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

Summary

This report covers the technical assessment of the voluntary submission of Thailand on its proposed forest reference emission level (FREL) and forest reference level (FRL) in accordance with decision 13/CP.19. The FREL/FRL proposed by Thailand 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, Thailand developed a national FREL/FRL. The FREL presented in the original submission, for the reference period 2006–2016, corresponds to 15,326,056 tonnes of carbon dioxide equivalent per year; and the FRL for the same reference period corresponds to –31,511,649 tonnes of carbon dioxide equivalent per year. As a result of the facilitative process during the technical assessment, the FREL was modified to 12,341,444 tonnes of carbon dioxide equivalent per year, and the FRL was modified to –28,622,811 tonnes of carbon dioxide equivalent per year.

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

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Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AD	activity data
AT	assessment team
BUR	biennial update report
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
COP	Conference of the Parties
DMCR	Department of Marine and Coastal Resources
DNP	Department of National Parks, Wildlife and Plant Conservation
EF	emission factor
FREL	forest reference emission level
FRL	forest reference level
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
NC	national communication
NFI	national forest inventory
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)
RFD	Royal Forest Department
TA	technical assessment

I. Introduction and summary

A. Overview

1.   This report covers the TA of the voluntary submission of Thailand on its proposed FREL/FRL,[1] submitted on 8 January 2021, in accordance with decisions 12/CP.17 and 13/CP.19. The remote TA[2] took place from 19 to 23 April 2021 and was coordinated by the secretariat.[3] The TA was conducted by two land use, land-use change and forestry experts from the UNFCCC roster of experts[4] (hereinafter referred to as the AT): Carlos Riano (Colombia) and Chisa Umemiya (Japan). In addition, Gervais Ludovic Itsoua Madzous, an expert from the Consultative Group of Experts, participated as an observer[5] during the remote session. The TA was coordinated by Dirk Nemitz (secretariat).

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

3.   The objective of the TA is to assess the degree to which the information provided by Thailand is in accordance with the guidelines for submissions of information on reference levels[7] and to offer a facilitative, non-intrusive, technical exchange of information on the construction of the FREL/FRL with a view to supporting the capacity of Thailand to construct and improve its FREL/FRL in the future, as appropriate.[8]

4.   The TA of the FREL/FRL submitted by Thailand 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.

5.   Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Thailand. The facilitative exchange during the TA allowed Thailand 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, Thailand provided a modified version of its submission on 28 June 2021, which took into consideration the technical input of the AT. The modifications improved the clarity and transparency of the submitted FREL/FRL. This TA report was prepared in the context of the modified FREL/FRL submission. The modified submission, containing the assessed FREL/FRL, and the original submission are available on the UNFCCC website.[11]

B. Proposed forest reference emission level and forest reference level

6.   In decision 1/CP.16, paragraph 70, the COP encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities, as deemed appropriate by each Party and in accordance with their respective capabilities and

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[1] The submission of Thailand is available at https://redd.unfccc.int/submissions.html?country=tha.

[2] Owing to the circumstances related to the coronavirus disease 2019, the TAs of the FREL and FRL submissions of developing country Parties in 2021 had to be conducted remotely.

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

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

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

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

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

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

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

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

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

national circumstances, in the context of providing adequate and predictable support. The FREL/FRL proposed by Thailand, 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, Thailand developed a national FREL/FRL that covers its entire territory, which is some 51.3 million ha in size (see para. 36 below). As of 2015, 47 per cent of the nation's total land area (24 million ha) was zoned as agricultural land. Non-agricultural land and forested land accounted for 21 and 32 per cent of the total area, respectively. For its submission, Thailand applied a stepwise approach to developing its FREL/FRL in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve their FRELs or FRLs by incorporating better data, improved methodologies and, where appropriate, additional pools.

7. Thailand proposed separate FREL/FRL values for emissions and removals for the historical reference period 2006–2016, spanning 10 years. The national FREL proposed by Thailand is the annual average of the CO_2 emissions associated with gross deforestation, defined as the conversion of natural forest to other land uses. The FREL includes only the gross emissions from deforestation that are associated with clear-cuts and excludes any subsequent emissions and removals from deforested areas. The proposed FREL excludes the conversion of forest plantations of exotic species, such as rubber, eucalyptus and oil palm, to other land uses.

8. The national FRL proposed by Thailand is the annual average of the CO_2 removals, which are the sum of emissions associated with forest degradation and removals associated with enhancement of forest carbon stocks and the conversion of non-forest land to forest land. Under the proposed FRL, separate values are not calculated for forest degradation and enhancement of forest carbon stocks; owing to technical limitations, a single aggregated value of the net effect of these two activities combined is provided. The AD used in constructing the FREL/FRL were estimated using a sample-based approach applied to a stratified map produced from a historical time series of forest and non-forest maps developed by DNP and RFD for 2006 and 2016. The EFs were obtained from Thailand's NFI. For the forest type of mangrove only, a separate data set was used from a DMCR study. The FREL and FRL presented in the modified submission for 2006–2016 correspond to 12,341,444 and –28,622,811 t CO_2 eq/year, respectively.[12]

9. The proposed FREL/FRL includes the pools above-ground biomass and below-ground biomass and excludes the pools litter, deadwood and soil organic carbon. Regarding gases, the submission includes CO_2 only.

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

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

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

10. For constructing its FREL/FRL, Thailand used the modalities provided in the 2006 IPCC Guidelines. Thailand's approach is based on the historical average of emissions and removals (in CO_2 eq) at the national scale associated with the activities reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks for the 10-year reference period from 31 December 2006 to 31 December 2016.

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[12] In its original submission, Thailand proposed a national FREL of 15,326,056 t CO_2 eq/year for 2006–2016, and the FRL for the same reference period corresponded to –31,511,649 t CO_2 eq/year.

11.   The FREL/FRL includes three REDD+ activities described by Thailand as deforestation, for forest areas where tree canopy cover has been reduced to below 10 per cent; forest degradation, for forest areas with a canopy cover equal to or above 10 per cent but in which canopy cover has been reduced but have remained forest land (in practice, forest degradation occurred when forest type changed from a higher carbon stock forest type to a lower carbon stock forest type, or when a stable forest type had its carbon stock decreased); and enhancement of forest carbon stocks, divided into two categories for the purposes of this FRL: reforestation/afforestation (when non-forest land is converted to forest land) and restoration (enhancement of forest carbon stocks in forest remaining forest).

12.   Two land-cover maps for 2006 and 2016 were developed using Landsat cloud-free best-pixels mosaics. For 2006 the map includes scenes from Landsat 4, Landsat 5 and Landsat 7, and for 2016 the map includes scenes from Landsat 8 and Sentinel-2. For all maps, Thailand used auxiliary data from the Government and images from Google Earth. Land-cover maps include the forest classes evergreen, deciduous and mangroves, in addition to a non-forest class. In Thailand, evergreen forest is subdivided into tropical evergreen forest, hill evergreen forest, dry evergreen forest, pine forest, mangrove forest and beach forest, and deciduous forest is subdivided into mixed deciduous and dry dipterocarp. However, Thailand clarified during the technical exchange that as there are no significant differences between the EFs for the two deciduous forest subclasses, in the FREL/FRL they were considered as a single class. Similarly, the evergreen forest subclassifications were considered as a single category in the FREL/FRL, with the exception of mangrove forest, which is a very distinct ecosystem with considerable significance in terms of forest carbon stocks.

13.   Thailand developed the AD by estimating the extent of forest change, which was measured as estimated forest area using a forest-change map and stratified random distribution in accordance with Olofsson et al. (2014). The forest-change assessment included the use of forest mask maps generated with the mosaics of 2006 and 2016 (showing forest and non-forest land separately) overlaid with the 2006 and 2016 forest-type maps by DNP and RFD, respectively, to detect changes in forest canopy over the reference period. The final forest-change map was combined with the forest-type maps. The final map has a minimum mapping area of 0.5 ha and includes 10 classes: one stable non-forest (i.e. non-forest land in both 2006 and 2016), and stable forest, forest loss and forest gain according to three forest types (mangrove, evergreen and deciduous forest).

14.   To obtain the final AD for areas, the Party followed the methodologies of Olofsson et al. (2014) and the Food and Agriculture Organization of the United Nations (2016). The Party collected 2,116 spatial sample units, each one approximately 0.5 ha in size, distributed among the forest-change map classes using stratified random distribution. The error-adjusted deforestation area estimates were used to calculate the final AD for the change in area for each forest type.

15.   Thailand estimated the EFs for the evergreen and deciduous forest classes using data from the first and third cycles of the NFI. According to the FREL/FRL submission, Thailand excluded the second cycle because there were no available AD for the middle years of the reference period. The first cycle, conducted from 2003 to 2010, involved sampling grids of 20×20 km covering the entire country and 10×10 km within forest land. Though the inventory was conducted over seven years, more than half of the plots on the 10×10 km grid had been measured by the end of 2005; therefore, carbon stock estimates calculated from this inventory are considered to relate to 2005. During the third cycle, which was implemented in 2013–2018, the centre plot of a 10×10 km grid was sampled, and an inventory of forests in conserved areas was then taken on a 2.5×2.5 km grid. The Party selected 2017 as the reference year for the third cycle since half of the plots on the 10×10 km grid had been measured by that year. In the case of mangroves, a field campaign was conducted in 2016 and 2017.

16.   In order to maintain consistency between the two cycles, only the centre plots of the 10×10 km grid from the first cycle were used. Two strata were defined: one for conserved areas and one for reserved areas. The initial reference period of the forest inventory was 11 years, but in the modified FREL/FRL, this was recalculated to 12 years (2005–2017).

17.   The mangrove forest EFs were calculated from the aggregated above-ground biomass measurements of 37 plots in 2016 provided by DMCR. Since the plots were not remeasured, Thailand was not able to estimate the stock difference for this forest type.

18.   The EFs and removal factors for the strata evergreen, deciduous and mangroves were calculated as the difference between the carbon stock of the first and third NFI cycles divided by the number of years between the two inventories (12), resulting in positive values when the stock decreased (emissions) and negative values when the stock increased (removals). The confidence intervals were calculated using equations 3.1 (for multiplication) and 3.2 (for addition) of the 2006 IPCC Guidelines (vol. 1, chap. 3).

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

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

19.   Information on the EFs was obtained from the NFI. The AT noted that, although there have been three cycles of the forest inventory, only partial data from the first and third cycles could be used because each cycle involved different goals, designs and methodologies. For example, the grids used had different dimensions, different coordinates systems were used for the first and second cycles and there were no permanent plots during the cycles, meaning that it was not possible to remeasure the land parcels. Thailand clarified that the upcoming fourth cycle will introduce a standard methodology and permanent plots with a view to ensuring that data are more robust and comparable. The AT commends the Party's efforts to improve the information on EFs, noting that the NFI is an area for future technical improvement.

20.   In the Party's original submission, the period for calculating the annual EFs was considered as between 2005 (for the first cycle) and 2017 (for the third cycle). The Party reported an 11-year period between the two inventories, and during the TA, it explained that the period corresponds with the difference between the years of the two cycles (2005 and 2017). However, the AT noted that there is not an 11-year gap between these years. For the modified submission, Thailand revised the period of the EFs to 12 years. The AT notes that the revised approach is more consistent and results in more accurate emission and removal estimates.

21.   In the original FREL/FRL, Thailand reported an EF associated with mangrove forests but did not include methodological information or describe the data sets, approaches, methods, models and assumptions used to estimate above-ground and below-ground biomass for mangrove forests. Thailand explained that the data, which were obtained from DMCR, were not available at the time of submission. During the TA, Thailand shared the aggregated data and sources of information on above-ground biomass of mangrove forests and modified the submission's mangroves supplement. The AT, however, considers that it is not possible to fully reconstruct the estimates of emissions and removals associated with mangrove forests, which account for 30 per cent of the FREL and 4 per cent of the FRL. Since Thailand's mangrove forests represent a very distinct ecosystem that is highly significant in terms of forest carbon stocks, the AT commends the Party's efforts to improve the information on the EFs for mangrove forests, noting this as an area for future technical improvement.

22.   Thailand constructed its FREL/FRL on the basis of two data points in time (i.e. 2006 and 2016) over the 10 years of its reference period. The AT sought clarification on whether the Party considered including any intermediate years between 2006 and 2016 as additional data points in time with a view to capturing a more accurate picture of the trend in forest changes. The annual trend in forest change reported by Thailand shows fluctuations (annex II, section 3.2, figure 5, p.123). During the TA, Thailand clarified that it considers that the two data points are adequate for its first FREL/FRL. However, it plans to shorten its reference period in future FREL/FRL submissions. Thailand further noted that NFI cycles may, depending on the budget and technical support available, be five years long from 2022 onward, which would enable it to increase the number of data points in a reference period. The AT commends the Party's efforts to increase the number of data points in time for a

reference period in its stepwise approach, noting this as an area for future technical improvement.

23.   The AT notes that Thailand maintains partial consistency in the methods, data and assumptions applied between its most recent national GHG inventory, included in the third BUR, and the FREL/FRL, partially in line with decision 12/CP.17, paragraph 8. Thailand provided in its FREL/FRL submission detailed information on allometric equations applied to calculate the EFs. During the TA, Thailand explained that it had confirmed, through conducting a review that included a field assessment, that the allometric equations applied in its FREL/FRL were the same as those applied in its latest GHG inventory contained in its third BUR and were, therefore, appropriate. However, the AT noted that consistency in the methodologies applied in the Party's most recent GHG inventory was described only up to its NC3, which was submitted before its third BUR, and that the GHG inventory of its NC3 used the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, meaning that consistencies between its FREL/FRL and its most recent GHG inventory were unclear, including in terms of the equations used. The AT notes the importance of maintaining consistency between the FREL/FRL and the GHG inventory and considers this as an area for future technical improvement.

24.   In its original submission, Thailand reported that the carbon stock of post-deforestation land uses is assumed to be zero. During the TA, the AT noted that it does not consider this assumption to be accurate for Thailand's FREL because its post-deforestation land uses include those with carbon stocks, for example, plantations of exotic species, such as eucalyptus, rubber and oil palms, which may lead to an overestimation of emissions in the FREL. The AT also noted that IPCC default values are available for carbon stocks of post-deforestation land uses (e.g. annual and perennial crops). In the modified submission, Thailand adjusted the carbon stocks of non-forest land by using the default value from the 2006 IPCC Guidelines for annual cropland (vol. 4, chap. 5, table 5.9) and recalculated the EFs associated with deforestation for three forest types. The AT commends the Party for adjusting its approach by applying the IPCC default value as the carbon stock of non-forest land. The AT also notes that Thailand may wish to continue collecting data on disaggregated land uses after deforestation, which would enable it to review the applicability of the IPCC default value in future FRELs, and notes this as an area for future technical improvement.

25.   Thailand calculated the net removals and emissions using the stock difference approach. In the case of forest land remaining forest land, Thailand estimated annual removals of 26,485,125 t CO_2 eq. During the TA, the AT sought clarifications on whether the results include the activities reducing emissions from forest degradation and enhancement of forest carbon stocks and how emissions from forest degradation were estimated. Thailand clarified that there is not currently a clear definition of degradation and it was unable to separate forest degradation from enhancement of forest carbon stocks for this submission. The Party also clarified that revisiting the same plots of the forest inventory during the fourth cycle will enable it to estimate forest degradation. The AT notes that separately estimating the EFs and removal factors of forest land remaining forest land is an area for technical improvement for the next submission.

26.   The FRL submission of Thailand includes a methodology for estimating the confidence intervals for the AD following the guidelines developed by Olofsson et al. (2014). The AT noted that the Party's implementation of the stratified area estimation methodology results in high uncertainties associated with the AD (78 per cent for evergreen forest loss, 90 per cent for mangrove forest loss, 8 per cent for stable evergreen forest and 7 per cent for stable mangrove). The aggregated results reveal a confidence interval of 30 per cent for forest loss and 77 per cent for forest gain. Thailand explained that the initial number of samples was calculated for only four classes, which did not allow for enough change samples to be captured in each forest class. Therefore, the Party performed a sampling intensification exercise using a forest-type change map, which shows that the omission error in stable classes had a more significant effect on confidence intervals than it did in non-stable classes. In the light of this, Thailand calculated the uncertainty of the EFs using the confidence interval for the difference of two means to calculate the confidence interval of the difference between carbon stocks. The resulting EFs and removal factors are contained in table 16 of the modified submission. The aggregated uncertainty was propagated with equation 3.1 for the sum and

product of uncertainties from the 2006 IPCC Guidelines (vol. 1, chap. 3). The overall uncertainty is ±40 per cent for the modified FREL and 74 per cent with a 95 per cent confidence interval for the modified FRL. The AT notes that reducing the uncertainty of the AD and the area error estimation of AD is an area for technical improvement and commends the efforts of Thailand to use a stratified random sample design with a proportional sample allocation and a multi-interpreter approach for reference data collection to calculate the interpretation bias and interpretation error.

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

27.   Thailand cited its National Strategic Plan as an overarching forest policy which aims to increase forest cover by up to 40 per cent (p.8). The Party's Climate Change Master Plan (2015–2050) lays the foundation for climate change adaptation and mitigation in the country. Thailand's priority areas in forestry policy include raising awareness and increasing public participation, promoting mitigation activities in line with Sustainable Development Goal 13, and supporting research and development and capacity-building for relevant institutions and staff. Thailand explained that agricultural expansion is the main cause of deforestation, accounting for 79 per cent of deforestation in the country (p.122). During the TA, the AT sought clarification on how the assumptions in the FREL/FRL consider future changes in drivers and associated policies. Thailand clarified that its current FREL/FRL is based exclusively on historical spatial data, and consideration was not given to drivers, changes in drivers or associated policies. In addition, Thailand noted that it plans to develop its national REDD+ strategy, which provides detailed information on drivers and its strategies for implementing REDD+ actions, and informed the AT that it intends to complete the strategy by the end of 2021. While acknowledging this plan, the AT notes that Thailand could improve its explanation of the assumptions underlying the construction of the current FREL/FRL, including by noting how future changes to policies were considered.

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

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

29.   The pools included in the Party's FREL/FRL are above-ground biomass and below-ground biomass. The other three pools (litter, deadwood and soil organic carbon) were not included. Thailand noted that this was due to limited data availability and it considered these omissions to be conservative (p.23). The Party also stated that it will consider including the omitted pools as part of the stepwise improvement of the FREL/FRL (p.50).

30.   With regard to emissions from dead organic matter (litter and deadwood), the AT noted that Thailand reported estimates in its latest GHG inventory, contained in its third BUR. The AT requested clarification on why this pool was omitted from the FREL/FRL. Thailand clarified that as the current FREL/FRL is the country's first, it still needs to examine the applicability of available data on this pool to the FREL/FRL. The AT acknowledged Thailand's justification for excluding the pools and welcomed its intention to make improvements in this area. The AT highlighted the importance of maintaining consistency between the FREL/FRL and the GHG inventory and noted that the Party could use available data associated with the GHG inventory to justify the insignificance of the omitted pools in its FREL/FRL. The AT noted that the treatment of emissions from this pool is an area for future technical improvement.

31.   With regard to emissions from soil organic carbon, which are not included in the Party's latest GHG inventory, the AT requested clarification on whether Thailand considered using the IPCC tier 1 methodology and applying the corresponding default EF and other values given that the methodology can be used to estimate emissions when country-specific data are not available and may be useful in terms of assessing the significance of soil organic carbon emissions. In response, Thailand explained that sufficient research data would be required to justify why the tier 1 methodology is appropriate for its national circumstances, but the Party understands that relevant scientific data are not currently available. Thailand noted that as more research data for the pool become available, it will consider including the

soil organic carbon pool. The AT acknowledges the steps taken by the Party to consider applying appropriate tiers and noted this as an area for future technical improvement, while welcoming the Party's intention to make improvements in this area in future, including by collecting scientific data with a view to considering the use of an appropriate IPCC method.

32.   The only gas included in the FREL/FRL is CO_2. Thailand's justification for excluding non-CO_2 emissions from the FREL/FRL centred on the insignificance of non-CO_2 gases and the limited availability of data (p.23). With regard to the former, Thailand cited the Global Forest Resources Assessment 2015 of the Food and Agriculture Organization of the United Nations, which indicates that the total area affected by forest fires is decreasing year-on-year. Further, Thailand stated that it will consider including non-CO_2 gases as part of the stepwise improvement of its FREL/FRL (p.50). The AT asked whether Thailand could provide additional references to support the declining trend in the total area affected by forest fires and explain the sudden drop in the affected area from 1,145,000 to 294,000 ha between 1998 and 1999 reported in the Global Forest Resources Assessment 2015, although these years are outside the reference period. In response, Thailand provided additional materials from DNP, which include information on recent measures for controlling forest fires in the country (e.g. forest fire management, campaigns and volunteer firefighters). Although the additional materials were in Thai, through exchanges with the Party, the AT understands that the total area affected by forest fires has declined recently owing to various domestic measures. The AT was unable to clearly understand the reason for the sudden drop between 1998 and 1999 because the additional materials did not cover those years. However, the AT recognizes that, as these years precede the reference period, it may be difficult to find background information for the sharp decline. The AT commends the Party for providing the additional materials, noting that these could be added as references to improve the transparency of the FREL/FRL.

33.   With regard to the lack of available non-CO_2 emission data, the AT notes that Thailand may be able to estimate these emissions given that its latest GHG inventory includes non-CO_2 emissions in the land use, land-use change and forestry sector. Thailand responded that as the current FREL/FRL is its first, and there was limited time to prepare it, non-CO_2 emissions were not included. The AT acknowledged Thailand's justification for excluding non-CO_2 emissions and welcomed its intention to make improvements in this area. The AT highlighted the importance of maintaining consistency between the FREL/FRL and the GHG inventory and noted that the Party can use available data associated with the GHG inventory to justify the exclusion of non-CO_2 emissions from its FREL/FRL on the basis of their insignificance. The AT considers the treatment of non-CO_2 gases as an area for future technical improvement so as to maintain consistency with the GHG inventory included in the Party's third BUR.

34.   The AT acknowledges that Thailand included in its FREL/FRL the most significant activities (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. On the basis of the information provided by the Party, the AT notes that forest degradation and enhancement of forest carbon stocks were calculated as the net difference of emissions and removals from forest land remaining forest land and the two activities cannot be separated. The AT notes that Thailand will remeasure the land parcels of the forest inventory in order to separately estimate the activities.

4. Definition of forest

35.   Thailand provided in its submission the definition of forest used in constructing its FREL/FRL, which is based on the forest definition used by RFD (p.22). The FREL/FRL applied forest definition thresholds of a minimum area of 0.5 ha and at least 10 per cent canopy cover. Although the Party stated that it did not use forest height as a threshold, in practice, a 2 m measurement was used. This definition is different from that used by the Party for its national GHG inventory. Thailand also explained how it distinguished between forests defined for REDD+ and those defined for other purposes; the former definition does not include areas of grassland and bedrock areas, unlike the forest definition used by RFD. Tree crops and plantations of exotic species, such as rubber, eucalyptus and oil palm, were excluded from REDD+, although these species were included in the GHG inventory.

36.   During the TA, the AT sought several clarifications on the definition of forest used in the FREL/FRL. The AT also asked whether the different forest definitions used in the FREL/FRL and by RFD resulted in different total national land areas. National land was calculated as 51.3 million ha for the former, and as 52.7 million ha for the latter (p.18). Thailand explained that it cited 2 m as the tree height used in practice, while also reporting that tree height was not used as a threshold, because trees that have the potential to reach 2 m in height were counted as forests; however, this is not yet consistently applied across the three organizations that provided the forest data used in the FREL/FRL (RFD, DNP and DMCR). Thailand noted that it will continue to make efforts to ensure consistency in the forest definition used across the organizations and include height as part of the definition. The AT commends Thailand for its ongoing work on ensuring a consistent forest definition, while noting this as an area for future technical improvement.

37.   With regard to the differences between the forest definitions used in the FREL/FRL and the GHG inventory, during the TA, Thailand explained that grassland and bedrock areas were excluded from the FREL/FRL because they contain little or no carbon. The AT acknowledged and understood this explanation but did not understand why these areas were originally counted as forests under the RFD definition. Thailand also explained that tree crops and plantations of exotic species were excluded from the FREL/FRL to avoid incentivizing an increase to areas of these species under REDD+ in the country, and the AT understands this reasoning. The AT commends the Party for adjusting existing forest definitions to ensure that the definition is suitable for the FREL/FRL, noting that a clearer explanation of the reasons for using different forest definitions for the FREL/FRL and the GHG inventory could improve the transparency of the FREL/FRL. Furthermore, the AT highlighted the importance of maintaining consistency between the FREL/FRL and the GHG inventory. Thus, Thailand may wish to continue its efforts to consolidate the two forest definitions for future FREL/FRL submissions.

III.   Conclusions

38.   The information used by Thailand in constructing its FREL/FRL for reducing emissions from deforestation, reducing emissions from forest degradation and enhancement of forest carbon stocks is transparent and complete and in overall accordance with the guidelines for submissions of information on reference levels.

39.   The FREL presented in the modified submission, for the reference period 2006–2016, corresponds to 12,341,444 t CO_2 eq/year, and the modified FRL for the same reference period corresponds to –28,622,811 t CO_2 eq/year.

40.   The AT acknowledges that Thailand included in its FREL/FRL the most important forest types, the most significant pools and the most significant activities, although two activities (reducing emissions from forest degradation and enhancement of forest carbon stocks) were not assessed separately (see paras. 25 and 34 above). The AT considers that, in doing so, Thailand followed decision 1/CP.16, paragraph 70, on activities undertaken, and decision 12/CP.17, paragraph 10, on applying the stepwise approach. The AT commends Thailand for providing information on its ongoing work to develop the FREL/FRL to include other activities and to include complete information on other forest types and pools.

41.   As a result of the facilitative interactions with the AT during the TA, Thailand provided a modified submission that took into consideration the technical input of the AT. The AT notes that the transparency and completeness of the information provided were significantly improved in the modified FREL/FRL submission, without having to alter the approach used to construct the FREL/FRL, and commends Thailand on its efforts. The new information provided in the modified submission increased the reproducibility of the FREL/FRL calculations.

42.   The AT notes that, overall, Thailand can further improve consistency, in terms of sources of AD and EFs used for its FREL/FRL, with those used for the GHG inventory included in its third BUR (2020).[13] The Party noted that it is assessing the applicability of

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

available GHG inventory data to the FREL/FRL with a view to completing the pools and activities for the next FREL/FRL submission.

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

        (a)   Implementing a standard methodology to collect data and calculate the EFs and removal factors for each forest type (including mangrove forest), and establishing permanent plots as part of the fourth cycle of the NFI (see paras. 19, 21 and 22 above);

        (b)   Enhancing consistency between the Party's GHG inventory and its FREL/FRL (see para. 23 above);

        (c)   Continuing to collect data on disaggregated land uses after deforestation with a view to reviewing the applicability of the IPCC default value in future FRELs (see para. 24 above);

        (d)   Clarifying the land areas allocated to the various REDD+ activities included in the submission, notably separately estimating the EFs and removal factors of forest land remaining forest land for reducing emissions from forest degradation and enhancement of forest carbon stocks (see paras. 25 and 34 above);

        (e)   Reducing the uncertainties of AD by improving the implementation of the stratified area estimation methodology, using a multi-interpreter approach and integrating reference data with a higher spatial resolution (see para. 26 above);

        (f)   Collecting scientific data with a view to considering the use of an appropriate IPCC method and tier (see para. 31 above);

        (g)   Ensuring that a consistent forest definition is used across the organizations that manage forests in Thailand and including tree height as part of the definition (see para. 36 above).

44.   Pursuant to decision 13/CP.19, annex, paragraph 2(f), in assessing the pools and gases included in the FREL/FRL the AT noted that the pools and gases excluded by Thailand are likely to be insignificant in the context of the FREL/FRL. Nevertheless, pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following additional areas for future technical improvement regarding pools and gases excluded from the FREL/FRL:

        (a)   Treatment of emissions from dead organic matter and soil organic carbon (i.e. including the pool or providing more information justifying its omission) (see paras. 29–31 above);

        (b)   Treatment of non-CO_2 gases (i.e. to maintain consistency with the GHG inventory included in the Party's NC/BUR), for example by including the available data associated with the GHG inventory, which can be used by the Party to justify the exclusion of non-CO_2 emissions from its FREL/FRL on the basis of their insignificance, with a view to maintaining consistency with the GHG inventory included in the Party's third BUR (see para. 33 above).

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

        (a)   Improve the forest monitoring methods by using direct supervised change detection or time-series analysis;

        (b)   Improve the AD by enhancing the methodology for mapping enhancement of forest carbon stocks and distinguishing changes between forests within and outside of conserved areas;

        (c)   Diversify the carbon pools by collecting data on the litter, deadwood and soil organic carbon pools;

        (d)   Implement the fourth cycle of the NFI, establishing permanent plots and increasing the number of plots measured outside of conserved areas, especially in evergreen forest, to better understand whether there are differences in dynamics.

46.   In conclusion, the AT commends Thailand for showing strong commitment to continuously improving its FREL/FRL estimates in line with the stepwise approach. A

number of areas for the future technical improvement of Thailand's FREL/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.[14] The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Thailand.

47.   The table contained in annex I summarizes the main features of Thailand's proposed FREL/FRL.

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

Annex I

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

Main features of the FREL/FRL		*Remarks*
Proposed FREL/FRL	12 341 444 t CO_2 eq/year (FREL) –28 622 811 t CO_2 eq/year (FRL)	The FREL includes only gross emissions from deforestation that are associated with clear-cuts and excludes any subsequent emissions and removals from deforested areas. The FRL is the annual average of CO_2 removals, which are the sum of emissions associated with forest degradation and removals associated with enhancement of forest carbon stocks (see para. 8 of this document)
Type and reference period of FREL/FRL	FREL = average of historical emissions FRL = annual average of historical emissions and removals in 2006–2016	See paragraph 7 of this document
Application of adjustment for national circumstances	No	–
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	Owing to technical constraints, Thailand was not able to separate emissions from forest degradation and removals associated with enhancement of forest carbon stocks (see paras. 25 and 34 of this document)
Pools included	Above-ground biomass Below-ground biomass	The Party still needs to examine the applicability of available default data on deadwood and soil organic carbon to the FREL/FRL (see para. 30 of this document)
Gas included	CO_2	See paragraphs 32–33 of this document
Forest definition	Included	Minimum area: 0.5 ha; crown cover: minimum 10 per cent; height: not defined (in practice 2 m). Forest definition differs from the definition used for the GHG inventory, as it excludes tree crops and plantations of exotic species (see para. 35 of this document)
Consistency with latest GHG inventory	Methods used for estimating the FREL/FRL are not consistent with those used for the latest GHG inventory (2020)	The allometric equations used to establish the EF and the treatment of emissions from the deadwood and soil organic carbon pools and of non-CO_2 gases are not consistent with the GHG inventory contained

Main features of the FREL/FRL		*Remarks*
		in the third BUR (see paras. 23, 30 and 33 of this document)
Description of relevant policies and plans	Included	See paragraph 28 of this document
Description of assumptions on future changes to domestic policy, if included in constructing the FREL/FRL	Not applicable	–
Description of changes to previous FREL/FRL	Not applicable	–
Identification of future technical improvements	Included	Several areas for future technical improvement have been identified (see paras. 43–44 of this document)

Annex II

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. JL Houghton, LG Meira Filho, B Lim, et al. (eds.). Paris: IPCC/Organisation for Economic Co-operation and Development/International Energy Agency. Available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html.

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl.

B. UNFCCC documents

First modified FREL/FRL submission of Thailand. Available at https://redd.unfccc.int/submissions.html?country=tha.

"Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels". Annex to decision 13/CP.19. Available at https://unfccc.int/sites/default/files/resource/docs/2013/cop19/eng/10a01.pdf#page=36.

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

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:

Olofsson, P., et al. "Good Practices for Estimating Area and Assessing Accuracy of Land Change." *Remote Sensing of Environment*, vol. 148, 2014, pp. 42–57, https://sciencedirect.com/science/article/abs/pii/S0034425714000704.

Food and Agriculture Organization of the United Nations. *Global Forest Resources Assessment 2015.* FAO, 2015, http://www.fao.org/forest-resources-assessment/past-assessments/fra-2015/en/.

Food and Agriculture Organization of the United Nations. 2016. Map Accuracy Assessment and Area Estimation: A Practical Guide. Y Finegold and A Ortmann. Rome, Italy. National Forest Monitoring and Assessment Working Paper 46. Available at: https://www.fao.org/documents/card/en/c/e5ea45b8-3fd7-4692-ba29-fae7b140d07e/.