

HANDBOOK FOR REVIEW OF NATIONAL GHG INVENTORIES

CHAPTER VI: LAND USE CHANGE AND FORESTRY SECTOR ISSUES

CONTENTS

	<i>Page</i>
Introduction	2
Table 1: CRF Tables relevant to Land-use Change and Forestry Sector reviews	6
Review of the LULUCF Sector	7
Table 2: Review issues on consistent representation of land areas	8
Table 3: Cross-cutting and general issues to consider during the review	10
Table 4: Sectoral Report for Land Use, Land-use Change and Forestry (CRF Table 5)	13
Table 5: Sectoral Background Data for LULUCF: Forest Land (CRF table 5.A)	14
Table 6: Sectoral Background Data for LULUCF - Cropland (CRF Table 5.B)	19
Table 7: Sectoral Background Data for LULUCF - Grassland (CRF Table 5.C)	23
Table 8: Sectoral Background Data for LULUCF - Wetlands (CRF Table 5.D)	27
Table 9: Sectoral Background Data for LULUCF - Settlements (CRF Table 5.E)	31
Table 10: Sectoral Background Data for LULUCF - Other Land (CRF Table 5.F)	34
Reporting of carbon emissions and non-CO ₂ emissions from land use management activities	37
Table 11: Direct N ₂ O emissions from N fertilization (CRF Table 5(I))	37
Table 12: N ₂ O emissions from drainage of forest soils (CRF Table 5(II))	39
Table 13: N ₂ O emissions from disturbance associated with land-use conversion to cropland (CRF Table 5(III))	40
Table 14: Carbon emissions from agricultural lime application (CRF Table 5(IV))	41
Table 15: Biomass Burning (CRF Table 5(V))	43

Introduction

1. This chapter provides introductory information on the Land Use, Land Use Change and Forestry sector and a series of tables to guide the reviewer through the technical review of each major source sink category. The specific guidance provided in this chapter is to assist in the review of the estimation of emissions and removals of CO₂ and non-CO₂ for the Land Use, Land-use Change and Forestry (LULUCF) sector. It is based on Chapter 5 of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines), and as such, is only relevant for the review of inventories prepared in accordance with the IPCC Guidelines. With the completion of the “*Good Practice Guidance for Land Use, Land-use Change and Forestry (GPG LULUCF)*” by the IPCC, and which provides advice consistent with the IPCC Guidelines; this chapter also draws from the guidance given in GPG LULUCF. Parties have since, through a COP decision, agreed to use GPG LULUCF and revised CRF tables for preparing annual inventories under the Convention from 2005.
2. The guidance is for use by experts during an annual technical review. The overall aim is to help review experts in performing their tasks, avoid duplication of efforts, and promote consistency in the different types of reviews of national greenhouse gas (GHG) inventories (desk, centralized and in-country review teams) for the technical review of GHG inventories.
3. The guidance presented in the tables in this handbook is not intended as a checklist where the team must complete all the questions, but rather as a reference manual for the reviewers. Each of the tables, and to a large extent the questions, may be used independently. Questions relevant for checking cross cutting issues like choice of Tier, uncertainty and QA/QC are provided once in the Chapter II general review tables.
4. This chapter of the handbook comprises a series of tables highlighting the key pieces of data that need to be reviewed in order to reach a conclusion on the quality of the inventory of the LULUCF sector, as part of the National GHG Inventory. The tables are based on the Sectoral Background Data for LULUCF Tables in the CRF, but they also draw on the reporting tables and worksheets presented in the IPCC Guidelines: Workbook, and the GPG LULUCF.
5. The GPG LULUCF introduced six broad categories of land use in the estimation of carbon stocks and emissions and removals of GHG associated with the LULUCF sector. Within these six broad land use categories, the changes in carbon stocks and emissions and removals of GHG associated with lands converted to the category in question are reported. The tiered methodologies in GPG LULUCF, that range from default data and simple equations to country-specific data and models, are organized by the land use categories and then, by the broad carbon pools. As such, the former tables of the CRF for the LUCF sector were revised to incorporate the LULUCF categories and emissions sources associated with these land use categories.
6. There are twelve (12) LULUCF CRF tables that are based on the land use categories:

Table 5: Sectoral Report for LULUCF

Tables 5.A - 5.F: Sectoral Background Data for LULUCF for each of the land use categories:

- 5.A: Forest Land*
- 5.B: Cropland*
- 5.C: Grassland*
- 5.D: Wetlands*
- 5.E: Settlements*
- 5.F: Other Land*

Tables 5 (I) - (V): Sectoral Background Data for LULUCF for emission sources from land use categories:

Table 5(I): Direct N₂O emissions from N fertilization

Table 5(II): N₂O emissions from drainage of soils

Table 5(III): N₂O emissions from disturbance associated with land-use conversion to cropland

Table 5(IV): Carbon emissions from agricultural lime application

Table 5 (V): Biomass burning

7. **Structure of the tables:** Each table in this chapter of the handbook carries a short introduction in the form of a definition of the activities that should be reported within this source and sink category; the potential key issues that the reviewers should be aware of; and a short list of other references. Reviewers should then read the methodology that the Party has followed. This may be a default methodology, a supplemented default methodology, or a completely different, country-specific approach that accommodates national circumstances.

8. The general and cross-cutting requirements are common to all the tables and serve to remind reviewers of the wider objectives of the review.

Each table shows:

- The land use category, conversions to the land use covered by the land-use category and the GHG in question;
- Asks Questions and makes short comments – generally asking the reviewer to check how data was collected or where it came from and commenting if/where the information is presented in the CRF Tables;
- Provides elaboration on the key issues and potential problems that may arise in relation to the pieces of information or clarifies how a calculation has been performed. Guidance for the review of data that is used in the calculations but not presented in the CRF table is presented below in normal text.

9. **Special considerations for LULUCF inventories:** The LULUCF inventory is complicated by several considerations:

- Many Parties already have national programmes in place to estimate forest inventories, and produce agriculture census and land use maps. However, instead of implementing a new inventory process, some Parties choose to manipulate existing data to meet the CRF requirements. This creates difficulties in the comparison of reports between countries and, if estimates are based on interpolation between periodic inventories, consistency in reports within countries.
- The key to an accurate LULUCF inventory is to have good data on land use. The historical importance of land use change complicates the process as it is vital that land areas remain consistent over time. Consequently the use of accurate land use data from the current year may be hampered by the quality of historic data in some sub-categories.
- High levels of natural variation and uncertainty, which makes the application of standard calculation techniques particularly difficult and results in compromises that may be favourable to some Parties.
- Analysis of trends is complicated by (a) the length of time over which activities impact upon carbon dynamics (b) changes in the methodologies by Parties as they rationalize accounting rules with existing inventory practices and (c) gross changes in sub-categories that can have significant effects on net values

10. **Key components of a LULUCF Inventory:** Consistent representation of land areas. Information on land areas is needed to estimate carbon stock changes and greenhouse gas emissions/removals associated with land use, land -use change and forestry. The national classification system used to classify the six broad categories of land should be used consistently over time to avoid gaps and overlaps in land area data. GPG LULUCF presents three approaches

for representing land areas; use of basic land-use data, survey of land use and land-use change and geographically explicit land use data. While the approaches are not mutually exclusive, the mix of approaches selected by an inventory agency should reflect calculation needs and national circumstances. One approach may be applied uniformly to all areas and land-use categories within a country, or different approaches may be applied to different regions or categories or in different time intervals.

11. Forest Land: As with the IPCC Guidelines, the GPG LULUCF covers managed forests, which are subject to periodic or ongoing human interventions and include the full range of management practices. Thus, the category on forest land covers all forest land remaining forest land and land converted to forest. Forest land is an important sink category in many Annex I Parties, but it can also be a source of emissions. Parties need to estimate the carbon stock changes and greenhouse gas emissions and removals associated with changes in biomass, dead organic matter and soils on forest lands and lands converted to forest land.

12. Cropland: Cropland includes all annual and perennial crops as well as temporary fallow land. Arable land temporarily used for forage crops or grazing as part of an annual crop-pasture rotation is included under cropland. The amount of carbon stored in cropland, and emitted or removed from, depends on crop type, management practices, and soil and climate variables. Carbon stocks in soils can be significant and changes in stocks can be affected by management practices and conversion of other land uses into cropland.

13. Grassland: Grassland includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the thresholds used in the forest land category and are not expected to exceed, without human intervention, the thresholds used in the forest land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastoral systems, subdivided into managed and unmanaged consistent with national definitions. Carbon stocks in permanent grassland are influenced by human activities and natural disturbances. Hence, the aboveground component (woody biomass) is usually small, while belowground carbon stocks dominates, mainly in roots and soil organic matter.

14. Wetlands: Wetlands include land that is covered or saturated by water for all or part of the year (e.g. peatland), and does not fall into the categories of forest land, cropland, grassland or settlements. Managed wetlands are those in which the water table is artificially changed or those that are created through human activity. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions. The reporting of emissions and removals for this category is required only for land conversion to wetlands, mainly to complete the reporting of forest and grassland conversion to other land categories. The importance of this category may vary a lot from Party to Party.

15. Settlements: Settlements are defined as including all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories. It includes all classes of urban tree formations. Change in carbon stocks, particularly in living biomass, and non-CO₂ greenhouse gas emissions can be estimated in two parts, for the category "Settlements remaining Settlements" and for "Land converted to Settlements." The contribution of the latter category to the emissions/removals caused by deforestation (or other nationally important land conversions) may be important for some Parties.

16. Other Land: Other Land includes bare soil, rock, ice and all unmanaged land areas that do not fall into any of the other five land use categories. This land use category is included to allow the total of identified land areas to match the national area. Consistent with the IPCC Guidelines, change in carbon stocks and non-CO₂ emissions and removals would not need to be assessed for the category "Other Land remaining Other Land". In the conversion of managed land use to "Other Land", either starting with a human activity or a natural event, the estimation of CO₂ emissions is necessary as the conversion releases carbon previously held on the land, and emissions and/or removals due to management activities cease.

17. **Non-CO₂ emissions:** Reporting of the non-CO₂ emissions in the LULUCF Sector is mainly related to the Forest land and the Wetlands categories. An important source of non-CO₂ emissions is from biomass burning, which is often associated with land conversion and clearing of vegetation. Non-CO₂ emissions from wildfires on managed land should be reported. Conversion of land to cropland can also be a source of emissions of N₂O. The importance of the non-CO₂ greenhouse gas emissions in the LULUCF inventory is for most Parties smaller than the importance of the carbon stock changes. All Parties do not fertilise forests or have drained forest land or wetlands. The contribution of non-CO₂ emissions in the LULUCF Sector to the total inventory can be very different for different Parties. Non-CO₂ emissions can be reported by area (like N₂O emissions from drainage of soils) or based on activity data independent of land areas (e.g. total amount of nitrogen fertilizer applied).

18. **Key References:** The *UNFCCC Guidelines on Reporting and Review* (FCCC/CP/2002/8) (UNFCCC Guidelines), the UNFCCC reporting guidelines on annual inventories (following incorporation of the provisions of decision 13.CP.9) (FCCC/SBSTA/2004/8), the *Revised 1996 Guidelines for National Greenhouse Gas Inventories* (Vols. 1 to 3; IPCC/OECD/IEA, 1997) (IPCC Guidelines) and the *IPCC Good Practice Guidance for LULUCF* are key technical references for reviewers. FAO statistics may provide useful means of checking reported values such as forest areas, activity data related to soils etc. The UNFCCC Guidelines define several terms that are used in the *Preliminary guidance for experts participating in the individual reviews of national greenhouse gas inventories* and are important in ensuring consistency in the structure and content of reviews.

Note 1: In Decision 13/CP.9, the Conference of Parties decided that Parties included in Annex I to the Convention should use the IPCC Good Practice Guidance for Land use, Land-use change and Forestry for preparing annual inventories under the Convention, due in 2005 and beyond. It also decided to use, for a trial period for inventory submissions due in 2005, the tables of the common reporting format for LULUCF categories contained in an annex to this decision. The provisions of Decision 13/CP.9 have been incorporated in the UNFCCC reporting guidelines on annual inventories (FCCC/SBSTA/2004/8).

19. **In addition to the technical references mentioned above, the following documents are required for the review:**

1. Common Reporting Format (CRF) - essential
2. A National Inventory Report (NIR)
3. Status Report
4. Synthesis and Assessment Reports (S&A Reports)
5. Party's responses to the S&A Reports
6. Reports on previous reviews and the Party's responses to previous reviews.

Reviewers are encouraged to examine the general comments and Land Use, Land-use Change and Forestry Sector comments in the S&A Reports along with the Party's responses to these reports and previous reviews. Awareness of the content of these documents enables the reviewer to focus on potential problems, and recognise the actions that the Party is undertaking to improve their LULUCF Sector inventory.

20. The CRF Tables that include or should include information (data, notation keys and textual material) relevant to the Land Use, Land-use Change and Forestry Sector are shown in table 1.

Table 1: CRF Tables relevant to Land-use Change and Forestry Sector reviews

CRF table	CRF table Content
Table 5	Sectoral Report for Land Use, Land-use Change and Forestry
Table 5.A - 5.F, Table 5(I) - 5(V)	Sectoral Background Data for Land Use, Land-use Change and Forestry
Summary 1.A/1.B	Summary report for National GHG Inventories (IPCC Table 7A) (Reports Net CO ₂ emissions/removals, CH ₄ , N ₂ O, NO _x , CO, NMVOC and SO ₂). Summary Report for Methods and Emission Factors Used (includes summary information on whether methods and emission factors are IPCC Default (D), Country Specific (CS), Corinair (C), or Model (M).
Summary 2	Summary report for CO ₂ equivalent emissions.
Summary 3	Summary report for methods and emission factors used in estimating CO ₂ emissions/removals, CH ₄ , N ₂ O emissions.
Table 7	Summary overview of Key Categories of emissions and removals.
Table 8a	Recalculation – Recalculated Data
Table 8b	Recalculation – Explanatory Information
Table 9s1	Completeness – explanation of notation keys not estimated (NE) and included elsewhere (IE)
Table 9s2	Completeness – information on additional greenhouse gas emissions reported
Table 10s1 to 10s3 and 10s5	Emission Trends (CO ₂ , CH ₄ , N ₂ O, CO ₂ -e respectively)

21. The following tables (table 2 to table 15) provide detailed review guidance for each land use category. Tables are not provided for the source categories referred to as “Other.” Where emission estimates are reported for the “Other” categories, these categories can be reviewed using the same detailed approach outlined in the tables.

Note 3: Sources included in the “Other” categories should be examined carefully to ensure that they are correctly categorised.

Review of the LULUCF Sector

22. The LULUCF Sector differs from the other sectors in that it covers both emissions and removals of CO₂ and emissions of other greenhouse gases. The technical review of this sector requires the checking and assessment of both quantitative and qualitative data and information from the reporting of carbon stock changes and emissions and removals of greenhouse gases due to management of land and conversion of land from one land-use category to another. The emissions and removals in this sector are subject to a high level of natural variation and high uncertainties. Many Parties will be reporting net removals from the LULUCF Sector.

23. The review of the LULUCF Sector requires good knowledge of the requirements in the UNFCCC reporting and review guidelines as well as the methodologies and guidance contained in the *IPCC Good practice guidance for Land Use, Land-use Change and Forestry* (GPG-LULUCF). Reviewers need to be familiar with the relevant parts in the Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories incorporating the provisions of decision 13/CP.9 (FCCC/SBSTA/2004/8) and the UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention (Decision 19/CP.8, in FCCC/CP/2002/8).

24. The review of the LULUCF inventory using the GPG LULUCF and the new CRF Tables will take place for the first time in the annual review of the 2005 submissions. For 2005, some Parties may have had difficulties in implementing the new requirements or part of these but this situation is expected to improve as Parties gain experience in the use of the new guidelines. Use of the information from previous reviews will be helpful in the reviews of the LULUCF Sector in 2005, but should be viewed with care due to the changed reporting requirements.

25. The following sections present some of the issues and problems which could arise in a LULUCF inventory. These issues and problems have been tabulated according to the land-use categories in the CRF tables for LULUCF, and the general and cross-cutting areas of the sector. The purpose of the tables is to facilitate the reviewer in his/her review of the sector, including essential areas to consider and note when reviewing the inventory data.

Consistent Representation of Land Areas

26. LULUCF reporting is done for the six main land-use categories. This is further divided into two subsections based on the status and recent history of land-use:

- Lands that begin and end an inventory period in the same use
- Conversions to the land use covered by the land-use category in question

27. The GPG LULUCF presents three approaches for representing land areas. The choice of the approaches will depend on the national circumstances (e.g. the areas of the country, the land use types and accessibility to all areas), availability of data and resources available to improve the inventory. The approaches complement each other and different approaches can be used for different LULUCF categories.

28. Below are some issues a reviewer is likely to encounter and should take note during the review of land areas in the LULUCF inventory.

Table 2: Review issues on consistent representation of land areas

Consistent representation of land areas
<p>Information on land areas is needed to estimate carbon stock changes and greenhouse gas emissions/removals associated with land use, land -use change and forestry. Land areas are reported in CRF Tables for the land-use categories. The CRF Tables should also give information on subcategories (e.g. climatic zone, vegetation type, management type) used in inventory preparation. The choice of subcategories should reflect national circumstances and the level at which the estimates are calculated. In addition, Parties will use their own definitions for the land-use categories and sub-categories needed in making the estimates on emissions/removals.</p> <p>In addition to reporting land-use categories and subcategories, these should be complemented with the following information in the NIR:</p> <ul style="list-style-type: none"> ○ land-use definitions and the correspondence of the classification systems used to the LULUCF categories ○ approaches used for representing land areas ○ land-use data bases used for the inventory preparation ○ a summary table on the national areas under different land-use and land-use change should be provided for QA/QC purposes.
Review issues related to consistent representation of land areas
<p>When reviewing land area data in Tables 5, 5.A to 5.F and 5(I) to 5(V) in the CRF, and the NIR, check the following:</p> <p>Possible omissions or double-counting of land areas and consistency of the reporting</p> <ul style="list-style-type: none"> • Has the Party provided a summary table on the national areas of different land-use and land-use change as part of the section on QA/QC? <ul style="list-style-type: none"> ○ compare the areas with those in CRF Tables - the land areas should be the same as the areas reported in the sectoral tables for each subcategory ○ compare reported areas of total forest land, and cropland/grassland areas, other categories as appropriate with corresponding areas in earlier reporting ○ for large changes in previous reporting see if there are some explanations in the NIR or ask the Party for explanations ○ check the total area of all reported land-use categories and compare with the total area of the country - for inconsistencies and explore reasons ○ if the total area of the reported land-use categories is larger than the total area of the country, some areas may have been double-counted ○ if the total area of the reported land-use categories is smaller than the total area of the country, some land areas may have been omitted from the inventory ○ the above checking can also be done based on the land-area data provided in the CRF ○ land areas need not be reported for liming or fertilization of forests as they are not relevant for the estimation of the associated emissions (CRF Tables 5(I) and 5(IV)) <p>Documentation on the definitions and classification system</p> <ul style="list-style-type: none"> • Has the Party provided national land-use definitions and classification systems and how do these correspond to the LULUCF categories reported? <ul style="list-style-type: none"> ○ Are there differences in the definitions of the broad categories to those provided in the GPG-LULUCF? ○ Are sub-categories appropriate? ○ Is data provided on how managed and unmanaged land are distinguished? <p>Documentation on approaches for representing land areas</p> <ul style="list-style-type: none"> • Has the Party provided data on the approaches used for representing land areas in the NIR? • Has the Party provided data on land-use databases used for the inventory preparation? <ul style="list-style-type: none"> ○ Are the sources of information given? ○ Are sampling routines described? ○ How have inconsistencies with different databases been harmonized? ○ Are possible gaps or overlaps addressed?

Cross-cutting Issues Related to LULUCF

29. There are six major cross-cutting issues related to the estimation of emissions and removals from the LULUCF sector which inventory and review experts should be aware of and take into consideration in the preparation or review of the LULUCF inventory. The GPG LULUCF provides good practice guidance on these six issues, taking into account the specific characteristics of the LULUCF sector. The IPCC GPG2000 provides additional background information on these issues in general.

30. Uncertainty Assessment: Estimates of uncertainty need to be developed for all categories in an inventory and for the inventory as a whole. Estimated carbon stock changes, emissions and removals arising from LULUCF activities have uncertainties associated with area or other activity data; estimation parameters such as biomass growth rates, expansion factors and other coefficients. The uncertainty estimate for the LULUCF sector can be combined by uncertainty estimates for other source categories using either a Tier 1 or Tier 2 method.

31. Sampling: Data for the LULUCF sector are often obtained from sample surveys. National forest inventories are important examples of the type of surveys used. Sampling is used in area estimation as well as in the estimation of carbon stocks and emissions and removals of greenhouse gases. Measurements made at the sample level need to be scaled up to obtain estimates for larger areas and several kinds of errors may occur. Measurement errors occur due to imperfect technique or instrumentation. When models are applied to derive estimates, model errors occur because they cannot predict target quantities exactly. Sampling errors may also occur during scaling up from the plot level. Uncertainty can also arise when land areas are classified incorrectly; these are classification errors. The final type of errors that can contribute to uncertainty are data registration and calculation errors.

32. Key Category Analysis: The inclusion of the LULUCF categories in the key category analysis facilitates the determination of priorities across all sectors of the national inventory. Key source categories are first identified for the inventory without the LULUCF inventories. The analysis is repeated for the full inventory including the LULUCF categories. The recommended level of analysis for the LULUCF sector is the level of land use categories and land conversion categories. Each of these categories comprises several sub-categories and these sub-categories should be considered key if they account for 25-30% of the overall emissions or removals of the category. There should also be separate key category assessments for the gases CO₂, N₂O and CH₄ because the methods, emission factors and related parameters differ for each gas. In addition, countries also need to assess the impact of deforestation occurring within the country and be considered key if the sum of emission estimates associated with forest conversion to any other land category is larger than the smallest category considered key in the quantitative analysis.

33. Quality Assurance and Quality Control: A QA/QC system must recognize that the LULUCF sector is unique because CO₂ can be both removed from and emitted to the atmosphere. There are four important features of LULUCF inventory methods that generally affect QA/QC: (a) reliance on periodic sampling and its influence on the representativeness of input data; (b) the need for sufficient historical data as past land-use activities affect current CO₂ emissions and removals; (c) the need to use sophisticated models in which the data, assumptions and characteristics of the model may not always be transparent and QA/QC needs to focus on such documentation; and (d) QA/QC should involve the assessment of the suitability of the selected methods for the estimation of GHGs.

34. Time Series Consistency and Recalculations: Ensuring the time series consistency of inventory estimates is essential in order to have confidence in reported inventory trends. When different methods are used in two different periods there is potential for the time series to be inconsistent for the two periods. The standard method for ensuring consistency is to recalculate the estimates using the same method for all inventory years and to ensure that the entire time series reflects the new data and/or method. Clear documentation of recalculations is essential for transparent emissions estimates and to demonstrate that there is an improvement in accuracy and completeness.

35. **Verification:** The purpose of verifying national greenhouse gas inventories is to establish their reliability and to check the accuracy of the reported numbers by independent means. There are many approaches to verification of emission and removal estimates for the LULUCF sector, including comparison with other inventories and other independent datasets, applying higher tier methods, direct measurement, remote sensing and modelling. While emissions and/or removals that are not key can be selected for verification, any source/sink category that is key or expected to change significantly over the inventory reporting period should be given priority.

Table 3: Cross-cutting and general issues to consider during the review

Cross-cutting issue	Review issue
Uncertainty Assessment	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Uncertainties of the input data are specified based on empirical data, or if quantitative estimates of uncertainties are not available, expert judgment is applied. The Party should report specified uncertainties in a transparent manner. • Uncertainties are reported as a confidence interval, with the range within which the underlying value of an uncertain quantity is thought to lie for a specified probability. The GPG suggests the use of a 95% confidence interval. • Models applied in the inventory are validated and references to articles where tests of validity are reported are listed as references
Sampling	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Is the inventory or a part of it based on sample survey? How are those components of the inventory covered? Are the empirical data collected based on sound statistical sampling? • Is the entire forested area used as source population for sampling? Which parts (if any) are excluded? How about other land-use categories? • Is detection of land areas of each category and changes between them identified by sample survey? Is estimation based on direct estimation of area or estimation of proportions? (see Guidance on Sampling Methods for area estimation in GPG-LULUCF, Section 5.2.4, pp 5.24-5.25)
Key Category Analysis	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Has the Party provided the key category analyses in the CRF Table 7? Has the Party provided data on the key category analysis excluding and including LULUCF? (Note the special provisions for the submissions due in 2005.) • Has the Party provided information on the key categories and methodology used in the NIR (Section 1.5 and Annex 1) • Is the level of the key category analysis for the LULUCF Sector appropriate (if different from that in Table 5.4.1 in GPG-LULUCF, p. 5.31, is reasoning for the aggregation level used by the Party given)? • Are the methods used for the key categories in the LULUCF Sector appropriate? If Tier 1 methods are used, is reasoning for this given in the NIR? • Choose randomly some non-key categories for more thorough checks. Data from previous reviews provided by the secretariat could be used to facilitate the choice.
Time series consistency and recalculations	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Has the Party recalculated the LULUCF estimates for the whole time series or provided information on how to map the estimates for the inventory year to previous reporting using the categories in the

	<p>Chapter 5 of the Revised 1996 IPCC Guidelines?</p> <ul style="list-style-type: none"> • Are the CRF sheets for recalculation filled in an appropriate way? • Is information in Chapter 10 of the NIR transparent and are all relevant items included? • If the Party has used different methods for land-area estimation, has the time series consistency been addressed in the NIR? • Are the methods to estimate the emission/removals in the LULUCF Sector applied in a consistent way? Are approaches to obtain consistency in time series when methods and data availability has improved been applied according to the guidance in Section 5.6 in GPG-LULUCF?
Verification	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Does the inventory of the LULUCF sector document the data and assumptions used for estimating emissions and removals for all IPCC source/sink categories? • Have all important carbon pools been included in the inventory? • If some LULUCF emissions/removal categories have been omitted, does the report explain why? • Are emissions and removals reported as <i>positive</i> and <i>negative</i> terms, respectively? • For the total area of the inventory of the LULUCF sector, are the overall changes in land-use for the inventory year equal to zero within the confidence limits? • Are any discontinuities in trends from base year to end year evaluated and explained? <p>(The checks listed above are called for in GPG LULUCF and are considered essential. Ideally, these checks should have been conducted as part of QA/QC by the Party.)</p>
QA/QC	<p>When reviewing the inventory check:</p> <ul style="list-style-type: none"> • Has the Party provided information on QA/QC plan including verification in Section 1.6 of the NIR and addressed LULUCF specific QA/QC and verification in Chapter 7 of the NIR? • Has the Party provided a summary table on land-use and land-use change for QA/QC purposes? • Is the information provided transparent and sufficient? Are the QA/QC procedures and reporting on verification following the good practice guidance given in GPG-LULUCF?

Issues relating to inappropriate emission/removal factors or other parameters
<ul style="list-style-type: none"> • Comparison of emission factors and parameters used in earlier inventories may be helpful. Due to changes in the structure and inclusion of new pools in the reporting, this should be done with care when reviewing the inventory submissions in 2005. Only data based on the same category split and definitions can be used in the comparison. • The implied emissions factors (IEFs) in the CRF Tables (calculated automatically based on the activity data and emission/removal estimates provided by the Party) can be used to detect outliers (very high or low factors compared with default values given in the GPG-LULUCF and/or implied emission factors from Parties with similar climate and practices in managing the lands). • Many Parties have already programmes in place for national forest inventories, and instead of implementing new processes they may manipulate data to meet the requirements for reporting in the CRF tables. This may make comparison between Parties difficult, as the underlying data may be collected with different frequency and different level of detail. • An unusual value or outlier does not necessarily indicate an underlying problem. IEFs are in most cases based on aggregated activity data and emissions and therefore, do not necessarily correspond to the actual emission/removal factors used by the Party. However, the reasons for the unusual values or outliers should be explored. <ul style="list-style-type: none"> ○ Check the method and factors at a more disaggregated level, if possible. Ask the Party for more information, if needed. ○ The LULUCF sub-categories may vary much from Party to Party. Only categories with the same or similar descriptions should be compared. In comparing similar categories expert judgment on the differences is needed. ○ Check the definitions used by the Party. Do they differ from those in GPG-LULUCF or those used by other Parties in the reference group? ○ The conclusion on the appropriateness of the factors or parameters should be based on actual values used in the inventory preparation - not IEFs. If this is not possible due to lack of documentation or transparency, explain this fact in the review report. ○ Note that e.g. growth increments can vary much for the same species in different conditions (climate, soil type, etc.). In the case of commercial forests the amount of harvest may vary markedly from year to year due to socio-economic reasons. Also disturbances may cause abrupt changes in all categories.
Issues related to completeness in reporting
<ul style="list-style-type: none"> • Transparent reporting is a key issue. <ul style="list-style-type: none"> ○ Problems with transparency can sometimes be cleared by asking and receiving additional information from the Party. • Gaps in reporting - inadequate coverage of the land areas, inadequate coverage of pools <ul style="list-style-type: none"> ○ The reasons for the gaps should be explained in the documentation boxes in the CRFs and in the NIR. ○ Has the Party provided information how it will address the gaps in the future? ○ In reported land areas, check for overlaps in national land classification systems ○ National land classification systems often differ from those used in international datasets - the differences in the definitions may not always be obvious and comparisons may therefore be difficult • Omissions, overlaps or inconsistencies in reporting of emissions and removals in the LULUCF and Agriculture Sectors <ul style="list-style-type: none"> ○ Check that the relevant emissions are reported in the right place ○ Check that activity data common to both sectors is consistent

Table 4. Sectoral Report for Land Use, Land-use Change and Forestry (CRF Table 5)

Land Use Category	Total land-use categories
Definition	<p>Table 5 summarizes the net CO₂ emissions/removals, and emissions of the non-CO₂ greenhouse gases (CH₄, N₂O, CO and NO_x) for the LULUCF sector.</p> <p>CO₂ emissions/removals and emissions of direct non-CO₂ greenhouse gases (CH₄ and N₂O) as reported in CRF Table 5 are linked to information provided in:</p> <ul style="list-style-type: none"> • CRF Tables 5.A to 5.F Sectoral Background Data for Land Use, Land-Use Change and Forestry on carbon stock changes by pool in each land-use category • CRF Tables 5(I) to 5(III), and 5(V) Sectoral Background Data for Land Use, Land-Use Change and Forestry on non-CO₂ emissions from fertilization, drainage of soils, disturbance associated with land-use conversion to cropland, and biomass burning • CRF Table 5(IV) CO₂ emissions from agricultural lime application • In addition, estimates on harvested wood products and estimates of non-specified sources and sinks, as well as estimates on the indirect greenhouse gases CO and NO_x mentioned above, can be reported in the CRF Table 5.
Potential Key Issues	<ul style="list-style-type: none"> • The information should cover the whole time period from the base year to the latest inventory year. If a Party does not provide information in the new CRF tables for LULUCF for all years, and has not recalculated the estimates for LULUCF for these years, it should provide information on mapping categories provided to the categories (5.A to 5.E) in the Revised 1996 IPCC Guidelines. • In the CRF Table 5, emissions and removals from Forest Land and Grassland converted to other land categories are reported as information items and will not be added to the totals, because they are already included in the subcategories 5.A.2, 5.B.2, 5.C.2, 5.D.2 and 5.F.2 in Tables 5.A to 5.F. The net CO₂ emissions/removals can be obtained by summing the values for forest land and grassland converted to the other land-use categories as applicable. • The estimates on the non-CO₂ emissions can be obtained similarly from Tables 5(I) to 5(III), and 5(V), as applicable. • If Parties have provided only aggregated estimates for land conversions in the Sectoral Background Data tables, they may need to separately assess the emissions and removals for forest and grassland conversion. • Information on methods, data and parameters used should be provided in the NIR.
General References	<p>The methodologies for estimating the emissions and removals including general guidance on reporting and documentation for the LULUCF Sector are found in the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF). The GPG-LULUCF complements the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Good knowledge of the GPG-LULUCF is essential in the review of the LULUCF Sector.</p>

Table 5: Sectoral Background Data for LULUCF: Forest Land (CRF table 5.A)

Land Use Category	Forest Land remaining Forest Land/ Land Converted to Forest Land
GHG	CO₂
Definition	Forest land includes all land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory, sub-divided into managed and unmanaged, and also by ecosystem type as specified in the Revised 1996 IPCC Guidelines. It also includes systems with vegetation that currently fall below, but are expected to exceed, the threshold of the forest land category. Definitions at the national level should be applied consistently over time and cover all forest subject to periodic or ongoing human intervention, including the full range of management practices.
Potential Key Issues	<p>The reporting of carbon stock changes in the forest land is quite challenging, complicated and requires much data (activity data and parameters) as well as calculations. The possibilities for omissions, insufficient documentation and errors are many:</p> <ul style="list-style-type: none"> • Parties may not use the best available data in the inventories to avoid complicated calculations • the subcategories may be too rough • Parties may use detailed calculations but report only aggregated values • Parties using Tier 1 methods may choose inappropriate parameters from the GPG-LULUCF • the subcategories may not cover all climate zones and forest types • errors may have been made in the choice of default parameters • Parties may apply the equations erroneously • Parties using sophisticated models may not report the key assumptions and parameters transparently in the NIR • The quality of greenhouse gas inventories based on forest inventories may vary much as the quality of forest inventories varies much. • The uncertainty estimates provided by different Parties may not be comparable - some Parties may not be able to provide uncertainty estimates
General References	<p>Forest Land remaining Forest Land is covered under Section 3.2.1 in GPG LULUCF</p> <p>Land converted to Forest Land is covered under Section 3.2.2 in GPG LULUCF</p> <p>Worksheets for the module on Forest Land covered under Annex 3A.2 in GPG LULUCF</p> <p>The category Forest Land remaining Forest Land is linked to/covered under Category 5A of the IPCC Guidelines.</p> <p>Land from other land-use categories can be converted to forest land by afforestation and reforestation, either by natural or artificial regeneration (including plantations). These activities are covered under categories 5A, 5C, and 5D of the IPCC Guidelines.</p>

Detailed Review	Questions/Comments	Elaboration/Clarification
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Element		
Methodology	<p>The estimation of CO₂ emissions and removals from forest land and land converted to forest land comprise changes in carbon stock in:</p> <ul style="list-style-type: none"> • living biomass (Sections 3.2.1.1 & 3.2.2.1) • dead organic matter (Sections 3.2.1.2 & 3.2.2.2) and • soils (Sections 3.2.1.3 & 3.2.2.3) • Is the choice of method appropriate for the national circumstances? • Is estimation based on a national forest inventory (NFI) (Tier 2, Tier 3)? • Has proper documentation on the forest inventory methodology, coverage (complete coverage or only for a subset) and frequency been provided? • Is the sampling procedure appropriate? 	<p>The increases and decreases in the carbon stocks in living biomass should be reported separately except in cases, where due to the method it may be technically impossible to separate the information on increases and decreases.</p> <p>The Parties may use different methods for estimating the carbon stock changes and sometimes different terminology can be used to describe the same parameter, or the same term can have a national definition that is different from that used in the GPG-LULUCF. Information on the tier used should be provided in the NIR and the Summary Table 3 in the CRFs.</p>
	<ul style="list-style-type: none"> • Is the estimation based on higher tiers (Tier 2, Tier 3)? • Has proper documentation on the values been provided? • Are the national values within the range for similar conditions in other countries? If values are very different, does the documentation provided give reasoning and justification for this? 	<p>Higher tiers presume the use of national parameters.</p>
Changes in carbon stock in living biomass	<ul style="list-style-type: none"> • Are the increment estimates per area unit (growth rates) reasonable? Do they differ greatly from other countries in the region? Are the differences explained and justified in the NIR? • Are the losses very low compared to the increment (growth)? Are all losses covered? • Is the estimate of growing stock within the same magnitude as in earlier reports? • Are the losses (e.g. harvest, mortality, fuelwood gathering) taken into account? Are natural losses (wildfires, pest outbreaks, drought, etc.) included? 	
Changes in carbon stock in dead organic matter	<p>If a Party is reporting a sink or source for these pools, check:</p>	<p>It is likely that many Parties will report a "zero" for carbon stock changes in these pools. According</p>

(dead wood and litter)	<ul style="list-style-type: none"> • Has the Party provided transparent description of the methodology used? Is the methodology consistent with guidance in the GPG-LULUCF? • Are the values provided based on models or measurement? How have the models been verified and/or validated? • Are the parameters used in the estimates within the range of values given in the GPG-LULUCF or found in literature and other sources? Compare values with reporting by other Parties. 	<p>to GPG-LULUCF: “The <i>IPCC Guidelines</i> do not require estimation or reporting on dead wood or litter, on the assumption that the time average value of these pools will remain constant with inputs to dead matter pools balanced by outputs.”</p> <p>All assumptions and key parameters used in models should be transparently described in the NIR.</p> <p>If there is reporting of significant sinks for these pools, the estimates should be reviewed thoroughly.</p>
Changes in carbon stocks in soils	<ul style="list-style-type: none"> • If the Party is using the Tier 1 methods given in the GPG, check that the reporting is consistent with the GPG-LULUCF: • If Party is using higher tier methodologies, check if the Party provided transparent description of the methodology used? Is the methodology consistent with guidance in the GPG-LULUCF? • Are the values provided based on models or measurements? • Are the parameters used in the estimates within the range of values given in the GPG-LULUCF or found in literature and other sources? Compare values with reporting by other Parties. • How have the models been verified and/or validated? What kind of measurements are used or would be needed to verify the reported values? • Are uncertainties estimated? 	<p>Check that the Party has provided separate estimates for mineral soils and organic soils in this category.</p> <p>The Tier 1 methodology assumes the carbon stocks in mineral forest soils remains constant in forest land remaining forest land. Default reference values for organic carbon content of mineral forest soils under negative vegetation are given in Table 3.2.4, p.3.43 in GPG-LULUCF.</p> <p>Drained organic soils are a source of CO₂ emissions according to the default method in GPG-LULUCF. Default values are given in Table 3.2.3 on p. 3.42. The same default values apply both for forest land remaining forest land and lands converted to forest land.</p> <p>If Party reports significant sinks for soil organic matter, estimates should be reviewed thoroughly.</p>
Removal/Emission Factors	Default values vs. country-specific values	<p>The GPG LULUCF gives default values for the parameters needed in estimating the carbon stock changes for forest land in Annex 3A.1. These tables can be used to compare the parameters used by Parties in their submissions. Use of country-specific values is encouraged. The source of the emission factors and other parameters should be given. Country-specific values should be</p>

		well-documented: the reference and information how the factor was derived, comparison to other published factors (significant differences should be explained) as well as an uncertainty estimate should be given.
Activity Data	<p>All tiers require information on areas of managed forest land.</p> <p>Forest areas should be reported separately for forest land remaining forest land and land converted into forest land. National circumstances will affect further subdivision.</p> <ul style="list-style-type: none"> When reviewing data on forest land areas, check that the subcategories are appropriate and correspond to the national circumstances. Subcategories are linked to the use of emissions factors and parameters in the preparing estimates on carbon stock changes. <p>Typical subcategories are based on climate zones, forest type, tree species, etc. Descriptions on subcategories used in preparing the estimates should be given in the NIR.</p> <ul style="list-style-type: none"> Check that the sum of areas of the subcategories corresponds with the total area of the Party, if data on all land categories is provided Does the reported forest area match with other sources? 	<p>Guidance on area estimates is given in Chapter 2 of the GPG LULUCF. Proper inventory and sampling methods should be used.</p> <p>Values provided by the Party can be compared with values in international databases and reports, for example: UNECE TBFRA 2000, FAO FRA 2000, and the State of Europe's Forests 2003 by MCPFE.</p> <p>Due to differences in the national definitions and FAO definition for forest area, these estimates will most likely be different.</p> <p>Lands converted to forest land are followed in conversion status for 20 years (default value specified by the IPCC Guidelines). Tier 3 methods may use longer periods where appropriate to national circumstances.</p>
Completeness	<p>Check completeness of the data in the CRF Table 5.A on carbon stock changes in Forest land</p> <ul style="list-style-type: none"> Are estimates provided separately for forest land remaining forest land and land converted to forest land? Are estimates provided for land converted to forest land according to land-use category or only to the total value of land converted to forest land? 	<p>In the latter case, the Party should provide information on which type of conversions are included in the documentation box in Table 5.A.</p>
	<ul style="list-style-type: none"> Are estimates provided for all pools? Are estimates provided separately for increases and decreases for the living biomass pool? 	<p>If not, reasoning for this should be provided in the documentation box or in the NIR.</p>
Consistency/	<ul style="list-style-type: none"> Is the estimate of growing stock 	Activity data may only be

Recalculations/ Time series consistency	<p>within the same magnitude as in earlier reports?</p> <ul style="list-style-type: none"> • Are the values for the increment within the same range for the period from 1990 to the inventory year, or is there a trend with it? • Is the trend explained in the NIR? 	available every few years. Hence achieving time series consistency may require interpolation and extrapolation from longer time series or trends.
Uncertainty	Have the uncertainties at all levels of estimation been estimated and reported?	
Reporting and documentation	<ul style="list-style-type: none"> • Did Party archive and document all data and information (such as figures, statistics, sources of assumptions, modelling approaches, uncertainty analyses, validation studies, inventory methods, research experiments and field site studies, analysis of emissions, etc.) applied to produce the national emissions/removals inventory? • Were definitions on pools and extent of managed lands applied consistently over time? • Is the documentation provided transparent to allow assessment of the accuracy of the estimates? 	Documentation is needed to demonstrate completeness and consistency of time series data. Additional documentation is needed when Parties use more advanced and accurate methodologies, country-defined parameters and high resolution data sets and maps, which are not described in the IPCC Guidelines. The inventory should include summaries of approaches and methods used, references to source of data such that reported emissions estimates are transparent and calculation steps may be retraced.

Table 6: Sectoral Background Data for LULUCF - Cropland (CRF Table 5.B)

Land Use Category	5.B Cropland remaining Cropland/Land converted to Cropland
GHG	CO₂
Definition	<p>Cropland includes all annual and perennial crops as well as temporary fallow land (i.e. land set at rest for one to several years before cultivation again). Arable land which is normally used for cultivation of annual crops but temporarily cultivated with forage crops or used for grazing as part of an annual crop-pasture rotation is included under cropland. Cropland is an important category for all Annex I Parties.</p> <p>Land converted to cropland includes all conversion of land from other uses and from natural states to cropland.</p>
Potential Key Issues	<p>Many Parties are in the process of developing their inventory methodologies for the cropland category. Previous reporting, has therefore, in many cases been incomplete and/or the methods used earlier may have been rough. This situation is expected to improve in the coming years due to the improved guidance and data from ongoing research programmes in the field. Non-reporting or incomplete reporting of the emissions and removals in this category may still occur.</p> <p>Many Parties are developing models for the estimation of the emissions and removals in this category. The assumptions and parameters in models should be described transparently in the NIR. Any significant deviation in the parameters used from the default in the GPG LULUCF and regional research should be explained.</p> <p>The non-CO₂ emissions from management of cropland and grassland (fertilization, rice cultivation, cultivation of organic soils, emissions from grazing animals, biomass burning on-site and off-site for cropland as well as savannah burning) are reported in the Agriculture Sector.</p>
General References	<p>Cropland remaining Cropland is covered under Section 3.3.1 in GPG LULUCF</p> <p>Land converted to Cropland is covered under Section 3.3.2 in GPG LULUCF</p> <p>Worksheets for the module on Cropland covered under Annex 3A.2 in GPG LULUCF</p> <p>The category Cropland remaining Cropland is linked to/covered under Categories 5A and 5D of the IPCC Guidelines.</p> <p>Land from other land-use categories can be converted to cropland. Conversion of forest land and grassland to cropland are covered under Categories 5B and 5D of the IPCC Guidelines. Conversion of wetlands, settlements and other lands to cropland are covered by Category 5D of the IPCC Guidelines.</p>

Land Use Category	Cropland remaining Cropland/ Land converted to Cropland	
Detailed Review Element	Questions/Comments	Elaboration/ Clarification
Methodology	<ul style="list-style-type: none"> Is the estimation based on the IPCC default methodologies (Tier 1)? Has the country used IPCC default parameters in preparing the estimates? Is the estimation based on higher tiers (Tier 2, Tier 3)? Higher tiers presume the use of national parameters. Has proper documentation on the values been provided? Is the category a key category? Is the choice of method appropriate for the national circumstances (assess data and resources available)? Check that the choice is consistent with the information provided for the category, the climate zone and other relevant factors? Are models used? Are the model assumptions (principles, equations, etc.) described and key parameters used in the model given in the NIR? 	<p>The estimation of CO₂ emissions and removals from cropland and land converted to cropland comprise changes in carbon stocks in:</p> <ul style="list-style-type: none"> living biomass (Sections 3.3.1.1 & 3.3.2.1) soils (Sections 3.3.1.2 & 3.3.2.2) <p>The changes in living biomass are estimated and reported only for perennial woody biomass (for Tier 1)</p> <p>Default values for changes in living biomass in croplands are given in Table 3.3.2 in GPG-LULUCF, p. 3.71.</p> <p>Reporting of carbon stock changes in dead organic matter is optional (changes in this pool are likely to be small).</p> <p>The carbon stock changes in soils in this category are likely to be more significant than changes in the other carbon pools.</p>
Activity Data	<ul style="list-style-type: none"> Are areas reported separately for land remaining in the respective categories and land converted into the categories? National circumstance will affect further subdivision. Were proper inventory and sampling methods used? Sub-categories may include data on climate zones in the country, soil types, crop types, management practices and other activities. These are by rule also provided by area or as percentages/ fractions of the area. Are descriptions on subcategories used in preparing the estimates given in the NIR? Data is needed for a 20-year period (minimum) for estimation of the carbon stock changes in mineral soils. 	<p>Soil characteristics, crop types and management practices are important activity data for the estimation of the emissions/removals in the category.</p> <p>Soils are divided to mineral soil and organic soils.</p> <p>Data on management practices can be scarce in many countries and is often not available by area. Some parties may have point-based land use and management inventories making up a statistically-based sample of land area.</p> <p>Parties that report significant emissions or removals for the category using very rough data should be encouraged to improve their estimates by giving priority to improving the activity data collection.</p>

	<ul style="list-style-type: none"> All countries may not have good statistical data on the areas of organic soils drained for cultivation. Check consistency of the activity data in reporting of the CO₂ emissions (reported in the LULUCF Sector) and N₂O emissions (reported in the Agriculture Sector) for cultivation of organic soils. Were uncertainties of the land area estimates estimated and reported? 	
Emission factors and other parameters	<ul style="list-style-type: none"> Use of country-specific values is encouraged. Are the experiments well-designed with adequate sampling in developing country-specific values? Are the national values within the range for similar conditions in other countries in the region? If values are very different, does the documentation provided give reasoning and justification for this? Have the uncertainties been estimated and reported? 	<p>The GPG LULUCF gives default values for the parameters needed in estimating the carbon stock changes in Cropland. The default values can be used to compare the parameters used by Parties in their submissions.</p> <p>Country-specific values should be well-documented: the reference and information how the factor was derived, comparison to other published factors in the region (significant differences should be explained) should be given.</p>
Completeness	<p>Check completeness of the data in the CRF Table 5.B on carbon stock changes.</p> <ul style="list-style-type: none"> Are estimates provided for carbon stock changes in living biomass and soil organic carbon? Are separate estimates provided for land conversions to the category? 	<p>Note that the Tier 1 method for cropland covers only aboveground perennial woody biomass</p> <p>Note that the methodology to estimate carbon stock changes in soil organic carbon due to both management changes and land-use changes is based on 20-year averages (default time period, can also be longer).</p>
	<ul style="list-style-type: none"> Are estimates for land converted to cropland provided by land-use category or only the total value of land converted to the category? Are estimates provided separately for increases and decreases for the living biomass pool? 	<p>In the latter case, the Party should provide information on which type of conversions are included in the documentation box in Table 5.B.</p> <p>If not, the description of the method in the NIR should provide information why this is not possible.</p>
Consistency/Recalculation/Time series	<ul style="list-style-type: none"> Have the methodology and definitions been the same throughout the time series? Are the estimates of the emissions/ removals within the same magnitude as in earlier reports? 	

	<ul style="list-style-type: none"> Are the values for the parameters within the same range for the period from 1990 to the inventory year, or is there a trend with it? Is the trend explained in the NIR? 	
Uncertainty	Have the uncertainties at all levels of estimation been estimated and reported?	The uncertainties in the estimates for carbon stock changes especially for soil organic carbon in mineral soils can be significant. The availability and development of area-specific activity data on the management and land-use changes is important for the provision of accurate estimates.
Reporting and documentation	<p>The following should be transparently reported and documented by the Party:</p> <ul style="list-style-type: none"> metadata and data sources for information used to estimate country-specific factors; activity data and definitions used to categorise or aggregate the activity data procedures used to categorise activity data by climate and soil types (Tiers 1 & 2) For Tier 3, model version and identification. It is possible for the total cropland area for which estimates were prepared to be less than the total area of cropland within the country boundaries. Did the Party document and explain difference in cropland area in the inventory and total cropland within their boundaries? 	

Table 7: Sectoral Background Data for LULUCF - Grassland (CRF Table 5.C)

Land Use Category	5.C Grassland remaining Grassland/Land converted to Grassland
GHG	CO₂
Definition	Grassland includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the thresholds used in the forest land category and are not expected to exceed, without human intervention, the thresholds used in the forest land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastoral systems, subdivided into managed and unmanaged consistent with national definitions.
Potential Key Issues	<p>Carbon stocks in permanent grassland are influenced by human activities and natural disturbances, including harvesting of woody biomass, rangeland degradation, grazing, fires, rehabilitation and pasture management. Due to rapid turnover and removals through grazing and fire, standing stock of aboveground biomass (dominated by perennial grasses) rarely exceeds a few tones per hectare. Belowground carbon dominates in grassland, mainly in roots and soil organic matter.</p> <p>Many Parties are in the process of developing their inventory methodologies for the grassland category. Previous reporting, has therefore, in many cases been incomplete and/or the methods used earlier may have been rough. This situation is expected to improve in the coming years due to the improved guidance and data from ongoing research programmes in the field.</p> <p>Non-reporting or incomplete reporting of the emissions and removals in this category may still occur.</p> <p>Many Parties are developing models for the estimation of the emissions and removals in this category. The assumptions and parameters in models should be described transparently in the NIR. Any significant deviation in the parameters used from the default in the GPG LULUCF and regional research should be explained.</p>
General References	<p>Grassland remaining Grassland is covered under Section 3.4.1 in GPG LULUCF</p> <p>Land converted to Cropland is covered under Section 3.4.2 in GPG LULUCF</p> <p>Worksheets for the module on Grassland covered under Annex 3A.2 in GPG LULUCF</p> <p>The category Grassland remaining Grassland is linked to/covered under Categories 5A and 5D of the IPCC Guidelines.</p> <p>Land from other land-use categories can be converted to grassland. Conversion of forest land to grassland are covered under Categories 5B and 5D of the IPCC Guidelines. Conversion of cropland, wetlands, settlements and other lands to cropland are covered by Categories 5C and 5D of the IPCC Guidelines.</p>

Land Use Category	Grassland remaining Grassland/ Land converted to Grassland	
Detailed Review Element	Questions/Comments	Elaboration/ Clarification
Methodology	<p>The methodologies to estimate the emissions and removals for grassland are basically the same as cropland.</p> <ul style="list-style-type: none"> Is the estimation based on the IPCC default methodologies (Tier 1)? Has the country used IPCC default parameters in preparing the estimates? Is the estimation based on higher tiers (Tier 2, Tier 3)? Higher tiers presume the use of national parameters. Has proper documentation on the values been provided? Is the category a key category? Is the choice of method appropriate for the national circumstances (assess data and resources available)? Check that the choice is consistent with the information provided for the category, the climate zone and other relevant factors? Are models used? Are the model assumptions (principles, equations, etc.) described and key parameters used in the model given in the NIR? 	<p>The estimation of CO₂ emissions and removals from grassland and land converted to grassland comprise changes in carbon stocks in:</p> <ul style="list-style-type: none"> living biomass (Sections 3.4.1.1 & 3.4.2.1) soils (Sections 3.4.1.2 & 3.4.2.2) <p>Tier 1 method assumes that there is no change in carbon stocks for the living biomass pool.</p> <p>Reporting of carbon stock changes in dead organic matter is optional (changes in this pool are likely to be small). There is currently insufficient information for a basic approach with default parameters to estimate carbon stock changes in dead organic matter.</p>
Activity Data	<ul style="list-style-type: none"> Are areas reported separately for land remaining in the respective categories and land converted into the categories? National circumstance will affect further subdivision. Were proper inventory and sampling methods used? Sub-categories may include data on climate zones in the country, soil types, crop types, management practices and other activities. These are by rule also provided by area or as percentages/ fractions of the area. Are descriptions on subcategories used in preparing the estimates given in the NIR? 	<p>Soil characteristics, vegetation composition and density and management practices are important activity data for the estimation of the emissions/removals in the category. Soils are divided to mineral soil and organic soils.</p> <p>Data on management practices can be scarce in many countries and is often not available by area. Some Parties may have point-based land use and management inventories making up a statistically-based sample of land area.</p> <p>Parties that report significant emissions or removals for the category using very rough data should be encouraged to improve</p>

	<ul style="list-style-type: none"> Data is needed for a 20-year period (minimum) for estimation of the carbon stock changes in mineral soils. 	their estimates by giving priority to improving the activity data collection.
Emission factors and other parameters	<ul style="list-style-type: none"> Use of country-specific values is encouraged. Are the experiments well-designed with adequate sampling in developing country-specific values? Are the national values within the range for similar conditions in other countries in the region? If values are very different, does the documentation provided give reasoning and justification for this? Have the uncertainties been estimated and reported? 	<p>The GPG-LULUCF gives default values for the parameters needed in estimating the carbon stock changes in Grassland. The default values can be used to compare the parameters used by Parties in their submissions.</p> <p>Country-specific values should be well-documented: the reference and information how the factor was derived, comparison to other published factors in the region (significant differences should be explained) should be given.</p>
Completeness	<p>Check completeness of the data in the CRF Table 5.C on carbon stock changes.</p> <ul style="list-style-type: none"> Are estimates provided for carbon stock changes in living biomass and soil organic carbon? Are estimates provided separately for increases and decreases for the living biomass pool? Are separate estimates provided for land conversions to the categories? 	<p>Note that the Tier 1 method for grassland assumes no change in carbon stocks for living biomass.</p> <p>Note that the methodology to estimate carbon stock changes in soil organic carbon due to both management changes and land-use changes is based on 20-year averages (default time period, can also be longer).</p>
	<ul style="list-style-type: none"> Are estimates for land converted to grassland provided by land-use category or only the total value of land converted to the category? 	<p>In the latter case, the Party should provide information on which type of conversions are included in the documentation box in Table 5.C.</p> <p>If not, the description of the method in the NIR should provide information why this is not possible</p>
Consistency/Recalculation/Time series	<ul style="list-style-type: none"> Have the methodology and definitions been the same throughout the time series? Are the estimates of the emissions/ removals within the same magnitude as in earlier reports? Are the values for the parameters within the same range for the period from 1990 to the inventory year, or is there a trend with it? Is the trend explained in the NIR? 	

Uncertainty	Have the uncertainties at all levels of estimation been estimated and reported?	The uncertainties in the estimates for carbon stock changes especially for soil organic carbon in mineral soils can be significant. The availability and development of area-specific activity data on the management and land-use changes is important for the provision of accurate estimates.
Reporting and documentation	<p>The following should be transparently reported and documented by the Party:</p> <ul style="list-style-type: none"> • metadata and data sources for information used to estimate country-specific factors; • activity data and definitions used to categorize or aggregate the activity data • procedures used to categorize activity data by climate and soil types (Tiers 1 & 2) • For Tier 3, model version and identification. 	

Table 8: Sectoral Background Data for LULUCF - Wetlands (CRF Table 5.D)

Land Use Category	5.D Wetlands remaining Wetlands/Land converted to Wetlands
GHG	CO₂
Definition	Wetlands include land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. The category can be subdivided into managed and unmanaged according to national definitions. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.
Potential Key Issues	<p>The methodologies for the category wetlands remaining wetlands are provided in the Appendix 3a.3 of the GPG LULUCF. Parties do not have to provide estimates for categories for which the methodologies are described in the appendices of the GPG LULUCF.</p> <p>The reporting of emissions and removals for this category is required only for land conversion to wetlands, mainly to complete the reporting of forest and grassland conversion to other land categories. Land conversions from other land-use categories to wetlands are most likely when land is flooded to establish large reservoirs e.g. hydroelectric dams.</p> <p>The conversion of lands to wetlands may be an important component of national estimates of deforestation (or other nationally important land use conversions).</p> <p>For conversions related to peat extraction, the GPG LULUCF addresses carbon stock changes associated with living biomass and soil. For conversions related to flooding, the GPG-LULUCF addresses only the carbon stock change associated with the loss of living biomass.</p> <p>The importance of this category may vary much from Party to Party.</p>
General References	<p>Wetlands remaining Wetlands is covered under Appendix 3a.3 in GPG LULUCF</p> <p>Land converted to Wetlands is covered under Section 3.5.2 in GPG LULUCF</p> <p>Worksheets for the module on Wetlands covered under Annex 3A.2 in GPG LULUCF</p> <p>The category Wetlands remaining Wetlands is linked to/covered under Categories 5A and 5E of the IPCC Guidelines.</p> <p>Land from other land-use categories can be converted to Wetlands. Conversion of Forest Land and Grassland to Wetlands are covered under Categories 5B of the IPCC Guidelines. Conversion of Cropland, Settlements and Other Lands to Wetlands are covered by Category 5E of the IPCC Guidelines.</p>

Land Use Category	Wetlands remaining Wetlands/ Land converted to Wetlands	
Detailed Review Element	Questions/Comments	Elaboration/ Clarification
Methodology	<ul style="list-style-type: none"> Is the estimation based on the IPCC default methodologies (Tier 1)? Is the category a key category? <ul style="list-style-type: none"> Is the choice of method appropriate for the national circumstances (assess data and resources available)? Has the country used IPCC default parameters in preparing the estimates? <ul style="list-style-type: none"> Check that the choice is consistent with the information provided on climate zones and wetland type (e.g. for peat extraction nutrient rich or nutrient poor wetlands) in the country? Could country-specific values be developed based on national or regional data and research? Has the country used some national parameters in the calculations to complement the IPCC default values? <ul style="list-style-type: none"> Has proper documentation on the values been provided? Are the national values within the range for similar conditions in other countries? If values are very different, does the documentation provided give reasoning for this? Is the estimation based on higher tiers (Tier 2, Tier 3)? <ul style="list-style-type: none"> Is the choice of method appropriate for the national circumstances? Higher tiers presume the use of national parameters. If models are used, have the underlying assumptions and parameters been described transparently and validated appropriately? 	<p>The Tier 1 methodologies given in the GPG-LULUCF are rough and Parties for which the category is significant (a key category) are likely to develop higher tier methodologies for preparing the estimates. The data on carbon stock changes in the category in scientific literature is still scarce, and ranges for estimates on emissions and removals can be large. Inclusion of the non-CO₂ greenhouse gases for the category will further complicate the situation. Information of the tier used should be provided in the NIR.</p> <p>The Appendix 3a.3 gives methodologies for estimation of carbon stock changes on land managed for peat extraction (living biomass and soils) and emissions of CO₂ and other greenhouse gases from flooded land remaining flooded land. Tier 1 assumes that change in carbon stocks in living biomass on managed peatland is zero.</p> <p>Parties for which peat extraction and/or flooded land is an important category, are encouraged to develop country-specific data to improve the accuracy of the estimates and which correspond to local circumstances.</p>
Activity Data	<ul style="list-style-type: none"> When reviewing data on areas 	Sources of area information for peat

	<p>of land converted to wetlands check that the subcategories used are appropriate and correspond to the national circumstances.</p> <ul style="list-style-type: none"> • Descriptions on subcategories used in preparing the estimates should be given in the NIR. 	<p>extraction include national statistics, peat mining industries or agencies/ ministries responsible for land use, or estimated from the peat production data.</p> <p>Flooded land area can be obtained from national agencies/ministries responsible for land use, or from hydro electric companies. Data on the total flooded area may be easier to obtain than the area of flooded land (the former includes the flooded lake or river surface areas).</p>
Emission factors and other parameters	<ul style="list-style-type: none"> • Use of country-specific values is encouraged. The source of the emission factors and other parameters should be given. • Country-specific values should be well-documented: the reference and information how the factor was derived, comparison to other published factors (significant differences should be explained) as well as uncertainty estimates should be given. • In cases where a Party reports emissions or removals that are very different from the defaults given in the GPG-LULUCF, the reviewer may need to contact a wetland expert to assess the accuracy of the estimates. 	<p>The GPG-LULUCF gives default values for the parameters needed in estimating the carbon stock changes for land converted to peat extraction land in Table 3.5.2, p. 3.138.</p> <p>Default values for estimation of carbon stock changes in land converted to flooded land will depend on type of conversion and can be found e.g. in the Annex 3A.1.</p> <p>These tables can be used to compare the parameters used by Parties in their submissions.</p>
Completeness	Check completeness of the data in the CRF Table 5.D on carbon stock changes in land converted to wetland	
	<ul style="list-style-type: none"> • Are estimates for land converted to wetlands provided by land-use category or is only the total value of land converted to wetlands given? 	<p>In the latter case, the Party should provide information on which type of conversions are included in the documentation box in Table 5.D</p>

	<ul style="list-style-type: none"> Are estimates for carbon stock changes in living biomass for land converted to flooded land and estimates for carbon stock changes in living biomass and soil organic matter in peat extraction lands provided? <ul style="list-style-type: none"> If not, reasoning for this should be provided in the documentation box in CRF Table 5.D or in the NIR <u>NOTE</u> that these sources do not occur for all Parties 	
Consistency/Recalculation/Time series consistency	<p>Are significant fluctuations in emissions between years explained? If country-specific data are used, was the same measurement protocol used over time? If over time, not the same method or measurement protocol was used, was a recalculation done?</p> <p>Consistency checks are needed if area of organic soils converted to peat extraction are interpolated for longer time series or trends.</p>	If different emission factors, parameters and methods are used for different years, the reasons for this should be explained.
Uncertainty	Have the uncertainties at all levels of estimation been estimated and reported?	For the estimation of emissions from land conversions to peat, the principal uncertainties are related to area estimates and emission factors.
Reporting and documentation	<ul style="list-style-type: none"> Is the documentation provided transparent to allow assessment of the accuracy of the estimates? The scientific basis of new emission factors, parameters and models should be completely described and documented. Description of the processes and sources of uncertainties should also be provided. Documentation of activity data should cover frequency of data collection, sources plus communication with companies dealing with peat extraction and reasons for significant changes in emission levels. 	

Table 9: Sectoral Background Data for LULUCF - Settlements (CRF Table 5.E)

Land Use Category	5.E Settlements remaining Settlements/Land converted to Settlements
GHG	CO₂
Definition	Settlements include all developed land, transportation infrastructure and human settlements of any size, unless they are already included under other land-use categories. The focus of settlements is on the terrestrial components of developed land that are managed and may influence CO ₂ fluxes between the atmosphere and terrestrial carbon pools. In this context, Settlements include all classes of urban tree formations, namely; trees grown along streets, in public and private gardens and in different kinds of parks, provided such trees are functionally or administratively associated to cities and villages.
Potential Key Issues	Change in carbon stocks and non-CO ₂ greenhouse gas emissions would not need to be evaluated for the category "Settlements remaining Settlements", these emissions/removals should however be reported for "Land converted to Settlements." The contribution of the latter category to the emissions/removals caused by deforestation (or other nationally important land conversions) may be important for some Parties.
General References	Settlements remaining Settlements is covered under Appendix 3a.4 in GPG LULUCF Land converted to Settlements is covered under Section 3.6.2 in GPG LULUCF Worksheets for the module on Settlements covered under Annex 3A.2 in GPG LULUCF The category Settlements remaining Settlements is linked to/covered under Category 5A of the IPCC Guidelines. Land from other land-use categories can be converted to settlements. Conversion of forest land and grassland to settlements are covered under Category 5B of the IPCC Guidelines. Conversion of cropland, wetlands, and other lands to settlements are covered by Category 5E of the IPCC Guidelines.

Land Use Category	Settlements remaining Settlements/	Land converted to Settlements
Detailed Review Element	Questions/Comments	Elaboration/ Clarification
Methodology	Appendix 3a.4 in GPG LULUCF presents a basic method for estimating emissions and removals of carbon by trees in settlements. Parties do not have to prepare estimates for the categories addressed in the appendix. Reporting emissions/ removals of land converted to Settlements is needed for complete reporting of forest land converted to the other land-use categories. This information can also be reported separately for all forest land converted to the other land-use categories in CRF Table 5 (Information item) in case when only aggregate information land conversions to settlements is provided in CRF Table 5.E.	The GPG-LULUCF gives a Tier 1 methodology for estimation of carbon stock changes in living biomass and soils for land converted to Settlements. The default values should be chosen based on the type of conversion. Higher tier methodologies could encompass all carbon pools and non-CO ₂ emissions associated with the conversion. Refer to sections on other land conversions (e.g. land converted to forestland) and estimation of carbon stock changes in living biomass in these categories for further guidance.
Activity Data	<ul style="list-style-type: none"> Is the sampling procedure appropriate? (in determining number of trees or interpretation of areas of tree crown cover from aerial photographs) 	
Emission factors and other parameters	<ul style="list-style-type: none"> If higher tiers were used, were the removal factors developed appropriate for the national circumstances? Are country-specific removal rates based on dominant climate zones and tree species of settlements areas in the country? 	
Completeness	Check for completeness if the Party has provided estimates in CRF Table 5.E on land areas for the category and estimates on carbon stock changes for Land Converted to Settlements.	The completeness of emissions and removals from settlements requires the inclusion of all settlements in a country or at least those above some definite threshold size, and estimates of all greenhouse gases relevant to settlements.
Consistency/Recalculation/Time series	Is the Party making an effort to develop a regular inventory of settlements trees	
Uncertainty	Have the uncertainties at all levels of estimation been estimated and reported?	The two primary sources of uncertainties are in removal factors (crown cover area-based growth rate and annual carbon accumulation per tree for Tier 1 a & b respectively) and activity data

		(area estimates or tree numbers).
Reporting and documentation	<ul style="list-style-type: none"> • Is the national system to prepare the estimates robust? • Is the documentation provided transparent to allow assessment of the accuracy of the estimates? 	

Table 10: Sectoral Background Data for LULUCF - Other Land (CRF Table 5.F)

Land Use Category		5.F Other Land remaining Other Land/Land converted to Other Land
GHG		CO₂
Definition		Other Land includes bare soil, rock, ice and all unmanaged land areas that do not fall under any of the other five land-use categories in CRF Tables 5a-5E. This land-use category is included to allow the total of identified land areas to match the national area. It allows the checking of overall consistency of land area and tracking conversions to and from other land since many methods require knowledge of associated carbon stocks.
Potential Key Issues		At present, the GPG LULUCF does not give any guidance on Other Land that is managed. Reporting emissions/removals of Land converted to Other Land is needed for complete reporting of forest land and grassland converted to the other land-use categories. Conversion of other managed land-use categories to Other Land, either through a human activity or natural event, requires the calculation of emissions of CO ₂ because the act of conversion releases carbon previously held on the land and emissions and/or removals due to management activities cease. This category is likely of minor importance for most Parties.
General References		Land converted to Other Land is covered under Section 3.7.2 in GPG LULUCF Worksheets for the module on Other Land covered under Annex 3A.2 in GPG LULUCF The category Other Land remaining Other Land is linked to/covered under Category 5A of the IPCC Guidelines. Land from other land-use categories can be converted to other land. Conversion of forest land and grassland to other land are covered under Category 5B of the IPCC Guidelines. Conversion of cropland, wetlands, and settlements to other land are covered by Category 5E of the IPCC Guidelines.
Land Use Category	Other Land remaining Other Land/ Land converted to Other Land	
Detailed Review Element	Questions/Comments	Elaboration/ Clarification
Methodology	The GPG-LULUCF gives a Tier 1 methodology for estimation of carbon stock changes in living biomass and soil organic matter for land converted to Other Land. The Tier 1 method assumes that all biomass is removed in the year of the conversion and that the carbon in the biomass is released to the atmosphere either on-site or off-	

	<p>site.</p> <p>The conversion of land to "Other Land", especially to bare soils, could result in release of carbon previously held in the soil on the land.</p> <p>The default values should be chosen based on the type of conversion.</p> <p>Higher tier methodologies could encompass all carbon pools and non-CO₂ emissions associated with the conversion.</p>	
Activity Data	<p>Were the same aggregate area estimates used for both biomass and soil in the calculations of change in carbon stocks on land converted to other land?</p> <p>Were area estimates of land-use conversions to Other Land stratified according to major soil types for estimation of soil carbon stock changes using a Tier 1 method?</p> <p>If Tier 2 or 3 used, were area estimates stratified based on country-specific stratifications (overlays with suitable soil maps and spatially-explicit data of the location of land conversion)?</p>	All tiers require some estimate of the area of land converted to other land over a time period that is consistent with land-use surveys.
Emission factors and other parameters	If Party is using Tier 2 or 3 methods, are parameters country-specific? Tier 2 can use some default carbon stock values but require some country-specific information.	Default parameters for the estimation of carbon stocks before conversion (Tier 1) can be found in Tables 3.A.1.7 and 3.A.1.8 (forest land) and Sections 3.3.2 and 3.4.2 (cropland, grassland).
Completeness	<p>Check if the Party has provided estimates in CRF Table 5.F on land areas and estimates on carbon stock changes for living biomass and soil organic carbon for Land Converted to Other Land.</p> <p>If such estimates have not been provided, check information provided in the documentation box in CRF Table 5.F and possible additional information provided in the NIR</p>	
Consistency/Recalculation/Time series	Do country records track the total area classified as Other Land in the inventory?	
Uncertainty	Higher degrees of uncertainties result from the use of global or national average rates of conversion	

	and coarse estimates of land areas converted to Other Land. Default parameters for carbon stocks also contribute to relatively high degrees of uncertainty.	
Reporting and documentation	<ul style="list-style-type: none"> • Is the documentation provided transparent to allow assessment of the accuracy of the estimates? • Are the following documented by the Party: <ul style="list-style-type: none"> ○ metadata and data sources for information used to estimate country-specific parameters; ○ activity data and definitions used to categorise or aggregate the activity data; 	Information on forest land and grassland converted to other land can be reported in Table 5 (Information items) in the case when only aggregate information on land conversions to other land is provided in CRF Table 5.F.

Reporting of carbon emissions and non-CO₂ emissions from land use management activities

36. Carbon emissions and non-CO₂ emissions from land use activities or management practices are reported in CRF tables 5(I) - 5(V). Carbon emissions from agricultural lime application for cropland, grassland and Other are reported in CRF Sectoral background data table 5(IV). The reporting of non-CO₂ emissions in the LULUCF Sector, mainly related to the Forest land and Wetlands categories, are reported in CRF Sectoral background data tables 5(I), 5(II), 5(III) and 5(V).

37. The LULUCF Sector has links to the Agriculture Sector. It is important to note that non-CO₂ emissions from agricultural soils (N fertilization, cultivation of organic soils, burning of agricultural residues as well as savannah burning) are reported in the Agriculture sector. However, the carbon stock changes in agricultural soils and CO₂ emissions due to liming are reported in the LULUCF Sector.

38. For most Parties, the importance of the non-CO₂ greenhouse gas emissions in the LULUCF inventory is smaller than the importance of the carbon stock changes. Not all Parties fertilize forests or have drained forest land or wetlands. The contribution of non-CO₂ emissions in the LULUCF Sector to the total inventory can be very different for different Parties.

39. Non-CO₂ emissions can be reported by area (like N₂O emissions from drainage of soils) or based on activity data independent of land areas (like fertilization of forest soils where the emissions are calculated based on the total amount of nitrogen in the fertilizer applied).

40. For the checking and review of these land activity/management practices categories, to ensure completeness of the information provided, consistency in time series, completeness in reporting and documentation, QA/QC, the review guidance provided for CO₂ emissions from the land use categories apply likewise here for these categories.

Table 11: Direct N₂O emissions from N fertilization (CRF Table 5(I))

Land Use Category	Forest land remaining Forest Land/Land converted to Forest Land/Other	
GHG	N ₂ O	
Description	This CRF table considers direct N ₂ O emissions from forest soils. N ₂ O emissions from managed forests are calculated on the basis of mineral and organic nitrogen inputs in forest soils.	
Potential Key Issues	Some countries have separate data for fertilization of forests from fertilization of agricultural soils. However, many countries may only have national fertilizer sales statistics. Countries can determine the amount of synthetic nitrogen fertilizer applied in forest by subtracting the amount of fertilizer used for agriculture from the national total nitrogen fertilizer applied. N ₂ O emissions from nitrogen fertilization of cropland and grassland are reported in the Agriculture sector. Indirect N ₂ O emissions from N deposition, runoff and leaching are also addressed in the Agriculture sector. It is assumed that leaching and run-off from fertilized forests is negligible. In addition, N ₂ O emissions from manure deposited by animals grazing in forest areas are reported in the Agricultural sector.	
General References	Section 3.2.1.4 on non-CO ₂ GHG emissions in GPG LULUCF Chapter 4 Agriculture of the IPCC Guidelines	
Detailed Review Element	Questions/Comments	Elaboration/Clarification
Methodology/ Activity Data/Emission Factors	If the Party is not able to separate the fertilizer applied to forest land from that applied to agriculture, it may report all N ₂ O emissions from	The method used to estimate N ₂ O emissions from forest soils is identical to that provided in the IPCC Guidelines for Agriculture and

	<p>fertilization in the Agriculture Sector. This should be explicitly indicated.</p> <ul style="list-style-type: none"> • Has the country provided estimates on N fertilization by land category, in total for all LULUCF categories or in the Agriculture sector? <ul style="list-style-type: none"> ○ If these emissions are provided in the Agriculture sector, this should be explicitly cited in the documentation box in Table 5(I). • Check the importance of the source, the way the statistics were compiled and if they are used in an appropriate way. • Are the country-specific emission factors appropriate for the national circumstances? Do these factors consider the effects of liming and management? • If models are used to estimate N₂O emissions, do the models distinguish between “indirect N₂O emissions” from N deposition and fertilization? 	<p>GPG2000.</p> <p>As all of these emissions can be reported in the Agriculture Sector - this may cause overestimation of the emissions. Overestimation may have an affect on the trends. Problems normally arise only for Parties where fertilization of forest soils is a significant source.</p> <p>Liming can reduce N₂O emissions from forest in some environments and increase them in others.</p>
Uncertainties	<p>Estimates of N₂O emissions from fertilization of forests can be highly uncertain because of:</p> <ul style="list-style-type: none"> • high spatial and temporal variability of emissions • scarcity of long-term measurements and limited representativity of data for larger regions • and uncertainty in spatial aggregation, in emission factors and activity data. 	
Completeness	<ul style="list-style-type: none"> • Check completeness of the data in the CRF Table 5(I) • Check the inventory for omissions or possible double counting in collaboration with the review of the Agriculture Sector. Use of the notation key NE may be an indication of omissions in the submission. Use of notation key IE is likely to occur in the tables for many Parties. • Transparency in reporting of these emissions is very important. 	

Table 12: N₂O emissions from drainage of forest soils (CRF Table 5(II))

Land Use Category	Organic soils and Mineral Soils in Forest land/Wetlands /Other	
GHG	N ₂ O	
Description	The guidance to estimate N ₂ O emissions from drainage is given in the GPG-LULUCF in Appendix 3a.2 and reporting is optional. Intensively drained soils have large N ₂ O emissions because drainage increases the aerated layer and enhances the mineralization of soil organic matter. The effect of drainage on N ₂ O emissions depends on soil characteristics with higher emissions associated with nutrient rich and lower emissions with nutrient poor peat types.	
Potential Key Issues	Data on N ₂ O emissions from drained organic soils and wet mineral soils are relatively sparse and variable. Uncertainty associated with the methods presented in the GPG LULUCF is high. N ₂ O emissions from drained cropland and grassland soils are covered in the Agriculture Chapter of the IPCC Guidelines and under the CRF for Agriculture, Cultivation of Histosols. Estimates of N ₂ O emissions from forests are highly uncertain because of: (a) high spatial and temporal variability of the emissions, (b) scarcity of long-term measurements and their likely non-representativeness over larger regions and (c) uncertainty in spatial aggregation and inherent to emission factors and activity data.	
General References	Appendix 3a.2 of the GPG LULUCF The basic method for estimating direct N ₂ O emissions from drained forest organic soils is shown in Equation 3a.2.1 in GPG LULUCF.	
Detailed Review Element	Questions/Comments	Elaboration/Clarification
Methodology/Activity Data/Emission Factors	<ul style="list-style-type: none"> In Tier 2, are area data adequately disaggregated and are specific emission factors developed for each sub-class of management practice? Check that the models (Tier 3) are validated with measured data and verified. Are all assumptions and key parameters used in the models transparently described in the NIR? 	<p>The same method is applied for forest land remaining forest land and lands converted to forest land. Default emission factors for use in Tier 1 are shown in Table 3a.2.1 in GPG LULUCF.</p> <p>Use of models for Tier 3 approach is most appropriate in a country in which direct N₂O emissions from managed forests are a key category.</p>

Table 13: N₂O emissions from disturbance associated with land-use conversion to cropland (CRF Table 5(III))

Land Use Category	Organic soils and Mineral Soils in Lands converted to Cropland (5.B.2.1/2.2/2.3/2.5) and Other	
GHG	N ₂ O	
Description	An increase in N ₂ O emissions can be expected following the conversion of forest land, grassland and other land to cropland. This is a consequence of the enhanced mineralization of soil organic matter (SOM) that normally takes place as a result of that conversion. The mineralization results not only in a net loss of soil C and hence, a net CO ₂ emission but also conversion of nitrogen previously in SOM to ammonium and nitrate. Microbial activity in the soil converts the latter to N ₂ O.	
Potential Key Issues	The total emissions of N ₂ O are equivalent to the sum of all N ₂ O emissions from land use conversions as shown in equations 3.3.13 and 3.3.14 in GPG LULUCF. These are emissions from mineralization of soil organic matter resulting from conversion of forest land, grassland, settlements and other land to cropland. Emissions from nitrogen application (fertilization) in the preceding land use (managed forest land or grassland) and new land use (cropland) are calculated elsewhere in the inventory and should not be reported here to avoid double counting.	
General References	Section 3.3.2.3 in GPG LULUCF.	
Detailed Review Element	Questions/Comments	Elaboration/Clarification
Methodology/Activity Data/Emission Factors	<ul style="list-style-type: none"> The default method (Tier 1) assumes a constant C:N ratio in SOM over the period. If Party applies a Tier 2 method, was locally specific C:N ratios in SOM used? Did the N₂O emission factors used take into account the major crop growing regions, geographic and soil regions, soil factors and different management regimes? Check that the models (Tier 3) are validated with measured data and verified. Are all assumptions and key parameters used in the models transparently described in the NIR? Were the N₂O emission measurements taken over an entire year (including fallow periods) or more preferably, over a series of years, to reflect differences in weather conditions and inter-annual climatic variability? If a higher tier was used, was the activity data (area of land being converted) disaggregated by the types of conversion? 	
Completeness	<ul style="list-style-type: none"> Check completeness of the data in the CRF Table 5(III) Check the inventory for omissions or possible double counting. Check the use of notation keys like NE or IE, which may be an indication of omissions in the submission or double counting. Transparency in reporting of these emissions is very important. 	

**Table 14: Carbon emissions from agricultural lime application
(CRF Table 5(IV))**

Land Use Category	Cropland/Grassland/Other	
GHG	CO ₂	
Description	<p>The IPCC Guidelines include application of calcic limestone or dolomite to agricultural soils as a source of CO₂ emissions. Although the liming affect generally has a duration of a few years (after which lime is again added), depending on climate, soil and cropping practices, the IPCC Guidelines account for emission as CO₂ of all added carbonate carbon in the year of application.</p> <p>Thus, the basic methodology is the amount of lime applied times an emission factor that varies slightly depending on the composition of the material added.</p> <p>CO₂ emissions from liming of cropland and grassland are reported in CRF Table 5(IV). Parties that cannot separate liming application for different land-use categories can report the total emissions of liming for all land-use categories.</p>	
Potential Key Issues	<p>While carbonate limes are the dominant liming material used, oxides and hydroxides of lime, which do not contain inorganic carbon, are used to a limited extent for agricultural liming and should not be included here.</p>	
General References	<p>Section 3.3.1.2, p3.79 and Section 3.4.1.2, p. 3. 114 in GPG LULUCF. As the methodologies for estimating emissions and removals from cropland and grassland are essentially the same, refer also to the review guidance given for these two land categories.</p>	
Detailed Review Element	Questions/Comments	Elaboration/Clarification
Methodology/Activity Data/Emission Factors	<ul style="list-style-type: none"> Are the methods, activity data and parameters appropriate? For Tier 1, the total amount of carbonate containing lime applied annually to cropland/grassland soil and an emission factor of 0.12 can be used to estimate CO₂ emissions, without differentiating between variable compositions of lime material. If a Party is using higher tiers (Tier 2 or 3), did the Party differentiate the different forms of lime used and use specific emission factors? 	<p>The data on liming can be provided for the categories separately or in total for all land-use categories. Croplands are more likely the land-use category where most of the lime use occurs. The data should be provided separately for different lime types (lime stone and dolomite), if available.</p>
Completeness	<ul style="list-style-type: none"> Check completeness of the data in the CRF Table 5(IV) on CO₂ emissions from liming Are estimates provided separately for liming of 	<p>Parties that are able to provide data for lime application to forest land should provide this information under 5.G Other. It should be specified in the documentation box that forest land application is included in this</p>

	<p>cropland, grassland and other land-use categories or is only the total estimate for all land-use categories provided?</p> <ul style="list-style-type: none"> • Are estimates provided for liming separately for limestone and dolomite, or for all lime types in total? 	category.
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Table 15: Biomass Burning (CRF Table 5(V))

Land Use Category	Forest land/Cropland/Grassland/Wetlands/ Settlements/Other Land	
GHG	CO ₂ , N ₂ O, CH ₄	
Description	<p>Biomass burning occurs in many types of land uses causing emissions of CO₂, CH₄, N₂O, CO and NO_x. While biomass burning in managed forest should be considered and reported, it is also often associated with land conversion and clearing of vegetation resulting in an important source of non-CO₂ emissions. In addition to CO₂ emissions, non-CO₂ emissions from both controlled burning (prescribed fires) and wildfires on managed land should be reported.</p> <p>GPG LULUCF provides guidance for estimating emissions from biomass burning in forest land remaining forest land and land converted to forest land or cropland or grassland.</p>	
Potential Key Issues	<p>The basic approach for estimating GHG emissions from biomass burning are the same regardless of the specific land use type. Burning of savannah and agricultural residues is addressed in the Agriculture Sector. These sources are not considered as a net source of CO₂ as the carbon released is reabsorbed during the next growing season.</p> <p>Emissions from biomass burning for energy are reported in the Energy Sector. If the biomass is taken to waste incineration facilities, reporting can be done in the Waste Sector.</p> <p>Fire impact in unmanaged forest lands should not be reported.</p>	
General References	<p>Section 3.2.1.4, p3.48 and Sections 3.4.1.3 and Sections 3.4.2.3 in GPG LULUCF.</p> <p>The IPCC Guidelines addresses emissions from burning for land use conversion under Forest and Grassland Conversions and for land management under On-site burning of Forest Biomass in Chapter 5.</p>	
Detailed Review Element	Questions/Comments	Elaboration/Clarification
Methodology/Activity Data/Emission Factors	<ul style="list-style-type: none"> Are CO₂ emissions from burning in managed forest estimated? CO₂ emissions must be reported because the uptake of carbon by regrowing vegetation is estimated. Do the methods applied in estimating CO₂ emissions capture removals by regrowth after natural disturbances? Is this documented in a transparent manner? Did Party specify type of activity data used - area burned (ha) or biomass burned (kg dm)? Check that calculations are made separately for each GHG, using the 	<p>The national circumstances that affect biomass burning (controlled burning, wildfires) and methodologies to estimate corresponding emissions can vary much.</p> <p>Data on wildfires are highly country- and year-specific and cannot be generalized by region.</p> <p>Estimates of non-CO₂ emissions from fires of forests can be highly uncertain, particularly uncertainty inherent in emission factors and activity data.</p>

	<p>appropriate emission factor.</p> <ul style="list-style-type: none"> • Check that all fluxes are reported as emissions (+ positive sign) and should be reported in Gg of respective gases. 	
Completeness	<ul style="list-style-type: none"> • Check completeness of the data in the CRF Table 5(V) on CO₂ emissions from biomass burning • Are estimates of CO₂ from combustion of woody biomass provided in Tables 5.A - 5.F or in Table 5(V)? If CO₂ emissions from biomass burning are reported in CRF Tables 5.A to 5.F, check consistency of the activity data. • Is this clearly documented in the NIR and the documentation box in Table 5(V)? • Are estimates provided separately for controlled burning and wildfire? If not, is it described in a transparent manner in the NIR or the documentation box in Table 5(V)? • Are non-CO₂ emissions from biomass burning reported in CRF Table 5(V)? • The reviewer should check the inventory for omissions or possible double counting in collaboration with the review of the Energy and Waste Sectors. Use of the notation key NE may be an indication of omissions in the submission. Use of notation key IE is likely to occur in the tables for many Parties. • Transparency in reporting of these emissions is very important. 	
