Report on the technical assessment of the proposed forest reference emission level of Pakistan submitted in 2020

Summary

This report covers the technical assessment of the voluntary submission of Pakistan 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 Pakistan covers the activity reducing emissions from deforestation, which is among the activities included in decision 1/CP.16, paragraph 70. For its submission, Pakistan developed a national FREL. The FREL presented in the original submission, for the reference period 2004–2012, corresponds to 1 million tonnes of carbon dioxide equivalent per year. As a result of the facilitative process during the technical assessment, the FREL was modified to 946,653 tonnes of carbon dioxide equivalent per year. The assessment team notes that the data and information used by Pakistan in constructing its FREL are transparent, complete and in overall accordance with the guidelines contained in the annex to decision 12/CP.17. This report contains the assessed FREL and a few areas identified by the assessment team for future technical improvement in accordance with the provisions on the scope of the technical assessment contained in the annex to decision 13/CP.19.

Abbreviations and acronyms

AD	activity data
AT	assessment team
COP	Conference of the Parties
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
EF	emission factor
FREL	forest reference emission level
FRL	forest reference level
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
NFI	national forest inventory
REDD+	reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
TA	technical assessment
2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

I. Introduction and summary

A. Overview

1.   This report covers the TA of the voluntary submission of Pakistan on its proposed FREL,[1] submitted on 6 January 2020, in accordance with decisions 12/CP.17 and 13/CP.19. The remote TA[2] took place from 22 to 26 June 2020 and was coordinated by the secretariat.[3] The TA was conducted by two land use, land-use change and forestry experts from the UNFCCC roster of experts[4] (hereinafter referred to as the AT): Rizaldi Boer (Indonesia) and Pierre Brender (United Kingdom of Great Britain and Northern Ireland). Although an expert from the Consultative Group of Experts was invited to participate during the remote session as an observer,[5] no representative was able to attend. The TA was coordinated by Dirk Nemitz (secretariat).

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

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

4.   The TA of the FREL submitted by Pakistan was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELs and/or FRLs.[9] This report on the TA was prepared by the AT following the same guidelines and procedures.

5.   Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Pakistan. The facilitative exchange during the TA allowed Pakistan to provide clarifications and additional information, which were considered by the AT in the preparation of this report.[10] As a result of the facilitative interactions with the AT during the TA, Pakistan provided a modified version of its submission on 5 December 2020, which took into consideration the technical input of the AT. The modifications improved the clarity and transparency of the submitted FREL without needing to alter the approach used to construct it. This TA report was prepared in the context of the modified FREL submission. The modified submission, containing the assessed FREL, and the original submission are available on the UNFCCC website.[11]

B. Proposed forest reference emission level

6.   In decision 1/CP.16, paragraph 70, the COP encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities,

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[1] The submission of Pakistan is available at https://redd.unfccc.int/submissions.html?country=pak.
[2] Owing to the circumstances related to the coronavirus disease 2019, the TAs of the FREL and FRL submissions of developing country Parties in 2020 had to be conducted remotely.
[3] As per decision 13/CP.19, annex, para. 7.
[4] As per decision 13/CP.19, annex, paras. 7 and 9.
[5] As per decision 13/CP.19, annex, para. 9.
[6] See decision 1/CP.16, para. 71(b).
[7] Decision 12/CP.17, annex.
[8] Decision 13/CP.19, annex, para. 1(a–b).
[9] Decision 13/CP.19, annex.
[10] As per decision 13/CP.19, annex, paras. 1(b), 13 and 14.
[11] https://redd.unfccc.int/submissions.html?country=pak.

as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances, in the context of providing adequate and predictable support. The FREL proposed by Pakistan, on a voluntary basis for a TA in the context of results-based payments, covers the activity reducing emissions from deforestation, which is one of the five activities referred to in that paragraph. Pursuant to paragraph 71(b) of the same decision, Pakistan developed a national FREL that covers its entire territory. The total FREL area is 879,106 km^2, which comprises the country's official territory (which has an area of 796,096 km^2 according to the Survey of Pakistan) and the territories of Gilgit-Baltistan, and Azad Jammu and Kashmir according to the references provided by the respective subnational units (see chap. 2.1 of the Party's submission). For its submission, Pakistan applied a stepwise approach to developing its FREL in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve their FRELs or FRLs by incorporating better data, improved methodologies and, where appropriate, additional pools.

7.   The national FREL proposed by Pakistan for the historical reference period 2004–2012 is the annual average of the CO_2 emissions associated with gross deforestation, defined as the conversion of natural forest to other land uses. The FREL includes only the gross emissions from deforestation that are associated with clear-cuts, assuming instantaneous oxidation, and excludes any subsequent emissions and removals from the deforested areas. The proposed FREL excludes the conversion of forest plantations to other land uses. The AD used in constructing the FREL were extracted from a historical time series of land-use maps developed at regular four-year intervals over 2004–2016 to differentiate deforested areas from temporarily unstocked forest areas, complemented by visual interpretation of very-high-resolution images for the reference period. The EFs were obtained from Pakistan's pilot NFI and provincial inventories. The FREL presented in the modified submission, with the aim of accessing results-based payments for REDD+ activities for 2004–2012, corresponds to 946,653 t CO_2 eq/year.[12]

8.   The proposed FREL includes the pools above-ground and below-ground biomass. Regarding GHGs, the submission includes CO_2 only.

9.   Pakistan included seven annexes to its modified submission, which further improved the transparency of the FREL. The annexes contain an administrative boundary map; a land-use and land-cover map of Pakistan for 2012; wood densities by species; forest carbon densities and EFs; average forest carbon stock values for 2004–2012; information on national circumstances; and information on quality assurance and quality control for the NFI. Annex 6, on Pakistan's national circumstances, includes a description of the socioeconomic context and policies for reducing emissions, including information on the consumption of fuelwood per capita and associated emissions. Overall, the annex illustrates that the pressure from a growing population and economy could lead to a significant increase in emissions from the forestry sector.

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

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

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

10.   For constructing its FREL, Pakistan used the 2006 IPCC Guidelines. The Party used equation 2.16 from the 2006 IPCC Guidelines for estimating carbon stock changes in forest land converted to non-forest land. The emissions from deforestation were calculated by multiplying the areas of deforestation by the difference in the average biomass carbon stocks of forest and non-forest land.

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[12] In its original submission, Pakistan proposed a national FREL of 1 Mt CO_2 eq/year for 2004–2012. The difference between the original and the modified submission is due mostly to the exclusion of deforestation of irrigated forest plantations from the modified submission.

11.   To generate AD, Pakistan used information on land use for 1992–2016 collected at four-year intervals. Land-use, land-cover classification and time-series analyses were conducted using 55 historical Landsat satellite images for each reference year. More specifically, the deforestation estimates for 2004–2008 and 2008–2012 were based on the analysis of land cover in 2004, 2008 and 2012, complemented by the analysis for 2016, to distinguish temporarily unstocked forest areas from deforested areas in 2008–2012. Very-high-resolution satellite imagery from Google Earth was used as reference data when producing land-use and land-use change maps, and the accuracy of the data was verified by means of visually interpreted and multitemporal systematic plots using the Collect Earth tool developed by Open Foris. A total of 12,532 50 m by 50 m square plots were sampled and visually interpreted to obtain a subset of a 1.25' (arcminute) systematic grid. This sampling design was chosen by Pakistan to gather a representative sample for all the major land-use and land-cover types, complemented by additional randomly sampled visually interpreted plots (over 1,600) over the deforestation hotspot areas. The adjusted statistics concerning deforested areas were obtained using methodological guidance and formulae from Olofsson et al. (2014), using the visual plots as reference.

12.   To generate the EFs, Pakistan used carbon stocks from the recent pilot NFI, complemented by provincial carbon stock inventory results for the regions of Khyber Pakhtunkhwa and Gilgit-Baltistan.

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

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

13.   The AT sought clarification on the sampling strategy that was applied to the visual classification of very-high-resolution images to create reference data. Pakistan provided further information and explained what it meant by "subsets of 10', 5', 2.5' and 1.25' (arcminute) systematic grid" complemented by "some additional randomly sampled visual interpretation plots over the deforestation hotspot areas", and why Pakistan considered that the sampling approach was unbiased although it did not correspond to traditional approaches for which statistical bases are well established (in terms of absence of bias and estimator of variance). Pakistan included additional information about its sampling approach in the modified FREL submission. The AT considers the use of a sampling approach with well-established statistical foundations (or provision of a description of the statistical properties applicable to the non-systematic grid adopted) as an area for future technical improvement, which could also help to improve the transparency and reproducibility of calculations included in the Party's future FREL submissions.

14.   Pakistan clarified that the sampling intensity was greater in forest areas than in areas of other land uses (according to the most recent forest map). The Party shared the matrices to which the method described in Olofsson et al. (2014) was applied. In those matrices, the stratification used was limited to deforested land, afforested land and land not subject to conversion between forest and other land uses. The AT considers that the Party should reflect the differences between sampling intensities in forest areas and areas of other land uses in the error correction method applied by maintaining two separate classes for forest land and non-forest land when assessing the impact of omission errors on the deforestation estimate. The AT considers the application of a stratification that is consistent with the sampling approach throughout the error correction procedure for estimating AD as an area for future technical improvement.

15.   Pakistan used approach 1 to land representation from the 2006 IPCC Guidelines (vol. 4, chap. 3) to estimate deforested areas rather than using approach 2 or 3 with land-use transition matrices. The Party explained that it did not use transition matrices since its FREL only focused on deforestation (i.e. conversion from forest land to non-forest land) without specifying the post-deforestation land use (e.g. cropland, settlements). The AT considers that the use of approach 2 or 3 from the 2006 IPCC Guidelines for tracking land-use change would facilitate understanding the proportion of the different land uses post deforestation (and

where deforestation occurs) and the use of more accurate EFs to estimate emissions from deforestation. The AT considers this as an area for future technical improvement.

16.   In response to a query from the AT about the estimation of post-deforestation biomass, Pakistan explained that its approach was based on the non-forest plots surveyed for the pilot NFI and that zero biomass had to be assumed for annual and perennial crops to avoid destructive sampling of the latter. The AT notes that the Party could use a combination of the estimate calculated for other land use in the pilot NFI and tier 1 estimates for cropland based on the default values provided in the 2006 IPCC Guidelines (or other EFs available in the IPCC database that are more representative of the context of Pakistan) to obtain an unbiased estimate. The AT considers the use of a more accurate approach to estimating post-deforestation biomass as an area for future technical improvement.

17.   Pakistan clarified that natural forest land was determined using satellite images of crown cover and environmental conditions (soil condition and climate zone) and finalized with input from provincial forestry departments, which have extensive local knowledge. This forest land met the crown cover threshold in 2004. When exposed to disturbances in 2004–2008, which caused the crown cover to fall below the threshold, the forest land was designated as deforested area as the crown cover did not reach the threshold before 2012, regardless of the potential to reach the threshold later (in which case the areas should have been designated as temporarily unstocked forest areas without land-use change, rather than as non-forest areas). Similarly, areas that were defined as forest land in 2008 and whose crown cover fell below the threshold in 2008–2012 were considered to be deforested areas as long as their crown cover could not meet the threshold before 2016. The AT commends Pakistan for its efforts to prevent overestimation of emissions from deforestation. However, the AT notes that this approach may still lead to an overestimation of emissions if the forest would grow back to reach the crown cover threshold over a longer period than the interval defined by the Party. The AT considers the identification of temporarily unstocked forest areas without actual land-use change (or the provision of evidence that the effect of natural regrowth or restocking practices allow forest to meet the thresholds of the forest definition again within four years) as an area for future technical improvement.

18.   Pakistan estimated the uncertainty associated with the AD assuming that the errors in the reference data identified through visual interpretation of very-high-resolution images could be disregarded, as could potential issues of spatial independence of plots that had been subject to visual interpretation for different years. In response to a query from the AT, in its modified submission Pakistan included a brief explanation of the quality assurance and quality control procedures that were implemented for those reference data to improve the robustness of the assessment of land-use change. The AT commends Pakistan for applying quality assurance and quality control procedures and for including this information in the modified submission.

19.   The AT sought clarification regarding the method used for generating the EFs for forest and non-forest land. During the TA and in its modified submission, Pakistan clarified how the pilot NFI was used to help construct the FREL. The sampling design was based on clustered plots consisting of five subplots and the sampling was optimized for forest land. All clusters with a central subplot located within forest land were measured in the field. Measurements were taken at all subplots, regardless of whether some of them were outside forest land. Thus, biomass data were also acquired for non-forest land (labelled "other land uses"). The EFs for these land uses refer only to tree and bush biomass. Annual and perennial crops were excluded to avoid destructive sampling; thus, their non-woody biomass was assumed to be zero when developing the EFs. The AT commends Pakistan for its efforts to improve the transparency of its modified submission by clarifying how it developed its EFs.

20.   A total of 307 field plots were selected for field data collection for different forest types in Azad Jammu and Kashmir, Punjab, Balochistan, the Federally Administered Tribal Areas and Sindh, while existing plot data for Khyber Pakhtunkhwa and Gilgit-Baltistan were provided by the respective forest departments. To calculate the above-ground biomass stocks of forest land, Pakistan used allometric equations from Chave et al. (2014) and wood densities of tree species, which are listed in the modified submission. During the TA, Pakistan explained that the root-to-shoot ratios provided in the 2006 IPCC Guidelines (vol. 4, chap. 4, table 4.4) were adjusted depending on above-ground biomass and used at the plot level.

Biomass stocks were converted into carbon stocks assuming a carbon fraction value of 0.47, which is the default provided in the 2006 IPCC Guidelines (vol. 4, chap. 4, table 4.3). The AT commends Pakistan for including details about assumed wood density in the modified submission, and considers the inclusion of information on the level of discretization at which root-to-shoot ratios were used as an area for future technical improvement, which could also help to enhance the transparency and reproducibility of calculations included in the Party's future FREL submissions.

21.   Pakistan did not include uncertainty estimates for the EFs (or consequently for the FREL itself) in the original submission. In its modified submission, Pakistan evaluated the uncertainty of the EFs related to sampling errors in its pilot NFI. During the TA, Pakistan explained that this was the only source of uncertainty affecting the EFs that could be evaluated in the absence of national reference information for wood densities and allometric models. The AT commends Pakistan for sharing all of its calculation sheets of uncertainties affecting the EFs and correcting its national-scale estimates in response to the TA. The AT considers the inclusion of a comprehensive estimate that takes into account other sources of uncertainty affecting the EFs (or information justifying the omission of potential sources of uncertainty) and, where relevant, the application of the guidance on how to deal with large and asymmetric uncertainties provided in the 2006 IPCC Guidelines as an area for future technical improvement.

22.   In the modified submission, the deforestation of riverine forests was assessed as a major component of the total deforestation in Sindh province. The AT notes that the assessment of changes in areas of riverine forest could have a higher uncertainty than that for other forest classes as a result of the mapping procedure used, which includes as a post-treatment a sieving procedure that could disproportionally affect the estimate of deforestation of forests arranged along linear features such as rivers. During the TA, Pakistan explained that the effect of the sieving on the mapped deforestation area was assessed for four provinces (but not Sindh). For the combined area of the provinces where the analysis was conducted, the sieving step removed roughly 11 per cent of the initially mapped deforestation area (with a variation of between 5 and 22 per cent). In its modified submission, Pakistan explained that it had confidence in the estimate of deforestation of riverine forests, as the higher figure was consistent with the enaction of a new forest land lease policy introduced in 2004 that could have led to significant deforestation of riverine forests. The AT commends Pakistan for including this explanation in the modified FREL submission, thus increasing the transparency of the emission estimates.

23.   The AT notes the efforts of Pakistan to improve the transparency of the FREL in its modified submission, which clarifies that the FREL is based on the average emissions from deforestation estimated for 2004–2012. In its original submission Pakistan appeared to propose a FREL using a trend based on the difference between the average deforestation for 2004–2008 and that for 2008–2012, but in fact the Party included those projected trends for illustrative purposes only. The AT commends Pakistan for clarifying this issue in the modified submission.

24.   The AT notes that, overall, the AD and EFs used for the FREL are not consistent with those used for the GHG inventory included in Pakistan's national communication.[13] Pakistan explained that the FREL is based on data collected over a longer period using harmonized definitions and classes, whereas the GHG inventory included in the national communication was compiled using secondary sources based on different standards and methodologies. Pakistan intends to update the estimates in a future biennial update report to be consistent with the FREL submission. The AT notes that ensuring consistency between the methods and data sources used for the FREL and those used for the GHG inventory is an important area for future technical improvement.

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

25.   The Party noted that the Government is making considerable efforts to revive forestry in the country. These include expanding the forest cover through large-scale tree planting

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

programmes, strengthening the regulatory and forest protection policy mechanism, and implementing international initiatives under the UNFCCC, such as REDD+.

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

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

27.   The pools included in the Party's FREL are above-ground and below-ground biomass. Litter, deadwood and soil organic carbon were not included.

28.   In its submission, Pakistan mentioned that the results of its pilot NFI showed that in some areas the soil organic carbon contents were even higher outside forest land, depending on the applied land management. The Party explained that monitoring and modelling soil carbon changes would require implementing a permanent soil monitoring design under different forest management regimes. The AT commends the Party's efforts to obtain better information on soil organic carbon in mineral soils with the aim of including it in the FREL in future using the stepwise approach. The AT considers the treatment of emissions from soil organic carbon in mineral soils (i.e. including the pool or providing more information justifying its omission) as an area for future technical improvement.

29.   With regard to emissions from soil organic carbon in organic soils, the AT requested clarification of the reasons for omitting the pool. In response, Pakistan explained that the pool was not included because forest areas on peatland are very limited in Pakistan. The AT considers that, even for small areas, the impact of deforestation on this pool could be significant. Furthermore, the AT notes that the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* provides a method for estimating carbon stock changes in soil organic carbon and the corresponding default EFs, and that Pakistan already collected information on the carbon content of organic soils at a subset of mangrove sites (measurements were taken at 2 of 14 mangrove sites as part of the pilot NFI). The AT considers the treatment of emissions from soil organic carbon in organic soils and mangroves (i.e. including the pool or providing more information justifying its omission) as an area for future technical improvement.

30.   Pakistan stated in its submission that, according to the NFI pilot inventory data, the above-ground and below-ground biomass and soil organic carbon pools make up 93–99 per cent of the total forest carbon stock in Pakistan. The AT commends the Party's efforts to obtain better information on litter and deadwood with the aim of including those pools in the FREL in the future as described in its plan for improvement using the stepwise approach. The AT concludes that, although emissions from litter and deadwood are likely to be at a relatively low level according to the information collected by Pakistan, it considers the treatment of emissions from those pools (i.e. including the pool or providing more information justifying its omission, including information about litter and deadwood carbon stocks in deforested areas) as an area for future technical improvement.

31.   Pakistan did not include emissions of non-CO_2 gases from fires in its FREL. The Party explained in its modified submission that fires are not a significant issue causing deforestation in the country and that only a small fraction of fires occur in forests (6 per cent of the fires occurring in the two provinces most affected by fires). The AT considers that the exclusion of non-CO_2 emissions from fires was adequately justified by Pakistan in its modified submission.

32.   Pakistan did not include emissions of non-CO_2 gases from drainage and rewetting of organic soils. During the TA, the Party explained that conversion of wet organic soils rarely takes place in forests in the country and that it does not have an estimate of the extent of undrained and drained organic soils under forest land. The AT considers that the exclusion of those emissions was adequately justified. The AT also considers the treatment of emissions of non-CO_2 gases from drainage and rewetting of organic soils (i.e. including the emissions or providing more information justifying their omission) as an area for future technical improvement.

33.   The AT acknowledges that Pakistan included the activity reducing emissions from deforestation, which is one of the five activities identified in decision 1/CP.16, paragraph 70, in accordance with its national capabilities and circumstances. The AT notes that other activities could also be significant, in particular reducing emissions from forest degradation and enhancement of forest carbon stocks. The AT commends Pakistan's efforts to obtain better AD to calculate emissions and removals from forest degradation and enhancement of forest carbon stocks with the aim of including those activities in the FREL in future as described in its plan for improvement using the stepwise approach. The AT considers the treatment of emissions and removals from forest degradation and enhancement of forest carbon stocks as an area for future technical improvement.

34.   The Party noted that nationwide data on forest growth, wood removal and disturbance are not available to enable it to produce reliable estimates of annual forest degradation rate to assess the levels of forest degradation and forest carbon stock enhancement. Further, Pakistan mentioned in its submission that carbon stock enhancement takes place through forest restoration (afforestation, reforestation and natural regeneration) and forest growth, but the growth-related research and modelling bases for measuring removals from these activities are very limited. The AT commends the Party for providing an estimate of the order of magnitude of the emissions from fuelwood collection (1.0–1.3 Mt CO_2/year) based on available information on the share of fuelwood coming from forests in 2003, and for noting in annex 7 to its modified submission that this estimate demonstrates that emissions from forest degradation could be at the same level or higher than emissions from deforestation.

35.   In addition, Pakistan explained that afforestation areas in 2009–2013 were of a similar size to deforestation areas (around 30 kha/year). While the associated carbon stock gains need more time to materialize after afforestation than the immediate carbon losses resulting from deforestation, in the longer term the effects of enhancement of forest carbon stocks (through afforestation) are likely to reach a level that corresponds to the cumulative impact of deforestation documented in the FREL submission.

36.   The AT commends Pakistan for collecting data on all carbon pools when compiling its pilot NFI. The AT acknowledges the Party's intention to include emissions and removals from all REDD+ activities in the future and for presenting in its modified submission its plan to use the stepwise approach to improve future FREL or FRL submissions as new and adequate data and better information become available.

4.   Definition of forest

37.   Pakistan provided in its submission the definition of forest used in constructing its FREL. The definition is different from the one that the Party uses for its reporting to the Food and Agriculture Organization of the United Nations for the Global Forest Resources Assessment (i.e. a minimum area of 0.5 ha and at least 10 per cent canopy cover is used for both, but a height of 5 m or more is used for reporting to the latter as opposed to 2 m for the FREL). This definition is used for natural forests.

38.   In defining land as forest, Pakistan included natural forest classes, such as scrubs and thorns, that may not always reach a height of 2 m, as well as irrigated plantations, which are not considered natural forest. The AT requested clarification regarding how Pakistan defines scrubs and thorn as forest or non-forest and why it included irrigated plantations with natural forest classes. The Party explained that the dominant species of scrubs and thorns (i.e. acacias, olives and some shrubs) can potentially reach 2 m at maturity and thus they were classed as forest. Pakistan only considers emissions from deforestation of natural forests and explained in its submission that it is assumed that the Government-owned irrigated plantations are subject to sustainable forest management and there are therefore no permanent deforestation events within their boundaries. Any deforested areas detected within Government-owned irrigated plantations would thus very likely be temporarily unstocked forest areas without land-use change. Pakistan therefore excluded emissions from those plantations in its modified FREL submission.

III. Conclusions

39.   The information used by Pakistan in constructing its FREL for reducing emissions from deforestation is transparent and complete and in overall accordance with the guidelines for submissions of information on reference levels.

40.   The FREL presented in the modified submission, for the reference period 2004–2012, corresponds to 946,653 t CO_2 eq/year.

41.   The AT acknowledges that Pakistan included in its FREL the most important forest type and the most significant pools in terms of emissions from forests. The AT considers that, in doing so, Pakistan followed decision 1/CP.16, paragraph 70, on activities undertaken, and decision 12/CP.17, paragraph 10, on applying the stepwise approach. The AT commends Pakistan for providing information on its plan to use a stepwise approach to develop a FREL or FRL that includes other activities and pools.

42.   As a result of the facilitative interactions with the AT during the TA, Pakistan provided a modified submission that took into consideration the technical input of the AT. The AT notes that the transparency and completeness of the information provided were significantly improved in the modified FREL submission, without having to alter the approach used to construct the FREL, and commends Pakistan on its efforts. The new information provided in the modified submission and the additional data sets (spreadsheets and maps) shared with the AT increased the reproducibility of the FREL calculations.

43.   The AT notes that, overall, the FREL does not maintain consistency, in terms of sources of AD and EFs, with the GHG inventory included in Pakistan's national communication.

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

        (a)   Using a sampling approach with well-established statistical foundations, or providing a description of the statistical properties applicable to the non-systematic grid adopted (see para. 13 above);

        (b)   Applying a stratification that is consistent with the sampling approach throughout the error correction procedure for estimating AD (see para. 14 above);

        (c)   Using approach 2 or 3 to land representation from the 2006 IPCC Guidelines to present correctly the proportion of the different land uses post deforestation and to facilitate the use of more accurate EFs to estimate emissions from deforestation (see para. 15 above);

        (d)   Using a more accurate approach to estimating post-deforestation biomass (see para. 16 above);

        (e)   Improving the identification of temporarily unstocked forest areas without actual land-use change (or providing evidence that the effect of natural regrowth or restocking practices allow forest to meet the thresholds of the forest definition again within four years) (see para. 17 above);

        (f)   Providing more information on the level of discretization at which root-to-shoot ratios were used (see para. 20 above);

        (g)   Providing a comprehensive estimate of uncertainty taking into account other sources of uncertainty affecting the EFs and, where relevant, applying the guidance on how to deal with large and asymmetric uncertainties provided in the 2006 IPCC Guidelines (see para. 21 above);

        (h)   Ensuring consistency between the methods and data sources used for the FREL and those used for the GHG inventory (see para. 24 above).

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

(a)   Treatment of emissions from soil organic carbon in mineral soils, organic soils and mangroves (see paras. 28–29 above);

(b)   Treatment of emissions from the deadwood and litter pools (see para. 30 above);

(c)   Treatment of emissions of non-CO_2 gases from drainage and rewetting of organic soils (see para. 32 above);

(d)   Inclusion of emissions from forest degradation and removals from enhancement of forest carbon stocks (see para. 33 above).

46.   The AT acknowledges and welcomes Pakistan's intention to:

(a)   Update the estimate of emissions from deforestation in its biennial update report to be consistent with that in the FREL submission and address inconsistencies between the FREL submission and the national communication;

(b)   Include emissions and removals from all REDD+ activities.

47.   In conclusion, the AT commends Pakistan for showing strong commitment to continuously improving its FREL estimates in line with the stepwise approach. A number of areas for the future technical improvement of Pakistan's FREL have been identified in this report. At the same time, the AT acknowledges that such improvements are subject to national capabilities and policies, and notes the importance of providing adequate and predictable support.[14] The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Pakistan.

48.   The table contained in annex I summarizes the main features of Pakistan's proposed FREL.

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

Annex I

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

Main features of the FREL		Remarks
Proposed FREL	946 653 t CO_2 eq/year	See paragraph 7 of this document
Type and reference period of FREL	FREL = average of historical emissions in 2004–2012	Assuming instantaneous oxidation of the difference between the average carbon stock of pre-deforestation land and the average carbon stock of non-forest land in the relevant climatic zone (see para. 7 of this document)
Application of adjustment for national circumstances	No	
National/subnational	National	Covers a total area of 879 106 km^2, comprised of the country's official territory (as published by the Survey of Pakistan) and the territories of Gilgit-Baltistan, and Azad Jammu and Kashmir (see para. 6 of this document)
Activity included	Reducing emissions from deforestation	See paragraphs 6–7 of this document
Pools included	Above-ground biomass Below-ground biomass	Some data on other pools (litter, deadwood and soil organic carbon) were collected as part of the pilot NFI, but these pools were not included (see paras. 27–30 of this document)
Gas included	CO_2	Emissions of non-CO_2 gases from fires and drainage and rewetting of organic soils were not estimated (see paras. 31–32 of this document)
Forest definition	Included	Minimum land area of 0.5 ha with tree crown cover of more than 10 per cent, comprising trees with the potential to reach a minimum height of 2 m. Deforestation and emission estimates are based on changes only to natural forests and exclude irrigated plantations, although the forest definition includes irrigated plantations as one of the forest types (see paras. 37–38 of this document)
Consistency with latest GHG inventory	Methods used for estimating the FREL are not consistent with those used for the latest GHG inventory (2015 inventory, published in 2019)	The FREL is based on harmonized classes and consistent data sampling while the GHG inventory was compiled using secondary sources based on different standards and methodologies (see para. 24 of this document)
Description of relevant policies and plans	Included	See paragraph 25 of this document

Main features of the FREL		*Remarks*
Description of assumptions on future changes to domestic policies, if included in the construction of the FREL	Not applicable	
Description of changes to previous FREL	Not applicable	
Identification of future technical improvements	Included	Several areas for future technical improvement were identified by the AT (see paras. 44–46 of this document)

Annex II

Documents and information used during the technical assessment

A.   Reference documents

First FREL submission of Pakistan. Available at https://redd.unfccc.int/submissions.html?country=pak.

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

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

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

IPCC. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/publication/2013-supplement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories-wetlands/.

Second national communication of Pakistan. Available at https://unfccc.int/non-annex-I-NCs.

B.   Other documents

The following references have been reproduced as received:

Chave J, Réjou-Méchain M, Búrquez A, et al. 2014. Improved allometric models to estimate the aboveground biomass of tropical trees. *Global Change Biology.* 20(10): pp.3177–3190. Available at https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.12629.

Confusion Error Matrices for the characterisation of Land Use and Land-Use Change by Pakistan.

Food and Agriculture Organization of the United Nations Global Forest Resource Assessment 2015. Country Report: Pakistan. 2014.

List of satellite imagery (Landsat) used for forest cover mapping for the years 1996, 2000, 2004, 2008, 2012 and 2016.

Maps of the locations which have been subject to visual interpretation of Land Use/Land Cover and Land-Use/Land-Cover Change.

Raster Maps of Land Use and cover map for each province in years 2004, 2008 and 2012.

Spreadsheet of calculation of Pakistan FREL.

Olofsson P, Foody GM, Herold M, Stehman SV, Woodcock CE and Wulder MA. 2014. Good practices for estimating area and assessing accuracy of land change. *Remote Sensing of Environment.* 148: pp.42–57. Pakistan Forest Inventory and Field Survey Manual (version 1.1). Arbonaut and WWF. December 2017.

Pakistan Satellite Land Monitoring System. Training Manual. Arbonaut and WWF. December 2017.

Plot wise summary results of the pilot NFI, including estimated Carbon stock by pool.

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