United Nations

FCCC/TAR/2016/IDN

Framework Convention on Climate Change

Distr.: General
25 November 2016

English only

Report on the technical assessment of the proposed forest reference emission level of Indonesia submitted in 2016

Summary

This report covers the technical assessment of the submission of Indonesia, on a voluntary basis, on its proposed forest reference emission level (FREL), in accordance with decision 13/CP.19 and in the context of results-based payments. The FREL proposed by Indonesia covers the activities "reducing emissions from deforestation" and "reducing emissions from forest degradation", which are among the activities included in decision 1/CP.16, paragraph 70. In its submission, Indonesia has developed a FREL for natural forests in the entire national territory of Indonesia. The assessment team notes that the data and information used by Indonesia in constructing its FREL are transparent and complete, and are in overall accordance with the guidelines contained in the annex to decision 12/CP.17. This report contains the assessed FREL and a few areas identified for further technical improvement by the assessment team, according to the scope of the technical assessment in the annex to decision 13/CP.19.

GE.16-20887(E)

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I. Introduction and summary

A. Overview

1. This report covers the technical assessment (TA) of the submission of Indonesia on its proposed forest reference emission level (FREL),[1] submitted on 4 January 2016 in accordance with decisions 12/CP.17 and 13/CP.19. The TA took place (as a centralized activity) from 17 to 18 March 2016 in Bonn, Germany, and was coordinated by the secretariat.[2] The TA was conducted by two land use, land-use change and forestry (LULUCF) experts from the UNFCCC roster of experts[3] (hereinafter referred to as the assessment team (AT)): Mr. Nagmeldin Elhassan (Sudan) and Mr. Till Neeff (Germany). In addition, Mr. Kamel Djemouai, an expert from the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention, participated as an observer[4] during the centralized activity in Bonn.

2. In response to the invitation by the Conference of the Parties (COP) and in accordance with the provisions of decision 12/CP.17, paragraphs 7–15, and its annex, Indonesia submitted, on a voluntary basis, its proposed FREL. This proposed FREL is one of the elements[5] to be developed in the implementation of the activities referred to in decision 1/CP.16, paragraph 70. The COP decided that each submission of a proposed FREL or forest reference level (FRL), as referred to in decision 12/CP.17, paragraph 13, shall be subject to a TA in the context of results-based payments, pursuant to decision 13/CP.19, paragraphs 1 and 2, and decision 14/CP.19, paragraphs 7 and 8.

3. The objective of this TA was to assess the degree to which information provided by Indonesia was in accordance with the guidelines for submissions of information on FRELs and FRLs[6] and to offer a facilitative, non-intrusive, technical exchange of information on the construction of the FREL, with a view to supporting the capacity of Indonesia for the construction and future improvement of FRELs, as appropriate.[7]

4. The TA of the FREL submitted by Indonesia was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELs and FRLs as contained in the annex to decision 13/CP.19. This report on the TA was prepared by the AT following the guidelines and procedures in the same decision.

5. Following the process contained in the guidelines and procedures of the same decision, a draft version of this report was communicated to the Government of Indonesia. The facilitative exchange during the TA allowed Indonesia to provide clarifications and information that were considered by the AT in the preparation of this report.[8] As a result of the facilitative interactions with the AT during the TA session, Indonesia submitted a modified version on 13 May 2016, which took into consideration the technical input by the AT. The modifications improved the clarity and transparency of the submitted FREL, without the need to alter the approach used to construct the originally proposed FREL. This TA report was prepared based on the context of the modified FREL submission. The

[1] The submission of Indonesia is available at <http://unfccc.int/8414>.
[2] Decision 13/CP.19, annex, paragraph 7.
[3] Decision 13/CP.19, annex, paragraphs 7 and 9.
[4] Decision 13/CP.19, annex, paragraph 9.
[5] Decision 1/CP.16, paragraph 71(b).
[6] Decision 12/CP.17, annex.
[7] Decision 13/CP.19, annex, paragraph 1(a) and (b).
[8] Decision 13/CP.19, annex, paragraphs 1(b), 13 and 14.

modified submission, which contains the assessed FREL, and the original submission are available on the UNFCCC website.[9]

B. Proposed forest reference emission level

6. The FREL proposed by Indonesia for the historical reference period 1990–2012 is the annual average of carbon dioxide (CO_2) emissions associated with deforestation and forest degradation occurring in the areas that were natural forest in 1990. Deforestation is included as the gross emissions associated with the conversion of natural forest lands to non-forested lands, excluding any subsequent emissions or removals. Emissions from forest degradation are included in the FREL as results from the conversion of primary forest to secondary forest, taking into account that, for Indonesia, secondary forests encompass all disturbed forest types.

7. The proposed FREL covers all land areas covered by natural forests in the year 1990, which is about 113.2 million hectares (ha) or 60 per cent of Indonesia's total land area. For this FREL submission, data from eight unequal time periods between 1990 and 2012 were used to capture historical land-cover change. The FREL takes into account emissions from the aboveground biomass carbon pool and also, for deforestation and forest degradation over peatlands, from soil organic carbon. It does not include other gases and pools or REDD-plus[10] activities.

8. In its submission, Indonesia applies a stepwise approach to the development of the FREL, in accordance with decision 12/CP.17, paragraph 10, with the aim of improving the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools. The submission lists a number of areas for technical improvement, such as refining activity data and emission factors, estimating peatland fire emissions and including additional REDD-plus activities.

9. The national FREL submitted by Indonesia is 568,859,881 tonnes of carbon dioxide equivalent (t CO_2 eq) for the year 2013, but increasing annually because of accumulating emissions from peat decomposition, and reaching 593,329,235 t CO_2 eq for the year 2020.

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

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

1. Information that was used by the Party in the construction of the forest reference emission level

10. Indonesia includes in its FREL submission information about earlier work on reference levels related to deforestation and forest degradation. The current FREL builds on experiences and capacities gained from these efforts. The AT commends Indonesia for early action on the implementation of activities to reduce emissions from deforestation and forest degradation.

[9] <http://unfccc.int/8414>.

[10] In decision 1/CP.16, paragraph 70, the COP encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks.

11. The methods used by Indonesia are consistent with the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) and the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines), as applied to the construction of the FREL. For the estimation of emissions from peat decomposition the *2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands* (hereinafter referred to as the Wetlands Supplement) was used.

12. Indonesia's proposed FREL covers emissions from gross deforestation (defined as loss of natural forest cover below a certain threshold) and forest degradation (defined as a change from primary forest to disturbed secondary forest). It covers the reference period from 1990 to 2012. Data are available for eight time points during that 22-year period, totalling seven measurement periods with a duration of between one and six years: 1990–1996, 1996–2000, 2000–2003, 2003–2006, 2006–2009, 2009–2011 and 2011–2012. More recent years have a greater availability of data and therefore shorter measurement periods. The timing of mitigation activities, for example under Indonesia's National Action Plan for Reducing Greenhouse Gas Emissions[11] or the Indonesian logging moratorium,[12] were not considered as most important in defining the end date of the reference period. During the TA, Indonesia explained that a long reference period was chosen to capture the dynamics of policy and social aspects, which in turn provides an opportunity to appropriately predict national circumstances affecting land-use policy; for example, changes in government, anthropogenic disasters and fluctuating market demand for commodities. The AT commends Indonesia for the effort made in analysing the different measurement periods and compiling information across such a long reference period.

13. The activity data used for the construction of the FREL are land-cover data from the National Forest Monitoring System (NFMS), which are publicly available on the NFMS website.[13] These official data describe land-cover classes and forest-cover change over the years, which have been developed and updated regularly since 2000. In addition, data from the 1990s were added to the NFMS (from freely available Landsat satellite data archives). For this FREL submission, data sets for 1990, 1996, 2000, 2003, 2006, 2009, 2011 and 2012 were available and were used to capture historical land-cover data. The wall-to-wall land-cover maps that serve as activity data were produced by the Ministry of Environment and Forestry, using Landsat satellite images. The images were digitized manually by visual interpretation. The peatland spatial data used in the construction of the FREL were provided by the Ministry of Agriculture, and were based on several related maps, field surveys and ground checks.

14. The primary source of data used to derive emission factors for deforestation and forest degradation was the national forest inventory (NFI), complemented by additional research plots to fill information gaps for certain forest types (e.g. mangrove forest) that had not enough NFI plots. The NFI uses more than 3,900 clusters of sample plots, with each cluster consisting of a permanent sample plot of 1 ha surrounded by eight temporary sample plots. Emission factors for peat decomposition were taken from the Wetlands Supplement, which, according to Indonesia, were in fact mostly derived from data from Indonesia and can therefore be considered suitable for estimating emissions from peat decomposition in the FREL.

[11] Presidential regulation 61/2011 on *Rencana Aksi Nasional Penurunan Emisi* GRK (RAN-GRK).

[12] The moratorium was first declared under presidential instruction 10/2010, and has been renewed every two years (presidential instructions 6/2013 and 8/2015).

[13] <http://nfms.dephut.go.id>.

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

Methodological information, including description of data sets, approaches and methods

15. According to the approach applied, forest loss can occur only once in each specific area. The submission covers only natural forests, defined as forests never having undergone unstocking, not even temporarily. During the TA, Indonesia clarified that it uses a mask to exclude any areas of prior deforestation from the data processing. The AT considers this to be an effective approach. As a result of the facilitative exchange, Indonesia included a step-by-step description of the methodology applied in the modified submission. The AT considers that the explanations improve the transparency of the submission and commends Indonesia for these efforts.

16. The AT understands that deforestation and forest degradation activity data were quantified by overlaying maps from different time points. In a first step, for each of the time points, a set of satellite images was used to generate land cover maps. In a second step, changed areas were determined from overlaying these maps with others. During the technical assessment, the AT pointed out that direct comparison of satellite images would reduce the sources of errors and is seen as best practice in remote sensing analysis. Indonesia acknowledged that such an approach is often considered to generate better results, but explained that processing data for the complex land-cover information of the whole country and for the long time frame in question would be highly challenging and would require extensive ground truthing. Indonesia highlighted, however, its plans to improve land-use and land-cover mapping. The AT acknowledges this explanation and commends Indonesia for these efforts, agreeing that moving from single-date interpretation to interpretation techniques for time series of satellite images is an area for improvement.

17. During the TA, Indonesia provided a large amount of background information and material, including land-cover matrices for peatlands. The AT observed some discontinuity in these data that may indicate difficulties in ensuring consistency.[14] According to the FREL submission, land-cover maps were derived largely using visual interpretation, with a large number of image interpreters contributing to the task. The AT acknowledged the immense effort that went into building the time series of land-cover maps, but noted that maintaining a consistent interpretation approach across diverse interpreters is very difficult and that this is a potential source of the observed discontinuity. In response, Indonesia explained that it is exploring ways to develop the existing NFMS, for example by combining automated methods and visual interpretation, in order to improve the land-cover data. In line with this, in the view of the AT, improving quality management is an area for improvement. The AT commends Indonesia for its efforts to compile land-cover databases using automated interpretation approaches across long time series of satellite images and to improve the existing NFMS. Introducing automated processing may help to ensure a coherent interpretation.

18. Emission factors used in the FREL for deforestation and forest degradation are based on data from Indonesia's NFI. In the submission, Indonesia reports that 4,450 measurements of permanent sample plots were available for calculations, complemented by additional forest research data. Despite the large number of plots, the AT noted that there are still gaps for individual strata. For example, there are very few measurements for the island of Java or for mangrove forests. The submission highlights ongoing work to improve

[14] For example, the data show that: estate crops increased from 131,000 ha to 493,000 ha in four years, between 1996 and 2000; plantation forest increased from 281,000 ha to 482,000 ha in two years, between 2009 and 2011; and wet shrubs increased from 0 ha to 479,000 ha and further to 1,401,000 ha in six and ten years, between 1990 and 1996 and between 1990 and 2000.

the NFI and to refine the set of emission factors. The AT acknowledges these plans and agrees that improving the set of emission factors is an area for improvement.

19. In its submission, Indonesia includes only the gross emissions from deforestation that are associated with clear-cut forests, excluding any potential biomass regrowth and associated removals after the deforestation event. The AT noted that this is a reasonable approach when forest is converted to cropland with annual crops, but not necessarily when the crops are perennial or when there are other woody biomass stocks. In response, Indonesia clarified that when natural forest has been converted to non-forested lands, they rarely grow back into natural forest. Therefore the proposed FREL excludes plantation forests and non-forest classes such as croplands, agricultural lands, shrubs, savannah and grasses, paddy fields, transmigration areas, settlement areas, ports and harbours, mines and bare lands. The AT notes that this exclusion of removals in post-conversion carbon stocks likely leads to an overestimation of emissions from deforestation. The AT considers that it would be useful to assess whether post-conversion removals are significant and could be taken into account when estimating emissions from deforestation, and notes this as an area for technical improvement.[15]

20. To identify activity data for soil organic carbon emissions from peatland drainage in areas subject to deforestation or forest degradation, the FREL submission overlays land-cover maps with Indonesia's peatland map. For deforestation and forest degradation occurring on peatlands, additional emissions from the soil organic carbon pool are then calculated. These two data sets are not perfectly harmonized.[16] During the TA, Indonesia acknowledged that such imperfect harmonization may occur in "sliver areas". While maps and definitions could technically be harmonized, Indonesia explained that fully harmonizing data sets would require collaboration and arrangements between several ministry-level agencies and is therefore not easy to achieve. The AT acknowledges that Indonesia has plans to improve peatland mapping and agrees that ensuring consistency between the land-cover map and the peatland map is an area for improvement.

21. Indonesia's FREL includes soil organic carbon emissions from peatland decomposition associated with deforestation and forest degradation on peatlands. Indonesia calculates these emissions for all areas of deforestation or forest degradation that occur on peatlands using detailed information on the post-conversion land cover, which determines decomposition rates. The decomposition rate is variable; for example, the rate in peatlands with annual crops may differ from that in peatlands with secondary forest. The AT commends Indonesia for its efforts to track land-cover changes post-conversion. The AT noted that while the emission factors from the Wetlands Supplement are intended to be applied only to "drained organic soils", the FREL does not distinguish areas with and without drainage. During the facilitative exchange for the TA, Indonesia explained that deforestation and forest degradation on peatlands are usually accompanied by drainage. The Party also included information in the modified FREL submission explaining that it is impossible to trace back the drained and the negligibly small areas of undrained secondary peat forest and therefore Indonesia considers it justifiable to consider all of the secondary forests as drained forests. The AT notes that the FREL submission does not currently include data to substantiate this. The submission does, however, highlight Indonesia's plans to improve the data on peatlands, chiefly with regard to emission factors and their

[15] The AT estimated the relevance of such conversion for natural forests on peatlands using a set of land-cover change matrices provided by Indonesia. With the available data, the estimation was possible only for peatlands where, over the reference period, 999,694 ha of natural forests were converted to estate crops and 549,366 ha of natural forests were converted to forest plantations, representing 35 per cent of natural forest loss. Total forest loss until 2012 amounted to 4,407,621 ha. It is unclear whether this estimation could be indicative of a more general trend.

[16] For example, the calculations identify dryland forests growing on organic soils.

dependency on the water table. The AT acknowledges these plans and agrees that collecting more detailed data on the management of peatlands is an area for improvement.

22. Most of Indonesia's land-cover information covers time periods of up to six years. The emission factors from the Wetlands Supplement describe annual emissions for land use types. Applying one single emission factor across a multi-year period would introduce bias. Indonesia avoids such bias by averaging the emission factors from before and after the change and then applying the average to the whole period. The AT commends Indonesia for its diligence in avoiding bias.

23. The submission uses different approaches to calculating means for the biomass pools over the reference period. For calculating average deforestation emissions and degradation emissions in the aboveground biomass pool, a simple arithmetic mean is used across all available periods, although the underlying forest-cover change is measured for unequal time intervals according to the availability of land-cover maps. For example, the estimate for the years 1990–1996 is taken into account only once for aboveground biomass. For calculating peatland emissions in the soil organic carbon pool, however, the applied regression approach reuses the estimates according to the different lengths of time interval. For example, the estimate for the years 1990–1996 is taken into account six times for the soil organic carbon pool. The AT notes that it would be useful if the submission explained the reasons for such methodological differences.

24. During the TA, Indonesia pointed out that the first biennial update report (BUR) of Indonesia and the FREL use the same principal data sources. The AT commends Indonesia for establishing overall consistency of data sources between the FREL and the national greenhouse gas (GHG) inventory contained in the BUR.

25. The AT notes that the FREL applies a different forest definition than that used in the national GHG inventory contained in Indonesia's first BUR (see paras. 34 and 35 below). In addition to the six natural forest classes contained in the FREL, the GHG inventory includes information about plantation forests. This addition may contribute to the difference between the deforestation estimate in the FREL and the area estimate for conversion of forest to other land-cover categories in the GHG inventory.[17] The GHG inventory estimates emissions and removals from forest land remaining forest land, taking into account statistical wood harvesting data and adjustments for illegal logging. Whether these estimates are fully consistent with the FREL data for forest degradation cannot be assessed, because the forest degradation estimates for the FREL are prepared using a different methodology that applies emission factors based on different average carbon stock values according to land-cover changes from primary to secondary forest, as discovered by remote sensing. In the modified FREL submission, Indonesia addressed this concern by explaining that emissions from further degradation of secondary forest were not included in the construction of the FREL because, at present, Indonesia does not have the capacity or data to assess the different levels of degradation occurring within secondary forests. The AT commends Indonesia for including an explanation of the forest definition in the modified FREL submission.

26. Indonesia carries out an uncertainty analysis of its FREL. The AT commends Indonesia for the exemplary effort made in providing the uncertainty analysis. During the TA, several aspects of the uncertainty analysis were discussed and areas for future improvement were identified; for example, moving from overall map accuracy to classification accuracy of individual classes or differentiating sampling errors between the individual forest classes. The AT notes that, in line with the stepwise approach, the current

[17] According to the BUR, the deforestation rate fluctuated between 335 and 1,106 thousand ha/year from 2000 to 2012, while in the FREL the deforestation rate fluctuated between 444 and 914 thousand ha/year in the same period.

uncertainty analysis covers only selected sources of error, and the AT sees broadening the scope of the uncertainty analysis to cover further potential sources of error, and differentiating between land-cover classes with regard to emission factors and activity data, as an area for technical improvement.

Description of relevant policies and plans, as appropriate

27. The FREL submission provides information on legal, policy and planning frameworks related to the forest sector since 1967, and highlights the increasing demand on land and natural resources to meet the population's food, energy and other development needs. The submission also includes information on the development of forest planning, management and allocation of lands of national forest for conversion for development purposes. In response to a question raised by the AT during the TA, Indonesia explained that the causes of deforestation and forest degradation have been considered in the construction of the FREL, and highlighted the fact that there was no specific quantitative calculation of deforestation and forest degradation drivers in the submission, because these drivers are very complex, involving cross-cutting issues related to policy, economic growth, population growth and individual sectors, as well as requiring appropriate data sets and research outputs to support them. The AT commends Indonesia for providing information on planning and policies and legal developments that have implications for deforestation.

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

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

29. The carbon pools included in the FREL are aboveground biomass and soil organic carbon. Aboveground biomass is included for all strata, while soil organic carbon is included only for deforestation or forest degradation occurring on peatlands. Belowground biomass, litter and deadwood are not included. Soil organic carbon on any soils except peatlands is also not included.

30. Based on preliminary data from the Indomalaya ecozone, Indonesia estimates that belowground biomass, deadwood and litter amount to 13.6 per cent, 14.5 per cent and close to 2 per cent, respectively, of forest biomass (excluding soil organic carbon). The low biomass volume in litter is an indication of its low significance. In the modified FREL submission Indonesia explains that, at the national level, the information about other carbon pools is very limited. If the quantitative information presented in the submission is confirmed to be similar in other ecozones, the deadwood and belowground biomass carbon pools would likely be significant sources of emissions. The AT considers the treatment of emissions from belowground biomass, deadwood and soil organic carbon as an area for technical improvement. Further, the AT notes that default IPCC root-to-shoot ratios could be used to estimate belowground biomass, and soil organic carbon on mineral soils could be estimated using IPCC stock change factors, which would allow a first indication of the importance of these carbon pools in Indonesia to be gained.

31. The submitted FREL includes only CO_2 emissions and does not cover emissions of other GHGs. The submission states that CO_2 contributes more than 99.9 per cent of total GHG emissions from LULUCF. The AT noted that, according to Indonesia's first BUR as well as its second national communication, fires occur frequently in the country and these could result in large amounts of non-CO_2 emissions, in particular on peatland forests. The AT considers the inclusion of non-CO_2 GHG emissions an area for technical improvement.

32. The submitted FREL does not include emissions from peatland fires. According to the first BUR, peatland fires make up 30.6 per cent of emissions from the land use sector,

which is more than forest and grassland conversion, which total 23.9 per cent. In the submission Indonesia explains that peatland fires have not been included in the FREL owing to the complexity and high uncertainty of related activity data, but that the Party has plans to include peatland fires in the FREL in the future. The AT acknowledges these plans and considers the inclusion of peatland fires an area for improvement.

33. The activities included in the FREL that are likely the REDD-plus activities with the most significant emissions in Indonesia are: reducing emissions from deforestation and from forest degradation. In its submission, Indonesia explains that data gaps, in particular those related to carbon stock enhancement, led to the exclusion of the other three REDD-plus activities (conservation and enhancement of forest carbon stocks and sustainable management of forests). The AT notes that Indonesia could explore whether the data set used for estimating the emissions from degradation could also be used for estimating the opposite conversions, which would lead to a carbon stock enhancement. The AT commends Indonesia for its plans to include additional REDD-plus activities and considers this inclusion an area for improvement.

4. Definition of forest

34. In the FREL submission, Indonesia uses a "formal right definition" and a "working definition" of forests. Such a distinction is common practice in many countries because of the technical difficulties in monitoring forests directly according to their legal definition. Both forest definitions are based on land-cover criteria, a set of quantitative thresholds. The formal right definition includes "land spanning more than 0.25 ha with trees higher than 5 metres at maturity and a canopy cover of more than 30 per cent, or trees able to reach these thresholds in situ". The working definition includes areas with "a land area of more than 6.25 ha with trees higher than 5 metres at maturity and a canopy cover of more than 30 per cent". This working definition is in line with well-defined Indonesian standards.[18] Moreover, Indonesia complements the application of threshold criteria with two other methodological features. First, the FREL is limited to areas covered by natural forests in 1990. Second, the forest definition takes into account criteria that relate to predominantly agricultural or forest-related use (e.g. to distinguish between forest plantations and estate crops) as well as the history of past conversion (to define natural forests). The AT notes that using a forest definition based on land use that is consistent with the IPCC methodologies as set out in the IPCC good practice guidance for LULUCF or the 2006 IPCC Guidelines reduces the risk of overestimating emissions from deforestation by allowing for better reflection of post-conversion carbon stocks, and commends Indonesia for its efforts to move beyond purely land cover based definitions.

35. The forest definition in the FREL submission is slightly different from that used in Indonesia's national GHG inventory for its first BUR. The FREL encompasses six forest types that are considered natural forest, and the FREL does not include plantations, while the BUR does include plantations. During the TA, Indonesia explained that this discrepancy results from natural forests being the main concern for REDD-plus implementation.

III. Conclusions

36. The information used by Indonesia in constructing its FREL for deforestation and forest degradation is transparent and complete and is in overall accordance with the

[18] These are the standards for "Land cover classification" (SNI 7645:2010) and "Method for calculating forest cover change based on results of visual interpretation of optical satellite remote sensing image" (SNI 8033:2014), where forests are defined based on satellite data features used for interpretation, including colour, texture and brightness.

guidelines for submission of information on FRELs (as contained in the annex to decision 12/CP.17).

37. The AT acknowledges that Indonesia included in the FREL emissions from deforestation and forest degradation, which are the two most significant REDD-plus activities in Indonesia. The FREL covers mainly natural forest, both primary and secondary, which is considered to be the most important land-cover category in Indonesia in terms of deforestation and forest degradation. The FREL limits its scope to aboveground biomass and soil organic carbon on organic soils, and to CO_2, which are the most significant pools and gas in terms of emissions from forests. The AT considers that Indonesia generally followed decision 1/CP.16, paragraph 70, on activities undertaken, paragraph 71(b) and decision 12/CP.17, paragraph 10, on implementing a stepwise approach. The AT commends Indonesia for the information provided on its ongoing work in the development of the FREL and improving the accuracy and coverage of the estimates.

38. As a result of the facilitative interactions with the AT during the TA session, Indonesia submitted a modified submission that took into consideration the technical inputs by the AT. The AT notes that the transparency and completeness of information improved significantly in the modified FREL submission, without the need to alter the approach or values used to construct the FREL, and commends Indonesia for the efforts it made.

39. The AT notes that Indonesia achieves consistency between the FREL and the national GHG inventory contained in its first BUR in terms of using the same principal data sets.

40. In its submission, Indonesia explains that the FREL was constructed based on the currently available data and knowledge of national circumstances, capacity and capability. Indonesia indicated a number of areas with opportunities for improvement. The AT agrees with Indonesia's assessment and commends Indonesia for the ongoing work in the following areas for improvement:

(a) Activity data: to improve accuracy and consistency in satellite image interpretation, time series satellite images could be directly compared (rather than analysing satellite images for time points individually by overlaying maps to detect changes) and automated image processing techniques could be introduced (see paras. 16 and 17 above);

(b) Forest emission factors (carbon stock): the submission describes plans for further improving the emission factors derived from the NFI (see para. 18 above);

(c) Peatland emission factors: the current approach assumes that deforestation and forest degradation always occur together with peatland drainage. Indonesia's plans to improve data collection on peatlands will lead to a better understanding of their characteristics and to better peatland emission factors (see para. 21 above);

(d) Peatland fire emission estimates: the national GHG inventory highlights the importance of peatland fires in Indonesia. Indonesia is working on improvements to the methodology for activity data identification in order to reduce uncertainties and include emissions from peatland fires in the FREL (see para. 32 above);

(e) Inclusion of other REDD-plus activities: Indonesia describes efforts to understand the technical aspects as well as the socioeconomic aspects related to the enhancement of forest carbon stocks and the role of conservation and sustainable management of forests, with the aim of including additional REDD-plus activities in the FREL (see para. 33 above).

41. In addition to the areas for improvement already identified in the submission, and pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following areas for future technical improvement:

(a) Assessment of whether post-conversion removals in different land uses are significant and could be taken into account when estimating emissions from deforestation. Based on information provided by Indonesia, the AT notes that some of the necessary information may potentially be extracted from already available land-cover change matrices (see para. 19 above);

(b) Broadening of the scope of the uncertainty analysis to cover further potential sources of error, and differentiating between land-cover classes with regard to emission factors and activity data (see para. 26 above);

(c) Inclusion of other significant pools, such as belowground biomass, deadwood and soil organic carbon (see para. 30 above), as well as the inclusion of non-CO_2 GHG emissions (see para. 31 above).

42. In conclusion, the AT commends Indonesia for developing its national capabilities for forest monitoring, and for showing a strong commitment to the continuous improvement of its FREL estimates, in line with the stepwise approach. The AT acknowledges that the areas for future improvement identified in this report are subject to national capabilities and policies, and notes the importance of adequate and predictable support. The AT also acknowledges that the assessment process was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Indonesia. Finally, the AT notes the willingness of Indonesia to contribute to the global effort to mitigate climate change through REDD-plus.

43. The table in the annex summarizes the main characteristics of Indonesia's proposed FREL.

Annex

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

Main features of the FREL		*Remarks*
Proposed FREL (in t CO_2 eq/year)	From: 568 859 881 (for 2013) To: 593 329 235 (for 2020)	Paragraph 9
Type and duration of FREL	FREL based on average historical emissions from 1990 to 2012	Paragraph 6
Adjustment for national circumstances	No	–
National/subnational[a]	National	Indonesia has developed a national FREL that covers all land areas covered by natural forests in the year 1990, which is about 113.2 million hectares (ha) or 60 per cent of the total land area of Indonesia (para. 7)
Activities included[b]	Deforestation and forest degradation	The FREL includes gross emissions from deforestation (without considering forest regeneration) and emissions from forest degradation (conversion of primary forests to secondary forests) (para. 6)
Pools included[b]	AB and SOC	AB is included for all strata. SOC is included only for deforestation and forest degradation occurring on peatlands. BB, L and DW are not included. SOC on any soils except peatlands is also not included. BB, DW and SOC could not be included in calculations because the necessary data were unavailable (para. 29)
Gases included	CO_2	Paragraph 31
Forest definition[c]	Included	Land of minimum area 0.25 ha with trees higher than 5 m at maturity and a canopy cover of more than 30 per cent, or trees able to reach these thresholds in situ. Based on remote sensing data used by Indonesia, the minimum area of 0.25 ha cannot be captured, thus Indonesia used a minimum area of 6.25 ha. The definition is restricted to natural forests, both primary and secondary, while excluding plantation forests (para. 34)
Relationship with latest GHG inventory	Same principal data sources and key methodological	The FREL and the national GHG inventory in the first biennial update report of Indonesia both use the same principal data sources. The emission

Main features of the FREL		*Remarks*
	guidance	factors are derived from the national forest inventory 1990–2013. Key activity data are a time series of land-cover maps for 1990–2014. Both the FREL and the GHG inventory rely on the 2006 IPCC Guidelines and the Wetlands Supplement (paras. 14 and 24)
Description of relevant policies and plans[d]	Included	Paragraph 27
Description of assumptions on future changes in policies[d]	Not applicable	–
Descriptions of changes to previous FREL	Not applicable	–
Future improvements identified	Yes	Several areas for future technical improvement were identified (para. 41)

Abbreviations: AB = aboveground biomass, BB = belowground biomass, DW = deadwood, FREL = forest reference emission level, GHG = greenhouse gas, L = litter, SOC = soil organic carbon, t CO_2 eq/year = tonnes of carbon dioxide equivalent per year, Wetlands Supplement = *2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands*, 2006 IPCC Guidelines = *2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

[a] If subnational, comments should include information on the treatment of displacement of emissions.

[b] In the case of omitted pools or activities, comments should include the justification provided by the country.

[c] The forest definition should be summarized, and it should be stated if it differs from the definition used in the greenhouse gas inventory or in reporting to other international organizations.

[d] May be relevant to the description of national circumstances, which is required in the case of adjustment.