



Technical report on the technical analysis of the technical annex to the first biennial transparency report of Bhutan submitted in accordance with paragraph 14 of decision 18/CMA.1 on 31 December 2024

Summary

This technical report covers the technical analysis of the technical annex submitted on a voluntary basis, in the context of results-based payments, by Bhutan on 31 December 2024 through its first biennial transparency report in accordance with paragraph 45 of decision 1/CP.24 and paragraph 14 of decision 18/CMA.1. The technical annex provides data and information on the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks, which are activities included in paragraph 70 of decision 1/CP.16, and covers the same national territorial forest area as the assessed forest reference emission level (FREL) and forest reference level (FRL) proposed by Bhutan in its modified FREL and FRL submission of August 2020.

Bhutan reported the results of implementing these activities for 2015–2023, which amount to –1,152,681.56 tonnes of carbon dioxide equivalent per year (t CO₂ eq/year) and were measured against the assessed FREL and FRL of 505,837 and –8,539,085 t CO₂ eq/year respectively.

The data and information provided in the technical annex are in overall accordance with the guidelines contained in the annex to decision 14/CP.19. The technical analysis concluded that the data and information provided by Bhutan in the technical annex are mostly transparent and partially consistent with the data and information used for establishing the assessed FREL and FRL in accordance with paragraph 71(b) of decision 1/CP.16 and section II of decision 12/CP.17. This report contains the findings from the technical analysis and a few areas identified for capacity-building and future technical improvement in accordance with paragraph 14 of decision 14/CP.19.



Abbreviations and acronyms

2006 IPCC Guidelines	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
2019 Refinement to the 2006 IPCC Guidelines	<i>2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
AD	activity data
BEF	biomass expansion factor
BTR	biennial transparency report
C	carbon
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
dm	dry matter
EF	emission factor
FREL	forest reference emission level
FRL	forest reference level
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
M _B	mass of fuel available for combustion
MPGs	modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement
N ₂ O	nitrous oxide
NFI	national forest inventory
NFMS	national forest monitoring system
QA/QC	quality assurance/quality control
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)
SOC	soil organic carbon
SOC _{REF}	reference soil organic carbon stocks
TA	technical analysis

I. Introduction, overview and summary

A. Introduction

1. This technical report covers the TA of the technical annex provided by Bhutan on 31 December 2024 in accordance with paragraph 45 of decision 1/CP.24 and paragraph 14 of decision 18/CMA.1 as part of its BTR1, which was submitted in accordance with paragraph 3 of decision 18/CMA.1. In the technical annex, Bhutan provided the data and information used for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and changes in forest carbon stock and forest area resulting from implementing REDD+ activities. The submission of the technical annex is voluntary and in the context of results-based payments in accordance with paragraph 8 of decision 14/CP.19.

2. In this context, Bhutan underlined that the submission of the technical annex through its BTR1 is voluntary and is solely intended to demonstrate performance and secure results-based payments in line with paragraph 2 of decision 13/CP.19 and paragraphs 7–8 of decision 14/CP.19. Consequently, the submission does not modify, revise or otherwise alter the nationally determined contributions voluntarily submitted by the Party under Article 4 of the Paris Agreement.

3. In accordance with paragraph 14 of decision 18/CMA.1, the TA of the technical annex to the BTR is carried out concurrently with the technical expert review of the BTR referred to in Article 13, paragraph 11, of the Paris Agreement. The technical expert review team conducted the technical expert review of the information reported in the BTR1 of Bhutan as per the scope of the review defined in paragraph 146 of the MPGs,¹ resulting in a separate technical expert review report.²

4. Bhutan made its first FREL and FRL submission, in accordance with decision 12/CP.17, on 6 January 2020, which was subject to technical assessment following the guidance provided in decision 13/CP.19 and its annex. As a result of the facilitative interactions with the LULUCF experts during the technical assessment, the Party provided a modified version of its latest FREL and FRL submission on 5 August 2020. The assessed FREL and FRL were included as one of the elements of the technical annex to its BTR1 in accordance with the guidelines contained in the annex to decision 14/CP.19. The findings from the technical assessment of the FREL and FRL are included in a separate report.³

B. Process overview

5. The technical expert review of the BTR1 of Bhutan took place from 6 to 10 October 2025 as an in-country review and was undertaken by a technical expert review team drawn from the UNFCCC roster of experts on the basis of the criteria defined in paragraphs 172–182 of the MPGs. Dinh Hung Nguyen (Viet Nam) and Anatoli Poultouchidou (Greece) were the LULUCF experts who undertook the TA of the technical annex in accordance with paragraphs 10–13 of decision 14/CP.19. The TA was coordinated by Dirk Nemitz (secretariat).

6. The TA of the technical annex provided by Bhutan was undertaken in accordance with the procedures contained in decisions 2/CP.17, 14/CP.19 and 20/CP.19. This technical report on the TA was prepared by the LULUCF experts in accordance with paragraph 14 of decision 14/CP.19.

7. During the TA and subsequent exchanges, the LULUCF experts and Bhutan engaged in technical discussions, and Bhutan provided clarifications in response to questions raised by the LULUCF experts, in order to reach an understanding on the identification of the capacity-building needs of the Party and areas for future technical improvement. As a result of the facilitative interactions with the LULUCF experts during the TA, Bhutan provided a

¹ Decision 18/CMA.1, annex.

² FCCC/ETF/TERR.1/2024/BTN.

³ FCCC/TAR/2020/BTN, published on 11 December 2020.

modified version of its technical annex, including updated values of estimated results, on 30 January 2026, which took into consideration the technical input of the LULUCF experts. The modifications improved the clarity and transparency of the submitted technical annex.

8. Following the TA of the technical annex, the LULUCF experts prepared and shared the draft technical report with Bhutan for its review and comments. The LULUCF experts responded to the Party's comments and incorporated them into and finalized this technical report in consultation with Bhutan. This technical report on the TA of the technical annex was prepared in the context of the modified technical annex submitted by the Party.

C. Summary of results

9. In paragraph 70 of decision 1/CP.16 the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking a number of activities, as deemed appropriate by each Party in accordance with its respective capabilities and national circumstances. In the context of results-based payments and in line with decision 12/CP.17, Bhutan, on a voluntary basis, proposed a national FREL and FRL covering the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks for the purpose of a technical assessment in accordance with decision 13/CP.19 and its annex. The activities are being implemented in Bhutan's national territory. The assessed FREL of Bhutan is 505,837 t CO₂ eq/year and the assessed FRL is –8,539,085 t CO₂ eq/year.

10. The Party's FREL is based on its annual average historical CO₂ emissions associated with the activity reducing emissions from deforestation for the historical reference period 2005–2014. In accordance with paragraph 9 of decision 12/CP.17, Bhutan adjusted its proposed FREL upward by 0.1 per cent of the biomass carbon stock (in line with its approach under the Forest Carbon Partnership Facility). The national FRL proposed by Bhutan for the same historical reference period 2005–2014 is based on the annual average of combined net removals associated with the activities conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks. No adjustments were applied to the FRL. Bhutan reported the results of implementing the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks for 2015–2023, calculated against the FREL or FRL, as appropriate, which amount to carbon removals of –1,152,681.56 t CO₂ eq annually. The table contained in annex II summarizes the main features of the results in the technical annex, with the aim of accessing results-based payments for REDD+ activities, including the results period, the assessed FREL and FRL, and the pools and gases included.

II. Technical analysis of the information reported in the technical annex

11. For the technical annex to the BTR1 submitted by Bhutan, see annex I.⁴

12. The scope of the TA is outlined in paragraph 11 of decision 14/CP.19, according to which the LULUCF experts shall analyse the extent to which:

(a) The methodologies, definitions, comprehensiveness and information provided are consistent between the assessed FREL and FRL, on the one hand, and the results of implementing REDD+ activities, on the other;

(b) The data and information provided in the technical annex are transparent, consistent, complete and accurate;

(c) The data and information provided in the technical annex are consistent with the guidelines referred to in paragraph 9 of decision 14/CP.19;

⁴ As per decision 14/CP.19, para. 14(a).

(d) The results are accurate, to the extent possible.

13. The table below describes the findings from the TA of the data, methodologies and procedures used by the developing country Party for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and changes in forest carbon stock and forest area resulting from implementing REDD+ activities within the scope of the TA outlined in paragraph 12 above.

Findings from the technical analysis of the data and information used by the developing country Party for estimating its anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and changes in forest carbon stock and forest area resulting from implementing REDD+ activities

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
1	11(a) Consistency with the guidelines in paragraph 3 of the annex to decision 14/CP.19 (consistency with the assessed FREL/FRL)	The LULUCF experts noted that Bhutan maintained consistency between its assessed FREL and FRL, on the one hand, and estimated results of implementing the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks in 2015–2023, on the other, with regard to the following elements: (a) Using consistent methodologies and data to generate AD on deforestation, which were derived using a stratified area estimation approach in accordance with Olofsson et al. (2014). In particular, the same stratified area estimator analysis tool was used in the System for Earth Observation Data Access, Processing and Analysis for Land Monitoring to estimate the bias-corrected area of deforestation, and estimates for wood removals from fire-disturbed areas and from sustainable forest management and conservation areas were derived from consistent data sources, specifically records maintained by the Department of Forests and Park Services; (b) Using consistent methodologies and data to generate EFs, in particular carbon density was calculated using 14 species-specific equations and two general equations, consistent with those applied for the first NFI and the assessed FREL and FRL. Bhutan's technical annex is based on data obtained from the second NFI, conducted between July 2021 and June 2022 using the same sampling design, data-collection protocols, and parameters applied for the first NFI. Data were collected from 2,424 permanent cluster plots distributed across the country. The first and second NFIs are therefore methodologically consistent, and future inventories are expected to use the same design and data-collection parameters; (c) Covering the same five carbon pools: above-ground biomass, below-ground biomass, deadwood, litter and SOC; (d) Covering the same gases: CO₂ and non-CO₂ gases (CH₄, CO and N₂O) and using the same global warming potential values from the IPCC Fifth Assessment Report; (e) Covering the same area: entire national territory; (f) The estimation of emissions assumes complete loss and instantaneous oxidation of forest biomass carbon following deforestation, except in cases where forest land is converted to grassland, for which no losses of shrub, herb, dead organic matter or below-ground biomass carbon pools are assumed, consistent with the assessed FREL and FRL. Emissions from timber harvesting	

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		were estimated under the assumption that below-ground biomass remains unchanged; (g) Using the same forest definition: minimum area of 0.5 ha, height of 5 m or more and at least 10 per cent canopy cover. The definition is the same one used by the Party for its national greenhouse gas inventory and its reporting to the Food and Agriculture Organization of the United Nations for the Global Forest Resources Assessments. The LULUCF experts conclude that Bhutan ensured overall consistency between its assessed FREL and FRL, on the one hand, and estimated results, on the other, with regard to the above-mentioned elements.	
2	11(a) Consistency with the guidelines in paragraph 3 of the annex to decision 14/CP.19 (consistency with the assessed FREL/FRL)	The LULUCF experts noted that the wood density value used by Bhutan to estimate the results of implementing the activities conservation of forest carbon stocks and sustainable management of forests was not consistent with the value used for the assessed FRL; although the average wood density reported in both submissions is based on the same United Nations Industrial Development Organization data set (1994), the average wood density for broadleaf species differs between the assessed FREL and FRL (0.689 t/m³) and the technical annex (0.623 t/m³). The LULUCF experts note that this difference arises from the calculation of the average wood density value, which was calculated on the basis of 19 species for the assessed FREL and FRL and 21 species for the technical annex. In the light of the above, the LULUCF experts note that the wood density value for broadleaf species reported in the technical annex (0.623 t/m³) is derived from the complete data set using the correct averaging methodology. The LULUCF experts commend Bhutan for correcting the calculation of the average wood density value in the modified technical annex.	The LULUCF experts note that strengthening overall QA/QC procedures for future submissions is an area for future technical improvement.
3	11(a) Consistency with the guidelines in paragraph 3 of the annex to decision 14/CP.19 (consistency with the assessed FREL/FRL)	The LULUCF experts identified an inconsistency in the uncertainty values associated with the BEF used to estimate emissions and the associated uncertainty for conservation of forest carbon stocks and sustainable management of forests. While the BEF values (1.830 for broadleaf trees and 1.292 for coniferous trees) are consistent between the assessed FREL and FRL, on the one hand, and the modified technical annex, on the other, the associated uncertainties differ significantly; the relative margins of error for coniferous and broadleaf trees were reported as 60.759 and 66.667 per cent respectively in table 10 of the modified FREL and FRL submission, and as 3.83 and 5.62 per cent respectively in the spreadsheets accompanying the modified technical annex.	The LULUCF experts note that ensuring the consistent application of the equations used to estimate the margin of error for the BEF is an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		The LULUCF experts conclude that the differences between the uncertainty values associated with the BEF reported in the two submissions require clarification in order to ensure transparency and methodological consistency.	
4	11(b) Approaches – Completeness	The LULUCF experts noted that Bhutan only accounts for non-CO ₂ gases (CH ₄ , CO and N ₂ O) for biomass burning. The experts also noted that including only non-CO ₂ gases is consistent with the assessed FREL and FRL, and that the Party consistently applied the global warming potential values from the IPCC Fifth Assessment Report, as well as the EFs for each non-CO ₂ gas from table 2.5 of the 2006 IPCC Guidelines (vol. 4, chap. 2). However, according to the 2006 IPCC Guidelines, emissions from biomass burning include both CO ₂ and non-CO ₂ gases, and all relevant gases should be reported for fire.	The LULUCF experts note that including CO ₂ emissions from forest fires in future submissions is an area for future technical improvement.
5	11(b) EFs – Above-ground biomass and below-ground biomass – Consistency	The LULUCF experts noted that, although the original submission of the technical annex includes the same carbon pools as the assessed FREL and FRL, there are differences due to the use of different methodologies and data sources. Firstly, regarding above-ground biomass, the assessed FREL and FRL are based on data from the first NFI cycle (2012–2015), whereas the technical annex relies on data from the second cycle (2021–2022). An above-ground biomass value of 269.3 t dm/ha was used for the assessed FREL and FRL, while a value of 195.55 t dm/ha was reported in the original technical annex submission. Secondly, regarding below-ground biomass, Bhutan applied the equation from Mokany et al. (2006) (equation 5 in the assessed FREL and FRL) inconsistently; in the assessed FREL and FRL, the national average above-ground biomass value was used to estimate below-ground biomass for trees and saplings, whereas for the technical annex, below-ground biomass was initially estimated at plot level. Thirdly, the assessed FREL and FRL report above-ground and below-ground biomass as 26 and 8.88 t dm/ha respectively for saplings, which differ from the values reported in the modified technical annex (3.18 and 1.37 t dm/ha respectively). During the TA, Bhutan explained that, with regard to above-ground biomass, 35 country-specific allometric equations were developed for the second NFI. However, to maintain consistency with the assessed FREL and FRL, Bhutan recalculated the carbon density for the modified technical annex using the same 14 species-specific and two general allometric equations applied for the first NFI and the assessed FREL and FRL. The recalculated above-ground biomass value used for the modified technical annex is 275.55 t dm/ha, which is some 2 per cent higher than the value reported in the assessed FREL and FRL. In the modified technical annex, Bhutan clarified that below-ground biomass for trees and saplings was estimated using the national average above-ground biomass value to ensure consistency with the assessed FREL and FRL. The	

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		recalculated below-ground biomass value used for the modified technical annex is 72.83 t dm/ha, which is similar to the value reported in the assessed FREL and FRL (73.34 t dm/ha). The Party also explained in the modified technical annex that the decrease in sapling biomass may be attributed to a reduction in sapling density between the two NFI cycles. Bhutan confirmed that the first and second NFIs are fully consistent in terms of sampling design, data-collection protocols and data parameters, and that future inventories will follow the same design and data-collection procedures. The LULUCF experts noted that, given the confirmed methodological consistency between the two NFI cycles, the observed differences in sapling biomass reflect updated inventory data rather than a methodological inconsistency. The LULUCF experts commend Bhutan for recalculating the values for both above-ground and below-ground biomass using consistent allometric equations and estimation approaches, thereby ensuring methodological consistency between the assessed FREL and FRL, on the one hand, and the modified technical annex, on the other, and for including clarifications in the modified technical annex.	
6	11(b) EFs – M _B – Consistency	The LULUCF experts noted that the M_B value used for the assessed FREL and FRL was 267 t dm/ha, whereas a value of 273.75 t dm/ha was reported in the modified technical annex. In the modified technical annex, Bhutan clarified that the updated value for M_B were estimated using updated data from the second NFI and it applied the same allometric equations used for the assessed FREL and FRL and the first NFI. Bhutan confirmed that the value for M_B also includes above-ground biomass of trees and saplings, consistent with the assessed FREL and FRL. The LULUCF experts commend Bhutan for updating the values for M_B using consistent allometric equations and estimation approaches, thereby ensuring methodological consistency between the assessed FREL and FRL, on the one hand, and the modified technical annex, on the other, and for providing additional clarification in the modified technical annex.	
7	11(b) EFs – Annual above-ground biomass growth – Consistency	The LULUCF experts noted that the annual above-ground biomass increment used for the modified technical annex (2.43 t dm/ha/year) is approximately 21 per cent higher than the value applied for the assessed FREL and FRL (2.01 t dm/ha/year). During the TA, Bhutan clarified that the updated annual above-ground biomass increment used for the modified technical annex was derived from data collected under the second NFI, whereas the value used in the assessed FREL and FRL is based on the first NFI. Bhutan confirmed that the first and second NFIs are fully consistent in terms of sampling design, data-collection protocols and data	The LULUCF experts note that ensuring consistency in the calculation method used for the annual above-ground biomass increment between the FREL and FRL, on the one hand, and the technical annex, on the other, is an area for future technical improvement.

Finding ID#	Aspect of the scope of the TA (decision 14/CP.19, para. 11)	Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts	Area for future technical improvement
8	11(b) AD – Deforestation 2015–2017 – Transparency	parameters. The Party explained that the observed increase can be attributed to several factors, including (1) improvements to forest management planning since 2015, such as establishing and revising, as applicable, protected area management plans, forest management units, community forests, local forest management plans and non-wood forest management groups; (2) changes in forest growth dynamics, with a higher proportion of younger and middle-aged stands exhibiting greater biomass accumulation potential; and (3) enhanced data quality and representativeness in the second NFI, including as a result of strengthened QC and validation procedures. The LULUCF experts commend Bhutan for the explanations provided and noted that the reported improvements in forest management planning since 2015 are reflected in the reduction of emissions from sustainable forest management, which fell from 3,024,836 t CO₂ in 2010–2014 of the reference period to approximately 1,883,667 t CO₂, calculated as the equivalent four-year average during the results period (2015–2023). However, the LULUCF experts noted that the annual above-ground biomass increment of 2.43 t dm/ha/year, which was taken from the National Forest Inventory Volume II: State of Forest Carbon Report, was derived by calculating the difference in above-ground biomass between two inventory periods and dividing it by the number of years between the periods. The above-ground biomass values for the two periods in time were estimated using 35 species-specific allometric biomass equations and two general equations (see pp.8 and 33 of the report). In contrast, the above-ground biomass estimates used for the FREL and FRL were based on only 14 species-specific allometric equations and two general equations. The LULUCF experts noted that the total number of samples used for the accuracy assessment for the land-use/land-cover change map for 2015–2017 was reported as 1,700. However, the technical annex notes that, in total, 50 sample points were generated for each of the 36 land-cover change classes identified in the map, resulting in 1,800 sampling points. In contrast, the confusion matrix for 2015–2017 presented in table 14 of the modified technical annex shows a total of 1,700 samples. During the TA, Bhutan clarified that although the sampling approach was designed to allocate 50 sample points to each of the 36 possible land-use transition classes derived from the six land-use/land-cover classes, two transition classes – from forest to grassland and from other land to forest – were not present in the 2015–2017 land-use/land-cover change map. Consequently, no sample points were generated for these two transition classes. Therefore, the accuracy assessment was based on 34 observed transition classes, resulting in a total of 1,700 sample points (34 × 50). These samples were subsequently aggregated into the four reporting strata – stable forest (50	The LULUCF experts note that including additional text in the technical annex to document the reduction in sampled classes from 36 to 34 for the accuracy assessment for the 2015–2017 land-use/land-cover change map is an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		samples), stable non-forest (1,250 samples), forest gain (200 samples) and forest loss (200 samples) – which together account for the total sample size of 1,700 presented in the confusion matrix (table 14 of the modified technical annex) and the stratified area estimation. Bhutan acknowledged that this rationale is not explicitly described in the modified technical annex, which may have led to the apparent discrepancy between the theoretical sampling design (36 transition classes) and the actual number of samples used in the analysis. The LULUCF experts commend Bhutan for the clarification and note that including additional text in the technical annex to document the exclusion of these two transition classes, and the resulting reduction from 36 to 34 sampled classes used in the accuracy assessment for the 2015–2017 land-use/land-cover change map, would improve the transparency of future submissions.	
9	11(b) AD – Accuracy	The LULUCF experts noted that, according to the modified technical annex, a proportional sample allocation was applied; however, the information reported in tables 14 and 16 of the modified technical annex suggests that the sample allocation is not proportional. In particular, only 50 samples were allocated to the stable forest stratum for the 2015–2017 land-use/land-cover change map (table 14), and 49 samples were allocated to the same stratum for the 2017–2023 land-use/land-cover change map (table 16). Since this stratum represents a large mapped area, the experts would expect a substantially higher number of samples to be allocated under proportional allocation; therefore, the sample allocated suggests an undersampling of the stable forest stratum relative to its area, and the sampling design should not be described as proportional. During the TA, Bhutan acknowledged that the sampling approach should not have been described as proportional in the technical annex. The original sampling design was developed for 36 land-use/land-cover transition classes, with a minimum allocation of 50 samples per transition class. Following sample interpretation, it was found that estimates for the 36 transition classes have relatively high uncertainties. As the primary objective of the methodology was to estimate REDD+ AD, the interpreted samples were aggregated into four reporting strata (stable forest, stable non-forest, forest gain and forest loss) without increasing the sample size. As a result of this aggregation, the final sample allocation among the four reporting strata was no longer proportional to their mapped areas. In particular, the stable forest stratum retained only 50 samples, resulting in a lower sampling intensity than would be expected under a proportional sampling design. Bhutan acknowledged that increasing the sampling intensity for the stable forest stratum would likely have improved the precision of the estimates; however, to maintain	The LULUCF experts note that increasing the sample size for stable forest and ensuring that sample allocation is roughly proportional to the area occupied by the dominant strata, particularly stable forest, is identified as an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		consistency with the methodology used for the FREL and FRL, the analysis was completed using the original interpreted sample data set. The LULUCF experts commend Bhutan for the clarification but note that the Party could improve its approach to sample allocation in line with Olofsson et al. (2014) by assigning a minimum sample size to land-use/land-cover change strata and allocating the remaining samples proportionally across the large, stable strata.	
10	11(b) AD – Deforestation 2015–2017 – Accuracy	The LULUCF experts noted that for 2015, the deforested area was assumed to be equal to the average annual deforested area estimated for 2015–2017 owing to a lack of data, implying that deforestation was assumed to be the same in 2015 and 2016–2017. However, no evidence was provided to support this assumption. During the TA, Bhutan explained that all land-use and land-cover maps were produced using end-of-year imagery, primarily from November to January of two overlapping years. Accordingly, the information reported in the 2015, 2017 and 2023 maps relates to the end of 2015, 2017 and 2023 respectively. The Party also indicated that the deforested area for 2015–2017 was divided by two (i.e. 2016 and 2017) on the basis of the image acquisition dates used in map production. The LULUCF experts conclude that the Party should further justify the assumption used to estimate deforestation for 2015 as the absence of data alone does not support the assumption regarding equivalent deforestation rates.	The LULUCF experts note that further justifying the use of extrapolation for 2015, or alternatively considering the use of a results period starting from 2016, where deforestation estimates are based on available data, is an area for future technical improvement that would increase the accuracy of the deforestation estimates in the technical annex.
11	11(b) AD – Deforestation – Transparency	The LULUCF experts noted that deforestation estimates were derived on the basis of stratified area estimation using two land-use/land-cover change maps for 2015–2017 and 2017–2023. For 2015–2017, the estimated deforested area was divided by two in the light of the image acquisition dates used to produce the map, which covers 2016 and 2017, and the deforested area for 2017–2023 was divided by six to reflect the years covered by the map (i.e. 2018–2023) (see finding ID# 10 above). As a result, annual deforestation was assumed to be constant across the years within each period and within each conversion stratum (i.e. cropland, grassland, settlements and other land). The LULUCF experts commend Bhutan for its efforts to improve the accuracy of its area estimates by reporting stratified area estimates and associated confidence intervals.	The LULUCF experts note that collecting information on the specific year of deforestation is an area for future technical improvement.
12	11(b) AD – Area burned – Accuracy	The LULUCF experts noted that the fire-affected areas reported in table 23 of the modified technical annex were derived from statistics provided by the Department of Forests and Park Services for State reserved forest land. These values include both forest and non-forest land on State reserved forest land. However, the LULUCF experts noted that including non-forest areas in the	The LULUCF experts note that separately reporting forest and non-forest burned areas and collecting information on the nature and impact of fires, especially how they affect forest carbon dynamics (e.g. effects on tree

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		reported totals may lead to an overestimation of forest-related emissions from fires. During the TA, Bhutan clarified that burned area data are collected by field staff using GPS and subsequently recorded in the Forest Information Reporting and Monitoring System, an online data repository managed by the Department of Forests and Park Services. The experts commend Bhutan for its annual monitoring of forest fire emissions and its improved reporting practices; until 2023, burned areas were reported as point coordinates, whereas since 2024, data have been collected and recorded at the polygon level.	mortality), is an area for future technical improvement that would enhance the transparency of the technical annex and reduce the potential for overestimating forest-related fire emissions.
13	11(b) AD – Consistency	The LULUCF experts noted that the AD for deforestation in the FREL and FRL submission were generated using the Global Forest Change product. Two multi-temporal image stacks were created from Landsat imagery for 2005–2009 (Landsat 7) and 2010–2014 (Landsat 7 and 8). Image segmentation was then performed in the eCognition software (version 9.2) to achieve a minimum mapping unit of 0.5 ha. Global Forest Change annual loss data were integrated with the multi-temporal segmentation, and zonal statistics were used to produce polygon-level information. In essence, under this approach, the satellite imagery is overlaid before segmentation and classification are carried out to generate the land-use/land-cover change map. In contrast, the AD for deforestation in the technical annex were derived by overlaying land-use/land-cover maps. These maps were produced through segmentation and classification of Landsat satellite imagery, and deforestation was identified by comparing the classified maps for different periods. In this approach, the Party first carried out segmentation and classification of the satellite images before overlaying the resulting maps to detect changes. In addition, the sampling designs used for sample-based area estimation differ between the FREL and FRL submission, on the one hand, and the technical annex, on the other. For the FREL and FRL, a sampling design based on four change classes (stable forest, stable non-forest, forest gain and forest loss) was applied, whereas a more detailed design based on 36 change classes (a 6 × 6 matrix of land-use/land-cover transitions) was used for the technical annex. The LULUCF experts conclude that, although the same tools were used for image segmentation, classification and sample-based area estimation, the differences in the approaches for generating the land-use/land-cover change maps, as well as the differences in sampling design, may contribute to discrepancies in the AD for deforestation between the reference period and the reporting period.	The LULUCF experts note that ensuring that consistent approaches are used for generating the land-use/land-cover change maps, as well as ensuring consistency in the sampling design used for sample-based area estimation, is an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
14	11(b) AD – Accuracy	The LULUCF experts noted that detailed land-cover transitions were estimated by proportionally distributing the total area for each broad transition class (e.g. forest loss) according to the frequency of reference sample points in its subcategories. However, this proportional allocation approach is only appropriate if the number of samples in each subcategory is proportional to the actual area corresponding to that subcategory, and according to the technical annex, exactly 50 samples were assigned to each of the 36 land-cover change classes, meaning that the sample distribution does not reflect true area proportions. As a result, applying proportional sample frequencies to derive subcategory area estimates may not be appropriate under this sampling design.	The LULUCF experts note that estimating detailed land-cover transitions under each broader change class is an area for future technical improvement.
15	11(b) Emissions – Consistency	The LULUCF experts noted that annual emissions from conservation of forest carbon stocks were reported as 51,297.66 t CO ₂ eq in table 26 of the modified technical annex and table 10 of annexure III, and as 51,299.46 t CO ₂ eq in the calculation file for conservation of forest carbon stocks. During the TA, the Party confirmed that the value in the Excel file is correct.	The LULUCF experts note that strengthening overall QA/QC procedures for future submissions is an area for future technical improvement.
16	11(b) Uncertainty – Accuracy	The LULUCF experts noted that the combined uncertainties for the annual emission reductions, annual removal enhancements and net annual emission reductions for 2015–2023 presented in table 5 of the modified technical annex were calculated incorrectly. These uncertainties were reported as 10.23, 7.69 and 14.75 per cent respectively, whereas the correct values are 20.02, 67.12 and 130.03 per cent (assuming that all intermediate uncertainty calculations are accurate). Several intermediate uncertainty values reported in the modified technical annex were also calculated incorrectly. If all intermediate uncertainty values were calculated correctly, the combined uncertainties for the annual emission reductions, annual removal enhancements and net annual emission reductions for 2015–2023 would be 35.38, 66.51 and 131.62 per cent respectively.	The LULUCF experts note that calculating combined uncertainties remains an area for future technical improvement.
17	11(b) SOC _{REF} – Consistency	The LULUCF experts noted that the default SOC _{REF} (under native vegetation) used for the assessed FREL and FRL was 64.07 t C/ha (table 7), whereas a value of 68.12 t C/ha was reported in the modified technical annex (table 19 and annexure III, table 3). However, the modified technical annex does not clarify whether the updated SOC _{REF} value was derived from the most recent NFI data, nor does it explain whether the methodologies and assumptions used to estimate the updated SOC _{REF} value are consistent with those used for the assessed FREL and FRL. During the TA, Bhutan clarified that the SOCREF value was derived from the second NFI. The LULUCF experts commend Bhutan for the clarification and note that including additional text in the technical annex to specify the source of	The LULUCF experts note that specifying the source of the SOC _{REF} value and demonstrating that the methodologies used to calculate the SOC _{REF} value are consistent is an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
		the SOC _{REF} value would improve the transparency and consistency of future submissions.	
18	11(c) Consistency with the guidelines in paragraphs 1–2 of the annex to decision 14/CP.19 (summary information and results)	The LULUCF experts noted that the established FREL and FRL and the results for 2015–2023 are based on the implementation of the same four activities (see para. 9 above). Forest degradation is not addressed as a separate activity; however, its principal drivers, including forest fires and wood removals, are incorporated into Bhutan’s NFMS. Although reducing emissions from forest degradation is not explicitly reported, all forest-related carbon fluxes are captured through the four activities reported. Emissions from wood removals are accounted for under conservation of forest carbon stocks and sustainable management of forests, while emissions from forest fires are accounted for under sustainable management of forests, ensuring consistency between the technical annex and the assessed FREL and FRL. The LULUCF experts commend Bhutan for ensuring consistency between the activities included in the FREL and FRL for 2005–2014 and those included in the technical annex, which reports the results of implementing the activities for 2015–2023.	The LULUCF experts note that separately reporting emissions from forest degradation is an area for future technical improvement that would increase the transparency of future submissions.
19	11(c) Consistency with the guidelines in paragraph 4 of the annex to decision 14/CP.19 (NFMS)	The LULUCF experts noted that Bhutan provided a description of the NFMS and a summary of the roles and responsibilities of the agencies and institutions involved in the measurement, reporting and verification of the results in the technical annex, together with weblinks for accessing further information. The NFMS covers the entire country, equalling 3,839,400 ha. The system assesses forest resources and includes national forest and land-cover data sets, as well as statistics on forest plantations, forest areas affected by fire, and wood removals. The statistics are updated annually and published online, while land-cover data sets are updated periodically using transparent, accurate and credible methodologies. The LULUCF experts commend Bhutan for sharing this information.	
20	11(c) Consistency with the guidelines in paragraph 4 of the annex to decision 14/CP.19 (NFMS)	The LULUCF experts noted that Bhutan did not report deforestation estimates disaggregated by forest type. However, under the second NFI, forests are classified into 10 major forest types, for which carbon stock estimates are available for above-ground biomass, below-ground biomass, deadwood, litter and soil. In addition, carbon stock estimates are available for two broader forest classes, namely broadleaf and coniferous forests. According to paragraph 4(b) of decision 11/CP.19, the NFMS should enable the assessment of different types of forest in the country, including natural forest. During the TA, Bhutan explained that it currently faces a number of challenges that prevent it from disaggregating forest into forest types for reporting on	The LULUCF experts note that stratifying forests by forest type and separately reporting deforestation estimates for natural forest and planted forest is an area for future technical improvement.

Finding ID#	Aspect of the scope of the TA (decision 14/CP.19, para. 11)	Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts	Area for future technical improvement
21	11(c) Consistency with the guidelines in paragraph 6 of the annex to decision 14/CP.19 (how the elements contained in para. 1(c–d) of decision 4/CP.15 have been taken into account)	deforestation, including the limited availability of consistent historical data on forest types, technical constraints in distinguishing between forest types using medium-resolution imagery, and limited resources for detailed field verification across all forest strata. The Party also explained that it recognizes the importance of disaggregating by forest type in terms of enhancing the robustness and transparency of its REDD+ reporting and indicated that capacity-building and technical support will be required in the future to enable the development of consistent national-level methods for mapping, classification and monitoring by forest type. The LULUCF experts commend Bhutan for its intention to further stratify forests by forest type and align deforestation AD with the most appropriate EFs by matching forest type area classifications as closely as possible with corresponding carbon stock estimates and appropriate EFs. Bhutan provided a description of how IPCC guidance and guidelines were taken into account in accordance with paragraph 1(c) of decision 4/CP.15. For estimating emission reductions in the national territory, Bhutan used the methodology provided in the 2006 IPCC Guidelines and the 2019 Refinement to the 2006 IPCC Guidelines, as well as methodological guidance from the Global Forest Observations Initiative. Accordingly, the emissions from deforestation were estimated for 2015–2023 by combining AD (i.e. areas of annual deforestation) with the appropriate EF (i.e. emissions associated with the corresponding forest type). The LULUCF experts noted that the Party estimated deforestation EFs using the same carbon pool disturbance matrix for the FREL and FRL submission and the technical annex. The matrix assumes that conversion of forest land to cropland results in complete loss of above-ground biomass (trees, saplings, shrubs and herbs), litter, deadwood and below-ground biomass, whereas conversion to grassland does not result in losses of above-ground biomass from shrubs and herbs, deadwood or below-ground biomass. However, according to the 2006 IPCC Guidelines (vol. 4, chap. 2.3, equation 2.15) and the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 5.3, table 5.9), emissions from deforestation should account for the annual increase in carbon stocks in biomass due to growth on land converted to another land use. During the TA, Bhutan clarified that the deforestation EFs for conversion to cropland do not account for carbon stocks in the post-conversion land use. The LULUCF experts commend Bhutan for ensuring consistency between the assessed FREL and FRL and the technical annex but noted that the Party could improve its methodology and ensure complete consistency with IPCC guidance	The LULUCF experts note that accounting for net carbon stocks across all post-deforestation land uses for all land-use conversions is an area for future technical improvement.

<i>Finding ID#</i>	<i>Aspect of the scope of the TA (decision 14/CP.19, para. 11)</i>	<i>Description of the issue, additional information shared by the Party during the TA and conclusions of the LULUCF experts</i>	<i>Area for future technical improvement</i>
22	11(d) Accuracy of the results proposed in the technical annex	by incorporating IPCC tier 1 default carbon stock values for cropland or country-specific post-conversion carbon stock estimates, if available. Both the established FREL and FRL and the results obtained for 2015–2023 from implementing the activity sustainable management of forests are based on the assumption that M_B corresponds to the total above-ground biomass of trees and saplings derived from NFI data. Bhutan applied a combustion factor of 0.45 in accordance with table 2.6 of the 2006 IPCC Guidelines (vol. 4, chap. 2.4) for all “other” temperate forests consistently across the submissions. The LULUCF experts noted that according to the 2006 IPCC Guidelines (vol. 4, table 2.4) M_B is influenced by the type, age and condition of the vegetation, as well as by fire type and intensity. For example, fuel available for low-intensity surface fires is typically limited to litter and dead organic matter, whereas higher-intensity crown fires may consume substantial portions of live tree biomass. Therefore, M_B may not necessarily correspond to total above-ground biomass of trees and saplings, particularly where large-diameter stems are not fully consumed during fire events. The experts also noted that the fuel consumption estimate based on the country-specific M_B value and IPCC default combustion factor ($M_B \times \text{combustion factor} = 123 \text{ t dm/ha}$) is about 2.4 times higher than the IPCC tier 1 default M_B value for all “other” temperate forests (50.4 t dm/ha) reported in table 2.4 of the 2006 IPCC Guidelines (vol. 4, chap. 2.4). The LULUCF experts conclude that providing further justification for the assumption that M_B equals the total above-ground biomass of trees and saplings would improve transparency and accuracy and ensure that fire-related emissions are not overestimated.	The LULUCF experts note that providing additional clarification on and justifying the use of total above-ground biomass of trees and saplings as M_B, including in terms of representativeness, as well as including information on fire type and biomass consumption patterns, is an area for future technical improvement.

III. Conclusions

14. The LULUCF experts conclude that Bhutan reported the results of implementing four activities, namely reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks. Reducing emissions from forest degradation was not addressed as a separate activity; however, the principal drivers of this activity, including forest fires and wood removals, are incorporated into the Party's NFMS. The results include estimates of CO₂ and non-CO₂ emissions and removals from five carbon pools: above-ground biomass, below-ground biomass, deadwood, litter and SOC in mineral soils for 2015–2023. The results of the activities were estimated and reported using methodologies, definitions, assumptions and information that are partially consistent with those used for constructing the assessed FREL and FRL.

15. The LULUCF experts also conclude that the results presented of implementing the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks are partially consistent with the assessed FREL and FRL.

16. The LULUCF experts further conclude that Bhutan provided the information necessary for reconstructing the results of implementing the activities reducing emissions from deforestation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks. The data and information provided in the technical annex are considered to be mostly transparent (see finding ID#s 8 and 11 in the table above), partially consistent (see finding ID#s 1–3, 5–7, 13, 15 and 17–21 in the table above), mostly complete (see finding ID# 4 in the table above) and partially accurate (see finding ID#s 9–10, 12, 14, 16 and 22 in the table above), to the extent possible.

17. The LULUCF experts acknowledge that the technical annex includes summary information from the final report containing the assessed FREL and FRL; results in -1 152 681.56 t CO₂ eq/year that are consistent with the assessed FREL and FRL; a demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed FREL and FRL; a description of the forest monitoring system and institutional roles and responsibilities in the measurement, reporting and verification of the results; the information necessary for reconstructing the results; and a description of how the elements contained in paragraph 1(c–d) of decision 4/CP.15 have been taken into account. The LULUCF experts conclude that the data and information provided in the technical annex are partially consistent with the guidelines referred to in paragraph 9 of decision 14/CP.19 (see finding ID#s 1–3 and 18–21 in the table above).

18. The LULUCF experts acknowledge and welcome the Party's intention to stratify forests by forest type and to separately assess and report deforestation in natural forest and planted forest.

19. During the consultation process, Bhutan identified a number of capacity-building needs. Addressing those needs could enable Bhutan to improve its data and methodologies in future FREL and FRL submissions. After exchanges with the LULUCF experts, Bhutan identified the following capacity-building needs relating to:

- (a) Technical training on Breaks For Additive Season and Trend algorithm;
- (b) The visual interpretation of reference data using Collect Earth or Collect Earth Online;
- (c) The Open Foris Arena platform;
- (d) The Open Foris Earth Map platform.

20. In conclusion, the LULUCF experts commend Bhutan for showing strong commitment to continuously improving the data and information used for calculating the results, in line with the stepwise approach, which are consistent with those used for constructing its assessed FREL and FRL. Some areas for future technical improvement and

capacity-building needs identified by Bhutan have been identified in this report. At the same time, the LULUCF experts acknowledge that such improvements are subject to national capabilities and circumstances, and note the importance of adequate and predictable support.⁵ The LULUCF experts also acknowledge that the TA process was an opportunity for a facilitative and constructive technical exchange of views and information with Bhutan.⁶

⁵ As per decision 2/CP.17, para. 57.

⁶ As per decision 14/CP.19, paras. 12–13.

Annex I

Technical annex to the biennial transparency report

Owing to the complexity and length of the submitted technical annex to the BTR, and in order to maintain the original formatting, the technical annex has not been reproduced here; it is available at <https://unfccc.int/first-biennial-transparency-reports>.

Annex II

Summary of main features of reported results of implementing activities referred to in paragraph 70 of decision 1/CP.16 based on information provided by Bhutan

<i>Key element</i>		<i>Remark(s)</i>
Results reported	–1 152 681.56 t CO ₂ eq/year	See paragraph 10 of this document
Results period	2015–2023	See paragraph 10 of this document
Assessed FREL and FRL	FREL: 505 837 t CO ₂ eq/year FRL: –8 539 085 t CO ₂ eq/year	See document FCCC/TAR/2020/BTN and the modified version of the Party's latest FREL and FRL submission of August 2020. See paragraph 9 of this document
Reference period	2005–2014	See paragraph 10 of this document
National/subnational	National	See paragraph 9 of this document
Activities included	Reducing emissions from deforestation Conservation of forest carbon stocks Sustainable management of forests Enhancement of forest carbon stocks	See paragraph 9 of this document. See also finding ID# 18 in the table in this document
Pools included	Above-ground biomass Below-ground biomass Deadwood Litter Soil organic matter	See finding ID#s 5 and 17 in the table in this document
Gases included	CH ₄ , CO, CO ₂ , N ₂ O	See finding ID# 4 in the table in this document
Consistency with assessed FREL and FRL	Methods, definitions and information used for the assessed FREL and FRL are partly consistent with those used for the results	See finding ID#s 1–3 in the table in this document
Description of NFMS and institutional roles	Included	See finding ID#s 19–20 in the table in this document
Identification of future technical improvements	Included	Several areas for future technical improvement have been identified (see finding ID#s 2–4, 7–18 and 20–22 in the table in this document)

Annex III

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

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. 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. E Calvo Buendia, K Tanabe, A Kranjc, et al. (eds.). Geneva: IPCC. Available at <https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html>.

B. UNFCCC documents

First modified FREL and FRL submission of Bhutan. Available at https://redd.unfccc.int/submissions/by-country/country_detail/btn.html.

“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 elements to be included in the technical annex referred to in decision 14/CP.19, paragraph 7”. Annex to decision 14/CP.19. Available at <https://unfccc.int/sites/default/files/resource/docs/2013/cop19/eng/10a01.pdf#page=42>.

“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>.

Report on the technical assessment of the proposed FREL and FRL of Bhutan submitted in 2020. FCCC/TAR/2020/BTN. Available at <https://unfccc.int/documents/267254>.

C. Other documents

The following references may not conform to UNFCCC editorial style as some have been reproduced as received or as cited in the technical annex:

FMID, unpublished. Calculation file for conservation of forest carbon stocks. 3. *Conservation of carbon stock_2015_2023.xlsx*.

FMID (2023). National Forest Inventory Volume II: State of Forest Carbon Report.

IPCC (2014). Anthropogenic and Natural Radiative Forcing. In C. Intergovernmental Panel on Climate (Ed.), *Climate Change 2013 – The Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 659-740). Cambridge: Cambridge University Press.

Mokany, K., Raison, R. J., & Prokushkin, A. S. (2006). Critical analysis of root: shoot ratios in terrestrial biomes. *Global Change Biology*, 12(1), 84-96.

Olofsson, P., Foody, G. M., Herold, M., Stehman, S. V., Woodcock, C., & Wulder M.A. (2014). Good practices for estimating area and assessing accuracy of land change. *Remote Sensing of Environment*, Volume 148, 42-57.

Olofsson, P., Foody, G. M., Herold, M., Stehman, S. V., Woodcock, C. Stibig, H.-J., Langner, A., & Simonetti, D. (2016). ReCaREDD Project: Workshop on 'Tools and Methods for Monitoring Deforestation and Forest Degradation by Remote Sensing' - Phnom Penh, Vientiane and Hanoi 2016; EUR 28572 EN; doi:10.2760/355110.

UNIDO (1994). Handbook of 25 timber species from Bhutan. United Nations Industrial Development Organization.
