 15,858,865 t CO_2 eq for 2021, 16,479,303 t CO_2 eq for 2022, 17,099,741 t CO_2 eq for 2023 and 17,720,179 t CO_2 eq for 2024. As a result of the facilitative process during the technical assessment, the FREL was modified to 14,008,882 t CO_2 eq for 2020, 14,612,231 t CO_2 eq for 2021, 15,215,572 t CO_2 eq for 2022, 15,818,913 t CO_2 eq for 2023 and 16,422,255 t CO_2 eq for 2024.

The assessment team notes that the data and information used by Suriname 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 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

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
AR	Assessment Report of the Intergovernmental Panel on Climate Change
AT	assessment team
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
COP	Conference of the Parties
EF	emission factor
FAO	Food and Agriculture Organization of the United Nations
FREL	forest reference emission level
FRL	forest reference level
GHG	greenhouse gas
GWP	global warming potential
IPCC	Intergovernmental Panel on Climate Change
N_2O	nitrous oxide
NC	national communication
NFMS	national forest monitoring system
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)
SBB	Foundation for Forest Management and Production Control of Suriname
TA	technical assessment

I. Introduction and summary

A. Overview

1. This report covers the TA of the voluntary submission of Suriname on its proposed FREL,[1] submitted on 8 January 2021, in accordance with decisions 12/CP.17 and 13/CP.19. The remote TA[2] took place from 22 to 26 March 2021 and was coordinated by the secretariat.[3] The TA was conducted by two land use, land-use change and forestry experts from the UNFCCC roster of experts[4] (hereinafter referred to as the AT): Naikoa Aguilar-Amuchastegui (Spain) and Luis Panichelli (Argentina). The TA was coordinated by Dirk Nemitz (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, Suriname submitted its proposed FREL on a voluntary basis. The proposed FREL is one of the elements[5] 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, as referred to in decision 12/CP.17, paragraph 13, shall be subject to a TA in the context of results-based payments.

3. The objective of the TA is to assess the degree to which the information provided by Suriname is in accordance with the guidelines for submissions of information on reference levels[6] 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 Suriname to construct and improve its FREL in the future, as appropriate.[7]

4. The TA of the FREL submitted by Suriname was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELs and/or FRLs.[8] This report on the TA was prepared by the AT following the same guidelines and procedures.

5. Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Suriname. The facilitative exchange during the TA allowed Suriname to provide clarifications and additional information, which were considered by the AT in the preparation of this report.[9] As a result of the facilitative interactions with the AT during the TA, Suriname provided a modified version of its submission on 9 August 2021, which took into consideration the technical input of the AT. The modifications improved the clarity, transparency and overall consistency of the submitted FREL. This TA report was prepared in the context of the modified FREL submission. The modified submission, containing the assessed FREL, and the original submission are available on the UNFCCC website.[10] During the TA, Suriname provided the AT with supporting information, which is also publicly available.[11]

B. Proposed forest reference emission level

6. 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,

[1] The submission of Suriname is available at https://redd.unfccc.int/submissions.html?country=sur.
[2] Owing to the circumstances related to the coronavirus disease 2019, the TAs of the FREL and FRL submissions of developing country Parties in 2021 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] See decision 1/CP.16, para. 71(b).
[6] Decision 12/CP.17, annex.
[7] Decision 13/CP.19, annex, para. 1(a–b).
[8] Decision 13/CP.19, annex.
[9] As per decision 13/CP.19, annex, paras. 1(b), 13 and 14.
[10] https://redd.unfccc.int/submissions.html?country=sur.
[11] Available at https://drive.google.com/drive/folders/1Hk31K8Iy7JAY31auGrabd_OmS-tRL_sq?usp=sharing.

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 Suriname, on a voluntary basis for a TA in the context of results-based payments, covers the activities reducing emissions from deforestation and reducing emissions from forest degradation, which are two of the five activities referred to in that paragraph. Pursuant to paragraph 71(b) of the same decision, Suriname developed a national FREL that covers its entire territory, which includes approximately 15.2 million ha forest. Forest land consists of managed and unmanaged land. Managed forest land consists of the forestry belt (an area designated as 'production forest'), areas of shifting cultivation and forests in protected areas (including most of the country's mangrove forests). The remaining forest land is considered unmanaged.

7. The FREL includes the pools above-ground biomass, below-ground biomass and deadwood and excludes litter and soil organic carbon owing to the absence of adequate data. Regarding GHGs, the submission includes gross CO_2 emissions from deforestation and forest degradation, and CH_4 and N_2O emissions from deforestation due to forest fires (i.e. conversion of forest to non-forest due to forest fires) and degradation due to forest fires (i.e. conversion of forest to area subject to shifting cultivation due to forest fires).

8. The FREL was calculated on the basis of linear projections of gross emissions from deforestation and forest degradation using historical data for 2000–2019. The national FREL proposed by Suriname covers the results period 2020–2024. As a result of the facilitative process during the TA, the FREL was modified.[12] The modified FREL corresponds to 14,008,882 t CO_2 eq for 2020, 14,612,231 t CO_2 eq for 2021, 15,215,572 t CO_2 eq for 2022, 15,818,913 t CO_2 eq for 2023 and 16,422,255 t CO_2 eq for 2024.

9. The FREL proposed by Suriname is its second FREL submitted in the context of applying the stepwise approach in accordance with decision 12/CP.17, paragraph 10. Its previous national FREL was submitted on 8 January 2018 and was subject to a TA in March 2018;[13] it covered the activities reducing emissions from deforestation and reducing emissions from forest degradation for 2016–2020. The previous assessed FREL corresponded to 14,627,465 (2016), 15,591,284 (2017), 16,555,103 (2018), 17,518,922 (2019) and 18,482,741 (2020) t CO_2 eq and was therefore higher than the FREL proposed in the most recent modified submission. The assessed FREL proposed in the modified 2021 submission differs from that in the modified 2018 submission owing mainly to the inclusion of additional sources of emissions from deforestation (i.e. conversion of areas of shifting cultivation to non-forest areas) and forest degradation (i.e. expansion of shifting cultivation, roundwood and fuelwood production), new data sources for generating EFs (i.e. Chave et al., 2014), new EFs for deforestation (i.e. non-mangrove forest carbon stocks, mangrove forest carbon stocks, conversion of areas of shifting cultivation to non-forest areas) and forest degradation (i.e. fuelwood logging, shifting cultivation), and linear projections of historical emissions by source.

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

10. The FREL includes gross emissions from deforestation, due mainly to gold mining, infrastructure development, urbanization and agriculture, and gross emissions from forest

[12] In its original submission, Suriname proposed a national FREL of 15,238,428 t CO_2 eq for 2020, 15,858,865 t CO_2 eq for 2021, 16,479,303 t CO_2 eq for 2022, 17,099,741 t CO_2 eq for 2023 and 17,720,179 t CO_2 eq for 2024. The difference between the original and the modified submission is due mostly to changes in the AD, the elimination of double counting of fuelwood data and changes in the projection methods.

[13] See document FCCC/TAR/2018/SUR.

degradation, due to roundwood and fuelwood logging and expansion of shifting cultivation. Deforestation is defined as the direct and/or induced conversion of forest cover to another type of land cover within a time frame of 10 years, excluding areas that undergo a temporary loss of forest cover, such as during shifting cultivation and natural deforestation, from which it is assumed the forest cover will recover naturally. Forest degradation is defined as the human-induced or natural loss of the goods and services provided by the forest land, in particular the forest carbon stocks, not qualifying as deforestation, over a determined period of time.

11. For constructing its FREL, Suriname used the 2006 IPCC Guidelines.

12. Suriname presented a reference level for the results period 2020–2024 using a combination of linear projections for each emissions source (i.e. driver) and each of the two activities reported. The FREL was calculated on the basis of linear projections of gross emissions from deforestation and forest degradation using historical data for 2000–2019. Suriname applied area-based AD on deforestation and forest degradation due to the expansion of shifting cultivation and volume-based AD on forest degradation due to roundwood and fuelwood production.

13. To determine historical areas of deforestation, Suriname used a combination of approaches 2 and 3 from the 2006 IPCC Guidelines. Historical assessments of deforestation used a Landsat-based baseline map for 2000 and historical assessments of deforestation, also based on Landsat satellite images, for 2000–2009, 2009–2013 and then annually until 2017. Annual Sentinel 2A satellite images were used for the 2018–2019 deforestation maps. In all cases the mapping input pixel was 30 m for Landsat and 10 m for Sentinel 2A. Deforestation areas were mapped using a semi-automatic method that (1) drew on data from the system for earth observations, data access, processing and analysis for land monitoring[14] of FAO, (2) produced cloud-free mosaics using the median value for each year and (3) used a random forest classifier to stratify areas into forest or non-forest classes. This mapping was then compared with a baseline forest map for 2000 to determine the updated non-forest areas. Unbiased area estimates were then produced using a stratified random sampling approach based on that of Olofsson et al. (2020), namely mapping classes as strata with the addition of a buffer stratum, in order to control for the significant impact of omission errors on the large class of forest remaining forest in the final confidence interval estimates. Samples were evaluated by visually comparing them with the original Landsat and Sentinel 2A data and any additional available data. Suriname indicated that a minimum mapping unit of 1 ha was used.

14. Regarding forest degradation due to shifting cultivation, namely the transition from forest to shifting cultivation, AD were produced by taking the location of observed tree cover loss compared with the baseline forest map for 2000 and aggregating detected losses consistently smaller than 1 ha, following the assumption that small clearings would be part of the shifting cultivation cycle. Suriname characterized areas of shifting cultivation, by location, in terms of clearing size, temporal dynamics regarding agriculture and subsequent regeneration of tree cover. Forest carbon stock recovery was not considered in producing AD on forest degradation due to shifting cultivation.

15. Regarding forest degradation due to roundwood production, volume-based AD were determined using the annual quantities of timber production recorded by the Sustainable Forestry Information System Suriname (an upgraded log tracking system that replaced LogPro in 2019) as well as by SBB, which are published on an annual basis. SBB data on roundwood production are not derived from the spatial monitoring of logging activities but from data recorded in its “cutting register”, which is used to register all legally produced roundwood. SBB has been responsible for forest monitoring and the registration of roundwood production since 1999, prior to which production data were recorded by the Forest Service. AD on log volumes were estimated using felled tree log dimensions.

16. In the original FREL submission, Suriname reported AD on forest degradation due to illegal logging on the basis of a three-month data set collected during 2020, which was used to estimate the ratio of illegal to legal logging for that three-month period. Further, it derived

[14] http://sepal.io/.

an estimate of unregistered logging from these data, collected during August, September and October 2020, on logs scanned on the roads and at log yards using mobile applications developed within the Sustainable Forestry Information System Suriname and on all logs encountered by forest guards. These data were compared with areas of unplanned logging activities that have been monitored on a yearly basis using satellite images since 2016. The estimates were then extrapolated to produce yearly estimates for the entire historical period (2000–2019). In the modified submission, Suriname excluded emissions from degradation arising from illegal logging (i.e. industrial roundwood extraction) owing to the lack of adequate data for calculating an accurate estimate.

17. Regarding forest degradation due to fuelwood collection, AD were derived for 2000–2019 from data collected annually by the General Bureau of Statistics on household fuelwood consumption using International Tropical Timber Organization standards. These data, supported by data from a 2013 SBB survey on fuelwood consumption, show that fuelwood production declined from 124,294 m^3 in 2000 to 77,459 m^3 in 2019, or about 2.5 per cent each year during that period (SBB, 2020a and 2020b).

18. The uncertainties regarding roundwood and fuelwood production were based on expert judgment resulting from SBB FREL working group discussions. For industrial roundwood, an uncertainty of 5 per cent was estimated to take into account the assumption that minor errors may be made when registering roundwood logging in the log tracking system, despite various checkpoints in the field and in the office. For fuelwood more generally, an uncertainty of 15 per cent was estimated by the FREL working group, as data on fuelwood are more difficult to register than those on industrial roundwood owing to the nature of the materials. Fuelwood not only includes industrial roundwood, but also smaller pieces of wood that are more difficult to measure accurately.

19. The EFs applied by Suriname for deforestation are based on the average total carbon stock of the three carbon pools taken into account (above-ground biomass, below-ground biomass and deadwood) for each of the four forest strata, assuming the instantaneous oxidation of all carbon stocks (see tables 4.10–4.11 of the modified FREL submission). Suriname included a new forest substratum for 2021, namely shifting cultivation, for which it established a new EF and corresponding uncertainty estimates on the basis of a peer-reviewed paper by Pelletier, Codjia and Potvin (2012), the geographical scope of which was Panama.

20. The EFs for the mangrove stratum were updated from those used in the 2018 FREL submission. For this purpose, Suriname established 11 new sampling plots (resulting in 13 in total). Mangrove data, reflected in the SBB technical report (SBB, 2021), were generated by distributing 13 sampling plots over the coastal mangrove forest. To calculate the mangrove forest carbon stocks, the Chave et al. (2014) allometric equation was used.

21. Regarding forest degradation due to shifting cultivation, Suriname derived its EF by taking the difference between the biomass quantities estimated for each of the four forest strata and the average biomass estimates reported by Pelletier, Codjia and Potvin (2012) for areas of early-cycle shifting cultivation in Panama. The first six years of the rotation were considered in deriving these EFs.

22. Regarding forest degradation due to legal logging of industrial roundwood, the EF and corresponding uncertainty estimates were produced in similar way as for the 2018 FREL submission, that is by following the methods developed by Pearson, Brown and Casarim (2014) and assuming instantaneous oxidation of the direct loss in living biomass due to logging, namely extracted logs, unextracted wood, incidental logging damage to other trees caused by tree felling, and skid-trail establishment. The methods used to determine the EF for forest degradation due to logging (CO_2 emitted/m^3 timber produced) are described by Zalman et al. (2019). The biomass of trees was estimated on the basis of an equation for pantropical forests developed by Chave et al. (2014) based on diameter at breast height, environmental stress and wood density values. Suriname updated the EF after this TA report was drafted as it detected an error in its application of the Chave et al. (2014) study. The AT commends Suriname for identifying this error and updating its estimates accordingly.

23. Logging data were collected for emissions resulting from skid-trail construction for logging infrastructure, collateral damage to other trees caused by tree felling, and extraction

of wood. For this purpose, 258 felled trees were sampled in order to determine the associated emissions from extracted timber and the timber left behind (e.g. damaged trees and unextracted tree parts). At least 20 trees were sampled randomly at each of the 10 plot locations along the skid trails. The carbon losses resulting from collateral damage were calculated by measuring all grounded and snapped trees in the harvested clearing and calculating the emitted carbon for those trees using the equations described by Chave et al. (2014) and Goodman et al. (2013). The carbon emissions for each clearing per m^3 were calculated by dividing the emitted carbon in the clearing by the volume extracted from that clearing.

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

24. The FREL proposed by Suriname 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 2018.[15] In its most recent submission, Suriname described changes from previously submitted information in accordance with decision 12/CP.17, annex, paragraph (b). The Party described the following changes:

(a) The inclusion of additional sources of emissions from deforestation (i.e. conversion of areas of shifting cultivation to non-forest areas, including as a result of forest fires) and emissions from forest degradation (i.e. expansion of shifting cultivation, roundwood production and fuelwood production);

(b) The inclusion of new data sources for generating EFs (e.g. Chave et al., 2014);

(c) The development of new EFs for deforestation (i.e. non-mangrove forest carbon stocks, mangrove forest carbon stocks, conversion of areas of shifting cultivation to non-forest areas) and forest degradation (i.e. fuelwood logging, shifting cultivation).

25. The AT commends Suriname for its provision of additional supporting information during the TA, including all relevant data, references and assumptions. The AT considers that this information could help to improve the transparency, overall consistency and reproducibility of the Party's future FREL submissions.

26. Regarding the AD on deforestation of shifting cultivation areas, Suriname presented some details on the estimation methods used within the FAO system for earth observations, data access, processing and analysis for land monitoring. During the technical exchange, the AT noted that the level of detail presented prevented it from reconstructing the process of elaborating the AD, particularly regarding the input and output parameters used and the application of the random forest classifier to input data. During the TA, the AT highlighted the implications of this for the long-term sustainability of the methods used should the FAO system cease to exist. The AT considers the acquisition of independent, in-country capacity for data processing as an area for future technical improvement.

27. Suriname shared with the AT the results of the quality assurance/quality control procedure applied for its AD. The AT understood that these results were used to produce adjusted area estimates. During the technical exchange, the AT noted that Suriname did not produce adjusted area estimates for all mapped classes for each period used for the FREL. The AT explained that adjusted area estimates should be produced for each period, as each period is assessed using specific data complete with specific characteristic-related uncertainties. In response, Suriname performed accuracy assessments for all mapped classes for each period reported and then combined the uncertainty estimates for all periods when estimating the overall change. The AT commends Suriname for substantially increasing both the quality and the transparency of its estimates.

28. Regarding the response design for the samples used to produce unbiased AD estimates for deforestation and forest degradation due to shifting cultivation, the AT considers that

[15] See document FCCC/TAR/2018/SUR.

additional details on the standard operating procedures used for interpreting the samples would greatly increase the transparency of the FREL submission, particularly as the samples differ depending on the input data and the reported uncertainties for AD on deforestation, based on Sentinel 2A data, were comparatively lower than those reported by other countries and in academic assessments. The AT considers this an area for future technical improvement.

29. Suriname explained that it incorporated Sentinel 2A data into the estimation of the FREL because of their higher spatial resolution (10 m) compared with Landsat data (30 m). During the TA, the AT sought clarification on the Party's assumption that Sentinel 2A produces higher-quality results than Landsat. Suriname explained that the results of the maps produced using Sentinel 2A data led it to the conclusion that using Sentinel 2A resulted in a significant improvement in the confidence interval. It also clarified that the shift from Landsat to Sentinel data did not affect the comparability of the data across the time series, because the same definitions were used for monitoring forest change. Nevertheless, the use of Sentinel 2A data has significantly reduced the uncertainty of the deforestation estimates. The AT considers the comparison of estimates to assess time-series consistency when using data from different satellites as an area for future technical improvement.

30. Suriname provided uncertainty estimates for areas of deforestation and forest degradation due to shifting cultivation in its FREL submission. Unbiased area estimates were produced using a stratified random sampling approach based on that of Olofsson et al. (2020), namely mapping classes as strata with the addition of a buffer stratum, for 2000–2018 and 2018–2019 for deforestation. The AT noted that these periods were not the same as those used for producing AD on deforestation: 2000–2009, 2009–2013 and then yearly until 2019. In the modified FREL submission, Suriname provided the uncertainty estimate for each period for which AD were presented. The AT commends Suriname for including this information in the modified FREL submission, which improved the consistency of the FREL and the transparency of its reporting.

31. The AT commends Suriname for providing in its modified submission historical data that demonstrate a positive correlation between gold price and deforestation rate. The Party explained in its modified submission that the international gold market has shown an increasing price trend since 2002 and the expectation is that this trend will lead to increased gold production, mostly from unplanned gold mining, and thus to increased deforestation. The gold price and deforestation correlation was used as an assumption by Suriname to justify the linear projection approach it applied to the deforestation data in the historical period to determine the FREL for the results period 2020–2024. The AT, while considering this approach to be justified, suggests that Suriname revisit its application of the linear projection approach if any unexpected changes in gold price or circumstances affecting deforestation rate occur.

32. No uncertainty estimates were presented for the linear projections used or their fit for the results period. The AT notes that including uncertainty estimates (i.e. confidence intervals) for projections would increase the transparency of the FREL as well as better inform the overall uncertainty estimates, and considers this an area for future technical improvement.

33. Regarding the interpretation of the samples used to produce unbiased estimates of AD on deforestation due to shifting cultivation (following Olofsson et al., 2020), Suriname did not present detailed information on how these estimates were assessed or how bias in their interpretation was avoided through the response design standard operating procedure. The AT considers this an area for future technical improvement.

34. Some AD did not cover the entire historical period (i.e. AD on fires or expansion of shifting cultivation). For these cases, Suriname extrapolated or interpolated the estimates from existing data. During the technical exchange, the AT reconstructed the reference level and found some inconsistencies regarding the extrapolation and interpolation used (see paras. 35–37 below). These inconsistencies were resolved in the modified FREL submission.

35. During the technical exchange, the AT noted that AD on illegal logging were unlikely to be representative of the entire historical period, as only three months of data were collected and then extrapolated. During the TA, the AT noted that using a time series of data covering

all months and years of the historical period would lead to more accurate estimated emissions from illegal logging. Because of Suriname's lack of the data needed to produce accurate estimates for the entire time series, the AT suggested that the Party exclude current estimates for illegal logging from its FREL. The exclusion would be a conservative measure provided that emissions from this source are not significant. In response, Suriname excluded illegal logging from its modified FREL submission. The AT considers the collection of data that allow the estimation of emissions from illegal logging an area for future technical improvement.

36. The AT noted that the FREL included AD on deforestation due to forest fires from 2000 to 2015 only. During the TA, Suriname indicated that burned areas included in the submission form part of the post-deforestation maps, produced through the NFMS, and are available for 2000–2009, 2000–2013 and 2000–2015. However, these AD were not reported in the original FREL submission. During the TA, the AT sought clarification on why these data were not available and why IPCC methods were not used to fill the gaps in the historical data series. Suriname indicated during the TA that, before 2015, areas that were burned did not have a clear land use at the time of mapping and were thus classified simply as burned areas. As a result of the TA, in the modified FREL submission Suriname included AD on deforestation due to forest fires for 2015–2019 by classifying these areas as deforested. This inclusion improved the completeness and consistency of the modified FREL.

37. The AT noted that AD on forest degradation due to shifting cultivation were available for 2000–2009, 2009–2013 and annually until 2019. However, Suriname did not include such data for 2000–2009 and 2009–2013 in its FREL submission, explaining that this was due to high uncertainties observed in the AD on shifting cultivation for those periods. The AT explained that including these data and the corresponding uncertainty estimates in the FREL would greatly enhance its transparency and better inform the fit of the projections used. In the modified FREL submission, Suriname included the corresponding AD and uncertainty estimates for 2000–2009 and 2009–2013. The AT commends Suriname for completing an accuracy assessment and including the complete data set for the historical period, including its uncertainty estimates.

38. In the original FREL submission, Suriname included estimated emissions from roundwood production and fuelwood together and also fuelwood separately. This resulted in double counting of fuelwood emissions. For the modified submission, the Party excluded fuelwood data from roundwood emission estimates and reported roundwood and fuelwood emissions separately. The AT commends Suriname for eliminating the double-counting issue and thus increasing the consistency and accuracy of the FREL.

39. During the TA, the AT noted that data from different time periods were used to aggregate emissions from deforestation and emissions from forest degradation in constructing the FREL. In the modified submission, on the basis of discussions with the AT during the technical exchange, Suriname standardized the historical period used for the linear fit of the projections. Estimates for each activity were elaborated and the overall projected estimates were then used to construct the FREL values for the results period 2020–2024. Total emissions from forest degradation were estimated as the sum of projected emissions from roundwood production, fuelwood production and expansion of shifting cultivation. The AT noted that applying consistent methods and time periods to complete the data series and aggregate emissions sources increased the consistency of the FREL.

40. In the submission, Suriname described the data sets, tiers and approaches used. The methods and data presented by Suriname in its FREL submission seemed to indicate the use of the stock change approach to estimate emissions. However, the temporal aspects in the definition of degradation imply that the biomass recovers within a given time frame, which would point to a gain–loss approach. During the TA, Suriname explained that the gain–loss approach is used for EFs for logging, as the associated emissions are calculated on the basis of the annual timber production registered (CO_2 emitted/m^3 wood produced). The Party also explained that this equation does not take into account recovery, but only the gross emissions. It clarified that other activities such as deforestation and shifting cultivation make use of the stock change approach, where remote sensing is used to determine changes in land cover, such as from forest to non-forest, where the changes in carbon stock are regarded as the

emissions. The AT noted that including this information in the FREL would increase the transparency of the FREL, and identified this as an area for future technical improvement.

41. During the TA, the AT sought clarification on how forest regrowth is considered in the FREL, how temporary forest cover loss is monitored and how the latter is adjusted over the AD time series of deforestation and forest degradation. Suriname explained that forest regrowth is not considered in monitoring shifting cultivation, because it is assumed abandoned areas will be cultivated again after a certain period. It added that deforestation is monitored annually, with the drivers of deforestation assessed using post-deforestation land-use, land-cover maps every two years. The AT commends Suriname for this clarification.

42. During the TA, the AT assessed the extent to which the FREL maintains consistency with the corresponding forest-related GHG emissions by sources and removals by sinks in the national GHG inventory, in accordance with the annex to decision 13/CP.19. It found that, as in the previous FREL submission, data, EFs and some methodologies used for the FREL were not consistent with those used for the latest GHG inventory, included in the Party's NC2. Suriname clarified that the main discrepancy relates to shifting cultivation. The conversion of natural forest land to areas of shifting cultivation was described as a conversion of "forest land to cropland" in the NC2, but as "forest land remaining forest land" in the FREL submission. Suriname stated that it is in the process of preparing its NC3 with the aim of submitting it in 2022. It clarified during the TA that it is still putting in place the institutional arrangements for its NCs and biennial update reports. All data collected through the NFMS will be used for the next NC and form the basis for further GHG inventory reporting, meaning that all forest-related definitions used within the NFMS will be used for the NC3. The AT commends Suriname for the efforts undertaken to make the FREL consistent with the national GHG inventory in the future.

43. During the technical exchange with the AT, Suriname clarified that the main discrepancy between the land-use classifications used in the FREL and the national GHG inventory relates to shifting cultivation (see para. 42 above). The Party noted that the consultation with indigenous and tribal peoples conducted for the national Strategic Environmental and Social Assessment (GOS, 2017) concluded that shifting cultivation is to be seen as a land use within forest land, and thus not as a driver of deforestation. Areas of shifting cultivation in the FREL are classified as, inter alia, forest converted to areas of shifting cultivation (i.e. degradation: expansion of shifting cultivation); and areas of shifting cultivation converted to non-forest land (i.e. deforestation: decrease in area of shifting cultivation). Suriname presented as supporting information a summary table showing the FREL categories and land-use categories from the 2006 IPCC Guidelines. The AT commends Suriname for enhancing clarity by providing this additional information.

44. Suriname also noted that the national forest definition used for its FREL was developed for monitoring purposes through an extensive participative process, and indicated that it will be used for its next NC and national GHG inventory, to be submitted in 2022. The NFMS will be the official source of land use and land-use change data, with carbon stocks and carbon stock changes related to land-use changes and forest land remaining forest land forming the basis for further GHG inventory reporting. The NC3 will include data for 2000–2017. The forest definition used for the FREL will also be used for reporting REDD+ results. The AT commends Suriname for its efforts to make the FREL consistent with the national GHG inventory and for including relevant clarifications in the modified FREL submission.

45. During the TA, the AT sought clarification on the classification for the FREL of land-use (i.e. forest, shifting cultivation, non-forest land) and land-use change categories (i.e. forest converted to area of shifting cultivation, forest converted to non-forest land, area of shifting cultivation converted to non-forest land) related to deforestation and forest degradation emissions sources. In response, Suriname provided summary tables as supporting information (see para. 5 above), detailing forest stratification, land-use category and subcategory, activity, carbon pools, gases and the related land use, land-use change and forestry category from the 2006 IPCC Guidelines (i.e. forest land, cropland, grassland, wetlands, settlements and other land) and subcategory (i.e. land remaining or land converted).

46. The AT noted that Suriname used approach 1 (error propagation) from the 2006 IPCC Guidelines. However, it found that uncertainty estimates were not produced for all activities

and periods. In the modified submission, Suriname addressed the observations made by the AT by providing uncertainty estimates for all activities and periods.

47. For shifting cultivation, during the technical exchange the AT noted that Suriname assumed the uncertainties reported by Pelletier, Codjia and Potvin (2012) regarding biomass estimates for data from Panama to be the same for Suriname, but did not explain how they were applicable in both contexts. The AT noted that this could result in the related uncertainties being underestimated since the data come from a different domain. The AT identified the biomass estimates for shifting cultivation and the derived EFs as an area for future technical improvement.

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

48. Suriname provided in section 4.7 and table 4.25 of its modified FREL submission a description of relevant policies and plans, and information on how national circumstances were taken into account in constructing its FREL, in accordance with decision 12/CP.17. Suriname stated that section 4.7 of the submission provided the basis for adjusting its projections by means of linear growth. The relevant national policies and plans included in the FREL submission were classified on the basis of the driver of the emissions they intend to address and its significance.

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

49. 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.

50. The pools included in the Party's FREL are above-ground biomass, below-ground biomass and deadwood. The litter and soil organic carbon pools were not included. Suriname, referring to findings in Crabbe et al. (2012), indicated that emissions from litter are insignificant (accounting for less than 5 per cent of the total emissions from deforestation and forest degradation), but reported that this pool will be included in future FREL submissions as soon as relevant data are available.

51. Suriname did not consider Crabbe et al. (2012) in relation to soil organic carbon despite the finding of that study that soil organic carbon holds 14 per cent of forest carbon. It noted that the data used by Crabbe et al. (2012) were collected from just a few sample plots distributed across a limited area of the country. The Party intends to undertake further studies on soil organic carbon to obtain information suited to higher-tier approaches, on the basis of which further decisions on inclusion of the pool will be made, following the stepwise approach. The AT considers that exclusion of the litter and soil organic carbon pools was adequately justified and commends Suriname for its intention to obtain better information on these pools with the aim of including them in future FREL submissions as part of the stepwise approach.

52. Regarding GHGs, during the TA, Suriname explained that forest fires take place because of the expansion of shifting cultivation and that, in some instances, deforestation is due to fires. In the modified submission, Suriname reported the areas (AD) and resulting CH_4 and N_2O emissions from such forest fires as well as the associated uncertainties.

53. The FREL submission includes CO_2 emissions from deforestation and forest degradation, and CH_4 and N_2O emissions from deforestation (i.e. conversion of forest to non-forest) due to forest fires and degradation (i.e. conversion of forest to area subject to shifting cultivation) due to forest fires. During the TA, Suriname clarified that non-CO_2 emissions (CH_4 and N_2O) for areas of shifting cultivation remaining areas of shifting cultivation and areas of shifting cultivation converted to non-forest areas are not included in the submission. The AT considers the treatment of non-CO_2 gases as an area for future technical improvement to maintain consistency within the FREL and with the GHG inventory. The Party noted during the technical exchange that non-CO_2 gases will be included in future FREL submissions. The AT commends Suriname for including this information in the modified FREL submission, which improved the consistency of the FREL and the transparency of its reporting.

54. Regarding emissions from forest fires, the Party provided in annex 2 to its modified FREL submission the GWP values used to estimate CO_2 eq emissions from forest fires, namely those from the AR2 (i.e. N_2O: 310; CH_4: 21). However, in its NC2, Suriname reported that it used the GWP values from the AR4 (i.e. N_2O: 298; CH_4: 25). The AT noted that using the same GWP values would improve the consistency of its reporting, and that providing this information in the FREL submission would increase transparency. The AT considers this an area for future technical improvement.

55. The AT acknowledges that Suriname included in its FREL the most significant activities (i.e. reducing emissions from deforestation and reducing emissions from forest degradation) of the five activities identified in decision 1/CP.16, paragraph 70, in accordance with its national capabilities and circumstances. According to Suriname, the other activities (i.e. conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks) are highly relevant for high-forest, low-deforestation countries and thus are included in its REDD+ strategy. The Party stated that it intends to include these activities in future FREL submissions when new, adequate and better data and information become available, as part of the stepwise approach.

4. Definition of forest

56. Suriname provided in its submission the definition of forest used in constructing its FREL. The definition is consistent with that used by Suriname for its reporting to FAO (i.e. minimum area of 1 ha, height of 5 m or more and at least 30 per cent canopy cover). The Party's rationale for its definition is described in annex 3 to the FREL submission.

57. Forest is defined as land covered primarily by trees, but often also containing shrubs, palms, bamboo, herbs, grass and climbers. The forest definition excludes crown cover from trees planted for agricultural purposes (including palm trees such as coconut trees and palm oil trees) and tree cover in areas predominantly under urban or agricultural use. Areas of shifting cultivation (slash and burn agriculture) are considered as forest and not as non-forest, so conversion from forest to areas of shifting cultivation is not classified as deforestation, but as forest degradation, provided it is done in a traditional way.

III. Conclusions

58. The information used by Suriname in constructing its FREL for reducing emissions from deforestation and reducing emissions from forest degradation is transparent and complete and in overall accordance with the guidelines for submissions of information on reference levels.

59. The FREL presented in the submission is Suriname's second FREL. Its previous national FREL was submitted on 8 January 2018 and was subject to a TA in March 2018; it covered the activities reducing emissions from deforestation and reducing emissions from forest degradation for 2016–2020.

60. The FREL presented in the modified submission, for the results period 2020–2024, corresponds to 14,008,882 t CO_2 eq (2020), 14,612,231 t CO_2 eq (2021), 15,215,572 t CO_2 eq (2022), 15,818,913 t CO_2 eq (2023) and 16,422,255 t CO_2 eq (2024).

61. The AT acknowledges that Suriname included in its FREL the most significant activities and the most significant pools in terms of emissions from forests. The AT considers that, in doing so, Suriname followed decision 1/CP.16, paragraph 70, on activities undertaken, and decision 12/CP.17, paragraph 10, on applying the stepwise approach. The AT commends Suriname for providing information on its ongoing work to include the litter and soil organic carbon pools, to improve consistency of its FREL with its national GHG inventory, and to include other drivers of emissions towards improving its FREL.

62. As a result of the facilitative interactions with the AT during the TA, Suriname provided a modified submission that took into consideration the technical input of the AT. The AT notes that the transparency and completeness of the information provided were significantly improved in the modified FREL submission and commends Suriname on its efforts. The new information provided in the modified submission, including the data made

available online[16] and the details of how estimates of CO_2 emissions from deforestation and forest degradation were calculated, increased the reproducibility of the FREL calculations.

63. The AT notes that, overall, Suriname did not maintain consistency, in terms of sources of AD and EFs and some methodologies used for its FREL, with those used for the GHG inventory included in its NC2, but that it intends to do so for its NC3.[17] During the TA, Suriname indicated that all data collected through the NFMS will be used in the NC3 and form the basis for further GHG inventory reporting.

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

(a) Ensuring independent, in-country capacity for data processing (see para. 26 above);

(b) Providing additional details on the standard operating procedures used for processing the samples used to produce unbiased AD estimates for deforestation and forest degradation due to shifting cultivation (see para. 28 above);

(c) Providing better evidence that the shift from Landsat to Sentinel 2A data did not affect the comparability of the data across the time series (see para. 29 above);

(d) Calculating uncertainty estimates for the projections or their fit for the results period (see para. 32 above);

(e) Presenting detailed information on how bias in the interpretation of the samples is avoided to produce unbiased estimates of AD on deforestation and shifting cultivation (see para. 33 above);

(f) Collecting better data that allow the estimation of emissions from illegal logging (see para. 35 above);

(g) Providing clear information on which calculations use a stock change approach and which use a gain–loss approach (see para. 40 above);

(h) Elaborating EFs for forest degradation due to shifting cultivation (see para. 47 above).

65. Pursuant to decision 13/CP.19, annex, paragraph 2(f), in assessing the pools and gases included in the FREL the AT noted that all relevant gases were included by Suriname in the context of the FREL, including CH_4 and N_2O emissions from forest fires, but that using the same GWP values as those used in the national GHG inventory would improve the consistency of the Party's reporting (see paras. 53–54 above).

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

(a) Improve the consistency of the FREL and national GHG inventory, in terms of AD, EFs and GWP values, and forest definition used (see paras. 42–44 above);

(b) Obtain better information on the litter and soil organic carbon pools with the aim of including them in future FREL submissions (see para. 50 above); in particular, for soil organic carbon, undertake further studies to obtain information suited to higher-tier approaches, on the basis of which further decisions on inclusion of the pool can be made (see para. 51 above);

(c) Include the activities conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks in future FREL submissions (see para. 55 above).

67. Suriname identified the following capacity-building needs:

(a) Developing a cost-efficient national forest inventory design with statistical estimation procedures (including a carbon inventory and information on the co-benefits of REDD+ and on timber production);

[16] https://www.gonini.org/SBB/index.php?r=projectedannualemissions%2Findex.
[17] In reference to the scope of the TA, as per decision 13/CP.19, annex, para. 2(a).

(b) Combining national- and community-level measuring and reporting systems and building capacity at those levels;

(c) Building a harmonized NFMS database that provides up-to-date reports on emissions (including sound uncertainty calculation methods and methods for calculating EFs related to conversion from forest land to a land-use type with remaining biomass) for the GHG inventory, as well as for reporting on criteria and indicators for, inter alia, the Convention on Biological Diversity, Global Forest Resources Assessments and International Tropical Timber Organization;

(d) Conducting research on carbon stock changes and associated EFs related to rotational shifting cultivation activities;

(e) Strengthening the capacity to report on emissions caused by forest degradation through field-based measurements and spatially explicit methods.

68. In conclusion, the AT commends Suriname 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 Suriname'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.[18] The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Suriname.

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

[18] 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 Suriname

Main features of the FREL		*Remarks*
Proposed FREL	14 008 882 t CO_2 eq for 2020 14 612 231 t CO_2 eq for 2021 15 215 572 t CO_2 eq for 2022 15 818 913 t CO_2 eq for 2023 16 422 255 t CO_2 eq for 2024	The previous assessed FREL was higher than the FREL proposed in the most recent modified submission (see paras. 8–9 of this document)
Type and reference period of FREL	FREL = based on projections of historical emissions in 2000–2019	The FREL is based on a linear trend fit to the emissions observed during 2000–2019, with partial trend fits included for the two activities included (see para. 10 of this document)
Application of adjustment for national circumstances	No	–
National/subnational	National	See paragraph 8–9 of this document
Activities included	Reducing emissions from deforestation Reducing emissions from forest degradation	See paragraph 9 of this document
Pools included	Above-ground biomass Below-ground biomass Deadwood	See paragraph 50 of this document
Gases included	CO_2, CH_4, N_2O	See paragraphs 52–54 of this document
Forest definition	Included	Forest is defined as land covered primarily by trees, but often also containing shrubs, palms, bamboo, herbs, grass and climbers, with a minimum tree crown cover of 30 per cent (or equivalent stocking level), with the potential to reach a minimum canopy height at maturity of 5 m and a minimum area of 1 ha (see paras. 56–57 of this document)
Consistency with latest GHG inventory	Methods used for estimating the FREL are not consistent with those used for the latest GHG inventory (2008)	The FREL is based on better, updated data, which Suriname intends to make use of for its upcoming NC3 (see paras. 42–44 of this document)

Main features of the FREL		*Remarks*
Description of relevant policies and plans	Included	Suriname explained its forestry policies relating to emissions from deforestation and forest degradation (see para. 48 of this document)
Description of assumptions on future changes to domestic policy, if included in constructing the FREL	Included	Annex 6 to the FREL submission presents possible outputs for future scenario modelling, including projects for developing input variables and expected increments in logging activities
Description of changes to previous FREL	Included	Table A in the FREL submission presents a summary comparison between the 2018 and 2021 FREL submissions (see also para. 9 of this document)
Identification of future technical improvements	Included	See paragraphs 64–66 of this document

Annex II

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

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. UNFCCC documents

First and modified FREL submissions of Suriname. Available at https://redd.unfccc.int/submissions.html?country=sur.

"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.

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C. Other documents

The following references may not conform to UNFCCC editorial style as some have been reproduced as received or as cited in the submission:

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