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Report on the technical assessment of the proposed forest reference level of Papua New Guinea submitted in 2023

Summary

This report covers the technical assessment of the voluntary submission of Papua New Guinea on its proposed forest reference level (FRL) in accordance with decision 13/CP.19 and in the context of results-based payments. The FRL proposed by Papua New Guinea covers the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks, which are among the activities included in decision 1/CP.16, paragraph 70.

For its submission, Papua New Guinea developed a national FRL. The FRL presented in the original submission, for the reference period 2009–2018, corresponds to 40,518,579 tonnes of carbon dioxide equivalent per year, after an upward adjustment owing to the Party's status as a high-forest, low-deforestation country. As a result of the facilitative process during the technical assessment, Papua New Guinea provided a modified submission without altering the value of its FRL.

The assessment team notes that the data and information used by Papua New Guinea in constructing its FRL are transparent, complete and in overall accordance with the guidelines contained in decision 12/CP.17, annex. This report contains the assessed FRL 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 decision 13/CP.19, annex.

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Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
ART TREES	Architecture for REDD+ Transaction's REDD+ Environmental Excellence Standard
AT	assessment team
BUR	biennial update report
C	carbon
CH_4	methane
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
COP	Conference of the Parties
EF	emission factor
FREL	forest reference emission level
FRL	forest reference level
GCF	Green Climate Fund
GHG	greenhouse gas
HFLD	high-forest, low-deforestation
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
N_2O	nitrous oxide
NFI	national forest inventory
PNGFA	Papua New Guinea Forest Authority
REDD+	reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
TA	technical assessment

I. Introduction and summary

A. Overview

1.   This report covers the TA of the voluntary submission of Papua New Guinea on its proposed FRL,[1] submitted on 12 January 2023, in accordance with decisions 12/CP.17 and 13/CP.19. The TA took place from 20 to 24 March 2023 and was coordinated by the secretariat.[2] The TA was conducted by two LULUCF experts from the UNFCCC roster of experts[3] (hereinafter referred to as the AT): Thomas Brandeis (United States of America) and Alejandra María Guevara (Honduras). In addition, Komlan Edou, an expert from the Consultative Group of Experts, participated as an observer[4] during the 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, Papua New Guinea submitted its proposed FRL on a voluntary basis. The proposed FRL 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 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.   Papua New Guinea provided its submission in English. The submission includes a link to the Climate Change and Forest Monitoring Web-Portal,[6] established for the public dissemination of forest and land-use information in order to ensure the transparency of the country's REDD+ process.

4.   The objective of the TA is to assess the degree to which the information provided by Papua New Guinea 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 FRL with a view to supporting the capacity of Papua New Guinea to construct and improve its FRL in the future, as appropriate.[8]

5.   The TA of the FRL submitted by Papua New Guinea 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.

6.   Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Papua New Guinea. The facilitative exchange during the TA allowed Papua New Guinea 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, Papua New Guinea provided a modified version of its submission on 17 July 2023, which took into consideration the technical input of the AT. The modifications improved the clarity and transparency of the submitted FRL without needing to alter the approach used to construct it. This TA report was prepared in the context of the modified FRL submission.

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[1] The submission of Papua New Guinea is available at
     https://redd.unfccc.int/submissions.html?country=png.
[2] As per decision 13/CP.19, annex, para. 7.
[3] As per decision 13/CP.19, annex, paras. 7 and 9.
[4] As per decision 13/CP.19, annex, para. 9.
[5] See decision 1/CP.16, para. 71(b).
[6] https://png-nfms.org/portal/.
[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.

B. Proposed forest reference level

7.   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 FRL proposed by Papua New Guinea, on a voluntary basis for a TA in the context of results-based payments, covers the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks, which are three of the five activities referred to in that paragraph. Pursuant to paragraph 71(b) of the same decision, Papua New Guinea developed a national FRL that covers its entire territory. For its submission, Papua New Guinea applied a stepwise approach to developing its FRL in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve their FREL or FRL by incorporating better data, improved methodologies and, where appropriate, additional pools.

8.   The national FRL proposed by Papua New Guinea for the historical reference period 2009–2018 is the annual average of the CO_2 emissions associated with deforestation, forest degradation and enhancement of forest carbon stocks. The AD used for constructing the FRL were obtained from an annual historical time-series analysis of monitoring points within a national systematic sampling grid carried out by the PNGFA, which used the Collect Earth assessment methodology to analyse medium- and high-resolution satellite imagery. The EFs were developed using country-specific values obtained from published scientific literature (Fox et al., 2010) and default factors from the 2006 IPCC Guidelines. The FRL presented in the modified submission, with the aim of accessing results-based payments for REDD+ activities for the historical reference period 2009–2018, corresponds to 40,518,579 t CO_2 eq/year,[11] which is valid for results in 2019–2027.

9.   The proposed FRL includes the pools above-ground and below-ground biomass. Regarding GHGs, the submission includes CO_2 only.

10.   The FRL proposed by Papua New Guinea is its second FRL submitted in the context of applying the stepwise approach in accordance with decision 12/CP.17, paragraph 10. Its previous national FRL was submitted on 15 January 2017 and was subject to a TA in March 2017;[12] it covered the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for the historical reference period 2001–2013. The values across the monitoring period of the previous assessed FRL were 43,369,737 (2014), 45,049,344 (2015), 46,728,951 (2016), 48,408,557 (2017) and 50,088,164 (2018) t CO_2 eq/year and therefore higher in all years of the FRL than the single FRL value proposed in the current submission for the historical reference period 2009–2018. The AD developed and used for the 2017 FRL and the current FRL are the same. However, the FRL proposed in the current submission differs from that in the 2017 modified submission previously assessed owing to the updated historical reference period, updated results period and projection methodology used, and the upward adjustment due to Papua New Guinea being a HFLD country. For constructing the current FRL, these elements were updated on the basis of the standards of the GCF pilot project on results-based payments, ART TREES and the World Bank's Forest Carbon Partnership Facility methodological framework.[13] The approach used to construct the FRL was updated from a linear projection of annual emissions for the 2017 FRL to the use of historical average emissions followed by an upward adjustment for the current FRL.

11.   Papua New Guinea shared with the AT, on 1 June 2023, the spreadsheets containing the data and information, including the applied HFLD adjustment factor, used in constructing the FRL.

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[11] Papua New Guinea did not modify its FRL value in its modified submission. The difference between the original and the modified submission is due mostly to the incorporation of clarifications and new information to improve transparency.

[12] See document FCCC/TAR/2017/PNG.

[13] Information on these initiatives is available at https://www.greenclimate.fund/redd#redd-results-based-payments-pilot, https://www.artredd.org/ and https://www.forestcarbonpartnership.org/.

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

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

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

12.   For constructing its FRL, Papua New Guinea used the 2006 IPCC Guidelines and applied the six land-use categories described therein to define its land uses. Forest land was stratified by forest type and natural forests were divided into primary forest and disturbed forest. Historical annual emissions were estimated using EFs appropriate to each forest type and that were derived from the scientific literature and the 2006 IPCC Guidelines (see para. 8 above). AD were obtained from satellite imagery analysed using the Collect Earth methodology. The FRL presented represents the average emissions over the historical reference period 2009–2018, which was chosen after stakeholder consultations as the period with the most reliable national land-use data for predicting future emissions under a 'business as usual' scenario.

13.   The REDD+ activities covered by the second FRL submitted by Papua New Guinea are reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks. Deforestation is defined as the conversion of forest land to any non-forest land use. It occurs in primary forest and during the conversion of degraded forest to non-forest land uses. Forest degradation is defined as the conversion of primary forest to disturbed forest and enhancement of forest carbon stocks is defined as the conversion of non-forest land to forest land. However, during the historical reference period no forest carbon stock enhancement activities were detected in the forest and land-use assessment using Collect Earth. Despite the increase in forest area in the country during the years of the reference period, the amount of carbon removals has been negligible. However, Papua New Guinea anticipates an increase in carbon removals from forest carbon stock enhancement activities soon due to a government tree planting programme and therefore chose to include this activity in the current FRL submission.

14.   AD were obtained from a remote sensing data analysis based on a systematic sampling method using the Collect Earth tool. Through this analysis, an annual historical time series covering the historical reference period was generated. Systematic 0.04-degree (about 4.44 km by 4.44 km) and 0.02-degree (about 2.22 km by 2.22 km) grids consisting of a total of 25,279 sample points[14] were established at the national level for the AD assessment. The spatial sampling unit from each point was defined as a 1 ha (100 m by 100 m) plot, onto which an internal grid of 5 by 5 points (a 20 m by 20 m grid) was superimposed. The analysis was performed using the image repository available through Google Earth, Bing Maps, Planet Maps and Google Earth Engine. Medium- and high-resolution satellite images that were available from the World View, Quickbird, Ikonos, SPOT, Dove, Skyesat, RapidEye, Landsat 7 and 8, and Sentinel satellites were used.

15.   The FRL considers emissions from only two carbon pools: above-ground and below-ground biomass. The 12 natural vegetation and forest types presented in Hammermaster and Sanders (1995) were used for forest stratification. An additional natural forest type, montane coniferous forest, was added for the analysis because of the high conservation value of this specific forest type. The forest plantations forest type was also added. Values for above-ground biomass per hectare were assigned to each of the forest types, either using country-specific values from the scientific literature or default values from the 2006 IPCC Guidelines. For the forest types low-altitude forest on plains and alluvial fans, low-altitude forest on uplands, littoral forest, seral forest and swamp forest, above-ground biomass values from Fox et al. (2010) were used. Default EFs from the 2006 IPCC Guidelines were applied for the other forest types – lower montane forest, montane forest, mountain coniferous forest, dry seasonal forest, woodland, savannah, scrub, mangrove and forest plantations – as locally

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[14] In the AD assessment, 25,209 sample points were actually used for the final assessment because 70 points were outside the population of interest or not visible due to clouds.

developed values were not available. The values for the root-to-shoot ratio and the carbon fraction from the 2006 IPCC Guidelines were applied to estimate below-ground biomass and the carbon content of above- and below-ground biomass respectively. Additionally, forest type subcategories such as primary, logged and other disturbed forest types were assigned adjusted EFs. Carbon stocks for some types of degraded forest were estimated as a percentage reduction from the primary forest carbon stocks. The percentage reduction was estimated at 65.47 per cent, a value derived from measurements in low-altitude forest on plains and alluvial fans.

16.   The FRL submission includes a quantitative uncertainty analysis of the AD used for the land-use categories and conversion between them during 2001–2019 using the methodology described in Bey et al. (2019). For the historical reference period 2009–2018, the uncertainties for estimates of stable forest, stable non-forest, deforestation and forest degradation were 0.74 per cent, 2.41 per cent, 15.71 per cent and 6.07 per cent respectively. Uncertainties estimated for the EFs for above-ground biomass were based on the standard errors of the values presented in Fox et al. (2010) and 2006 IPCC Guidelines default values. Uncertainty estimates for root-to-shoot ratios and carbon fraction values were taken from the 2006 IPCC Guidelines. Through a propagation of error approach, aggregated values of uncertainty were used to estimate the total uncertainty of the FRL as 10.31 per cent.

17.   An upward adjustment factor was applied in constructing the FRL on account of Papua New Guinea being a HFLD country. The Party considered the guidance on adjustment from ART TREES 2.0 to be the most reliable, following which Papua New Guinea calculated a HFLD score for every year over the reference period (2009–2018), resulting in values higher than the ART TREES 0.5 threshold for each year analysed. On the basis of the average HFLD score for the reference period of 0.71, an allowable upward adjustment of the FRL by 5,219,378 t CO_2 eq was calculated.

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

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

18.   In its most recent FRL submission, Papua New Guinea described the following changes from previously submitted information in accordance with decision 12/CP.17, annex, paragraph (b):

(a)   The addition of detailed information on the methodology used for and the results of the forest and land-use assessment and a stand-alone chapter on the national forest monitoring system;

(b)   The addition of detailed information on the uncertainty assessment and the resulting uncertainty estimates;

(c)   The use of new satellite imagery (i.e. imagery from the Sentinel 1 and 2 and Planet Lab satellites) as a reference to improve the quality of the forest and land-use assessment;

(d)   The update of the historical reference period from 2001–2013 to 2009–2018 and the results period from 2014–2018 to 2019–2027 and the use of historical average emissions in constructing the FRL, which was adjusted upward taking into account the Party's HFLD status.

19.   With reference to paragraph 18 above, the AT took note of the differences between the first and the current FRL submissions. The AT acknowledges that changes were made in response to the areas for future technical improvement identified during the TA in 2017 and taking into consideration lessons learned during the process of constructing the FRL. In addition, the AT found that the detailed information on the methodology used for the forest and land-use assessment, the expanded and improved uncertainty assessment (which included the uncertainties of EFs and AD) and the use of new satellite imagery enhanced the comprehensiveness and transparency of the FRL submission. The AT commends the Party for the efforts to increase the transparency and accuracy of the FRL.

20.	An important difference between the 2017 and current FRLs is the use of a HFLD adjustment factor. At the request of the AT, Papua New Guinea elaborated on the reasons for applying the 0.05 adjustment factor to the current FRL and explained the reasons for not applying an adjustment to the 2017 FRL. The GCF scorecard for the pilot phase of REDD+ results-based payments allows HFLD countries such as Papua New Guinea to adjust a proposed FREL or FRL. However, at the time of constructing the FRL there was uncertainty over the agreed criteria for applying the GCF scorecard for results-based payments. Hence, Papua New Guinea considered the guidance from ART TREES 2.0 to be the most reliable for HFLD adjustments. The guidance requires a HFLD score to be calculated for each year of the reference period and the obtained values to be above the threshold of 0.5 in order for the country to be considered to have HFLD status. In response to the request of the AT, the Party provided information on the process for calculating the applied HFLD adjustment factor. Furthermore, Papua New Guinea explained that it did not apply an adjustment to the 2017 FRL as during the preparation phase neither GCF REDD+ results-based payments nor ART TREES had been established. The AT appreciates the clarifications provided and identifies as an area for future technical improvement the provision of the sources of information used to determine the annual data on forest cover and the deforestation rate (e.g. summarizing such information or the sources of information in a table in future FRL submissions) and the monitoring methodology applied to justify the Party's HFLD status over time.

21.	The AT noted from the FRL submission that the national and provincial land-use status reported by the PNGFA shows a total forest land area of 35.95 million ha in 2018. However, the country report for the Food and Agriculture Organization of the United Nations Global Forest Resources Assessment 2020 presents a forest land area of 35.86 million ha in 2018 and 35.80 million ha in 2020. Papua New Guinea explained that for reporting the forest land area in its second BUR and the accompanying technical annex on REDD+ results, as well as for the current FRL, the Climate Change Development Authority used the forest and land-use assessment estimates provided by the PNGFA. After the technical analysis of its second BUR, the PNGFA improved and updated the results from the forest land area assessment by correcting some errors and making changes to the land-use categorization (e.g. rubber plantations are categorized as cropland). The Climate Change Development Authority and the PNGFA are considering updating the estimates of land-use status in preparation for the next round of reporting to the UNFCCC. The AT appreciates the clarifications provided and commends the Party for continually updating its area of forest land and land-use data. It considers as an area for future technical improvement ensuring that estimates of areas of land use are consistent across all reporting and providing additional clarification of the derivation of such estimates, particularly in cases where forest definitions or reporting requirements may differ according to decision 13/CP.19, annex, paragraph 2(g), and how consistency of the reported estimates is ensured in future FRL submissions.

22.	The AT noted apparent differences between the EFs used in constructing the FRL and those presented in the paper by Fox et al. (2010) and from which the EFs were supposed to have been derived. The FRL submission reports the average above-ground biomass of primary lowland tropical rainforest in Papua New Guinea as 222.8 t/ha. However, Fox et al. (2010) reports average above-ground living biomass for 10 permanent sampling plots in primary lowland forest as 111.4 Mg C/ha. Another difference appears in the values for above-ground biomass of logged lowland tropical rainforest in the country. The FRL submission reports the average above-ground biomass to be 146.0 t/ha, whereas Fox et al. (2010) notes the average above-ground biomass for trees greater than 10 cm diameter and less than 10 cm diameter for 115 permanent sampling plots in selectively harvested lowland tropical forest as 66.3 and 6.7 Mg C/ha respectively. Papua New Guinea clarified that it did not use the carbon estimates but did use the biomass estimates presented in Fox et al. (2010). The carbon estimates were derived by converting those biomass values to carbon using the carbon factor of 0.47 from the 2006 IPCC Guidelines instead of the conversion value of 0.5 used by Fox et al. (2010). In response to the AT inquiring why Papua New Guinea chose to derive EFs from the data in Fox et al. (2010) rather than from those in Bryan et al. (2010), Papua New Guinea explained that the Bryan et al. (2010) study was conducted at a single site, whereas Fox et al. (2010) used data obtained from a much larger sample that covered more of the country and was therefore considered to be more representative. The AT appreciates the

clarifications provided by the Party of the derivation of EFs for its FRL and the approach and carbon factors applied, and considers as an area for future technical improvement including such clarifications of the rationale applied in future FRL submissions.

23. Papua New Guinea stated in its FRL submission that using country-specific EFs and possibly including additional forest carbon pools in future FRL calculations are dependent upon the completion of its first NFI. The AT notes this as an area for considerable future technical improvement.

24. Initially, the AT did not understand the differences between the identification of managed and unmanaged land and the assumptions applied in the BUR and in the FRL submission, and whether this led to differences in the AD used in both submissions. In its second BUR, the Party assumed that all land is under some form of community management and hence considered to be managed land. However, in its FRL submission, the Party considered forest and land-use change areas to be managed if they were affected by anthropogenic activities. The distinction between managed and unmanaged land was made on the basis of the presence of logging roads, permanent roads and bridges, forest cover losses near to villages and accessibility in terms of the topography. When forest cover loss was observed in inaccessible areas or located far from settlements and roads, these losses were not recorded or reported as part of the AD. Such observations were assumed to be due to natural disturbances (e.g. volcanic activity, landslides, cyclones). The AT notes that the definition of managed and unmanaged land could influence the estimation of emissions and/or removals. Therefore, the AT considers the consistent application of the definitions of managed and unmanaged land in the different submissions of Papua New Guinea to be an area for future technical improvement.

25. Papua New Guinea shared spreadsheets containing the data and calculations used for the FRL, which allowed the AT to analyse whether the information provided was transparent and complete. While the AT was able to reconstruct the FRL, it faced challenges in doing so owing to the intermediate calculations contained in the spreadsheets and the lack of instructions on the order of the calculations and how to interpret the data and estimates therein. The AT appreciates Papua New Guinea sharing the spreadsheets, which enhanced the completeness of the proposed FRL. Additionally, the AT considers as an area for future technical improvement the provision of additional instructions for tracking the calculations and interpreting the data and estimates in the spreadsheets in order to facilitate the reconstruction of the FRL, thereby ensuring completeness and transparency.

26. The AT noted that, in accordance with decision 13/CP.19, annex, paragraph 2(a), the FRL should maintain consistency with the emissions and removals reported in the national inventory report, in this case the national inventory report included in the second BUR (2022). The AT also noted that the Party used the same AD and EFs for both submissions but there are differences related to carbon pools, GHGs and methods. Papua New Guinea mentioned that the litter and soil organic carbon pools were not included in the second FRL owing to the lack of reliable data, while the estimates for these pools in the LULUCF GHG inventory were developed using default values from the 2006 IPCC Guidelines. There is also a difference in regard to biomass values because the loss of carbon from fuelwood gathering was considered in the national inventory report but not included under the REDD+ activity reducing emissions from forest degradation owing to a lack of reliable data. The FRL includes only CO_2, while the GHG inventory includes CO_2 and the non-CO_2 gases CH_4 and N_2O. Papua New Guinea mentioned as reasons for not including non-CO_2 gases in the FRL both the lack of accurate data and the probable insignificance of non-CO_2 gases for the FRL activities. Another difference is the exclusion of the biomass regrowth of forest that was degraded prior to 2000 from the FRL estimates, which was included in the GHG inventory and for which the values for above-ground biomass growth for forests older than 20 years from the 2006 IPCC Guidelines were applied. The AT commends Papua New Guinea for including the information noted in this paragraph in the FRL submission and considers maintaining consistency between future FRL submissions and national inventory reports as an area for future technical improvement.

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

27.   The FRL submission includes detailed and informative descriptions of the national circumstances, history of and progress in the implementation of REDD+ under the Convention, national economic policies relevant to GHG emissions and future plans relating to REDD+ implementation in the country. Additionally, the submission notes the goal of the Government of Papua New Guinea of planting 800,000 ha trees; therefore, it is anticipated that enhancement of forest carbon stocks would become one of the Party's major REDD+ activities in the near future. The AT found these descriptions helpful in setting out the context for Papua New Guinea's FRL submission and commends the Party in this regard.

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

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

29.   The pools included in the Party's FRL are above-ground and below-ground biomass. Deadwood, litter and soil organic carbon are not included.

30.   The methods used for estimating above-ground and below-ground carbon stocks, carbon stock changes and emissions for these carbon pools are included in the modified FRL submission. With regard to the exclusion of the deadwood, litter and soil organic carbon pools, the Party noted that it does not have reliable country-specific carbon stock values and relevant default values are not available in the 2006 IPCC Guidelines. The AT considers that the exclusion of these pools was adequately justified, noting the Party's aim to include them in future FRL submissions as part of the stepwise approach. Papua New Guinea noted the importance of completing the first NFI, which would provide carbon stock estimates for developing EFs for these excluded forest carbon pools. The AT concludes that the eventual inclusion of emissions from the currently excluded forest carbon pools in order to enhance consistency with the GHG inventory for the LULUCF sector is an area for future technical improvement.

31.   As the FRL submission includes only CO_2 emissions, the AT considers the treatment of non-CO_2 gases as an area for future technical improvement and another area for increasing consistency with the GHG inventory for the LULUCF sector. Papua New Guinea may wish to explore the potential contribution of the emissions of the non-CO_2 gases CH_4 and N_2O to the total forest-related emissions in order to assess their significance and to inform the potential inclusion of such gases in future FRL submissions. The AT commends Papua New Guinea for its plans to monitor non-CO_2 emissions from biomass burning on forest land in the future.

32.   The AT acknowledges that Papua New Guinea included in its FRL the most significant activities, namely reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks, of the five activities identified in decision 1/CP.16, paragraph 70, in accordance with its national capabilities and circumstances. The AT notes that no removals from enhancement of forest carbon stocks were observed during the reference period of the current FRL. As noted in paragraph 13 above, Papua New Guinea considers this activity relevant for future national plans and therefore included it in the FRL as in previous FRL submissions to the UNFCCC. The AT considers that the transparency of future FRL submissions could be improved through the presentation of additional information to justify the inclusion of this activity, including describing the detection methods and providing estimates of carbon stock enhancements rather than assuming zero net change, as has been done in FRL submissions so far, and that the Party could consider reporting even minor carbon stock enhancements.

33.   On the basis of the information provided by the Party, the AT notes that the estimation of emissions and removals will be more comprehensive once the NFI has been completed. The AT commends Papua New Guinea for its ongoing efforts and its intention to improve its emission and removal factors on the basis of field data measurements, which is in line with the stepwise approach outlined in decision 12/CP.17, paragraph 10.

4. Definition of forest

34.   Papua New Guinea provided in its submission the definition of forest used in constructing its FRL. The definition is the same as that used by the Party for its national GHG inventory and its reporting to the Food and Agriculture Organization of the United Nations for the Global Forest Resources Assessment. Forest is defined as land spanning more than 1 ha, with trees higher than 3 m and canopy cover of more than 10 per cent.

III. Conclusions

35.   The information used by Papua New Guinea in constructing its FRL for the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks is transparent, complete and in overall accordance with the guidelines for submissions of information on reference levels.

36.   The FRL presented in the submission is Papua New Guinea's second FRL. The previous FRL was submitted in January 2017 and was subject to a TA in 2017. It covered the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for the reference period 2001–2013.

37.   The FRL presented in the current modified submission, for the reference period 2009–2018, corresponds to 40,518,579 t CO_2 eq/year.

38.   The AT acknowledges that Papua New Guinea included in its FRL the most significant activities, the most important forest types and the most significant pools in terms of emissions from forests. The AT considers that, in doing so, Papua New Guinea followed decision 1/CP.16, paragraph 70, on activities undertaken and decision 12/CP.17, paragraph 10, on applying the stepwise approach.

39.   As a result of the facilitative interactions with the AT during the TA, Papua New Guinea 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 FRL submission, without having to alter the approach or values used to construct the FRL, and commends Papua New Guinea on its efforts. The new information provided in the modified submission increased the reproducibility and transparency of the FRL calculations.

40.   The AT notes that, overall, Papua New Guinea maintained consistency, in terms of sources of AD and EFs used for its FRL, with those used for the GHG inventory included in its second BUR (2022).[15]

41.   Pursuant to decision 13/CP.19, annex, paragraph 2(f), in assessing the pools and gases included in the FRL, the AT noted that only the above-ground and below-ground biomass pools were included, and that non-CO_2 gases were excluded. According to the Party, non-CO_2 gases and the deadwood, litter and soil organic carbon pools were not included in the second FRL owing to a lack of reliable data.

42.   Pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following areas for future technical improvement regarding pools and gases excluded from the FRL:

        (a)   Including emissions from the currently excluded deadwood, litter and soil organic carbon pools in order to enhance consistency with the national GHG inventory (see para. 30 above);

        (b)   Exploring the potential contribution of the emissions of the non-CO_2 gases CH_4 and N_2O to the total forest-related emissions in order to assess their significance and to inform the potential inclusion of such gases in future FRL submissions (see para. 31 above).

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

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

(a)   Providing the sources of information used to determine the annual data on forest cover and the deforestation rate and the monitoring methodology applied to justify the Party's HFLD status over time (see para. 20 above);

(b)   Ensuring that estimates of areas of land use are consistent across all reporting and providing additional clarification of the derivation of such estimates, particularly in cases where forest definitions or reporting requirements may differ, and how consistency of such estimates is ensured in future submissions (see para. 21 above);

(c)   Clarifying the rationale behind the derivation of EFs for the FRL and the approach and carbon factors applied (see para. 22 above);

(d)   Completing the NFI to allow the development of country-specific EFs, improvement of removal factors and possible inclusion of additional carbon pools in future FRL submissions (see paras. 23 and 33 above);

(e)   Ensuring consistency in the identification of managed and unmanaged land and in the application of assumptions for such identification and providing more specific clarification in this regard (see para. 24 above);

(f)   Presenting additional instructions for tracking the FRL calculations and clarification of how to interpret the data and estimates contained in the spreadsheets to facilitate the reconstruction of the FRL (see para. 25 above);

(g)   Considering sharing in advance the supporting materials, in particular the spreadsheets, needed by the AT to reconstruct the FRL and providing them together with the submission or separately during the TA (see para. 11 above);

(h)   Maintaining consistency of information, gases and pools included between future FRL submissions and the national GHG inventory (see para. 26 above);

(i)   Providing additional information to justify the inclusion of the activity enhancement of forest carbon stocks, such as describing the detection methods and providing estimates of carbon stock enhancements rather than assuming zero net change, and considering reporting even minor carbon stock enhancements (see para. 32 above).

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

(a)   Estimate forest carbon stock enhancements once the government programme of tree planting is under way;

(b)   Include currently excluded forest carbon pools (deadwood, litter and soil organic carbon) once relevant EFs become available from the NFI;

(c)   Use country-specific EFs for forest types for which default values from the 2006 IPCC Guidelines are currently used once relevant data are available from the NFI;

(d)   Monitor non-CO_2 emissions from forest land biomass burning;

(e)   Address capacity-building needs relating to the use of a tier 2 level uncertainty analysis (Monte Carlo) methodology developed or adopted for assessing post-deforestation regrowth and associated emission reductions, and monitoring of near-real-time national-scale forest carbon dynamics using space-borne light detection and ranging data, such as with the Global Ecosystem Dynamics Investigation instrument.

45.   In conclusion, the AT commends Papua New Guinea for showing strong commitment to continuously improving its FRL estimates in line with the stepwise approach. A number of areas for the future technical improvement of Papua New Guinea's FRL 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.[16] The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Papua New Guinea.

46.   The table contained in annex I summarizes the main features of Papua New Guinea's proposed FRL.

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[16] 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 level based on information provided by Papua New Guinea

Main features of the FRL		*Remarks*
Proposed FRL	40 518 579 t CO_2 eq/year	The FRL is based on the average historical CO_2 emissions from deforestation, forest degradation and enhancement of forest carbon stocks (see para. 8 of this document)
Type and reference period of FRL	FRL = average of historical emissions in 2009–2018	The FRL was constructed on the basis of a 10-year historical reference period (2009–2018) to be applied for REDD+ results in 2019–2027 (see paras. 8 and 12 of this document)
Application of adjustment for national circumstances	Yes	An upward adjustment of 5 219 378 t CO_2 eq/year was applied (see para. 17 of this document)
National/subnational	National	The national FRL covers the country's entire territory (see para. 7 of this document)
Activities included	Reducing emissions from deforestation Reducing emissions from forest degradation Enhancement of forest carbon stocks	Sustainable management of forests and conservation of forest carbon stocks are not included (see paras. 7 and 13 of this document)
Pools included	Above-ground biomass Below-ground biomass	Deadwood, litter and soil organic carbon are not included (see paras. 9 and 30 of this document)
Gas included	CO_2	Other GHGs are not included owing to lack of available data (see paras. 9 and 31 of this document)
Forest definition	Included	Land spanning more than 1 ha, with trees higher than 3 m and canopy cover of more than 10 per cent. This excludes land that is predominantly under agricultural or urban land use (see para. 34 of this document)
Consistency with latest GHG inventory	Methods used for estimating the FRL are partially consistent with those used for the latest GHG inventory (2022)	Non-CO_2 GHGs, the carbon pools litter and soil organic carbon, loss of carbon from fuelwood gathering and biomass regrowth of forest degraded prior to 2000 are included in the GHG inventory but not the FRL (see para. 26 of this document)
Description of relevant policies and plans	Included	The FRL submission includes detailed and informative descriptions of the national circumstances, history of and progress in the implementation of REDD+ under the Convention, national economic policies relevant to GHG emissions and future plans relating to REDD+ implementation in the country (see para. 27 of this document)
Description of assumptions on future changes to domestic policy, if included in constructing the FRL	Not applicable	
Description of changes to previous FRL	Included	See paragraphs 10 and 18–20 of this document
Identification of future technical improvements	Included	Several areas for future technical improvement have been identified (see paras. 42–43 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 second, including modified, FRL submissions of Papua New Guinea. Available at https://redd.unfccc.int/submissions.html?country=png.

"Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels". Decision 13/CP.19, annex. 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". Decision 12/CP.17, annex. Available at https://unfccc.int/sites/default/files/resource/docs/2011/cop17/eng/09a02.pdf#page=19.

Report on the TA of the proposed FRL of Papua New Guinea submitted in 2017. FCCC/TAR/2017/PNG. Available at https://redd.unfccc.int/submissions.html?country=png.

Second BUR and national inventory report of Papua New Guinea, submitted in 2022. Available at https://unfccc.int/BURs.

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:

Bey A, Diaz AS, Maniatis, D, Marchi G et al. 2019. Collect Earth: Land use and land cover assessment through augmented visual interpretation. *Remote Sensing*. 8:807–830.

Bryan J, Shearman P, Ash J and Kirkpatrick J. 2010. Impact of logging on aboveground biomass stocks in lowland rain forest, Papua New Guinea. *Ecological Applications*. 20(8), pp. 2096–2103.

Food and Agriculture Organization of the United Nations. Global Forest Resources Assessment 2020. Rome: Food and Agriculture Organization of the United Nations. Available at https://www.fao.org/forest-resources-assessment/2020/en/.

Fox JC, Yosi CK, Nimiago P, Oavika F et al. 2010. Assessment of aboveground carbon in primary and selectively harvested tropical forest in Papua New Guinea. *Biotropica*. 42:pp 410–419.

Hammermaster ET and Saunders JC. 1995. Forest resources and vegetation mapping of Papua New Guinea. PNGRIS Publication No. 4. Canberra: CSIRO.