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Report on the technical assessment of the proposed forest reference emission level of Mexico submitted in 2014

Summary

This report covers the technical assessment of the submission of Mexico, 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 Mexico covers the activity "reducing emissions from deforestation", which is one of the activities included in decision 1/CP.16, paragraph 70. In its submission, Mexico has developed a national FREL. The assessment team notes that the data and information used by Mexico 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.

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Contents

I. Introduction and summary

A. Overview

1. This report covers the technical assessment (TA) of the submission of Mexico on its proposed forest reference emission level (FREL),[1] submitted on 8 December 2014 in accordance with decisions 12/CP.17 and 13/CP.19. The TA took place (as a centralized activity) from 16 to 21 February 2015 in Bonn, Germany, and was coordinated by the 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)): Ms. Thelma Krug (Brazil) and Mr. Raúl Abad Vinãs (Spain). In accordance with decision 13/CP.19, annex, paragraph 9, the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention (CGE) was invited to participate in the TA as an observer. However, no representative of the CGE was able to participate at this TA session.

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, Mexico submitted, on a voluntary basis, its proposed FREL. This proposed FREL is one of the elements[4] 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 and/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 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 Mexico was in accordance with the guidelines for submissions of information on FRELs[5] 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 Mexico for the construction and future improvement of FRELs, as appropriate.[6]

4. The TA of the FREL submitted by Mexico 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 of the same decision, a draft version of this report was communicated to the Government of Mexico. The facilitative exchange during the TA allowed Mexico to provide clarifications and information that were considered by the AT in the preparation of this report.[7] As a result of the facilitative interactions with the AT during the TA session, Mexico submitted a modified version on 1 June 2015, which took into consideration the technical input by the AT. The modifications improved the clarity and transparency of the submitted FREL and resulted in a modification of the FREL originally proposed. This TA report was prepared based on the context of the modified FREL submission. The modified submission, which

[1] The submission of Mexico 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 1/CP.16, paragraph 71(b).
[5] Decision 12/CP.17, annex.
[6] Decision 13/CP.19, annex, paragraph 1(a) and (b).
[7] Decision 13/CP.19, annex, paragraphs 1(b), 13 and 14.

contains the assessed FREL, and the original submission are available on the UNFCCC website.[8]

B. Proposed forest reference emission level

6. The FREL proposed by Mexico is a historical average of the carbon dioxide (CO_2) emissions associated with gross deforestation at national level from 2000 to 2010, using data from the National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía* (INEGI)) and the National Forest and Soils Inventory (*Inventario Nacional Forestal y de Suelos* (INFyS)) produced by the National Forestry Commission (*Comisión Nacional Forestal* (CONAFOR)). The land-use and vegetation maps of INEGI (hereinafter referred to as series) cover a broader time frame, but only data from series II, III, IV and V[9] have been used in the construction of the FREL. The choice of the period 2000–2010 is justified on the basis that it is a benchmark for changes in policies in the forest sector, as well as for the strengthening of the institutions implementing these policies at national level.

7. In response to the technical inputs of the AT, Mexico submitted a modified FREL,[10] in the context of accessing results-based payments for activities referred to in decision 1/CP.16, paragraph 70, of 44,388.62 gigagrams of carbon dioxide equivalent (Gg CO_2 eq) per year (or 44,388,620 t CO_2 eq/year).[11] The mean annual gross emissions from deforestation[12] for each year of the period 2000–2010 are presented in table 7 of the modified submission. The single value for the annual emissions from deforestation used for the years 2000 and 2001 (45,162.17 Gg CO_2 eq/year) was based on INEGI series II and III, while the single value used for all the years in the period 2002–2006 (57,760.70 Gg CO_2 eq/year) was based on INEGI series III and IV. The value of 27,286.75 Gg CO_2 eq/year used for the years 2007–2010 was based on INEGI series IV and V.

8. 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 proposed by Mexico for a TA in the context of results-based payments covers the activity "reducing emissions from deforestation", which is one of the five activities included in paragraph 70 of this decision. Pursuant to paragraph 71(b) of the same decision, Mexico has developed a national FREL covering all land with woody vegetation that meets the thresholds given in the forest definition applied by the national inventory of greenhouse gas (GHG) emissions and detailed in tables 2 and 3 of the modified submission. In its submission, Mexico applies a step-wise approach to its development of the FREL, in accordance with decision 12/CP.17, paragraph 10. The step-wise approach enables Parties to improve the FREL by incorporating better data, improved methodologies and, where appropriate, additional pools.

9. The proposed FREL includes the pools "above-ground biomass" and "below-ground biomass", while "litter", "dead wood" and "soil organic carbon" in mineral and organic

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

[9] Remote sensing dates (and publication dates): series II: 1993 (1996); series III: 2002 (2005); series IV: 2007 (2010) and series V: 2011 (2013).

[10] Decision 13/CP.19, annex, paragraph 15.

[11] In its original submission, Mexico proposed a national FREL of 45,072,520 t CO_2 eq/year for the period 2000–2010. The difference between the original and modified submissions is mostly due to the exclusion of forest fires and associated non-CO_2 emissions from the FREL. See details in paragraph 33 below.

[12] Deforestation is defined as forest conversion to other land uses.

soils are not included. With regard to GHGs, the modified submission includes only CO_2 emissions.

10. The annexes of the modified submission, containing additional information on forest degradation (annex (a)), forest fires (annex (b)), emissions in soils (annex (c)), INEGI cartographic methods (annex (d)) and forest national policy (annex (e)), were not subject to the TA but provided useful information for clarification of some of the technical issues and increased the transparency of the submission.

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

11. For the construction of the FREL, Mexico used the methodology provided in 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) as a basis for estimating changes in carbon stocks in living biomass from conversion of forest land to other land-use categories. Accordingly, the gross emissions from deforestation were estimated for the period 2000–2010 by combining activity data (i.e. areas of annual gross deforestation) with the appropriate emission factors (i.e. CO_2 emissions associated with the corresponding vegetation groups).

12. The activity data used in the construction of the FREL in Mexico's national territory were based on INEGI land-use and vegetation series developed using analogue methods (printed maps) and digital products from satellite imagery. Satellite images from different sources were used (Landsat Thematic Mapper 5 and Satellite Pour l'Observation de la Terre (SPOT) 5, which have distinct spatial resolutions of 30 m and 10 m, respectively). The AT noted that this could lead to an inconsistent assessment of land-use changes. In response to the technical input by the AT, Mexico clarified that the SPOT 5 images were resampled to make the spatial resolution (pixel size) consistent with that from the Landsat images. The AT agreed with this approach taken by Mexico to ensure consistency among the different sources of information to assess the changes in land use.

13. With regard to the emission factors used, table 5 of the modified submission[13] presents the above- and below-ground biomass for the 18[14] different vegetation groups defined by INEGI. The above-ground biomass was estimated using allometric equations[15] based on dasometric data (diameter at breast height and height) collected for 1,137,872 woody plants (trees and shrubs) with trunk diameters greater than 7.5 cm during INFyS

[13] Emission factors and their uncertainties for carbon from above-ground woody biomass and roots from "forest lands" that changed to "other uses".

[14] The original submission contained 19 vegetation groups. In the modified version, Mexico removed "planted forests" from the list of vegetation groups.

[15] The allometric model database is available at <http://www.mrv.mx/index.php/mrv-m/areas-de-trabajo/2013-09-17-22-03-45>. Eighty-three allometric equations were used at the level of species, genus and vegetation type, and were selected on the basis, inter alia, of smaller mean square errors and larger coefficients of determination.

field sampling between 2004 and 2007).[16] In response to the technical input from the AT, Mexico clarified that the biomass from trees smaller than 7.5 cm in diameter was not included in the FREL construction. The carbon in above-ground biomass ranged from 3.2 t C ha^{-1} to 40.4 t C ha^{-1}. The below-ground biomass of each vegetation group was estimated as a function of the corresponding above-ground biomass, using the allometric equations of Cairns et al. (1997).[17] The ratio of below-ground biomass to above-ground biomass ranged from 0.229 to 0.272. An average carbon content of 0.48 t C/t dry matter was used when specific carbon content was not available at the level of species, genus and/or vegetation group for a given record. The AT agrees with the values used for the above- and below-ground biomass and the carbon content in dry matter, which are consistent with the default values provided in the IPCC good practice guidance for LULUCF, the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines) and with other regional data.

14. To estimate the annual CO_2 emissions from deforestation, the following procedure was applied. First, the carbon stock in living biomass was estimated for each tree, aggregating at subplot level following the procedure described in paragraph 13 above. Second, each of the georeferenced national inventory plots was assigned to one of the 18 vegetation groups defined by INEGI,[18] using information from series IV. The total area deforested in each of these vegetation groups was multiplied by the corresponding average carbon stock in living biomass (t ha^{-1}) and then by 44/12 (to convert carbon into CO_2). The AT agrees with the methodologies used to estimate the annual emissions from gross deforestation, and commends Mexico for making available the information on disaggregated deforested area by vegetation group for each period, which allowed for better analysis. The disaggregated data provided by Mexico (area deforested and emission factors) allowed the AT to reconstruct the FREL. In the period 1993–2002, the percentages of annual area deforested in forests and wood xeric shrublands ("matorral") were 81.7 per cent and 13.8 per cent, respectively; in the period 2002–2007, the corresponding values were 85.3 per cent and 12.4 per cent, respectively; and in the period 2007–2011, they were 74.2 per cent and 23.4 per cent, respectively. The remaining percentages occurred in woody hydrophilous vegetation and other woody ecosystems. In the last five years, there has been increased deforestation in the "matorral" vegetation category, particularly in secondary "matorral" characterized by low carbon stock in living biomass.[19] In response to a request from the AT, Mexico clarified that the average minimum height of the "matorral xerófilo" is 2.8 m and that the average height is 4.2 m; Mexico also provided specific literature[20] that helped to clarify this issue. The TA agreed with the inclusion of "matorral xerófilo" as part of the vegetation groups.

15. The AT noted that the estimated annual area deforested (and hence the annual emissions) in years 2000 and 2001 (522,862 ha yr^{-1}) has been estimated using INEGI series II data, which were based on 1993 satellite images and field data from 1993 to 1998, and INEGI series III data, which were based on 2002 satellite images and field data collected in

[16] The tree records were collected for 18,780 primary sampling units and 70,868 secondary sampling units.

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

[18] See table 2 of the modified submission, which describes corresponding vegetation types for each of the 18 INEGI vegetation groups.

[19] The average carbon stock of living biomass in "matorral" vegetation is 4.0 t C ha^{-1}.

[20] Challenger A, Dirzo R, López JC and Mendoza E. 2009. Factores de cambio y estado de la biodiversidad. *In*: *Capital natural de México*, Vol. II: Estado de conservación y tendências de cambio. Conabio, Mexico, pp.37–73. See also Challenger A and Soberón J. 2008. Los ecosistemas terrestres. *In*: *Capital natural de México*, Vol. I: Conocimiento actual de la biodiversidad. Conabio, Mexico, pp.87–108.

2002–2003. Similarly, the emissions associated with deforestation in the period 2007–2010 were estimated using INEGI series IV data, which were based on 2007 satellite images and field data from 2007 to 2008, and INEGI series V data, which were based on 2011 satellite images and field data collected in 2012–2013. This could lead to an under- or overestimation of the area deforested for any specific year considered in the construction of the FREL, because the annual estimate represents an average value calculated over a period of four years or more.

16. Although Mexico has indicated in both the original and the modified submissions that the FREL refers to emissions from gross deforestation, in the original submission, the annual CO_2 removals from biomass growth of crops from forest land converted to cropland were included. It was not clear to the AT why a similar treatment was not conducted when forest land was converted to grassland. In the modified submission, Mexico provides an explanation for not considering any removals from grassland after the forest conversion in order to ensure a consistent treatment. Mexico assumes that there are no CO_2 removals from biomass growth after conversion of forest land to any other land-use category (i.e. it assumes that the annual biomass increment after forest conversion is zero). As the FREL submitted by Mexico is for gross deforestation, the AT considers that only emissions should be included in the construction of the FREL, and that this is part of the step-wise approach.

17. In response to a request by the AT to ensure greater transparency of the submitted FREL, Mexico has provided, in the modified submission, the annual area deforested for each of the 18 vegetation groups considered. The information was useful to identify the vegetation groups most affected by deforestation events, which were mostly concentrated in tropical forests and conifer, oak and cloud forests[21] (81.7 per cent in the period 1993–2002, 85.3 per cent in the period 2002–2007 and 74.2 per cent in the period 2007–2011). The remaining deforestation affected woody xeric shrublands (i.e. 13.8 per cent, 12.4 per cent and 23.4 per cent in the same periods, respectively), and the rest was in hydrophilous vegetation and other woody ecosystems. The AT commends Mexico for the availability of the data in such a disaggregated format, which has contributed to the assessment of completeness of the submission.

18. Deforestation events have been considered in primary and secondary forests. Deforestation in primary forests amounted to 53 per cent, 49 per cent and 55 per cent in the periods 1993–2002, 2002–2007 and 2007–2011, respectively, while deforestation in secondary vegetation corresponded to 47 per cent, 51 per cent and 45 per cent, respectively, for the same periods.

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

19. The construction of the FREL was based on estimates of the historical average of annual CO_2 emissions from gross deforestation in the period 2000–2010, with the activity data being derived from the series developed by INEGI, which used satellite images and data from INFyS plots (see also paras. 12 and 13 above). Mexico informed the AT that all of the INEGI information on land use and vegetation is publicly available,[22] because it is considered to be of national interest. The AT noted that making some of the data from INFyS publicly available to allow the reproduction of emission factors and their uncertainties would increase the transparency of the proposed FREL and facilitate the

[21] See table 3 in the modified submission, which describes annual deforestation by vegetation group for each period of time.

[22] <http://www.inegi.org.mx/geo/contenidos/recnat/usosuelo>.

assessment of completeness. In response, Mexico clarified that data from INFyS are available upon request from the National Institute of Transparency, Access to Information and Protection of Personal Data (*Instituto Nacional de Transparencia, Acceso a la Información y Protección de Datos Personales*).[23] These data, in addition to the information on the allometric equations used to estimate biomass[24] (see para. 13 above), allow the reconstruction of the FREL.

20. The AT noted that the data provided in the latest national communication[25] did not include all the data used in the construction of the FREL, in particular, INEGI series V data and data from the latest national forest inventory. However, the source of activity data for the FREL and for the GHG inventory contained in the fifth national communication was the INEGI series. Mexico applied the IPCC default values and used the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* in the latest GHG inventory, whereas the emission factors used in the FREL were mostly country-specific. These issues justify the differences in the CO_2 emission estimates provided in figure IV.25 of the latest GHG inventory in the national communication for forest and grassland conversion and those provided in table 7 of the modified FREL submission. The AT agrees that the approach used in the construction of the FREL is most likely more accurate than the previous estimates in the GHG national inventory.

21. The AT sought a number of clarifications regarding the activity data used by Mexico in the construction of the FREL, with the most significant being that the minimum mapping unit for identification of forest land was 50 ha. The AT noted that the INEGI land-use and vegetation series were produced at a scale of 1:250,000 and that this 50 ha (which corresponds to approximately 700 m × 700 m on the ground) is significantly different to the minimum mapping area given in the general definition of forest by the Food and Agriculture Organization of the United Nations (FAO) (with a minimum area of 0.5 ha). Mexico noted, however, that INEGI series data were developed to provide the distribution of different vegetation types and the land area allocated to agriculture, livestock production and forestry, including accurate information on the botanical species representative of the vegetation cover. For that purpose, the 50 ha considered in the INEGI series was considered to be appropriate.

22. In response to another question by the AT, Mexico provided the number of polygons of 50 ha or less for all the broad land-use categories of the IPCC good practice guidance for LULUCF, as well as the total and averaged areas for INEGI series II–V. For forest, the number of polygons, the total area and the averaged area for series II–V were as follows: series II: 1,603, 30,672 ha and 19 ha; series III: 2,681, 60,490 ha and 23 ha; series IV: 1,999, 45,213 ha and 23 ha; and series V: 417, 8,386 ha and 20 ha. These numbers indicate that only a small fraction of the forest polygons mapped were smaller than 50 ha, thus indicating that the potential underestimation of deforestation incurred as a result of the minimum mapping area of 50 ha is apparently small. However, Mexico acknowledged the need to have a more refined minimum mapping unit to increase the accuracy of the FREL, and mentioned that it is developing new cartographic products as part of the national forest monitoring system. These products will be similar to the INEGI series, but will have higher spatial and temporal resolutions and are expected to be made available in 2016. The AT commends Mexico for providing this information and recognizes the significant effort made to improve the quality of the activity data and the FREL.

[23] This institute is the official channel from which to request such information, available at <www.inai.org.mx>.

[24] Mexico has included methodological descriptions, and the allometric equation database is available at <http://mrv.cnf.gob.mx/modelosalometricos/index.php/equation/get_DB/excel>.

[25] The fifth national communication of Mexico (2012) is available at <http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php>.

23. Mexico clarified to the AT that deforestation events were assessed on a pixel-by-pixel basis, after the satellite data in vector format (polygons) were converted to raster format, in grids of 100 m × 100 m (1 ha). Hence, the minimum deforestation unit assessed is of this size. The AT noted that when comparing data from different satellite images, a forest condition observed at one particular time might be observed as "non-forest" at some later time. The AT raised a question regarding how these "non-forest" pixels were unequivocally associated with a deforestation event, and not with a temporarily unstocked condition typical of harvesting. Apparently, this question is addressed very much at the discretion of the interpreter to associate the "changed" pixel with deforestation or other. The AT identified that this may be an area for further improvement by Mexico. In response to a request for clarification, Mexico also explained that a pixel is only assigned to deforestation if it is associated with a change in land use. In case of doubt, field information is acquired in order to support the interpreter's decision.

24. Mexico provided estimates of uncertainties associated with the carbon stock in above- and below-ground biomass for each of the 18 vegetation groups following the methodology in the 2006 IPCC Guidelines. The uncertainties associated with the vegetation groups designated as "forests", with the exception of one group ("secondary cloud forest"), have uncertainties less than or equal to 10 per cent (for above- and below-ground biomass). The largest uncertainty associated with the "matorral" vegetation was 29 per cent ("secondary woody xeric shrublands"). The uncertainty of the remaining vegetation groups ranged from 22 to 95 per cent. Mexico provided uncertainty estimates for the annual CO_2 emissions from deforestation (2000–2010) that were used in the construction of the FREL (see table 7 of the modified submission). However, the AT notes that these estimates do not take into account the uncertainties associated with the activity data. The AT commends Mexico for having identified the specific uncertainties associated with the emission factors and its ongoing efforts to improve the activity data, which will provide more accurate estimates in future submissions.

Description of relevant policies and plans, as appropriate

25. As the proposed FREL is based entirely on historical data, no assumptions about future changes to domestic policies have been included in the FREL submission. Information on policies and plans was included in the original submission and expanded in the modified version, in response to a request by the AT. The AT commends Mexico for the initiatives implemented in the country and notes that the inclusion of this information in annex (e) to the modified submission increased the transparency of the actions in place by Mexico.

26. As part of its modified submission, Mexico provided, in annex (e), a brief description of relevant policies according to decision 13/CP.19, annex, paragraph 2(d). In this respect, Mexico mentioned the National Forest Programme (*Programa Nacional Forestal*) 2014–2018, which builds on 28 strategies and 124 lines of action. Twelve specific strategies of institutional intervention have been designed and implemented, including the National Strategy for Sustainable Management of Forests to Increase Production and Productivity (*Estrategia Nacional de Manejo Forestal Sustentable para Incrementar la Producción y Productivitdad*), the Programme for Commercial Forest Plantations (*Programa de Plantaciones Forestales Comerciales*), the National Program for Wildfires Prevention (*Programa Nacional para Prevención de Incendios Forestales*), the National Strategy for REDD-plus[26] (*Estrategia Nacional REDD+*) and the Strategy for Financing the Forestry Sector (*Estrategia de Financiamiento al Sector Forestal*). The AT

[26] 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.

noted that other forest-related programmes and policies have been developed by Mexico, such as the National Reforestation Programme (*Programa Nacional de Reforestacion*), the Forest Development Program (*Programa de Desarrollo Forestal*), the Support Program for the Development of Commercial Forest Plantations (*Programa de Apoyos para el Desarrollo de Plantaciones Forestales Comerciales*) and the Conservation and Sustainable Management of Forest Resources Project (*Proyecto de Conservación y Manejo Sustentable de Recursos Forestales*).[27]

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

27. 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.

28. The pools included in the FREL are above-ground biomass and below-ground biomass. Dead organic matter (litter and dead wood) and soil organic carbon in mineral and organic soils were not included.

29. Mexico did not include the litter or the dead wood pools in the construction of the FREL due to a lack of data available at national level at two points in time and also due to incomplete understanding of the changes that take place in these pools after conversion. As not all the carbon in the litter pool is lost after conversion, due to residues left on the forest floor, reporting the full loss of the carbon could lead to an overestimation of emissions. Other country-specific literature[28,29] indicates that litter is not a significant pool relative to other carbon pools. The AT agreed that the litter and the dead wood pools are not significant pools and that their exclusion from the FREL is a conservative approach.

30. Mexico justified that the soil organic carbon pool in mineral soils was not significant, taking as a basis the information published in the Protocol for Estimation of Emissions and Removals of Greenhouse Gases (CO_2) Resulting from the Soil Organic Carbon Concentration in Mineral Soils[30] (*Protocol de Estimación de Emisiones y Remociones de GEI (CO_2) Derivadas de la Concentración de Carbono Orgánico en los Suelos Minerales*), which is known as the Soil Protocol. Soil data were collected from five different and independent soil inventories designed for different purposes. The four INEGI inventories were oriented to the soil taxonomy with sample sites distributed over grassland areas (44.0 per cent), agricultural lands (30.1 per cent) and forest land (25.9 per cent). The inventory carried out by CONAFOR,[31] which started in 2009, was specifically designed to quantify carbon content over samples sites in forest land (87.0 per cent), prairies (9.2 per cent) and agricultural lands (3.7 per cent). In total, 61,959 profiles were gathered. The

[27] For information on these projects, see Bray DB, Antinori C and Torres-Rojo JM. 2006.The Mexican model of community forest management: the role of agrarian policy, forest policy and entrepreneurial organization. *Forest Policy and Economics*. 8: pp.470–484.

[28] Ordóñez JAB, de Jong BHJ, García-Oliva F, Aviña FL, Pérez JV, Guerrero G, Martínez R and Masera O. 2008. Carbon content in vegetation, litter, and soil under 10 different land-use and land-cover classes in the Central Highlands of Michoacan, Mexico. *Forest Ecology and Management.* 255(7): pp.2074–2084.

[29] García-Oliva F, Covaleda S, Gallardo JF, Prat C, Velázquez-Durán R and Etchevers JD. 2014. Firewood extraction affects carbon pools and nutrients in remnant fragments of temperate forests at the Mexican Transvolcanic Belt. *Bosque* (*Valdivia*) 35(3): pp.311–324.

[30] The Soil Protocol is available at <http://mrv.cnf.gob.mx/index.php/es/reportes-tecnicos/Publicaciones-Oficiales/Protocolo-de-estimaci%C3%B3n-de-emisiones-y-remociones-de-GEI(CO2)/>. Refer also to annex (c) on emissions in soils in the modified submission.

[31] Data from other governmental and academic institutions, such as CONAFOR, Postgraduate College of Mexico and the Mexican Carbon Program, were also used.

analyses of the data from the soil inventories and the additional data provided in annex (c) to the modified FREL submission led to the identification of the reference soil organic carbon in settlements, other lands, grassland, cropland and forest land (by vegetation group).[32] The changes in soil organic carbon from conversion of forest land to other land uses was estimated as the difference between the reference soil organic carbon content (at 30 cm depth) in forest (soil under native vegetation) and the soil organic carbon contained in the new land use, by using a default transition period of 20 years. The analysis of the data indicated that the changes were not significant relative to the emissions associated with the biomass carbon pool. An annual average[33] of 1,118.6 Gg CO_2 was estimated to be emitted from deforested soils, which accounts for 2.5 per cent of the annual emissions from the living biomass carbon pool included in the FREL. The AT considers that the exclusion of the soil organic carbon pool is adequately justified by Mexico in the modified submission and commends Mexico for its intensive and important work carried out on soils at national level.

31. The AT provided some suggestions to Mexico regarding the data provided in the Soil Protocol, including: the fact that the calculations were carried out using a default transition period of one year and the fact that the display of some information could imply that Mexico has used a stock change factor for land-use or land-use change type,[34] which has not actually been the case. To facilitate a better understanding of all the relevant data and information provided by Mexico in the Soil Protocol, the AT notes that Mexico can follow the suggestions given above in its next edition of the protocol.

32. With regard to emissions from organic soils, Mexico has not included specific information on this carbon pool in either of its submissions. The AT has reviewed the literature regarding the distribution of the main soil types in Mexico,[35] and it was found that histosols occur in only 0.05 per cent of the national territory (91,000 ha). Hence, the AT considers that emissions from organic soils when gross deforestation occurs are likely to be insignificant and their exclusion is justified.

33. Mexico has included in annex (b) to the modified submission a detailed section on forest fires and associated non-CO_2 emissions (methane, carbon monoxide, nitrous oxide and oxides of nitrogen) for some of the carbon pools not included in the FREL, including the pools of dead wood, litter and dead biomass in an advanced state of decomposition and living biomass of herbaceous vegetation and shrubs. In the original submission, emissions from forest fires were included in the FREL. However, the TA noted that fires could be associated with events not related to deforestation. As Mexico could not single out these specific fire events, their inclusion could lead to an overestimated FREL. In response to this observation from the TA, Mexico excluded the non-CO_2 emissions associated with forest fires from the construction of the FREL. Mexico informed the AT that fires are an important source of emissions for the country and will be considered in a future submission. The AT considers that the exclusion of non-CO_2 emissions from fires avoids a potential overestimation of non-CO_2 emissions and can be reconsidered by Mexico as part of a step-wise approach to the FREL.

34. The AT acknowledges that Mexico addressed in the FREL the most significant activity (reducing emissions from deforestation) of the five activities identified in paragraph 70 of decision 1/CP.16, in accordance with national capabilities and circumstances. Mexico has provided in annex (a) of the modified submission a preliminary analysis of forest degradation, to demonstrate that no significant activity was excluded from the FREL.

[32] See table 15 of the modified submission for soil carbon densities by land-use category and vegetation group.

[33] See figure 20 of the modified submission for emissions by soils transitions.

[34] See table 13 in the Soil Protocol. Refer to footnote 30 for the link to the Soil Protocol.

[35] Hernandez LA. 2007. *Soils of Mexico*. Mexico Soil Survey Program.

Mexico defined forest degradation as "the reduction of the carbon content in the natural vegetation, ecosystems or soils due to human intervention, in relation to that of same vegetation, ecosystem or soils in the absence of such intervention". The forest degradation data provided in annex (a) were assessed by the cartographers of the INEGI series through visual analysis of areas presenting a loss of tree cover density and show a systematic decrease in the area of forest degradation in these series. Emissions from forest degradation corresponded to approximately 15 per cent and 7 per cent of the emissions from gross deforestation in INEGI series II (2002–2006) and III (2007–2010), respectively. The AT commends Mexico for its effort to provide information on forest degradation in annex (a) of the modified submission, and acknowledges the preliminary nature of the analysis, which will be improved using new data obtained from a third cycle of INFyS.

35. The AT acknowledges the intentions expressed by Mexico to:

(a) Develop capacities for the development and implementation of the national forest monitoring system. Among other things, the monitoring system will allow for a semi-automatic satellite imagery classification that will generate products with higher spatial and temporal resolutions, as well as better information on changes in land use at national level;

(b) Continuously improve INFyS, including the recovery of information on inaccessible sampling sites and the starting of the third cycle for data collection (2015–2019), collecting data on each of the carbon pools. As new, adequate data and better information become available through these improvements, they will help to improve future FREL submissions as part of the step-wise approach.

4. Definition of forest

36. Mexico provided in its submission the definition of forest used in the construction of the FREL,[36] consistent with that established in the General Law for Sustainable Forest Development (*Ley General de Desarrolo Forestal Sustentable*) and used by INEGI. Mexico explained, in response to a request for clarification from the TA, how each of the parameters in the definition was assessed[37] and provided supporting material.[38] Mexico clarified that this definition is consistent with that used in the INEGI series.

III. Conclusions

37. The information used by Mexico in constructing its national FREL for deforestation is overall transparent and complete and is in overall accordance with the guidelines for submissions of information on FRELs (as contained in the annex to decision 12/CP.17).

38. The AT acknowledges that Mexico included in its FREL the most significant activity and the most significant pools in terms of emissions from forests. In doing so, the AT considers that Mexico followed decision 1/CP.16, paragraph 70, on activities undertaken, paragraph 71(b) and decision 12/CP.17, paragraph 10, on implementing a step-wise approach. The AT commends Mexico for the information provided on its ongoing work that may be useful for future submissions with new and updated data.

[36] "Forest lands with a canopy cover of more than 10 percent, with trees of more than 4 meters in height – or trees able to reach this height in situ – and a minimum mapping unit of at least 50 hectares. It does not include lands with predominant agricultural or urban use."

[37] For the height, the registries of INFyS were used, and for the canopy cover, the guidelines for the cartographic interpretation of land use and vegetation at the scale of 1:250,000 were used.

[38] Refer to annex (d) and the list of references in the modified submission on guidelines for the interpretation of cartographic information, land use and vegetation, scale 1:250,000, series II–IV; and land use and vegetation information, scale 1:250,000, series V.

39. As a result of the facilitative interactions with the AT during the TA session, Mexico submitted a modified submission that took into consideration the technical input by the AT. The AT notes that the transparency and completeness of the information improved in the modified FREL submission. The FREL in the modified submission excluded non-CO_2 emissions from forest fires that could lead to an overestimation of emissions from deforestation.

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

(a) Development of a more refined minimum mapping area of forest. It was noted that the 50 ha adopted by Mexico as part of the forest definition is too coarse and falls well above the minimum area in the FAO definition (0.5 ha). The AT considers that the implementation of a national forest monitoring system will allow the production of more accurate maps of land cover and land-cover change, which will generate more accurate data and information for future FRELs (see also paras. 21 and 22 above);

(b) Separation of the emissions from forest fires from those associated with deforestation. The AT acknowledges the significant efforts made thus far by Mexico to estimate non-CO_2 emissions from forest fires and notes that an additional effort to separate those emissions directly related to deforestation from other types of fire events would facilitate the inclusion of these emissions in future FRELs (see also para. 33 above).

41. In assessing the pools and the gases included in the FREL, pursuant to decision 13/CP.19, annex, paragraph 2(f), the AT notes that the current omissions of pools and gases are likely to be conservative in the context of the FREL. Nevertheless, the AT identified that the treatment of emissions from dead wood is an area for future technical improvement (see also para. 29 above).

42. The AT acknowledges and welcomes the intention expressed by Mexico to continue its efforts on the collection of data under INFyS in the period 2015–2019 (see also para. 35 above).

43. In conclusion, the AT commends Mexico for showing a strong commitment to continuous improvement of its FREL estimates, in line with the step-wise approach. Areas for future technical improvements of Mexico's FREL 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.[39] The AT also acknowledges that the assessment process was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Mexico.

44. The table in the annex summarizes the main characteristics of Mexico's proposed FREL.

[39] Decision 13/CP.19, annex, paragraph 1(b), and decision 12/CP.17, paragraph 10.

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/yr)	44 388 620	The FREL includes gross CO_2 emissions from deforestation (para. 7)
Type and duration of FREL	FREL = average annual CO_2 emissions for the period 2000–2010	Paragraph 6
Adjustment for national circumstances	No	-
National/subnational[a]	National	Paragraph 8
Activities included[b]	Deforestation	The FREL includes gross emissions from deforestation without taking into account subsequent removals in deforested areas
		Deforestation is defined as the conversion of forest land to other land uses. It is assumed that all the carbon stored in the above- and below-ground biomass was immediately lost after the deforestation event (paras. 8 and 14)
		Degradation is not included in the FREL but is addressed in annex (a), which provides a preliminary analysis and future improvements (para. 34)
Pools included[b]	AB and BB	Accurate data are not available for dead wood and litter (para. 29)
		Emissions from soil organic carbon in mineral soils are considered insignificant, on the basis of a quantitative justification (para. 30)
		No information is included to justify the omission of emissions from organic soils. However separate assessment provides evidence of the low significance of these types of soils in Mexico (para. 32)
Gases included	CO_2	Preliminary estimates of non-CO_2 gases from biomass burning, not necessarily associated with deforestation events, are included in annex (b) of the modified submission for information purposes (paras. 9 and 33)
Forest definition[c]	Included	"Forest lands with a canopy cover of more than 10 percent, with trees of more than 4 meters in height – or trees able to reach this height in situ – and a minimum mapping unit of at least 50 hectares. It does not include lands with predominant agricultural or urban use" (para. 36)
		The definition provided does not match the FAO general forest definition (para. 21)

Main features of the FREL		*Remarks*
Relationship with latest GHG inventory	Methods used for the FREL differ from those used in the latest GHG inventory (2012)	There are differences in data sources and emission factors due to more recent data becoming available and the use of the IPCC good practice guidance for LULUCF in the construction of the FREL as compared to the GHG inventory (para. 20)
Description of relevant policies and plans[d]	Included	Included for information purposes only in annex (e) of the modified submission (para. 26)
Description of assumptions on future changes in policies[d]	Not applicable	No assumptions about future changes to domestic policies are included (para. 25)
Descriptions of changes to previous FREL	Not applicable	-
Future improvements identified	Yes	Several areas for further technical improvement are identified (paras. 40 and 41)

Abbreviations: AB = above-ground biomass, BB = below-ground biomass, FAO = Food and Agriculture Organization of the United Nations, FREL = Forest reference emission level, GHG = greenhouse gas, IPCC good practice guidance for LULUCF = Intergovernmental Panel on Climate Change *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, t CO_2eq/yr = 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.