Technical report on the technical analysis of the technical annex to the second biennial update report of Papua New Guinea submitted in accordance with decision 14/CP.19, paragraph 7, on 25 May 2022

Summary

This technical report covers the technical analysis of the technical annex submitted on a voluntary basis, in the context of results-based payments, by Papua New Guinea on 25 May 2022 through its second biennial update report in accordance with decision 14/CP.19. The technical annex provides data and information on the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks, which are activities included in decision 1/CP.16, paragraph 70, and covers the same national territorial forest area as the assessed forest reference level (FRL) proposed by Papua New Guinea in its modified FRL submission of July 2017.

Papua New Guinea reported the results of implementing these activities for 2016–2018, which amount to 13,777,302 (2016), 24,394,158 (2017) and 23,169,695 (2018) tonnes of carbon dioxide equivalent and were measured against the assessed FRL of 46,728,951 (2016), 48,408,557 (2017) and 50,088,164 (2018) tonnes of carbon dioxide equivalent.

The data and information provided in the technical annex are in overall accordance with the guidelines contained in decision 14/CP.19, annex. The technical analysis concluded that the data and information provided by Papua New Guinea in the technical annex are transparent and overall consistent with the data and information used for establishing the assessed FRL in accordance with decision 1/CP.16, paragraph 71(b), and decision 12/CP.17, section II. This report contains the findings from the technical analysis and a few areas identified for capacity-building and future technical improvement in accordance with decision 14/CP.19, paragraph 14.

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Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
BUR	biennial update report
CGE	Consultative Group of Experts
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
EF	emission factor
FRL	forest reference level
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
NFI	national forest inventory
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)
TA	technical analysis
TTE	team of technical experts

I. Introduction, overview and summary

A. Introduction

1.   This technical report covers the TA of the technical annex provided by Papua New Guinea on 25 May 2022 in accordance with decision 14/CP.19, paragraph 7, included in its second BUR, which was submitted in accordance with decision 2/CP.17, paragraph 41(a), and annex III, paragraph 19. In the technical annex, Papua New Guinea provided the data and information used for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and changes in forest carbon stock and forest area resulting from implementing REDD+ activities. The submission of the technical annex is voluntary and in the context of results-based payments in accordance with decision 14/CP.19, paragraph 8. The TA was coordinated by Pierre Brender (secretariat).

2.   The TA of the technical annex is part of the international consultation and analysis of BURs referred to in decision 2/CP.17, annex IV, paragraph 4, the objective of which is to increase the transparency of mitigation actions and their effects through analysis by the TTE in consultation with Papua New Guinea and through a facilitative sharing of views, resulting in a separate summary report.[1]

3.   Papua New Guinea made its FRL submission, in accordance with decision 12/CP.17, on 15 January 2017, which was subject to a technical assessment following the guidance provided in decision 13/CP.19 and its annex. Taking into consideration the technical inputs of the assessment team, Papua New Guinea submitted a modified version of its proposed FRL on 10 July 2017. The assessed FRL was included as one of the elements of the technical annex to its second BUR in accordance with the guidelines contained in decision 14/CP.19, annex. The findings from the technical assessment of the FRL are included in a separate report.[2]

4.   Papua New Guinea previously submitted a technical annex to its first BUR on 17 April 2019. The outcome of the TA thereof is contained in document FCCC/SBI/ICA/2019/TATR.1/PNG. Previous FRL submissions, BURs with technical annexes and associated technical assessment and analysis reports for the Party are available online.[3]

B. Process overview

5.   The TA of the second BUR of Papua New Guinea took place from 29 August to 2 September 2022 as a desk analysis and was undertaken by the following TTE drawn from the UNFCCC roster of experts on the basis of the criteria defined in decision 20/CP.19, annex, paragraphs 2–6: Parvana Babayeva (Azerbaijan), Ménouer Boughedaoui (former member of the CGE from Algeria), Rémi D'Annunzio (France), Manuel Estrada (Mexico), Ngozi Eze (Nigeria), Akram Hamza (Tunisia), Gervais Ludovic Itsoua Madzous (former member of the CGE from the Congo), Rocio Lichte (former member of the CGE from Germany), Philippe Missi Missi (Cameroon), Takashi Morimoto (Japan), Ngoc Tran Thi Bich (Viet Nam) and Harry Vreuls (Kingdom of the Netherlands). Rémi D'Annunzio and Manuel Estrada were the LULUCF experts who undertook the TA of the technical annex in accordance with decision 14/CP.19, paragraphs 10–13.

6.   The TA of the technical annex provided by Papua New Guinea was undertaken in accordance with the procedures contained in decisions 2/CP.17, 14/CP.19 and 20/CP.19. This technical report on the TA was prepared by the LULUCF experts in the TTE in accordance with decision 14/CP.19, paragraph 14.

7.   During the TA and subsequent exchanges, the LULUCF experts and Papua New Guinea engaged in technical discussions, and Papua New Guinea provided clarifications in

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[1] FCCC/SBI/ICA/2022/TASR.2/PNG.

[2] FCCC/TAR/2017/PNG, published on 2 March 2018.

[3] https://redd.unfccc.int/submissions.html?country=PG.

response to questions raised by the LULUCF experts, in order to reach an understanding on the identification of the capacity-building needs of the Party and areas for future technical improvement.

8.   Following the TA of the technical annex, the LULUCF experts prepared and shared the draft technical report with Papua New Guinea for its review and comments. The LULUCF experts responded to the Party's comments and incorporated them into and finalized this technical report in consultation with Papua New Guinea.

C.   Summary of results

9.   In decision 1/CP.16, paragraph 70, the Conference of the Parties 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 in accordance with its respective capabilities and national circumstances. In the context of results-based payments and in line with decision 12/CP.17, Papua New Guinea, on a voluntary basis, proposed a national FRL covering the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for the purpose of a technical assessment in accordance with decision 13/CP.19 and its annex. The activities are being implemented in Papua New Guinea's national territory. The assessed FRL of Papua New Guinea is 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.

10.   The Party's FRL is based on its projected CO_2 emissions for 2014–2018 associated with the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks, extrapolated from the emissions over the historical reference period 2001–2013 using a linear regression equation. Papua New Guinea reported the results of implementing the activities for 2016–2018, calculated against the FRL, which amount to emission reductions of 13,777,302 (2016), 24,394,158 (2017) and 23,169,695 (2018) t CO_2 eq. In addition, measured against the same assessed FRL, Papua New Guinea submitted results amounting to 3,957,412 (2014) and 5,045,902 t CO_2 eq (2015), which were assessed in 2019.[4]

II.   Technical analysis of the information reported in the technical annex

A.   Technical annex

11.   For the technical annex to the second BUR submitted by Papua New Guinea, see annex I.[5]

B.   Technical analysis

12.   The scope of the TA is outlined in decision 14/CP.19, paragraph 11, according to which the TTE shall analyse the extent to which:

        (a)   The methodologies, definitions, comprehensiveness and information provided are consistent between the assessed FRL and the results of implementing REDD+ activities;

        (b)   The data and information provided in the technical annex are transparent, consistent, complete and accurate;

        (c)   The data and information provided in the technical annex are consistent with the guidelines referred to in decision 14/CP.19, paragraph 9;

        (d)   The results are accurate, to the extent possible.

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[4] See document FCCC/SBI/ICA/2019/TATR.1/PNG.
[5] As per decision 14/CP.19, para. 14(a).

13.   The remainder of this chapter presents the results of the TA of the technical annex to the Party's second BUR according to the scope outlined in paragraph 12 above.

1. Consistency in methodologies, definitions, comprehensiveness and information provided between the assessed reference level and the results in the technical annex

14.   In accordance with decision 14/CP.19, paragraph 3, the data and information used by a Party for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and changes in forest carbon stock and forest area resulting from implementing REDD+ activities should be transparent and consistent over time and with the data and information used for establishing its FRL in accordance with decision 1/CP.16, paragraph 71(b–c), and decision 12/CP.17, section II.

15.   The LULUCF experts noted that Papua New Guinea ensured overall consistency between its assessed FRL and estimated results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks in 2016–2018 by:

        (a)   Using consistent methodologies and data sources to generate AD on deforestation, degradation and enhancement of forest carbon stocks, in particular using the same sample-based approach, using systematic 0.04 and 0.02 degree grids (see para. 24 below) and the same satellite data interpretation tool (Collect Earth, developed by the Food and Agriculture Organization of the United Nations), in which the same classification system and sampling size was used (six IPCC land-use categories and various national subcategories). As for the FRL, the results were estimated using mainly satellite imagery made available through Google Earth, Bing Maps and Google Earth Engine as well as other medium- and high-resolution imagery made available through Collect Earth (see para. 25 below);

        (b)   Using consistent methodologies and data sources to generate most EFs, in particular using the same two sources described in the 2017 modified FRL submission, namely Fox et al. (2010) for the five forest types in the tropical rainforest ecological zone and the default values from the 2006 IPCC Guidelines for forest types in the other ecological zones (tropical mountain system, dry forest, shrubland, wet mangrove and rainforest plantation);

        (c)   Covering the same two carbon pools: above-ground and below-ground biomass;

        (d)   Covering the same gas: CO_2;

        (e)   Covering the same area: entire national territory;

        (f)   Assuming that all carbon from the two carbon pools is lost in the year of the deforestation event but then progressively recovered (taken into account using a post-deforestation regrowth factor);

        (g)   Using the same forest definition: land spanning more than 1 ha with trees higher than 3 m and canopy cover of more than 10 per cent, excluding predominantly agricultural or urban land.

16.   Papua New Guinea used a different methodology for the treatment of post-deforestation regrowth for the estimated results compared with that used for the assessed FRL. It explained in section 3.2 of the technical annex that the approach used for the FRL, namely linear projection of post-deforestation removals, did not reflect the assumed increase in deforestation over time in the FRL. While the LULUCF experts acknowledged that the correction factor applied to the projected FRL when estimating the results enabled the Party to avoid systematically overestimating them, they noted that this leads to inconsistency between the assessed FRL and the results in the technical annex. In response to a question from the LULUCF experts during the TA of the technical annex to the Party's first BUR for which the same approach was applied, Papua New Guinea stated that the updated method for treating post-deforestation removals used to calculate the results may be used for future FRLs. The LULUCF experts commend Papua New Guinea for its efforts to increase the

accuracy of the estimated results over time and for its plans to ensure consistency between future FRLs and results in line with the stepwise approach.

17. In view of the above, the LULUCF experts concluded that the results presented of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks are overall consistent with the assessed FRL.

18. Papua New Guinea included in the technical annex to its second BUR (section 4) a description of how its FRL and the estimated results could be recalculated in the context of a future submission to the Green Climate Fund under the pilot programme for REDD+ results-based payments. The LULUCF experts noted that this is beyond the scope of this TA.

2. Transparency, consistency, completeness and accuracy of the data and information provided in the technical annex

19. As part of the TA process, Papua New Guinea provided additional information, in particular on the sampling approach used, sources of AD and uncertainty calculations, including a detailed spreadsheet showing on how it calculated the results. The LULUCF experts commend Papua New Guinea for its efforts to ensure the completeness[6] of the data and information provided. However, the absence of a clear description of the statistical procedure used to estimate AD from the sampling plots, and of the raw data used to generate AD, meant that it was not possible to fully reconstruct the results. The LULUCF experts note this as an area for future technical improvement that would increase transparency and completeness. The LULUCF experts consider that the Party could improve transparency by improving public access to the data sources and calculations shared with the experts, noting this as an area for future technical improvement, as well as by including in the aforementioned spreadsheet explanation of what it contains.

20. According to decision 12/CP.17, paragraph 8, the FRL shall be established taking into account decision 4/CP.15, paragraph 7, and maintaining consistency with the anthropogenic forest-related GHG emissions by sources and removals by sinks reported in the Party's GHG inventory. The team assessing Papua New Guinea's FRL noted that the Party did not maintain consistency in terms of sources of AD and EFs with those used for the GHG inventory included in its second national communication, submitted in 2015.[7] The LULUCF experts noted that this is also true for the estimated results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for 2016–2018. During the TA, Papua New Guinea clarified that the second national communication was prepared and submitted before the NFMS was established in 2016; hence, AD and EFs (particularly AD) used for the second national communication were not from the NFMS. Papua New Guinea also clarified that it used AD from the NFMS to construct its first and second FRLs and to prepare the LULUCF GHG inventories included in its first and second BURs. The LULUCF experts welcome this additional information and commend Papua New Guinea on its efforts to use more recent and accurate information from the NFMS for estimating its FRL and results.

21. The LULUCF experts noted that there were differences in the aggregate LULUCF emissions for 2000–2015 presented in the GHG inventories included in the Party's first and second BURs. In response to a question from the LULUCF experts on how this affected consistency between the GHG inventory included in the second BUR and the estimated results, the Party explained that these differences were due to non-CO_2 emissions from biomass burning in forest land being recalculated with updated AD in the second BUR, while other recalculations were made in relation to cropland remaining cropland owing to the inclusion of organic soils, which had been omitted from the first BUR. The LULUCF experts acknowledge this information and consider that the recalculations did not create inconsistencies between the estimated results and the GHG inventory included in the second BUR.

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[6] "Complete" here means including the information necessary for reconstructing the results.
[7] Available at https://unfccc.int/documents/138878.

22. In the technical annex, Papua New Guinea reported that all methods and data are described on its national climate change and forest monitoring web portal. The LULUCF experts were unable to access the web portal during the TA owing to technical issues, but it was available at a later date through an updated web address.[8] In response to a question from the LULUCF experts during the TA, Papua New Guinea explained that the spatial information (images and annual maps) that is publicly available on the web portal is described in a publication by the Climate Change and Development Authority (2022) and enables users to reconstruct annual emission estimates. Additionally, the Party noted that detailed information on the sampling design used within the NFMS and for constructing the FRL can be found in a publication by the Papua New Guinea Forest Authority (2019). The LULUCF experts noted that the technical annex does not include a clear reference to external sources showing the assessment of land cover using Collect Earth. During the TA, the Party shared the link to the aforementioned Papua New Guinea Forest Authority report, where the results for 2000–2015 are publicly available, and shared a copy of a draft Papua New Guinea Forest Authority report containing more detailed information on the results for 2016–2018.

23. Papua New Guinea is currently developing an NFI, which is expected to provide data that will improve the accuracy of its emission estimates. The LULUCF experts commend Papua New Guinea for continuing to improve the accuracy of its estimates.

24. The LULUCF experts noted that Papua New Guinea mentioned two levels of sampling intensity (0.04 and 0.02 degree grids) in section 5.2.1 of the technical annex. However, it was not clear which grid was applied in which case. In response to a question from the LULUCF experts, the Party clarified that 0.02 degree grids were used for the three smaller provinces with less than 500,000 ha land mass each (Western Highlands, Jiwaka and Manus), while 0.04 degree grids were used for the remaining provinces. The grids were then laid over the national map, creating a total of 25,279 sampling plots. The 2019 report by the Papua New Guinea Forest Authority shared by the Party contains detailed information on the sampling design within the NFMS used for constructing the FRL. The LULUCF experts welcome this information and consider that including it in future FRL submissions would enhance transparency.

25. In comparing table 8 of the technical annex to the second BUR with table 4.1 of the technical annex to the first BUR, the LULUCF experts noted that, in the most recent technical annex, the Party included Sentinel-2A and Sentinel-2B imagery to complement its land-use assessment that was not considered in constructing the FRL or developing the previous technical annex. In response to a question from the experts on how this affected consistency between the FRL and the estimated results, Papua New Guinea noted that the assessment of land-use change was based on the same data (Landsat) in both cases and that interpretation of higher-resolution imagery (such as from Sentinel-2 or Google Earth, Bing Maps and Planet) was used as reference information.

26. The LULUCF experts noted the incorrect use of the annual unit (t CO_2 eq/year) for the quantification of emissions over several years. For instance, in table 2 of the technical annex, the estimated results are reported as 61,341,155.18 t CO_2 eq for 2016–2018, not 61,341,155.18 t CO_2 eq/year. Papua New Guinea agreed that the latter is incorrect and stated that it plans to correct this error in the next FRL submission. The experts also noted that table 8 of the technical annex mentions that the SkySat imagery used was of medium resolution (3–5 m). During the TA, the Party clarified that the submetric SkySat data were used through the Planet L1 base maps of Norway's International Climate and Forest Initiative, resampled at that medium spatial resolution. The experts noted checking the accuracy of units and clarifying the data sets used for the land-use change assessment as an area for future technical improvement.

27. The LULUCF experts concluded that the Party provided the information necessary for understanding how it estimated the results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks. The data and information provided in the technical annex are considered to be transparent, overall consistent, complete and accurate to the extent possible.

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[8] http://nfms-png.org/portal/.

3. Consistency with the guidelines on elements to be included in the technical annex

28. Papua New Guinea provided data and information on all the required elements in accordance with the guidelines contained in decision 14/CP.19, annex, namely summary information from the final report containing the assessed FRL; results in t CO_2 eq/year that are overall consistent with the assessed FRL; a demonstration that the methodologies used to produce the results are overall consistent with those used to establish the assessed FRL (as outlined in chap. II.B.1 above); a description of the forest monitoring system and institutional roles and responsibilities in the measurement, reporting and verification of the results; the information necessary for reconstructing the results (as outlined in chap. II.B.2 above; see also para. 19 above); and a description of how the elements contained in decision 4/CP.15, paragraph 1(c–d), have been taken into account.

29. Papua New Guinea provided a summary table with the results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for 2016–2018, which are overall consistent with the assessed FRL. The emission reductions achieved are listed in table 3 of the technical annex and amount to 13,777,302 t CO_2 eq for 2016, 24,394,158 t CO_2 eq for 2017 and 23,169,695 t CO_2 eq for 2018. These figures include the post-deforestation correction to reflect post-deforestation removals.

30. The LULUCF experts noted that Papua New Guinea provided a description of the NFMS and a summary of the roles and responsibilities of the agencies and institutions involved in the measurement, reporting and verification of the results in the technical annex, together with weblinks for accessing further information. During the consultation process, Papua New Guinea explained that, in the context of the BUR, the Climate Change and Development Authority is responsible for estimating emissions and removals from the LULUCF sector using AD provided by the Papua New Guinea Forest Authority. The Forest Authority assists in estimating emissions and removals by taking part in the REDD+ Technical Working Committee, which comprises representatives of government, the private sector, academia, non-governmental organizations, civil society and development partners, and provided technical support for the preparation of the technical annex. The LULUCF experts commend Papua New Guinea for sharing this information.

31. The forest monitoring system is a national system. The system assesses data related to forest and land use using statistical methods and wall-to-wall mapping. Information is disseminated through the Party's climate change and forest monitoring web portal. The Party is in the process of developing a multipurpose NFI that addresses forest management and biodiversity conservation needs in the country. The LULUCF experts commend Papua New Guinea for its efforts to improve its forest data and information in line with the stepwise approach.

32. According to decision 11/CP.19, paragraph 4(b), the NFMS should enable the assessment of different types of forest in the country, including natural forest. In the technical annex, Papua New Guinea explained that natural forests are stratified into 13 vegetation types and plantation forests are considered as separate forest categories. The Party plans to further categorize these forest types after the completion of the NFI. The LULUCF experts commend Papua New Guinea for its efforts in this regard.

33. As the NFMS is national in scope, the LULUCF experts noted that the displacement of forest emissions in the national territory will be captured by the NFMS and is thus not an issue in the context of the TA.

34. Papua New Guinea provided a description of how IPCC guidance and guidelines were taken into account in accordance with decision 4/CP.15, paragraph 1(c). For estimating emission reductions, Papua New Guinea used the methodology provided in the 2006 IPCC Guidelines for estimating carbon stocks in forest land converted to other land uses. Accordingly, the emissions from deforestation and forest degradation were estimated for 2016–2018 by combining AD (i.e. areas of annual deforestation) with the appropriate EF (i.e. emissions associated with the corresponding forest type). Papua New Guinea included the activity enhancement of forest carbon stocks in its assessed FRL and technical annex, though, as noted in the previous technical annex, no removals from enhancement of forest carbon stocks were observed during either the reference period or the results period, including 2016–

2018. As noted in the previous technical report on the TA of the technical annex, Papua New Guinea considers enhancement of forest carbon stocks (mainly through reforestation and afforestation) to be a critical component of its national policies and thus includes it in constructing its FRL and estimating its results to ensure its ongoing monitoring.

35.   In constructing its FRL and estimating the results, the Party covered the most significant carbon pools (above-ground and below-ground biomass) and gas (CO_2) on the basis of available information presented in its modified FRL submission. The LULUCF experts note that the reasons for excluding some carbon pools (deadwood, litter and soil organic carbon) and emissions of non-CO_2 gases (methane and nitrous oxide) from biomass burning were discussed extensively in the technical assessment report on Papua New Guinea's FRL and that the areas for future technical improvement identified during the assessment of the FRL related to pools and gases also apply to the results in the technical annex.

4.   Accuracy of the results proposed in the technical annex

36.   The LULUCF experts noted that the Party estimated the results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks in the national area using a transparent and overall consistent approach. They commend Papua New Guinea for its significant long-term efforts to build up a robust NFMS that is capable of providing transparent estimates of emissions from deforestation.

37.   Both the established FRL and the results obtained for 2016–2018 from implementing the activities are based on the following key assumptions related to accuracy:

(a)   The EF for forest degradation due to a disturbance or management practice includes CO_2 removals occurring after the event and assumes that the carbon stocks in degraded forests are 65.5 per cent of those in primary forests, estimated on the basis of measurements taken in commercially logged-over low-altitude forests by Fox et al. (2010). The removal factor for post-deforestation regrowth in forest land converted to cropland or grassland with perennial woody vegetation is based on the weighted average of the default mean annual biomass increment value (8.11 t dry matter/year/ha) for several cropland and grassland types provided in the 2006 IPCC Guidelines;

(b)   Removals from post-deforestation regrowth of trees in cropland and grassland were deducted when calculating emissions from deforestation. IPCC default values were used owing to lack of country-specific data on biomass and increments in biomass for land uses other than forest. Removals from deforested land were accounted for in the year of the deforestation event and for another 19 years with a linear growth function. The Party assumed an average annual mean increment in living biomass of 8.11 t dry matter/ha/year based on the weighted mean annual increment in above-ground biomass and a root-to-shoot ratio of 0.37. As for the technical annex to its first BUR, it applied a correction factor to post-deforestation removals in order to reflect that the linear increase of deforestation assumed in the reference level is associated with a non-linear increase in cumulated deforested areas, and not a linear one as assumed for the FRL submission. The LULUCF experts welcome the Party's efforts to improve the accuracy of the results by using a quadratic function (labelled "exponential increase" in the technical annex) for the increase of removals, while reiterating the suggestion from the previous TA to use, when possible, country-specific post-deforestation biomass growth rates for non-forest land use;

(c)   Emissions from forest degradation were estimated by applying the average above-ground biomass estimates provided by Fox et al. (2010) for carbon stocks in primary forests in five lowland tropical rainforest types (low-altitude forest on plains and fans, low-altitude forest on upland, littoral forest, seral forest and swamp forest) and for above-ground biomass for logged-over lowland tropical rainforest. In this study, the carbon stocks in selectively harvested forests were estimated by means of a random sampling of plots in forests that had been subject to harvesting within the last four years. The above-ground biomass value used for estimating the carbon stock of logged-over forest was also used for forest disturbed by anthropogenic activities other than commercial logging for the five lowland tropical rainforest types. These data were deemed to represent the average condition

of degraded forests in the country, which results from an initial loss of carbon during a logging event and its regrowth during the subsequent forest recovery. The LULUCF experts reiterate the finding from the TA of the technical annex to the Party's first BUR that, while the Party used the best data set available at the time to estimate post-disturbance regrowth, it is difficult to determine the extent to which the EFs include forest regrowth because post-disturbance stocks were measured within a period after logging ranging from a few months to four years. They therefore agree that this approach may result in a significant level of uncertainty and cause CO_2 removals from post-disturbance biomass accumulation to be underestimated for the historical reference period, and thus again consider the accurate determination of the extent of forest regrowth included in the EF for degradation as an area for future technical improvement. The experts also reiterate the previous finding that the EFs used for forest degradation, which assume that all disturbance types cause the same loss of biomass carbon stocks in primary forests (with the exception of mangroves) as commercial logging, may reduce the accuracy of the forest degradation emission estimates, and again consider accurately determining losses of biomass carbon stocks resulting from different types of disturbance as an area for future technical improvement that would enhance the accuracy of future FRLs and estimated results. Further, they reiterate the previous finding that assuming that forest degradation occurs only once and that there are no subsequent degradation events in forest areas already subject to degradation could lead to the underestimation of total emissions from forest degradation by excluding emissions from subsequent forest degradation in such areas, and thus again consider the tracking of land subject to degradation and the inclusion of emissions from subsequent degradation events as areas for future technical improvement that would increase accuracy;

(d) For enhancement of forest carbon stocks, a removal factor was developed only for plantations of 24.7 t CO_2 eq/ha/year based on a default increment of 9.5 m³ merchantable volume/ha/year, an average biomass conversion and expansion factor of 1.1 and a root-to-shoot ratio of 0.37, as per the 2006 IPCC Guidelines, but no area subject to such conversion was identified during either the reference period or the results period as mentioned in paragraph 34 above.

38. As mentioned in paragraph 19 above, Papua New Guinea provided information on uncertainty of estimated emissions and removals associated with the different REDD+ activities. In the table in section 6.2 of the technical annex, the Party presented the average area represented by each sampling plot. It was not clear to the LULUCF experts how the areas shown in that table were calculated or whether they apply to all plots uniformly. In response, Papua New Guinea explained that the areas in the second column stemmed from a Collect Earth assessment of plot numbers multiplied by an expansion factor, while the "area [Ai]" figures were calculated in accordance with the 2006 IPCC Guidelines (vol. 4, chap. 3). It noted that it did not treat the two different grid densities referred to in paragraph 24 above differently for the uncertainty analysis, while the expansion factors for the areas reported in the second column were calculated per province. The LULUCF experts thank the Party for the clarifications.

C. Areas identified for future technical improvement

39. The LULUCF experts concluded that the following areas for future technical improvement identified in the report on the technical assessment of Papua New Guinea's FRL also apply to the provision of information on the results of implementing the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks:

(a) Improving consistency between the FRL submission and the national GHG inventory, including through the selection of methods, data and assumptions, following the guidance provided in the relevant IPCC guidelines;

(b) Including a step-by-step description of the AD estimation procedure, including how AD on land use and land-use change are derived from Collect Earth (e.g. information on the statistical methods used to derive AD from Collect Earth assessments) to enable the reconstruction of the FRL and the results (see para. 19 above);

(c)   Using country-specific post-deforestation biomass growth rates for non-forest land use for estimating EFs for deforestation;

(d)   Improving the EFs for forest degradation, including through full implementation of the NFI, by:

(i)   Accurately determining the extent of forest regrowth included in the above-ground biomass carbon stocks in selectively logged forests;

(ii)   Accurately determining the losses in biomass carbon stocks in forest areas subject to disturbances other than logging;

(iii)   Tracking forest land subject to degradation and including in the FRL and the results emissions and removals from forest degradation events subsequently to the first occurrence of degradation;

(iv)   Using the actual values of pre-disturbance forest biomass carbon stocks rather than those for primary forests in estimating EFs for gardening;

(e)   Using information on national circumstances and the drivers of deforestation and forest degradation to support the selection of the model used to construct the FRL with a view to demonstrating its consistency with Papua New Guinea's national circumstances in future FRL and results submissions;

(f)   Exploring the use of a more robust methodology for identifying savannah and scrub areas meeting the forest definition;

(g)   Considering the treatment of emissions from deadwood (see para. 35 above);

(h)   Including emissions from soil organic carbon in the FRL and the results (see para. 35 above);

(i)   Monitoring non-CO_2 gases from biomass burning and considering their potential inclusion in the FRL, if considered significant (see para. 35 above).

40.   Furthermore, the LULUCF experts concluded that the area for improvement of applying the post-deforestation removal correction for the reference period of future FRLs (which is already being done for the results period), as identified in the report on the TA of Papua New Guinea's results for 2014–2015, also applies to the technical annex being analysed with a view to improving consistency between the methodologies used to establish the results and those used to construct the FRL.

41.   In addition, the LULUCF experts noted that Papua New Guinea could consider:

(a)   Clearly describing the statistical procedure used to estimate AD using the sampling plots, and the raw data used to generate AD (see para. 19 above);

(b)   Improving public access to (spatial) information on AD, uncertainty calculations and methods used as well as providing a spreadsheet showing how the results were calculated (see para. 19 above);

(c)   Checking the accuracy of units and clarifying the data sets used for the land-use change assessment (see para. 26 above).

D.   Comments and responses of the Party

42.   During the consultation process, Papua New Guinea noted a number of areas of capacity-building needs. Addressing those needs could enable Papua New Guinea to improve its data and methodologies and include additional activities and gases in future FRL submissions. After exchanges with the LULUCF experts, the Party identified the following immediate actions and capacity-building needs:

(a)   Improving the information provided in the FRL submission with a clear description of the statistical procedure used to estimate AD from the sampling plots, and of the raw data used to generate AD;

(b) Publishing the updated report on the assessment of land cover using Collect Earth for 2001–2019 (including 2016–2018) conducted by the Papua New Guinea Forest Authority;

(c) Improving the uncertainty analysis by treating the two different grid densities (0.04 and 0.02 degree grids) separately;

(d) Using tier 2 (Monte Carlo) level uncertainty analysis of AD;

(e) Enhancing EFs by replacing IPCC default values with more reliable country-specific data;

(f) Developing or adopting relevant methodology for assessing post-deforestation and post-degradation regrowth and associated emission reductions or removals;

(g) Accounting for CO_2 emissions from carbon pools other than living biomass, namely deadwood, litter and soil organic carbon;

(h) Monitoring near-real-time national-scale forest carbon dynamics using space-borne light detection and ranging data.

III. Conclusions

43. The LULUCF experts conclude that Papua New Guinea reported the results of implementing three activities, namely reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for 2016–2018. The results cover Papua New Guinea's national territory and include estimates of emissions of CO_2 from two carbon pools: above-ground and below-ground biomass. The results of the activities were estimated and reported using methodologies, definitions, assumptions and information that are overall consistent with those used for constructing the assessed FRL.

44. The LULUCF experts consider the data and information provided in the technical annex to be transparent, overall consistent, complete and accurate.

45. The LULUCF experts find the data and information provided in the technical annex to be consistent with the guidelines referred to in decision 14/CP.19, paragraph 9.

46. The results are overall accurate to the extent possible based on the assumptions used.

47. In conclusion, the LULUCF experts commend Papua New Guinea for showing strong commitment to continuously improving the data and information used for calculating the results, in line with the stepwise approach, which are overall consistent with those used for constructing its assessed FRL. Some areas for future technical improvement and capacity-building needs identified by Papua New Guinea have been identified in this report. At the same time, the LULUCF experts acknowledge that such improvements are subject to national capabilities and circumstances, and note the importance of adequate and predictable support.[9] The LULUCF experts also acknowledge that the TA process was an opportunity for a facilitative and constructive technical exchange of views and information with Papua New Guinea.[10]

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[9] As per decision 2/CP.17, para. 57.
[10] As per decision 14/CP.19, paras. 12–13.

Annex I

Technical annex to the biennial update report

Owing to the complexity and length of the submitted technical annex to the BUR, and in order to maintain the original formatting, the technical annex has not been reproduced here. It is available at https://unfccc.int/BURs.

Annex II

Summary of the main features of the reported results of implementing the activities referred to in decision 1/CP.16, paragraph 70, based on information provided by Papua New Guinea

	Key elements	*Remarks*
Results reported	13 777 302 t CO_2 eq (2016) 24 394 158 t CO_2 eq (2017) 23 169 695 t CO_2 eq (2018)	See paragraph 10 of this document
Results period	2016–2018	See paragraph 10 of this document
Assessed FRL	46 728 951 t CO_2 eq (2016) 48 408 557 t CO_2 eq (2017) 50 088 164 t CO_2 eq (2018)	The modified FRL submission (July 2017) and accompanying technical assessment report are available at https://redd.unfccc.int/submissions.html?country=PG (see para. 9 of this document)
Reference period	2001–2013	See paragraph 10 of this document
National/subnational	National	See paragraph 9 of this document
Activities included	Reducing emissions from deforestation Reducing emissions from forest degradation Enhancement of forest carbon stocks	The activity enhancement of forest carbon stocks is included but reported as accounting for zero removals during the historical reference period and the results period (see para. 34 of this document)
Pools included	Above-ground biomass Below-ground biomass	See paragraph 15(c) of this document
Gas included	CO_2	See paragraph 15(d) of this document
Consistency with assessed FRL	Methods, definitions and information used for the assessed FRL are overall consistent with those used for the results	The described methods, definitions and information used for reporting the assessed FRL and results are overall consistent. However, a different post-deforestation removal correction factor was applied to avoid an overestimation of the results, leading to inconsistency with the assessed FRL (see para. 16 of this document)
Description of NFMS and institutional roles	Included	See paragraph 30 of this document
Identification of future technical improvements	Included	Several areas for future technical improvement were identified (see para. 39 of this document)

Annex III

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 modified FRL submission of Papua New Guinea. Available at https://redd.unfccc.int/submissions.html?country=PG.

"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 technical assessment of the proposed FRL of Papua New Guinea submitted in 2017. FCCC/TAR/2017/PNG. Available at https://redd.unfccc.int/submissions.html?country=PG.

Technical report on the TA of the technical annex to the first BUR of Papua New Guinea. FCCC/SBI/ICA/2019/TATR.1/PNG. Available at https://redd.unfccc.int/submissions.html?country=PG.

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:

Fox JC, Yosi CK, Nimiago P, et al. 2010. Assessment of Aboveground Carbon in Primary and Selectively Harvested Tropical Forest in Papua New Guinea. *Biotropica.* 42(4): pp.410–419.

Papua New Guinea Forest Authority. 2019. Forest and Land Use Change in Papua New Guinea 2000–2015. Available at: https://pngreddplus.org/wp-content/uploads/2021/09/Forest_Land_Use_Change_PNG_2000-2015_FinalReport_20191203.pdf.

Papua New Guinea Forest Authority. 2021. Papua New Guinea Forest and Land Use Change Assessment 2019 Update (draft).

Climate Change and Development Authority. 2022. Introduction to PNG Climate Change and Forest Monitoring Web-Portal. Port Moresby. Available at https://pngreddplus.org/wp-content/uploads/2022/05/PNG_Climate_Change_and_Forest_Monitoring_Web-Portal_Documentation.pdf.