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Report of the technical assessment of the proposed forest reference emission level of Costa Rica submitted in 2016

Summary

This report covers the technical assessment of the submission of Costa Rica, on a voluntary basis, on its proposed forest reference emission level (FREL)/forest reference level (FRL), in accordance with decision 13/CP.19 and in the context of results-based payments. The FREL/FRL proposed by Costa Rica covers the activities "reducing emissions from deforestation" and "enhancement of forest carbon stocks", which are among the activities included in decision 1/CP.16, paragraph 70. In its submission, Costa Rica has developed a national FREL/FRL. The assessment team notes that the data and information used by Costa Rica in constructing its FREL/FRL 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/FRL and a few areas identified by the assessment team for further technical improvement, according to the scope of the technical assessment in the annex to decision 13/CP.19.

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I. Introduction and summary

A. Overview

1. This report covers the technical assessment (TA) of the submission of Costa Rica on its proposed forest reference emission level (FREL) and forest reference level (FRL),[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 14 to 18 March 2016 in Bonn, Germany, and was coordinated by the UNFCCC secretariat.[2] The TA was conducted by two land use, land-use change and forestry experts from the UNFCCC roster of experts[3] (hereinafter referred to as the assessment team (AT)): Mr. Manuel Estrada (Mexico) and Ms. Marina Vitullo (Italy). 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, Costa Rica submitted, on a voluntary basis, its proposed FREL/FRL. This proposed FREL/FRL 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/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 decisions 13/CP.19, paragraphs 1 and 2, and 14/CP.19, paragraphs 7 and 8.

3. The objective of this TA was to assess the degree to which information provided by Costa Rica was in accordance with the guidelines for submissions of information on FRELs/FRLs[6] 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 Costa Rica for the construction and future improvement of its FRELs/FRLs, as appropriate.[7]

4. The TA of the FREL/FRL submitted by Costa Rica was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELs and/or 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 contained in the annex to decision 13/CP.19, a draft version of this report was communicated to the Government of Costa Rica. The facilitative exchange during the TA allowed Costa Rica 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, Costa Rica submitted a modified version on 23 May 2016,[9] 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 proposed FREL, except for the removal of the harvested wood products (HWP) pool. This TA report

[1] The submission of Costa Rica is available at <http://redd.unfccc.int/submissions.html?country=cri>.
[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.
[9] The modified submission of Costa Rica is available at <http://redd.unfccc.int/submissions.html?country=cri>.

was prepared based on the context of the modified FREL/FRL submission that Costa Rica submitted on 23 May 2016 after the centralized activity referred to in paragraph 1 above. The modified submission that contains the assessed FREL/FRL and the original submission are available on the UNFCCC website.

B. Proposed forest reference emission level/forest reference level

6. The national FREL/FRL proposed by Costa Rica for the two contiguous historical reference periods 1986–1996 and 1997–2009 is the annual average of the carbon dioxide (CO_2) equivalent emissions associated with deforestation,[10] and the enhancement[11] of forest carbon stocks. For the activity "reducing emissions from deforestation", the FREL/FRL includes the emissions that are associated with clear-cuts and considers subsequent removals from deforested areas depending on the subsequent land use.[12] The proposed FREL/FRL excludes non-anthropogenic emissions associated with volcanic activity and river meandering, because they are considered to be natural disturbances. Gains and losses in carbon stocks in forest land remaining forest land in the reference periods are considered in Costa Rica's modified submission of 23 May 2016 only for secondary forest; gains and losses are excluded in primary forest that remain primary forest because they are considered to be unmanaged land. Carbon stock enhancements in forest land remaining forest land were estimated using growth models developed in Costa Rica that estimate carbon stocks as a function of age. The FREL/FRL presented in the modified submission corresponding to the reference period 1986–1996, with the aim of accessing results-based payments for REDD-plus[13] activities in the period 1997–2009, corresponds to 14,911,467 tonnes of CO_2 equivalent per year (t CO_2 eq/year), and the FREL/FRL corresponding to 1997–2009, with the aim of accessing results-based payments for REDD-plus activities in the period 2010–2025 corresponds to 4,365,160 t CO_2 eq/year.

7. In decision 1/CP.16, paragraph 70, the COP encourages developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances, in the context of the provision of adequate and predictable support. The FREL/FRL proposed by Costa Rica on a voluntary basis for a TA in the context of results-based payments covers the activities reducing emissions from deforestation and enhancement of forest carbon stocks, which are two of the five activities included in decision 1/CP.16, paragraph 70. Pursuant to paragraph 71(b) of the same decision, Costa Rica has developed a national FREL/FRL for the entire national territory of Costa Rica (5,133,939.50 ha), with the exception of the Coco Island (238,500 ha), which is 532 km from the country's continental territory and is not subject to anthropogenic intervention. Additionally, a total of 2.26 per cent of the forest area in the period 1986–2013 was excluded, because no information was available for some areas of the country owing to the presence of clouds and shadows during the data-collection period. The FREL/FRL incorporates all biomes/forests in the country. Costa Rica applies a stepwise approach to its development of the FREL/FRL, in accordance with decision 12/CP.17,

[10] Defined as forest land converted to non-forest land in the year of conversion (including primary and secondary forest).

[11] Defined as the annual average removals occurring in secondary forest (plantations) and natural regeneration of forest in non-forest lands.

[12] Only for croplands and grasslands; post-deforestation/conversion biomass regrowth for settlements, wetlands and other lands is considered to be 0.

[13] In decision 1/CP.16, paragraph 70, the COP encourages 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.

paragraph 10. The stepwise approach enables Parties to improve the FREL/FRL by incorporating better data, improved methodologies and, where appropriate, additional pools.

8. The proposed FREL/FRL includes the pools above-ground biomass, below-ground biomass, dead wood (only above ground) and litter. The soil organic carbon and HWP pools were excluded. Regarding greenhouse gases (GHGs), the submission includes CO_2, and methane (CH_4) and nitrous oxide (N_2O) from biomass burning, although biomass burning and related emissions of CH_4 and N_2O were included only for the period 1986–1996, and were excluded in the post-1996 period.

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

9. For the construction of the FREL/FRL, the methodology used by Costa Rica is generally in line with the methodology provided in the Intergovernmental Panel on Climate Change (IPCC) *2006 Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines). The AT notes that the forest-related carbon stocks used to assess carbon stock changes related to forest land and the conversion of forest land to other land-use categories have been assessed on the basis of a country-specific methodology, and this is not fully in accordance with the 2006 IPCC Guidelines (see paras. 16 and 17 below).

10. The activity data (AD) used in the construction of the FREL/FRL in Costa Rica's national territory were based on remote sensing data (Landsat 4, Landsat 5, Landsat 7, Landsat 8 OLI/TIRS), a "life zones" map used to stratify the forest into the different subcategories ("wet and rain forests", "moist forests", "dry forest") and ancillary data to further stratify the forest area, identifying two more subcategories "mangroves" and "palm forests". Areas classified as "urban areas" were detected through visual interpretation of 2013 high-resolution Rapideye satellite images. AD were estimated by combining all land-use maps created for 1986–2013 and then extracting from the combined set of multi-temporal data (1985/1986, 1991/1992, 1997/1998, 2000/2001, 2007/2008, 2011/2012 and 2013/2014) the areas that remained in the same category or converted to other land-use categories. Afterwards, land-use change matrices were assessed on the basis of the above-mentioned land-use maps. AD for deforestation have been obtained from the land-use change time series, on the basis of the two main subcategories (primary and secondary forest) and the different types of forests included in the above-mentioned subcategories ("wet and rain forests", "moist forests", "dry forests", "mangroves" and "palm forests"). The areas subject to the activity enhancement of forest carbon stocks have been identified from the land-use change time series, and it was found that all were included in the secondary forest category. It is assumed that no changes in carbon stocks are happening in the primary forest category, because primary forests are considered to be "not managed".

11. The estimation of forest carbon stocks was made using data from a 289-plot representative sample carried out as part of the national forest inventory (NFI), which was ongoing at the time of the elaboration of Costa Rica's submission (and therefore only

partial results could be used for this purpose). NFI plot distribution was based on fixed sample intensities by forest class, and the disturbed forest areas or managed lands, if occurring, were not included in the NFI plot locations. Therefore, these data are considered to be representative of all possible conditions and age classes of forest land at the national level. NFI data were complemented with the use of additional information on carbon stocks for some of the land-use categories that are considered in the national GHG inventory and in the FREL/FRL but not in the NFI (such as non-forest land-use categories and categories of age classes of secondary forests). Moreover, given that the NFI and the national GHG inventory differ in their forest classifications, it was necessary to allocate each of the 289 NFI plots to the five forest land strata (subcategories) in order to estimate average carbon stocks per hectare per stratum. To collect additional carbon stock data, Costa Rica carried out a meta-analysis that involved reviewing 110 publications meeting a number of specified criteria (publications that: report data from direct measurements carried out in Costa Rica; provide measurements carried out after 2005; contain data sufficiently disaggregated to obtain information on carbon stocks for relevant land-use categories and carbon pools; and offer information on uncertainties related to carbon stock estimates).

12. Costa Rica has developed a national FREL/FRL for the entire national territory of the country (5,133,939.50 ha), with the exception of the Coco Island (238,500 ha) (see para. 7 above). The losses of forest cover in the areas affected by natural disturbances (i.e. volcanic activities and river meandering) have been not included in the FREL/FRL. The FREL/FRL incorporates all biomes/forests in the country.

13. The construction of the FREL/FRLs was based on time series of land-use maps, covering the period from 1986 to 2013. The proposed FREL/FRL has been estimated as the sum of the annual average CO_2 net emissions from deforestation and the annual average CO_2 removals from enhancement of forest carbon stocks during the two historical reference periods: 1986–1996 for the first period of enhanced mitigation actions (1997–2009); and 1997–2009 for the second period of enhanced mitigation actions (2010–2025). For the historical reference period 1986–1996 emissions from deforestation have been assessed to be 17,064,070 t CO_2 eq/year (primary forest accounts for 87.3 per cent of these emissions, with the remaining 12.7 per cent related to deforestation of secondary forests), while removals through the enhancement of forest carbon stock are estimated to be 2,152,603 t CO_2 eq/year. For the historical reference period 1997–2009 emissions from deforestation have been assessed to be 8,590,840 t CO_2 eq/year (75.4 per cent primary forest; 24.6 per cent secondary forests), while removals through the enhancement of forest carbon stock are estimated to be 4,225,681 t CO_2 eq/year. The FREL/FRL includes the gross emissions from deforestation that are associated with clear-cuts and considers subsequent removals from the deforested areas only in the case of lands converted to croplands and grasslands.

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

14. The FREL/FRL has been estimated as the sum of the annual average emissions from deforestation and the annual average removals from enhancement of forest carbon stocks in two historical reference periods: 1986–1996 for the first period of enhanced mitigation actions (1997–2009); and 1997–2009 for the second period of enhanced mitigation actions (2010–2025). These time series were constructed based on: remotely sensed data from Landsat; a "life zones" map; and ancillary data used to edit the results of the spectral classification of remotely sensed data and to further stratify the forest categories (see para. 10 above). This information was used to construct land-use maps using a methodology to

pre-process, classify and post-process it, created specifically for Costa Rica's FREL/FRL.[14] AD were estimated by combining all land-use maps created for 1985/1986–2012/2013 in a geographical information system and then extracting the values of the areas that remained in the same category or converted to other land-use categories from the combined set of multi-temporal data.

15. The AT sought a number of clarifications on the estimation of AD from Costa Rica. The most important were:

(a) A 1978/1980 ancillary map was used to determine the proportion of primary and secondary forest land at the beginning of the land-use change time series. In the context of Costa Rica's submission, "secondary forests" are forests that regenerated on non-forest land, as well as forests that were classified as "secondary" in 1985/1986 according to the 1978/1980 ancillary map. The AT noted that the information provided in the original submission did not describe the technical details of the 1978/1980 map or the criteria used to classify primary and secondary forests in such a map. In response to this comment, Costa Rica included an annex in its modified submission (annex 2) which explains that the map was developed by the National Meteorology Institute (IMN) in 2013 and on the basis of five Landsat images spanning from March 1975 to December 1979. It also pointed out that it is estimated that the map has a 10 per cent error. The AT considers that the inclusion of this additional information to Costa Rica's submission increases its transparency and encourages Costa Rica to set up a data repository of all relevant information and data used in the FREL/FRL, including material related to the above-mentioned map, as the classification procedure used. However, the AT noted that the modified submission still lacks a description on how primary and secondary forests were distinguished in the 1978/1980 map and the AT identified this as an area for improvement in subsequent submissions from Costa Rica;

(b) In the FREL/FRL modified submission Costa Rica mentioned a test "carried out to determine how well the analysis of remotely sensed data performed in classifying "forests" according to its definition". In particular, it indicated that "only 53.31% of the areas classified as 'non-forest' in 2001 presented <30% of canopy cover, while for 2012 the percentage was 56.61%". On the basis of the above-mentioned statements, the AT found that some of these areas may be forests that are not being accounted for. The AT notes that a re-analysis of the area classified as "non-forest" and the inclusion of the main outcome of this process in the above-mentioned data repository of all FREL/FRL relevant information would enhance the transparency and improve the accuracy of the FREL/FRL submission by Costa Rica.

(c) In its submission, Costa Rica assumes that secondary forests in 1985/1986 are representative of all possible age classes, up to 400 years old, with equal proportions of areas. In this regard, the AT pointed out that this period is not consistent with the research by Cifuentes (2008),[15] where the age classes of secondary forests in Costa Rica are classified in categories ranging from some months to up to 85 years, varying by life zone. The AT also pointed out that assuming an equal representation of age classes in secondary

[14] Agresta, Dimap, Universidad de Costa Rica, Universidad Politécnica de Madrid. 2015. *Final Report: Generating a consistent historical time series of activity data from land use change for the development of Costa Rica's REDD plus reference level: Methodological Protocol*. Report prepared for the Government of Costa Rica under the Forest Carbon Partnership Facility (FCPF). [44 p.][p. 44.].

[15] Cifuentes M. 2008. *Aboveground Biomass and Ecosystem Carbon Pools in Tropical Secondary Forests Growing in Six Life Zones of Costa Rica*. Oregon State University. School of Environmental Sciences. Available at <https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/8904/Cifuentes-Jara_Dissertation.pdf?sequence=1>.

forests might not be realistic. In response to these comments, Costa Rica clarified that the 1978/1980 map was used to identify secondary forests and then an assumption was made on their age class distribution; namely, that all age classes have the same probability of occurring and, therefore, all present the same forest area in 1985/1986. Further, Costa Rica pointed out that this is a reasonable assumption considering the history of land use in Costa Rica, and that it is equivalent to allocating an average growth rate to this class of secondary forests. The AT welcomed this response, and noted that providing additional data to support these assumptions or revising them in the light of new information would increase the transparency and accuracy of future FREL/FRL submissions from Costa Rica;

(d) In response to the AT's request for information on areas subject to deforestation and to enhancement of forest carbon stocks Costa Rica provided land use and land-use changes tables, reporting the IPCC categories for the years 1985/1986, 1991/1992, 1997/1998, 2000/2001, 2007/2008, 2011/2012, 2013/2014. Costa Rica also explained that the category forest land is divided into forest land remaining forest land and land converted to forest land. In response to a further request by the AT, Costa Rica included in its modified submission the information on deforestation occurring in land classified as secondary forest. The AT welcomes the inclusion of this information.

16. Average carbon stocks by carbon pool and strata were estimated by Costa Rica from the consulted sources of information (NFI and selected studies from the meta-analysis referred to in para. 11 above). All carbon stock estimates from the consulted sources were compiled in tonnes of carbon per hectare (t C/ha), using the IPCC default carbon fraction (0.47) when the values were reported in tonnes of dry matter (t dm/ha). As information on the uncertainty of the estimates was reported in different ways, it was necessary to standardize the reporting of uncertainties associated to the average carbon stock values by applying an equation assuming a normal distribution of the data. Data collected were analysed in order to obtain mean t CO_2 eq values and associated uncertainties for all pools and land-use categories. Carbon stock changes were estimated using the stock difference method by applying equation 2.5 from the 2006 IPCC Guidelines, while non-CO_2 emissions from biomass burning were estimated using equation 2.27 from the 2006 IPCC Guidelines.

17. Above-ground carbon stocks for primary forest were estimated by multiplying area-weighted average carbon stock values by the area classified as primary forest; for mangroves and palm forests, a simple arithmetic mean was calculated. Above-ground carbon stocks for secondary forest (wet and rain forests, moist forests and dry forests) were estimated using a growth model developed by a national study (Cifuentes, 2008), based on a relationship between the age and the related above-ground biomass. The model was validated with a sample of 54 plots in age classes between 0 and 82 years. Secondary forests established after 1985/1986 were assumed to have a number of age classes equal to the number of years in the measurement period (i.e. six age classes for 1986–1991 and 1992–1997; three for 1998–2000; seven for 2001–2007; four for 2008–2011; and two ages classes for 2012–2013). For each monitoring period, the new forest area detected has been linearly distributed by dividing the total area detected by the number of the years of the monitoring period. For mangroves and palm forests included in the secondary forests, a linear function was assumed for estimating carbon stocks as a function of age. Carbon stocks in below-ground biomass, both for primary and secondary forest, have been assessed to be correlated to the above-ground carbon stocks and estimated accordingly, based on Cairns et al.[16] Non-tree below-ground biomass has been estimated on the basis of IPCC default values. Dead wood carbon stocks were assessed through the use of a dead wood/above-ground biomass ratio, for primary and secondary forest, except for mangroves

[16] Cairns MA, Brown S, Helmer EH and Baumgardner GA. 1997. Root biomass allocation in the world's upland forests. *Oecologia*. 111: pp. 1–11.

and palm forests, where a simple arithmetic mean was calculated. The carbon stocks for litter for primary forest were estimated by multiplying area-weighted average carbon stock values by the area classified as primary forest, except for mangroves and palm forests, where a simple arithmetic mean was calculated, while a litter/above-ground biomass ratio was used for secondary forest. Carbon stock values related to other land-use categories were assessed on the basis of national studies. Default emission factors and parameters from the 2006 IPCC Guidelines were used to assess non-CO_2 emissions from biomass burning from conversions of forests to cropland and grassland.

18. In assessing the robustness of the models used to predict the rates of biomass accumulation in the different life zones of Costa Rica, the AT noted that Cifuentes (2008) recognizes that sampling 5–10 secondary forest sites per life zone (the size of the sampling carried out for his research) is a small number to predict rates of biomass accumulation. He also recognizes that there are inherent limitations to the chronosequence approach regarding the substitution of spatial differences in stand age for measurements taken over time in a given location. Based on this information, the AT requested Costa Rica to provide information on the number of samples used to fit and validate the model developed by Cifuentes in order to make it representative of the forests included in the FREL/FRL. Costa Rica replied that a total of 54 sampling plots in secondary forests, stratified by six life zones (with additional information on the range of secondary forest ages in a life zone) were collected by interviewing local residents, plot by plot. In addition, sampling was narrowed by choosing sampling plots only in areas previously used as pasture and not considering secondary forests subject to logging activities. Costa Rica also acknowledged that no further validation of the model has been done. The AT notes that there is a small number of samples per life zone and that an increase in the number of sampling plots will increase the representativeness of all the forest in the six life zones included in the FREL/FRL assessment. Moreover, the AT sought clarifications regarding why the model developed by Cifuentes only takes into account carbon stock gains in secondary forests and does not consider losses (e.g. owing to harvesting, fires, mortality). Costa Rica responded that the Cifuentes model includes part of the effect of anthropogenic disturbance, because the data were collected in plots of different ages and subject to different types and degrees of disturbances, which reflects gains and some losses. Hence, total carbon stocks for above-ground biomass predicted by the Cifuentes model are considered to be net values by Costa Rica. Moreover, Costa Rica pointed out that currently there is no management (and thus no logging) of secondary forests in the country. The AT acknowledges that the carbon stock data from the Cifuentes model may consider some losses, but noted that secondary forest losses that occurred in each modelling year can be substantial (e.g. harvest, fires, mortality) and should be estimated. In addition, the AT notes that the model used by Costa Rica does not take into account the carbon stock losses owing to rotations in plantations, which have been classified as secondary forests because the quality of the satellite imagery employed (Landsat) was not sufficient to overcome the spectral confusion of forest plantations with secondary forests and certain agroforestry systems, and therefore it was not possible to include them as an additional subcategory in the land-use change time series. The AT considers that additional sampling and the validation of the model developed by Cifuentes would increase the accuracy of future FREL/FRL submissions by Costa Rica. The AT also considers that the comparison of the results of the Cifuentes model and IPCC default factors, presented by Costa Rica during the review process, would increase the transparency and accuracy of future FREL/FRL submissions from Costa Rica. The AT finally notes that, when estimating carbon stock changes in secondary forests, including all losses (e.g. harvest, fires, mortality) currently not taken into account by the modelling approach will enhance the accuracy of the future FREL/FRL submission from Costa Rica.

19. During the review process, the AT asked Costa Rica to supply detailed information on the carbon stock per hectare values used to assess deforestation of secondary forests,

according to the age class of the deforested area, and on the country-specific period used in the estimation process for removals for activities subject to carbon stock enhancement. The AT also asked Costa Rica to explain how it avoided the assumption that carbon stock enhancements continued to occur in areas of secondary forests that were deforested, in plantations that were cut or areas affected by forest fires during the historical period. The above-mentioned information has been included in the modified submission by Costa Rica. The AT notes that providing the carbon stock factors used to assess the emissions from deforestation as an annex to the modified submission increased the transparency of the FREL/FRL submission from Costa Rica.

20. To estimate the annual CO_2 emissions, Costa Rica estimated carbon stock changes using the stock difference method from the 2006 IPCC Guidelines, and multiplied the results by 44/12 to convert carbon into CO_2. The carbon stock changes have been estimated annually, through the use of the spreadsheet tool referred in the FREL/FRL submission (spreadsheet "FREL TOOL CR (28.12.2015).xlsx"). Emissions from deforestation were estimated by assuming constant carbon stocks over time in primary forest land and variable carbon stocks according to forest age in secondary forest land. After a deforestation event, all forest carbon stocks have been assumed to be oxidized; in the period after deforestation, non-forest carbon stocks have been considered. Non-CO_2 emissions from biomass burning have been estimated only for forest land areas subject to deforestation (i.e. wet and rain forests, moist forests and dry forests converted to other land use categories; it was assumed that mangroves and palm forests are not affected by biomass burning). Emissions from biomass burning associated with forest land conversion to other land uses have not been estimated for the period 1998–2013, under the assumption made by Costa Rica that, after 1997, biomass burning did not occur in conversion of forest to other land uses (i.e. deforestation). Costa Rica also assumed that, in secondary forests, the effect of forest fires is indirectly considered in the Cifuentes model for the estimation of carbon stock changes.

21. With regards to the spreadsheet "FREL TOOL CR", which contains all the data and calculations supporting the FREL/FRL, the AT found that, although this tool was aimed at improving the submission's transparency, its complexity and size make it difficult for the reader to understand the processes, equations and steps that the tool follows to obtain the estimations of the FREL/FRL. The AT acknowledges that Costa Rica provided, with the modified submission, the User's Manual for the reference-level estimation tool, and the AT notes that the provision of the manual and the tool as an annex to the submission, publicly available, would improve the transparency and accuracy of future FREL/FRL submissions and help build confidence in the estimated emissions.

22. The AT noted some inconsistencies between the AD and methodologies used in the latest GHG inventory[17] included in the Party's biennial update report (BUR) and the information used to assess the FREL/FRL, namely:

(a) The national GHG inventory includes non-CO_2 emissions from biomass burning, while non-CO_2 emissions from biomass burning are included in the FREL/FRL for the period 1986–1996 but are excluded in the post-1996 period;

(b) The national GHG inventory includes carbon stock change estimates for plantations but not for primary and secondary forests in the forest land remaining forest land category, while the FREL/FRL includes both primary and secondary forests, stating that plantations are included under secondary forest; and the information on plantations used in the GHG inventory has been deduced from the 2014 National Agriculture Census.

[17] Available at <http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=7818#beg>.

23. In relation to the inconsistencies with the GHG inventory mentioned in paragraph 22 above, Costa Rica stated that a harmonization process with the GHG inventory has begun, and a recalculation of the GHG inventory for the years 1990, 1995 and 2000 is a planned improvement.

Description of relevant policies and plans, as appropriate

24. The most relevant forest policy in Costa Rica is the current Forest Law, passed in 1996. This law established the Program for Environmental Services (PSA) and banned forest conversion, making deforestation illegal. In 2009, Costa Rica developed its first Climate Change National Strategy including specific climate change mitigation and adaptation objectives, as well as a national-level Carbon Neutrality goal, which was ratified in the country's intended nationally determined contribution (INDC) to the UNFCCC. Costa Rica's INDC draws a path for reducing emissions to a level consistent with the ultimate goal of the UNFCCC to avoid exceeding the global 2^{o}C temperature increase limit. Several nationally appropriate mitigation actions are being developed in the country. A national REDD-plus strategy that considers six new forest policies which complement the current National Forestry Development Plan has been completed and was in its final consultation phase at the time when the modified submission was provided.

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

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

26. The carbon pools included in the FREL/FRL are: above-ground biomass (trees and non-trees); below-ground biomass (trees and non-trees); dead wood (only above ground); and litter. The soil organic carbon, dead wood (below ground) and HWP pools were not included.

27. Costa Rica indicated that efforts are ongoing to obtain better information in order to include also the dead wood in the below-ground pool. The AT commends Costa Rica for its efforts to enhance the quantitative information on this pool in the future, with the aim of increase the accuracy of the reported information as part of the stepwise approach. The AT notes that emissions from dead wood are likely to be insignificant.

28. With regard to emissions from the soil organic carbon pool, the AT requested clarification on the reasons for the omission of this pool. In response to this question, Costa Rica explained that the rationale behind the non-inclusion of this pool was based on the consideration that insufficient tier 2 data were available to estimate emission factors. The AT considers that the soil organic carbon pool could be included using the default emission factors contained in the 2006 IPCC Guidelines. The AT considers the treatment of emissions from soil organic carbon (i.e. the inclusion of this pool or the provision of more information justifying its omission) as an area for future technical improvement of the FREL/FRL.

29. In its original FREL/FRL submission, Costa Rica estimated emissions from HWP using a country-specific methodology assuming that the sawn wood fraction of HWP does not oxidized immediately. The AT notes that this methodology is not comparable with methods in the 2006 IPCC Guidelines and is also not consistent with Costa Rica's GHG inventory. In response to a question in this regard from the AT, Costa Rica excluded the HWP carbon pool in its modified submission.

30. Biomass burning and related emissions of CH_4 and N_2O were included in the estimates related to the conversion of forests to cropland and grassland that occurred in the

period 1986–1996, and were excluded in the post-1996 period on the basis that, in 1997, conversion of forest became illegal with the passing of the Forest Law, leading to a dramatic decrease in slash-and-burn after 1996. However, Costa Rica included emissions of these gases in its national GHG inventory. The AT noted that not including non-CO_2 emissions from biomass burning in forest land remaining forest land in the period post-1996 is not consistent with the national GHG inventory estimates for 2012 included in the Party's BUR. In response to a question on this issue from the AT, Costa Rica explained that the national GHG inventory includes GHG emissions from biomass burning in forest land remaining forest land for the years 2005, 2010 and 2012, and that these emissions were not included in the FREL because they were not considered to be significant. At the same time, the FREL/FRL includes GHG emissions from biomass burning pre-1996, although the national GHG inventory does not include this information, given that only the years 2005, 2010 and 2012 years have been recalculated for the agriculture, forestry and other land use sector. Costa Rica also explained that recalculations for the inventories for the years 1990, 1995 and 2000 are a planned improvement. Costa Rica confirmed that, for its pre-1996 inventories (i.e. 1990 and 1995), the assumption of fire use for forest conversion will be kept consistent. During the assessment week, Costa Rica provided information on the forest area burned in the period 1998–2011 for secondary forests and tree plantations, as reported by the national information system of forest resources ("Sistema de Información de los Recursos Forestales de Costa Rica" – SIREFOR).[18] No data are available for primary forests, because these forests are considered unmanaged, and it is assumed that biomass burning in these areas does not incur in land-use change. The AT noted that even if biomass burning does not incur in land-use change, not accounting in full for these losses may result in an overestimation of the emissions from deforestation in primary forest areas. The AT considers that the treatment of CH_4 and N_2O emissions from biomass burning (i.e. the inclusion of this pool or the provision of more information justifying its omission) as an area for future technical improvement to ensure consistency with future GHG emissions inventories.

31. The AT acknowledges that Costa Rica included the most significant activities (reducing emissions from deforestation and enhancement of forest carbon stocks) of the five activities identified in paragraph 70 of decision 1/CP.16, in accordance with national capabilities and circumstances. The AT notes that other activities could also be significant, in particular, sustainable forest management and forest degradation. According to the modified FREL/FRL submission, Costa Rica currently does not have sufficient good-quality information for 1986–2013 to include the above-mentioned activities. During the assessment week, the Party provided the AT with national forestry statistics available from SIREFOR, including information on forest management areas.[19] Costa Rica further noted that these reports only exist for the years 2011, 2012 and 2013. Therefore, the AT notes that the current exclusion of three of the five activities identified in the same decision (forest degradation, conservation of forest carbon stocks and sustainable management of forests) from the FREL/FRL does not result in an overestimation of emissions.

32. Overall, the AT commends Costa Rica for the information provided in its modified submission. The AT acknowledges the intention expressed by Costa Rica to: include the remaining activities within the forest land remaining forest land category (forest degradation) and sustainable management of forests; update the whole emissions time series in the GHG inventory and ensure consistency of the GHG inventory data and methods with the FREL/FRL; and to design a new forest monitoring system compatible with the national measurement, reporting and verification framework. The AT further

[18] See <www.sirefor.go.cr/?page_id=1051>.

[19] See, for example, Sistema de Información de los Recursos Forestales de Costa Rica – SIREFOR, 2013, table 1, page 6. Available at: <www.sirefor.go.cr/?wpfb_dl=4>.

welcomes the efforts by Costa Rica to streamline the estimation process and institutional arrangements in the GHG inventory and those related to FREL/FRL construction.

4. Definition of forest

33. Costa Rica provided in its submission the definition of forest used in the construction of the FREL/FRL. The definition of "forest" used in the construction of the FREL/FRL is: minimum area: 1 ha; minimum crown cover: 30 per cent; minimum tree height: 5.00 m. This definition is consistent with the definition used in the context of the national GHG inventory and under the clean development mechanism. The forest definition is not consistent with the forest definition under the Global Forest Resources Assessments of the Food and Agriculture Organization of the United Nations (FAO-FRA) (minimum area: 0.5 ha; tree crown cover: 10 per cent; minimum tree height: 5 m). The national forest definition, as described by Costa Rica's Forest Law [7575], refers to the following parameters: minimum area: 2 ha; tree crown cover: 70 per cent; minimum tree height: not available; minimum number of trees: 60 per hectare. Costa Rica states in its modified FREL/FRL submission that the forest definition used in the context of REDD-plus is "broader and largely includes the definition of forest in the law (i.e. the 1-hectare threshold defined for REDD-plus includes the 2-hectare threshold requirement by law)". The AT encourages Costa Rica to explore the possibility to adopt a unique forest definition, consistent with the FAO-FRA definition, to be used in all contexts.

III. Conclusions

34. The information used by Costa Rica in constructing its FREL/FRL for reducing emissions from deforestation and the enhancement of forest carbon stocks was improved in the modified submission of 23 May 2016, but its transparency and completeness should be further improved. The modified submission is in overall accordance with the guidelines for the submission of information on FRELs/FRLs (as contained in the annex to decision 12/CP.17).

35. The AT acknowledges that Costa Rica included in the FREL/FRL the most significant activities, and the most significant pools in terms of emissions related to forests. In doing so, the AT considers that Costa Rica 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 Costa Rica for the information provided on the ongoing work into the development of future improvements to the FREL/FRL (i.e. by including additional activities).

36. As a result of the facilitative interactions with the AT during the TA session, Costa Rica 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 in the modified FREL/FRL submission, without the need to alter the approach or values used to construct the FREL, except for removing the [inclusion of the] HWP pool, and commends Costa Rica for the efforts it made. The new information provided in the modified submission, including through the data made available on websites and the examples on how estimates of CO_2 emissions from deforestation were calculated, increased the completeness of FREL/FRL calculations. However, the AT notes that the transparency of the FREL/FRL is an area for improvement, in relation to some assumptions made in the FREL/FRL assessment (e.g. forest classification, primary and secondary forest areas estimation).

37. The AT notes that, overall, the FREL/FRL maintains partial consistency, in terms of sources for the AD and the emission factors, with the GHG inventory included in Costa Rica's BUR.[20]

38. Pursuant to paragraph 3 of the annex to decision 13/CMP.19, the AT identified the following areas for future technical improvement on:

(a) Identification of primary and secondary forests: it was noted that the submission lacks a clear description on how primary and secondary forests were distinguished in the 1978/1980 map;

(b) Classification of forest/non-forest: The AT encourages Costa Rica to re-analyse the area classified as "non-forest" and include the main outcome of this verification activity in a data repository of all FREL/FRL relevant information;

(c) Age class distribution in secondary forests: provide more robust data in order to support the assumption that secondary forests in 1985/1986 are representative of all possible age classes, up to 400 years old, with equal proportions of areas;

(d) Representativeness of the carbon growth model: the AT noted that the sampling process on which the carbon growth model is based may result in a partial representativeness of the forests included in the FREL/FRL and recommends that Costa Rica revise and increase the sampling plots on which the carbon growth model is based in order to ensure the representativeness of all the forest included in the FREL/FRL;

(e) Accuracy of the carbon growth model: the AT noted that the data from Cifuentes do not take into account the carbon stock losses due to rotations in plantations, which have been classified as secondary forests and may thus be underestimating carbon losses, and pointed out the need to revise the growth model accordingly; the AT also recommends that Costa Rica include in the estimation process of carbon stock changes in secondary forests the losses currently not taken into account by the modelling approach;

(f) The FREL Tool: Make the "FREL tool" and manual, as provided in an annex to the modified FREL/FRL submission, publicly available, to enhance the transparency and comparability of future FREL/FRL submissions and help to build confidence in the estimated emissions;

(g) Consistency with the national GHG inventory: complete the harmonization process with the GHG inventory, including the recalculations for the years 1990, 1995 and 2000, as planned to be included in the country's next national communication to the UNFCCC.

39. In assessing the pools and the gases included in the modified FREL/FRL submission, pursuant to paragraph 2(f) of the annex to decision 13/CP.19, the AT notes that the current omissions of pools and gases is unlikely to be leading to an overestimation of emissions in the context of the FREL/FRL. Nevertheless, the AT identified the following additional areas for future technical improvement:

(a) The inclusion of the below-ground dead wood in the below-ground biomass pool;

(b) The treatment of emissions from soil organic carbon (i.e. the inclusion of this pool or the provision of more information justifying its omission);

(c) The inclusion of CH_4 and N_2O emissions from biomass burning.

40. The AT acknowledges and welcomes the intention expressed by Costa Rica to continue the ongoing process to harmonize the FREL/FRL with the GHG inventory, and to

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

recalculate the GHG inventory for the years 1990, 1995 and 2000, to be included in the country's next national communication.

41. In conclusion, the AT commends Costa Rica for showing a strong commitment to the continuous improvement of its FREL/FRL estimates, in line with the stepwise approach. A number of areas for future technical improvements of Costa Rica's FREL/FRL have been identified in this report. At the same time, the AT acknowledges that these improvements 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 Costa Rica. Finally, the AT notes the willingness of Costa Rica to contribute to the global effort to mitigate climate change through REDD-plus.

42. The table in the annex summarizes the main characteristics of Costa Rica's proposed FREL/FRL.

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/FRL (in t CO_2 eq/year)	From: 14 911 467 (for 1997–2009) To: 4 365 160 (for 2010–2025)	The FREL/FRL includes emissions from deforestation (i.e. those associated with forest clear-cuts and excluding any subsequent emissions and removals from deforested areas) and the annual average removals from enhancements of forest carbon stocks, defined as the gains in forest area that occurred during the same period of time, as well as the gains in forest areas occurred in previous periods (see para. 6 above)
Type and duration of FREL	FREL based on historical emissions for 1986–1996 and 1997–2009	
Adjustment for national circumstances	No	–
National/subnational[a]	National	–
Activities included[b]	Deforestation and enhancements of forest carbon stocks	Costa Rica defines "deforestation" as forest land converted to non-forest land in the year of conversion, and the "annual average from enhancements of forest carbon stocks", as the annual average removals in secondary forest (plantations) and natural regeneration of forest in non-forest lands. Forest degradation and sustainable forest management are not included because of lack of data
Pools included[b]	AB, BB, DW (above ground), L	For the reported pools Costa Rica considers subsequent removals from the deforested areas (net emission factors). Soil organic carbon and harvested wood products are not included because of a lack of accurate data (para. 26)
Gases included	CO_2, CH_4 and N_2O	Biomass burning and related emissions of CH_4 and N_2O were included in conversions of forests to cropland and grassland that occurred in the period 1986–1996, and excluded in the post-1996 period on the basis that in 1997 conversion of forest became illegal with the passing of the Forest Law No. 7575 (para. 30)
Forest definition[c]	Included	Minimum area: 1.00 ha; minimum forest canopy cover: 30%; minimum height of trees: 5.00 m (para. 33)
Relationship with latest	There are inconsistencies	Inconsistencies include the inclusion of non-CO_2 gases from biomass burning; the inclusion of

Main features of the FREL		*Remarks*
GHG inventory	between the FREL/FRL and the latest GHG inventory	plantations (para. 22)
Description of relevant policies and plans[d]	Included	Brief summary of information included for information purposes (para. 24)
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 improvements were identified (paras. 38–40 of this document)

Abbreviations: AB = above-ground biomass, BB = below-ground biomass, DW = dead wood, FREL = forest reference emission level, FRL = forest reference level, GHG = greenhouse gas, L = litter, t CO_2 eq/year = tonnes of carbon dioxide equivalent per year.

[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.