CHAPTER 7

CROSS-CUTTING ISSUES AND REPORTING

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7 CROSS-CUTTING ISSUES AND REPORTING

7.1 INTRODUCTION

The 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) contains updated and new methodological guidance for greenhouse gas emissions and removals from drained inland and rewetted organic soils, specific human-induced changes in coastal wetlands and inland wetland mineral soils, and Constructed Wetlands for Wastewater Treatment.

The supplementary methodological guidance introduces changes to the estimation and reporting of emissions and removals according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines) in all land-use categories (Forest Land, Cropland, Grassland, Wetlands, Settlements, and Other Land), some sources of methane (CH₄) and nitrous oxide (N₂O) emissions from managed land in the Agriculture, Forestry and Other Land Use (AFOLU) Sector, and CH₄ and N₂O emissions from wastewater treatment (Constructed Wetlands for Wastewater Treatment) in the Waste Sector. The changes come from updated methodologies for existing categories and supplemental methodologies for categories not covered by the 2006 IPCC Guidelines. The Wetlands Supplement maintains the approaches for estimation of emissions and removals in Volume 4 (AFOLU) of the 2006 IPCC Guidelines. The general guidance in Volume 1 of the 2006 IPCC Guidelines is also applicable.

This chapter provides guidance on cross cutting issues for the methodologies provided in Chapters 2 to 6 of this *Wetlands Supplement* by addressing the following:

- reporting and documentation
- uncertainty estimation
- key category analysis
- completeness
- time series consistency
- quality control (QC) and quality assurance (QA).

The chapter also summarises the *good practice* guidance on these cross-cutting issues found in Volume 1 of the 2006 IPCC Guidelines, to which inventory experts need to refer for detailed guidance. Cross-cutting issues specific to the categories and methodologies included in Chapters 2 to 6 of the Wetlands Supplement are addressed in the specific chapters. This chapter summarises and complements the category-specific information.

7.2 REPORTING AND DOCUMENTATION

7.2.1 Changes to reporting categories in the 2006 IPCC Guidelines

Chapter 1 of the *Wetlands Supplement* gives an overview of the purpose and scope of this supplement as well as a description of its contents, including specific guidance on how to use this supplement in the context of the 2006 IPCC Guidelines.

This chapter complements Chapter 1 with details on the reporting aspects of the *Wetlands Supplement*. The summaries of the methodologies of the *Wetlands Supplement* and the reporting of emissions and removals, as addressed in Sections 7.2.1.1 to 7.2.1.5 in this chapter, are based on the Tier 1 methodologies in Chapters 2 to 6 of the *Wetlands Supplement*.

The AFOLU and Waste Sector reporting tables given in Annex 8A.2, Chapter 8 in Volume 1 of the 2006 IPCC Guidelines are updated and complemented to incorporate the changes required by the application of the Wetlands Supplement (see Annex 7A.2 in this chapter). The category names and numbering referred to in the following sections are those presented in Annex 7A.2 in this chapter.¹

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¹ The Common Reporting Framework (CRF) tables used by Annex I Parties in reporting of greenhouse gas emissions and removals under the United Nations Framework Convention on Climate Change (UNFCCC) are not identical to the reporting tables developed by the IPCC. Reporting tables used by the Parties to the UNFCCC are produced by the UNFCCC through negotiations, although they usually build on the *IPCC Guidelines* and *good practice* guidance. The

7.2.1.1 Drained inland organic soils

Carbon dioxide (CO₂)

The guidance in Chapter 2 in the Wetlands Supplement for estimation of CO₂ emissions from drained inland organic soils implies changes for all land-use categories compared to the 2006 IPCC Guidelines. The Tier 1 methodology in the 2006 IPCC Guidelines for drained organic soils is simply a multiplication of the relevant areas with appropriate emission factors by land-use category and climate zone (boreal/temperate/tropical). The emission factors in the 2006 IPCC Guidelines for peat extraction in boreal/temperate climate zones also take into account the nutrient status of the drained lands. The supplementary methodology in Chapter 2 uses the same approach as in the 2006 IPCC Guidelines and provides updated CO2 emission/removal factors according to landuse categories and climate zones. For some land-use categories, these are further disaggregated by the type of vegetation, nutrient-status of the organic soils (rich vs. poor) and depth of drainage (drained, shallow drained and deep drained). Nutrient status is, however, not taken into account in the default CO₂ emission factors for peat extraction. New guidance is provided for estimation of off-site CO2 emissions from water-borne dissolved organic carbon (DOC), losses from drained organic soils, and soil CO₂ emissions from fires on drained organic soils. Most of these methodological changes can be implemented without changes in the reporting or background tables in the 2006 IPCC Guidelines. However, additional documentation would need to be provided in the national inventory report (see Section 7.2.3 and Annex 7A.2 in this chapter). Also, Background Table 3.4 (category 3C1) on burning has been modified to include emissions from the soil pool for organic soils (see Annex 7A.2 in this chapter).

Non-CO₂

The 2006 IPCC Guidelines did not provide a methodology for the estimation of CH₄ emissions associated with drainage, whereas Chapter 2 provides a methodology to address CH₄ emissions from the land surface of drained organic soils and drainage ditches. The emission factors for CH₄ from the land surface are given by land-use category and climate zone. These are further disaggregated by the type of vegetation, depth of drainage, and nutrient status of the soil. The emission factors for CH₄ from drainage ditches are also given by land-use category and climate zone and for grasslands by drainage depth (shallow or deep). A default CH₄ emission factor for drainage ditches is provided separately for peat extraction. The estimation of CH₄ emissions from drained organic soils requires the area of the drained organic soils and the fraction occupied by ditches. Indicative default values are provided for these fractions. These CH₄ emissions would be reported in Background Table 3.9 under new categories (3C8 CH₄ from Drained Organic Soils and 3C9 CH₄ from Drainage Ditches on Organic Soils) under appropriate headings highlighting the land-use category and other relevant specifications. The category 3C8 (Other) in the 2006 IPCC Guidelines has been re-numbered to 3C14.

The methodology for direct N₂O emissions from organic soils is the same as in the 2006 IPCC Guidelines but the default emissions factors are updated and more disaggregated. In accordance with the 2006 IPCC Guidelines, the direct N₂O emissions from organic soils should be reported as aggregated to N₂O emissions from managed soils. If data are available, the emissions can be provided by land-use category. The N₂O emissions from drainage/management of organic soils are reported under category 3C4 (Direct N₂O Emissions from Managed Soils). An exception to this are direct N₂O emissions on peat extraction lands, which are reported in category 3B4ai (Peat Extraction Remaining Peat Extraction²) or 3B4bi (Land Converted for Peat Extraction), depending on if the peat extraction lands remain in the category or are converted to it.

Chapter 2 in the *Wetlands Supplement* provides guidance on estimating CO₂, CH₄ and CO emissions from soil organic matter during fires on drained organic soils. N₂O emissions from these fires are addressed at higher tier levels. These emissions would be reported in the AFOLU category 3C1 (*Burning*) under relevant subcategories. Activity data and emissions by carbon pools should be provided in AFOLU Background Table 3.4, which is updated to include also emissions from soil burning (see Annex 7A.2 in this chapter).

7.2.1.2 REWETTED ORGANIC SOILS

Guidance on CO₂, CH₄ and N₂O emissions from rewetting of organic soils is not included in the 2006 IPCC Guidelines. Chapter 3 of the Wetlands Supplement provides this guidance. Tier 1 methodologies are given for

UNFCCC CRF tables are currently being revised. A major difference in the UNFCCC CRF tables compared to the IPCC reporting tables is that the IPCC AFOLU Sector will continue to be divided into the Agriculture sector and LULUCF sector in UNFCCC reporting.

² This category has been renamed (Peatlands Remaining Peatlands in the *2006 IPCC Guidelines*) to take into account the guidance related to peatlands in this *Wetlands Supplement*. The renaming is taken into account in the updated Table 3 AFOLU Sectoral Table and relevant AFOLU background tables in Annex 7A.2 in this chapter.

 ${\rm CO_2}$ emissions/removals from rewetted organic soils with moss and/or herbaceous vegetation, and also for dissolved organic carbon. Tier 1 guidance is also given for ${\rm CH_4}$ emissions from rewetted organic soils. ${\rm N_2O}$ emissions from rewetted organic soils are considered negligible and assumed to be zero under Tier 1. Fires on rewetted organic soils are not likely but, in case they occur, the methods given in Chapter 2 for fires on drained organic soils can be used to estimate the emissions from the soil. When rewetted lands contain perennial woody vegetation, the guidance in Chapters 2, 4, and 5 in Volume 4 of the 2006 IPCC Guidelines, should be used to estimate the emissions from the woody biomass and dead organic matter (DOM) pools.

The reporting of emissions/removals from rewetting depends on the land use after the rewetting. Rewetted grassland could remain in the same land-use category, e.g. when agricultural land with organic soil is rewetted to form a grazing marsh. The rewetting could also involve a land-use change, e.g. when a forest with organic soil is rewetted and the tree coverage declines below the threshold of the national forest definition. It is *good practice* to report emissions/removals from rewetting under relevant land-use categories (Table 3, Annex 8A.2, Chapter 8 in Volume 1 of the 2006 IPCC Guidelines). Additional information on carbon stock changes on these lands should be provided in Background Tables 3.2 and 3.3, which have been modified to allow reporting of removals from organic soils. CH₄ should be included in Background Table 3.9 (Non-CO₂ greenhouse gas emissions not included elsewhere), under category 3C10 (CH₄ from Rewetting of Organic Soils). When N₂O emissions from rewetting of organic soils are reported using higher-tier methods, these would be included under category 3C14 (Other).

7.2.1.3 COASTAL WETLANDS

Guidance on CO₂, CH₄ and N₂O emissions from managed coastal wetlands is not included in the 2006 IPCC Guidelines but provided in Chapter 4 of this Wetlands Supplement. This guidance covers emissions/removals from mineral and organic soils vegetated by vascular plants that are covered or saturated for all or part of the year by tidal freshwater or salt water (>0.5 ppt). The guidance addresses CO₂ emissions/removals from specific activities in mangroves, seagrass meadows, and tidal marshes. These activities include forest management, extraction (including excavation, aquaculture and salt production), drainage, and rewetting in coastal wetlands. New methods are presented for estimation of changes in soil carbon (Tier 1 level) whereas methods for biomass and dead organic matter follow those of the 2006 IPCC Guidelines. Methods are also provided for CH₄ emissions from rewetting of mangroves and tidal marshes and N₂O emissions from aquaculture.

Coastal wetlands can occur in any of the six IPCC land-use categories but also in coastal areas that are not part of the total land area of the country. For example, a mangrove wetland with trees may be classified as Forest Land, a tidal marsh used for grazing may be classified as Grassland, and a seagrass meadow used for aquaculture may be classified as Settlements. Emissions/removals from coastal wetlands that are not part of the total land area (e.g. seagrass meadows) should be reported separately and the associated areas excluded from the total land area and from the land-use matrix³. For example, forest management activities in mangroves classified as Forest Land may need to be split between areas included in the total land area and not included in the total land area. In reporting the emissions/removals from mangrove forest management activities, emissions/removals from both areas would be reported under Forest Land, but only the land areas of the mangroves included in the total land area would be included in the total Forest Land areas and reported in the land area matrix. The classifications of coastal wetlands are country-specific, but in all cases appropriate subcategories should be used in the reporting to reflect the specific land use and management as well as to indicate whether the emissions come from areas included or excluded from the total land area of the country.

The emissions/removals from coastal wetlands would be reported under relevant land-use categories and subcategories of the AFOLU Sectoral Table 3. Two new subcategories 3B4aiii Other Wetlands Remaining Other Wetlands and 3B4biii Land Converted to Other Wetlands have been added to this table to allow for complete reporting. Additional information on C stock changes on these lands should be provided in Background Tables 3.2 and 3.3. CH_4 and N_2O emissions from coastal wetlands would be included in Background Table 3.9, under category 3C11 (CH_4 Emissions from Rewetting of Mangroves and Tidal Marshes) to category 3C12 (N_2O Emissions from Aquaculture), and specified by land-use category. For information to be included in the inventory report, see Section 7.2.2 below.

³ Documentation on consistent reporting of land areas for the six land-use categories includes the provision of a land-use matrix with data on lands remaining in the categories and conversions between them. Unmanaged land areas are also included in the matrix. The sum of the areas should match the total land area. For this reason, areas that are not part of the total land area of a country should not be included in the total areas of the land-use categories or the land-use matrix.

7.2.1.4 INLAND WETLAND MINERAL SOILS

In Volume 4 of the 2006 IPCC Guidelines, general guidance for estimating CO₂ emissions/removals from soils, including wet mineral soils, is provided in Section 2.3.3 and complemented with land-use category-specific guidance in relevant sections of Chapters 3 to 6. Chapter 5 of the Wetlands Supplement complements and updates this guidance with new default values for reference soil carbon stock values for wetland mineral soils under all climate regions and carbon stock change factors for land use for long-term cultivation of cropland with inland wetland mineral soils (IWMS). New default carbon stock change factors are provided for rewetting on Cropland with IWMS. In addition, Chapter 5 provides data on CH₄ emissions from IWMS under any land-use category that has undergone rewetting, and from mineral soils that have been inundated for the purpose of wetland creation. The chapter does not include guidance on emissions/removals from rice cultivation. That is covered in Section 5.5, Chapter 5 in Volume 4 of the 2006 IPCC Guidelines.

IWMS can occur in any of the six IPCC land-use categories. For example, a riverine wetland with trees may be classified as Forest Land, while a riverine wetland without trees may be classified as Wetlands. The precise details of this classification are country-specific, so it is not possible to say exactly how IWMS may be classified. Appropriate subcategories should be used in the reporting to reflect the specific land use and management as specified by a country.

The total emissions/removals from IWMS should be reported under relevant land-use categories and subcategories of the AFOLU Sector in reporting Table 3 in Volume 1, Annex 8A.2. Additional information on carbon stock changes on these lands should be provided in Background Tables 3.2 and 3.3. CH₄ emissions from inland wetland mineral soils should be included in Background Table 3.9, under category 3C13 (*CH₄ Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils*). For information to be included in the inventory report, see Section 5.4 in Chapter 5 in this supplement and Section 7.2.2 below.

7.2.1.5 CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT

Supplementary guidance on CH_4 and N_2O emissions from wastewater treatment and discharge is provided in Chapter 6 on Constructed Wetlands for Wastewater Treatment. Constructed Wetlands for Wastewater Treatment are human-made wetlands and engineered systems that apply various technologies that use natural wetland processes, wetland hydrology, soils, microbes, and plants to assist in treating wastewater. In addition to Constructed Wetlands for Wastewater Treatment, methodologies in Chapter 6 cover natural wetland systems that have been modified for wastewater treatment (semi-natural treatment wetlands). Methodologies are based on the load of nitrogen and organic carbon into the systems. The CH_4 emissions are calculated based on biological or chemical oxygen demand data and emission factors related to the flows in these Constructed Wetlands for Wastewater Treatment (free water surface, vertical subsurface flow, and horizontal subsurface flow or hybrid systems). The N_2O emissions are calculated based on the amount of nitrogen in the wastewater.

 CH_4 and N_2O emission from Constructed Wetlands for Wastewater Treatment are reported under category 4D Wastewater Treatment and Discharge. The emissions should be divided into categories 4D1 (Domestic Wastewater Treatment and Discharge) and 4D2 (Industrial Wastewater Treatment and Discharge) according to source of wastewater treated.

The areas of Constructed Wetlands for Wastewater Treatment would be reported as part of areas under Settlements, Wetlands, or other land-use categories, as appropriate. If the establishment of the Constructed Wetlands for Wastewater treatment involves a land-use category conversion, the area changes should be reported under appropriate land-use categories and the notation key 'IE' should be used for the CH_4 and N_2O emissions under the category to which the land is converted, as these emissions are reported in the Waste sector. Any changes in carbon stocks due to the land-use conversion, e.g. due to cutting of trees or removal of other vegetation, should also be reported under the category to which the land is converted. Double-counting of CH_4 and N_2O emissions from the land areas should be avoided. The areas of Constructed Wetlands for Wastewater Treatment are often small, and, if thresholds for minimum areas for reporting are not exceeded, specific reporting in the AFOLU sector is not required.

No changes to the reporting tables and background tables in the 2006 IPCC Guidelines are made for the inclusion of the emissions from Constructed Wetlands for Wastewater Treatment. Section 7.2.2 below addresses the information that should be included in the inventory report.

7.8

7.2.2 Mapping the changes to categories in the 2006 IPCC Guidelines

Table 7.1 below shows how the supplementary guidance and new categories introduced in the *Wetlands Supplement* are linked to the guidance and categories in the 2006 IPCC Guidelines. This summarises the descriptions given in the above sections on the methodological changes introduced in Chapters 2 to 6 in this *Wetlands Supplement*.

Source of emissions/	2006 IPCC	Guidelines	Wetlands Supplement			
ink for emovals	Category	Guidance by	Category	Guidance by		
Orained inlan	nd organic soils					
CO ₂	3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land Category 3B4ai Peatlands Remaining Peatlands	 land-use category climate zone nutrient status for peat extraction lands 	3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land Category 3B4ai renamed as Peat Extraction Remaining Peat Extraction, respective change to 3B4bi New source: off-site CO ₂ emissions due to waterborne carbon losses	 land-use category climate zone drainage class (drained, shallow deep) nutrient status 		
CO ₂	Category 3C1 Emissions from Biomass Burning	pool excluding the soil organic matter	Category 3C1 renamed to <i>Burning</i> to take into account new guidance on CO ₂ emissions from the soil pool from fires on drained organic soils	pools (biomass, dead organic matter, soil organic matter)		
CH ₄	-	-	New category: 3C8 CH ₄ from Drained Organic Soils	 land-use category climate zone drainage class (drained, shallow deep) nutrient status 		
CH4	-	-	New category: 3C9 CH ₄ from Drainage Ditches on Organic Soils	 land-use category climate zone drainage class (drained, shallow deep) 		
N ₂ O	3C4 Direct N ₂ O emissions from Managed Soils	drained organic soils	3C4 Direct N ₂ O emissions from Managed Soils	 land-use category climate zone drainage class (drained, shallow deep) nutrient status 		

Rewetted org	ganic soils			
CO ₂ ,	-	-	New sources/sinks under 3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land: CO ₂ emissions/removals from rewetted soils and CO ₂ emissions due to dissolved organic carbon export from rewetted organic soils	 climate zone nutrient status (boreal climate zone)
CH ₄	-	-	New category: 3C10 CH ₄ from Rewetting of Organic Soils	 climate zone nutrient status (boreal and temperate climate zone)
N ₂ O	-	-	N ₂ O emissions from rewetted organic soils (only when higher-tier methods available)	
			To be reported under 3C14 (<i>Other</i>) (Non-CO ₂ GHG emissions not included elsewhere)	
Coastal wetla	ands			
CO ₂ ,		-	New sources/sinks under 3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land from the following activities: • forest management in mangroves • extraction in mangroves, tidal marshes and seagrass meadows (including excavation, aquaculture and salt production) • rewetting, revegetation and creation in mangroves, tidal marshes and sea grass meadows • soil drainage in	 climate zone/region vegetation type salinity (where applicable/available) management activity
			soil drainage in mangroves and tidal marches New subcategories under Wetlands need to be created to cover all potential reporting options: 3B4aiii (Other Wetlands Remaining Other	

			Wetlands), and 3B4biii (Land Converted to Other Wetlands) NOTE: When activities and emissions occur on areas that are not included in the total land area of the country, the reporting should be split into two parts: areas included in the total land area and areas not included in the total land area. The landuse change matrix should include only those areas that are part of the total land area.	
CH ₄	-	-	New category: 3C11 CH₄ Emissions from Rewetting of Mangroves and Tidal Marshes	wetland typesalinity
N ₂ O	-	-	New category: 3C12 N ₂ O Emissions from Aquaculture	fish-produced
Inland wetlar	nd mineral soils (IWMS)			
CO ₂	Guidance for estimating C stock changes in soils including inland mineral soil wetlands under all land-use categories 3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land	 land-use category climate zone 	Updated default reference soil organic carbon stocks (SOC) for inland wetland mineral soils under 3B1 to 3B6 Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land	climate zone/region management activity
CO_2	-	-	New stock change factors for land use for long term cultivation and rewetting of Cropland with IWMS	climate zone moisture regime
CH ₄	-	-	3C13 CH ₄ from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	climate zone
Constructed '	Wetlands for Wastewate	r Treatment		
CH ₄ , N ₂ O	4D Wastewater Treatment and Discharge	 wastewater type (domestic or industrial) BOD/COD load treatment and disposal type 	New treatment types under 4D Wastewater Treatment and Discharge	wastewater type (domestic or industrial) BOD/COD load treatment and disposal type including constructed wetlands and seminatural treatment wetlands flow type

	CO ₂	3B4 to 3B6 Wetlands, Settlements and Other Land	No specific guidance but C stock changes from land-use change covered by the general methodologies	3B4 to 3B6 Wetlands, Settlements and Other Land	No specific guidance but C stock changes from land-use change covered by the general methodologies in the 2006 IPCC Guidelines
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7.2.3 Documentation

Chapter 8 in Volume 1 of the 2006 IPCC Guidelines provides guidance on reporting complete, consistent, and transparent national greenhouse gas inventories. Category-specific guidance on documentation relevant to the supplementary guidance provided in this Wetlands Supplement is provided in Chapters 2 to 6.

Reporting in accordance with the *Wetlands Supplement* involves combining guidance from both this *Wetlands Supplement* and the *2006 IPCC Guidelines*. The estimation of emissions and removals requires, in some cases, a combination of methodologies which, if care is not taken, can lead to double-counting or omission of emissions or removals. The reporting of emissions and removals from specific activities, *e.g.* rewetting and drainage, is disaggregated among land-use categories and specific or generic categories for reporting of non-CO₂ emissions. National circumstances will also significantly affect reporting. In some countries, the categories will have a significant impact on total national emissions, but in others they will be insignificant.

It is *good practice* to provide the following information specific to the guidance in this *Wetlands Supplement* in the national inventory report:

- Methods for identifying activities and land areas;
- Classification of activities and land areas;
- Indication if emissions/removals are associated with areas that are not included in the total land areas.
- Disaggregated activity data and emission factors/parameters used by climate regime (temperature, precipitation), nutrient status, ecosystem type and activity/system, as relevant, and the level at which the emissions/removals are estimated.
- Information on how completeness has been assessed and double-counting avoided, i.e. in the following cases:
 - If the stock change method is used for a specific category/activity for estimation of CO₂ emissions/removals from soils and the default emission factors are used for dissolved organic carbon, the latter emissions may be included in the stock change estimate.
 - Combining a country-specific method to estimate emissions/removals from belowground biomass, litter,
 or understory (vegetation such as mosses) with default emission factors for drainage and rewetting,
 which integrate all carbon fluxes from the soil and the above- and belowground vegetation components
 other than trees, could double-count the respective emissions/removals.
 - Documentation for Constructed Wetlands for Wastewater Treatment should show that total organics in wastewater includes but does not double-count the part of organics treated in these systems.
 - Documentation on country-specific methods taking into account the impact of grazing on rewetted soils
 in the estimation of N₂O emissions from these lands should show that the nitrogen input is not
 calculated also under category 3A2 (*Manure Management*). Livestock emissions (CH₄ from enteric
 fermentation and N₂O from manure management) are, by default, not included under the land-use
 categories.
- When country-specific emission/removal factors or other parameters are used, documentation and references that justify their use should be provided. The documentation should show that the country-specific emission/removal factors or other parameters result in an improvement in the accuracy of the estimates.

7.2.4 Reporting tables

AFOLU sectoral reporting and background tables given in Annex 8A.2, Chapter 8 in Volume 1 of the 2006 *IPCC Guidelines* are applicable, with minor changes, for reporting of emissions/removals for methodologies in this *Wetlands Supplement*. AFOLU Sectoral Table 3 and Background Tables 3.2, 3.3, 3.4, 3.7 and 3.9, included

in Annex 8A.2, Chapter 8 in Volume 1 of the 2006 IPCC Guidelines, have been updated to cover the new categories introduced in this Wetlands Supplement (see Annex 7A.2 in this chapter).

Guidance on reporting, including a description of the changes made to the background tables, is presented above in Sections 7.2.2 and 7.2.3 by chapter of this *Wetlands Supplement*.

7.2.5 Worksheets

Annex 7A.1 also provides worksheets for each subcategory for which guidance is given in the *Wetlands Supplement*. The worksheets can be used to estimate emissions based on Tier 1 methods and appropriate emission/stock change factors and activity data.

7.3 UNCERTAINTIES

7.3.1 Overview of uncertainty analysis

Uncertainty is an expression of the degree to which the value of a variable is unknown (IPCC, 2007). In greenhouse gas inventories, uncertainty derives from quantifiable errors and variation in methods and data.

For greenhouse gas inventories, quantification of uncertainty is important because it allows inventory agencies to ascertain if estimated changes in greenhouse gas emissions and removals over two or more years are larger than the uncertainty of possible estimates for an individual year. In wetlands and drained soils, the magnitude of carbon stocks is often much larger than annual emissions or removals, so large uncertainties in carbon stock estimates may make it difficult to determine if estimated annual emissions or removals are real or a result of uncertainty. Uncertainty analysis can indicate areas for future improvement of inventory methods that can reduce the uncertainties.

In greenhouse gas inventories, major quantifiable sources of uncertainty include:

- field measurement errors
- remote sensing inaccuracies
- geographic and land cover map inaccuracies
- missing or incomplete data in time series
- · misreporting or misclassification
- data bias or unrepresentative sampling
- random sampling error
- spatial variation
- spatial or temporal autocorrelation, when not properly considered
- model inaccuracies

Uncertainty analysis generally proceeds through these steps:

- Identification of primary sources of uncertainty.
- Estimation of uncertainties of individual variables.
- Combination of individual variable uncertainties into total uncertainty estimates of emissions or removals for a land-use category for a geographic area.

This section summarises scientific methods for the two approaches of uncertainty analysis set forth in the 2006 IPCC Guidelines. This section aims to summarise material from Chapter 3 in Volume 1 and Chapter 7 in Volume 4 of the 2006 IPCC Guidelines, summarise new methods for the categories and subcategories described in Chapters 2 to 6 of this Wetlands Supplement, and assess methods across the wetlands and drained soil subcategories. To the extent possible, it provides published examples. Inventory compilers should consult the detailed information in the 2006 IPCC Guidelines and this Wetlands Supplement.

7.3.2 Methods for quantifying uncertainty

The measure of uncertainty for national greenhouse gas inventories is the 95% confidence interval (CI). It is good practice to report the 95% CI for individual variables, including activity data, emissions factors, biomass densities, other parameters, and total greenhouse gas emissions or removals from any key category or land-use category for a geographic area.

The 2006 IPCC Guidelines set forth two approaches for quantifying uncertainty. Approach 1 is a basic approach that uses algebraic equations to combine individual variable uncertainties. Approach 2 is an advanced approach that uses Monte Carlo analysis.

Approach 1 - Use the measures of uncertainty for individual variables given in the default tables in this Wetlands Supplement and the 2006 IPCC Guidelines. To combine individual variable uncertainties into total estimates of the uncertainty of emissions or removals for any key category or land-use category for a geographic area, use algebraic uncertainty combination methods (Mandel, 1984), identified in Chapter 3 in Volume 1 of the 2006 IPCC Guidelines.

Use Equation 7.1 to calculate the uncertainty of a set of added variables:

EQUATION 7.1

ALGEBRAIC COMBINATION OF UNCERTAINTIES – ADDITION AND SUBTRACTION

$$U_{1} = \sqrt{\left(U_{1} \times x_{1}\right)^{2} + \left(U_{2} \times x_{2}\right)^{2} + ... + \left(U_{n} \times x_{n}\right)^{2}}$$

 $U_{total} = \frac{\sqrt{\left(U_{1} \times x_{1}\right)^{2} + \left(U_{2} \times x_{2}\right)^{2} + \dots + \left(U_{n} \times x_{n}\right)^{2}}}{\left|x_{1} + x_{2} + \dots + x_{n}\right|}$

Where:

uncertainty (95% CI) of the sum of the variables $U_{total} =$

uncertainty (95% CI) of a variable $U_i =$

 x_i = value of a variable.

If the sum emissions and removals⁴ in the denominator approaches zero, Equation 7.1 may give very high uncertainty values and not reflect the true value of underlying uncertainties of the individual emissions or removals estimates. In a time series, changes in the value given by Equation 7.1 may not necessarily reflect real changes in uncertainties of individual variables. In such cases, it may be better to use absolute uncertainty values of removals in the denominator. These absolute values can be combined with absolute values of the rest of the inventory to give overall inventory uncertainty.

Use Equation 7.2 to calculate the uncertainty of a set of multiplied variables:

Equation 7.2
Algebraic combination of uncertainties – multiplication
$$U_{\textit{total}} = \sqrt{U_1^2 + U_2^2 + ... + U_n^2}$$

Where:

uncertainty (95% CI) of the product of a set of variables $U_{total} =$

uncertainty (95% CI) of a variable

Refer to the 2006 IPCC Guidelines for detailed steps of algebraic uncertainty combination, including calculation of uncertainties of temporal trends.

This Wetlands Supplement presents guidance to take into consideration the sources of uncertainty, either in activity data or emissions factors that are important specifically for wetlands and drained soils. The definitions of subcategories for wetlands and drained soils, and delineation of their surface areas can, by themselves, be sources of uncertainty. While the 2006 IPCC Guidelines generally stratify land-use categories by ecological zone (Chapter 3 in Volume 4) or climate zone, this Wetlands Supplement stratifies wetlands and drained soils into subcategories based on their characteristics and human activities. The following list summarises particular sources of uncertainty for the subcategories and new tables that provide inventory compilers with default uncertainty values.

⁴ Emissions are positive and removals negative values in greenhouse gas inventories.

- Drained inland organic soils Particular uncertainties include the high spatial variability of soil organic carbon, variation of surface areas and emissions factors by drainage class, which requires estimates of the depth of the water table, the fraction of land area occupied by drainage ditches, which is the key parameter for estimating CH₄ emissions, and high spatial and temporal variability of N₂O emissions, which can generate large standard errors relative to mean fluxes. Particular sources of uncertainty for estimates of fire emissions include variability of fire behavior among vegetation types, variation of the fraction of fuel combusted among ecosystems, fires, years, and land management practices, partitioning of smoke among CO₂, CO, and other gases, and estimates of burned area and fuels.
 - Table 2.1 Tier 1 CO₂ emission/removal factors for drained organic soils in all land-use categories
 - Table 2.2 Default DOC emission factors for drained organic soils
 - Table 2.3 Tier 1 CH₄ emission/removal factors for drained organic soils (EFcH_{4_land}) in all land-use categories
 - Table 2.4 Default CH₄ emission factors for drainage ditches
 - \bullet Table 2.5 Tier 1 Direct N_2O emission/removal factors for drained organic soils in all land-use categories
 - Table 2.6 Organic soil fuel consumption values
 - Table 2.7 Emission factors (g kg⁻¹ dry matter burnt) for organic soil fires
- **Rewetted organic soils** The principal uncertainty is the high spatial variability of soil organic carbon.
 - Table 3.1 Default emission factors (EF_{CO2}) and associated uncertainty, for CO₂-C from rewetted organic soils (all values in tonnes CO₂-C ha⁻¹ yr⁻¹)
 - Table 3.2 Default DOC emission factors (EF_{DOC_REWETTED} in tonnes CO₂-C ha⁻¹ yr⁻¹) for rewetted organic soils
 - Table 3.3 Default emission factors for CH_4 from rewetted organic soils (all values in kg CH_4 -C ha⁻¹ yr⁻¹)
- Coastal wetlands Particular uncertainties include variation of aboveground biomass by mangrove or seagrass species, forest age, tide height, soil fertility, salinity of flood waters, and flood frequency and interannual variation of vegetation production.
 - Table 4.2 Carbon fraction of above-ground biomass (tonnes C (tonnes d.m.)⁻¹) in mangroves
 - Table 4.3 Above-ground biomass in mangroves (tonnes d.m. ha⁻¹)
 - Table 4.4 Above-ground biomass growth in mangroves (tonnes d.m. ha⁻¹ yr⁻¹)
 - Table 4.5 Ratio of below-ground biomass to above-ground biomass (R) in mangroves
 - Table 4.6 Average density (D; tonnes m⁻³) of mangrove wood
 - Table 4.7 Tier 1 default values for litter and dead wood carbon stocks in mangroves
 - Table 4.8 Summary of Tier 1 estimation of initial changes in carbon pools for extraction activities
 - Table 4.9 Ratio of below-ground biomass to above-ground biomass (R) for tidal marshes
 - Table 4.10 Ratio of below-ground biomass to above-ground biomass (R) for seagrass meadows
 - Table 4.11 Soil carbon stocks for mangroves, tidal marshes and seagrass meadows for extraction activities
 - Table 4.12 Annual emission factors associated with rewetting (EF_{RE}) on aggregated organic and mineral soils (tonnes C ha⁻¹ yr⁻¹) at initiation of vegetation reestablishment
 - \bullet Table 4.13 Annual emission factors associated with drainage (EF_{DR}) on aggregated organic and mineral soils (tonnes C ha⁻¹ yr⁻¹)
 - \bullet Table 4.14 Emission factors for CH₄ (EF_{REWET}) Tier 1 estimation of rewetted land previously vegetated by tidal marshes and mangroves
 - Table 4.15 Emission factor (EF_F) for N₂O emission from aquaculture use in mangroves, tidal marshes and seagrass meadows

- Inland wet mineral soils Some emissions are a function of time under management.
 - Table 5.2 Default reference soil organic carbon stocks (SOC_{REF}) for wetland mineral soils under native vegetation (0-30 cm depth)
 - Table 5.3 Relative stock change factors for land use (FLU) for long-term cultivation on cropland with IWMS (over 20 years) and rewetting of cropland with IWMS (over 20 years and 40 years)
 - Table 5.4 Default emission factors for CH₄ from managed lands with IWMS where water table level has been raised
- Constructed Wetlands for Wastewater Treatment Major sources of uncertainty include estimation of the quantity of treated wastewater, fraction of organics converted anaerobically to CH₄ during wastewater collection, amount of industrial organic wastewater from small or medium industries discharged into constructed wetlands, and differences in gas exchange by different plant species.
 - ullet Table 6.2 Influent total organic carbon (TOC) and total nitrogen (TN) values, relevant CH₄-C and N₂O-N emissions, and share (%) of CH₄-C and N₂O-N in the initial loading of TOC and TN in constructed wetlands
 - Table 6.5 Default uncertainty ranges for domestic and industrial wastewater
 - Table 6.7 Nitrous oxide methodology default uncertainties

It is *good practice* to use uncertainty estimates reported by or derived from the same data sources used for the emissions and removals estimates. For Tier 1 estimates, use the uncertainties given in the IPCC default tables. For Tier 2, the data sources of the country- or ecosystem-specific parameters would provide the most appropriate uncertainty estimates. In the absence of country- or ecosystem-specific uncertainty estimates, it is possible to use published uncertainty estimates for similar ecosystems or circumstances, such as listed in Table 7.2 below. These published uncertainty estimates can also provide useful data to check country- or ecosystem-specific uncertainty estimates.

TABLE 7.2 EXAMPLES OF WETLANDS AND DRAINED SOILS WITH PUBLISHED ESTIMATES OF UNCERTAINTIES OF PARAMETERS USED IN ESTIMATING GREENHOUSE GAS EMISSIONS AND REMOVALS							
Continent	Country	Wetland or drained soil type	Reference				
	Botswana	Okavango Delta	Mladenov et al., 2005				
Africa	Madagascar	estuary	Ralison et al., 2008				
	Senegal	estuary area	Sakho et al., 2011				
	China	constructed wetland	Chen et al., 2011				
Asia	Indo-Pacific	mangroves	Donato et al., 2011				
	Indonesia	peat swamps and oil palms	Murdiyarso et al., 2010				
	Canada	restored wetlands	Badiou et al., 2011				
North America	Costa Rica	tropical inland wetlands	Bernal and Mitsch. 2008				
	USA	streams and rivers	Butman and Raymond, 2011				
	Argentina	river marsh	Vicari et al., 2011				
South America	Brazil	Pantanal	Schöngart et al., 2011				
	Peru	Amazonian peatland	Lähteenoja et al., 2012				
	Global	coastal ecosystems	Mcleod et al., 2011				
	Global	freshwater wetlands	Kayranli et al., 2010				
	Global	freshwater wetlands methane	Bastviken et al., 2011				
Global	Global	mangroves	Breithaupt et al., 2012				
Giodai	Global	restored wetlands	Moreno-Mateos et al., 2012				
	Global	seagrass	Fourqurean et al., 2012				
	Global	tropical peatlands	Page et al., 2011				
	Global	wetlands carbon and methane	Mitsch et al., 2010				

Approach 2 – For an individual variable, calculate the 95% CI from the probability density function (PDF) of measurements of the variable. Derive the PDF from a random sample. Capture the principal forms of spatial and temporal variation in the sample or calculate different PDFs for the principal spatial and temporal strata. Section 3.2.2.4, Chapter 3 in Volume 1 of the *2006 IPCC Guidelines* provides methods to develop PDFs.

To combine individual variable uncertainties into total estimates of emissions or removals for a land-use category or a geographic area, use the Monte Carlo method (Metropolis and Ulam, 1949), set forth by the 2006 IPCC Guidelines as Approach 2. The Monte Carlo method is a statistical technique that quantifies the uncertainty of a variable based on a large number of randomized realisations of the value of the variable based on its mean value and the standard error of the mean (for a PDF that follows a normal distribution) or other appropriate measure of error (for other types of PDFs).

For example, the width of a ditch is an essential variable in estimating CH_4 emissions from drained organic soils (Equation 2.6 in Chapter 2 of this supplement). In a typical field survey, a person might measure the width of a ditch once and record the measurement. If the measurement were immediately repeated, the result may be slightly different due to the exact placement of the measuring device, judgment of the level of water, which defines the width, possible errors in transcribing or transmitting the value, and other factors. Repeating the measurement 100 or 1000 times would generate a PDF that might typically take the form of a normal distribution. The 95% CI of the distribution is a measure of the uncertainty of the ditch width measurement.

Monte Carlo analysis consists of running a calculation for a statistically significant number of replications, typically 100 to 10 000, producing a probability density function of the result, and calculating the 95% CI of the PDF. For any equation, the Monte Carlo form of a variable (Equation 7.3 below) can replace each of the variables in the equation. The large number of realisations effectively combines the uncertainties of individual variables.

EQUATION 7.3 MONTE CARLO ANALYSIS – GENERAL FORM OF A VARIABLE $x_i = mean_x + (random_i \times SE_x)$

Where:

 $x_i =$ value of realisation *i* of a variable,

i = statistically significant number of realisations, typically 100 - 10000

 $mean_x = mean value of a variable$

 $random_i$ = random number for realisation i, from -1 to 1, taken from a set of random numbers that form a probability distribution function specific to the variable

 SE_x = standard error of the mean value of the variable

Refer to the 2006 IPCC Guidelines for detailed steps of Monte Carlo analysis, including selection of an appropriate PDF for a variable and its random numbers. Inventory compilers and scientists have quantified uncertainty in greenhouse gas inventories in a range of cases, including the national inventories of Austria (Winiwarter and Muik, 2010), Finland (Monni et al., 2007), and the Netherlands (Ramírez et al., 2008) and high-biomass ecosystems in California, USA (e.g. Gonzalez et al., 2010) and Canada (e.g. Kurz et al., 2008).

Ways to reduce uncertainty in both Approach 1 and Approach 2 include:

- Organic soils Spatially disaggregated CO₂ flux measurements can provide data to develop local emission factors, correcting for carbon losses through leaching of dissolved organic carbon or runoff. Quantification of impacts of land use and management on emissions can improve emissions estimates. Examples include organic matter additions to agricultural land that can increase substrate supply for methane production in ditches, short-term pulses of ditch CH₄ emission associated with land-use change, and nutrient-enriched soils that are a legacy of past land use.
- Rewetted peatlands CO₂ and CH₄ emissions are often a function of present vegetation composition and previous land use history. So, stratification of an area by these properties can improve emissions estimates. Determination of spatial variation of peat type and depth, vegetation composition, soil temperature, mean water table depth, the provision by vegetation of substrates for CH₄ production, and transport by vegetation of CH₄ from saturated soil to the atmosphere can improve emissions estimates.
- Coastal wetlands More detailed stratification of land by drainage and other management systems can improve emissions estimates. Quantification of the effects of coastal grassland management, including grazing, fire, liming, and fertilization, can improve emissions estimates.

- **Inland mineral soil wetlands** Chapter 5 in the *Wetlands Supplement* does not identify uncertainty reduction methods.
- Constructed Wetlands for Wastewater Treatment Provide separate estimates for domestic and industrial wastewater by type of constructed wetlands (surface flow (SF), horizontal subsurface flow (HSSF), and vertical subsurface flow (VSSF)).

7.4 IMPACT ON KEY CATEGORIES

7.4.1 Overview of *key category* analysis

A *key category* is a category that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals. Whenever the term *key category* is used, it includes both source and sink categories.

Methodological choice (choice of tier) for individual source and sink categories is important in managing overall inventory uncertainty. Generally, inventory uncertainty is lower when higher-tier methods are used to estimate emissions and removals. However, higher-tier methods generally require extensive resources for data collection, so it may not be feasible to use these methods for every category. It is therefore *good practice* to identify those categories that have the greatest contribution to the total magnitude of inventory emissions, removals, and/or uncertainty, to make the most efficient use of available resources. By identifying the *key categories* in the national inventory, inventory compilers can prioritize their efforts and improve the overall estimates. The purpose, general rules, and approaches for the *key category* analysis of the whole greenhouse gas inventory are presented in Chapter 4 in Volume 1 of the *2006 IPCC Guidelines*.

According to Section 4.2 in Volume 1 of the 2006 IPCC Guidelines, the general rules for performing the key category analysis are:

- The analysis should be performed at the level of IPCC categories or subcategories for which IPCC methods and/or decision trees are provided.
- Each greenhouse gas emitted from each category should be considered separately, unless there are specific methodological reasons for treating gases collectively.
- Emissions and removals from a category should also be considered separately, where possible and relevant.

Table 4.1 in Section 4.2 in Volume 1 of the 2006 IPCC Guidelines gives a recommended level at which the key category analysis should be performed. Countries may, however, choose to perform the quantitative analysis at a more disaggregated level than suggested in the table.

Key category analyses are performed using two approaches. Approach 1 is based on level and trend assessments. In the level assessment under Approach 1, categories of the inventory are listed in the order of absolute values of their contribution to the sum of the absolute value of emissions and removals, and the largest categories contributing to 95% of this sum are considered key categories. The trend assessment under Approach 1 analyses the contribution of a category to the trend and if the trend of the category is significantly different from that of the inventory. The categories contributing most to 95% of the trend are considered key categories. Section 4.3.1 in Chapter 4 in Volume 1 of the 2006 IPCC Guidelines presents the details on the key category analysis. Approach 2 is based on similar level and trend assessments, but it also takes into account uncertainties of the categories included in the analysis (for details, see Section 4.3.2 in Chapter 4 in Volume 1 of the 2006 IPCC Guidelines).

Countries are encouraged to undertake *key category* analysis using Approaches 1 and 2, because Approach 2 can provide additional insight, e.g. on the order in which to tackle categories identified in Approach 1.

Countries are also encouraged to include qualitative criteria in the *key category* analysis (see Section 4.3.3 in Chapter 4 in Volume 1 of the 2006 IPCC Guidelines). If quantitative *key category* analysis has not been carried out due to lack of completeness in the inventory, it is *good practice* to use qualitative criteria to identify *key categories*.

7.4.2 Key category analysis including the categories affected by the Wetlands Supplement

According to Table 4.1, Chapter 4 in Volume 1 of the 2006 IPCC Guidelines, the appropriate aggregation level for land use CO₂ emissions (carbon stock changes) distinguishes the emissions or removals for lands remaining and lands converted to each of the six land-use categories. Thus, twelve categories need to be distinguished. This approach is considered appropriate, as the CO₂ emissions/removals from the land-use categories are generally estimated using the same or similar generic methodologies and also using the same activity data (area data).

The Wetlands Supplement introduces new subcategories and more detailed guidance for some categories in the AFOLU Sector. Also, the Wastewater Treatment category in the Waste Sector is complemented with an additional treatment system (constructed wetlands). Despite these changes, inventory compilers should continue to perform the key category analysis at the level suggested in Table 4.1, Chapter 4 in Volume 1 of the 2006 IPCC Guidelines. In addition, inventory compilers should determine which pools and subcategories are significant. The significance of the categories and subcategories affected by the Wetlands Supplement should be assessed using the general rule that a subcategory is significant if it accounts for 25-30% of its key category (see decision trees in Figures 1.2 and 1.3 in Chapter 1 in Volume 4 of the 2006 IPCC Guidelines).

In the quantitative *key category* analysis, when emissions/removals from a specific activity, such as conversion of forest to other land uses, are estimated using the same methodology, but spread out among different land-use change categories, inventory compilers should identify and sum up the emission/removal estimates for this activity and compare its magnitude with the smallest category identified as key. If this sum is larger than the smallest category identified as key, the activity in question should be considered key. Countries should assess whether this rule would be applicable to their circumstance for categories addressed in this *Wetlands Supplement*.

7.5 COMPLETENESS

Complete greenhouse gas inventories include estimates of emissions and removals from the sources and sinks for which methodological guidance is provided in the 2006 IPCC Guidelines and the Wetlands Supplement unless the specific sources and sinks do not occur on the national territory. The decision tree in Figure 1.1 and Table 1.3 in Chapter 1 of this report provide guidance on the links between guidance in the 2006 IPCC Guidelines and the Wetlands Supplement to help countries in ensuring complete coverage of all relevant categories in the inventory.

A country may consider that a disproportionate amount of effort would be required to collect data for a category or a gas from a specific category that would be insignificant in terms of the overall level and trend in national emissions. The *Wetlands Supplement* addresses sources and sinks for which the significance varies considerably by country. For instance, some wetland and drained soil types occur only in some regions of the world. The amount of organic soils may be very small in some countries and tidal effects on emissions would be applicable only to coastal countries. In circumstances where the supplementary guidance is not applicable to a country or emissions/removals are not reported due to their insignificance, they should use the notation keys 'NO' (not occurring) and 'NE' (not estimated) respectively. For details on the use of the notation keys, the inventory compilers should refer to Section 8.2.5 in Volume 1 of the 2006 IPCC Guidelines. It is good practice to provide justification for each emission estimate for which the notation key 'NE' is used.

7.6 TIME SERIES CONSISTENCY

7.6.1 Overview of time series issues

Greenhouse gas inventory methods should be consistent for an entire time series so that each year in the time series can be compared with other years. This provides countries with information to properly assess temporal trends in greenhouse gas emissions and removals and the effectiveness of emissions reduction measures. Issues that will affect time series consistency include:

- changes and refinements to scientific methods due to research advances
- addition of new categories
- data gaps
- correction of errors

In a consistent time series, changes in emissions or removals over time are due to real phenomena in the field rather than any influence of the above set of circumstances.

This *Wetlands Supplement* includes substantial changes to the 2006 IPCC Guidelines methods for soil organic matter and refines the subcategories within all land-use categories. This will make necessary the recalculation of results from previous years to produce a consistent time series.

This section summarises material from the 2006 IPCC Guidelines, including Chapter 5 in Volume 1 and Chapter 7 in Volume 4. It also adds recent scientific information described in Chapters 2-6 of this Wetlands Supplement.

7.6.2 Methods for producing consistent time series

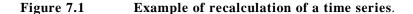
This section provides guidance for producing consistent time series of emissions and removals for the categories and subcategories addressed in this *Wetlands Supplement*. It presents the information by the tiers that inventory compilers already use to estimate emissions and removals.

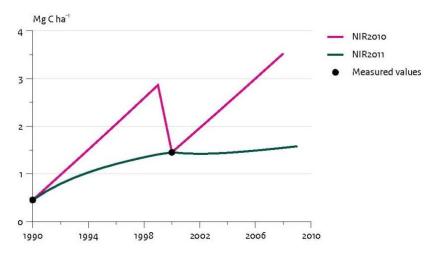
All tiers - Recalculate an entire data series when changing from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry, and 2006 IPCC Guidelines to the Wetlands Supplement, when methods are refined due to scientific advances, new data become available, QC finds errors in previous estimates, or a land classification changes. For data gaps, it is good practice to clearly report where an inventory presents measured or monitored results and where it presents model output.

Tier 1 – Use the activity data for years available in the default sources presented in the *Wetlands Supplement* and the *2006 IPCC Guidelines* or national data sources, where available, and fill gaps using appropriate methods in Section 5.3, Chapter 5 in Volume 1 of the *2006 IPCC Guidelines*.

Tiers 2 and 3 - To fill data gaps, examine available historical sources, administrative records, aerial photographs, or remote sensing and use appropriate methods in Section 5.3, Chapter 5 in Volume 1 the 2006 IPCC Guidelines.

Alternatively, interpolate using a function that models empirical trends or underlying processes. Identify years where the inventory presents measured or monitored results and where it presents model output. Some examples of producing consistent time series include field validation of model dead wood time series in the Netherlands national greenhouse gas inventory (van der Maas *et al.*, 2011; Figure 7.1), data gap filling of CO₂ fluxes from Everglades National Park, USA (Barr *et al.*, 2010), and filling of night-time gaps in ecosystem respiration in Lake Victoria wetlands, Uganda (Saunders *et al.*, 2012). The case of the Netherlands is an example that illustrates recalculation of a time series to improve consistency. When field measurements of dead wood showed that modelled estimates were not accurate, the inventory agency revised the parameters in its dead wood model and recalculated the entire time series (van der Maas *et al.*, 2011; Figure 7.1). Refer to Section 5.3, Chapter 5 in Volume 1 of the *2006 IPCC Guidelines* for detailed steps of filling historical gaps by splicing and for the use of surrogate parameters.





The 2011 national inventory report (NIR) for the Netherlands (van der Maas *et al.*, 2011) provided a more accurate time series of the carbon stock in dead wood than previous inventories. Measured values of dead wood stocks in the Netherlands national forest inventory (black dots) showed that national greenhouse gas inventories prior to 2011 (purple upper line) overestimated the build-up of the carbon stock. Inventory compilers found that their model underestimated the removal of dead wood from forests. Adjustment of that parameter generated a model time series (green lower line) that met the measured values.

7.7 QUALITY ASSURANCE AND QUALITY CONTROL

7.7.1 Overview of quality issues

Quality assurance and quality control are procedures to improve the accuracy, transparency, consistency, comparability, and completeness of inventories. Effectively implemented quality procedures can reduce uncertainties of greenhouse gas inventories. Quality control (QC) is a system of routine activities to assess, improve or maintain the quality of the inventory as it is being compiled. Quality assurance (QA) is a planned system of review procedures conducted by personnel not directly involved in the inventory and performed on a completed inventory. This section summarises material from the 2006 IPCC Guidelines, including Volume 1, Chapter 6 and Volume 4, Chapter 7. It also adds recent scientific information described in Chapters 2-6 of this Wetlands Supplement.

7.7.2 Quality assurance and quality control methods

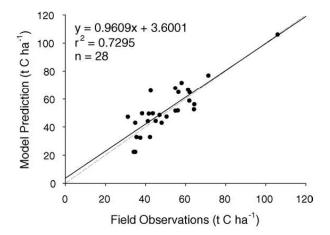
Provide routine and consistent checks to ensure data integrity, correctness, and completeness. Identify and address errors and omissions. Document and archive inventory material and record all QC activities. Check labelling, transcription, and other clerical issues related to data entry (See complete list in Table 6.1, Volume 1 of the 2006 IPCC Guidelines). Double-check outlying values against data sources. Check final results against previous years and published values. Compare inventories with results from similar ecosystems in other countries. Conduct an area-balance for land-use category areas and, when applicable, a mass-balance for greenhouse gas emissions and removals. Develop automated data control procedures. It is *good practice* to prioritize *key categories* for more extensive QA and QC.

Where default values are used, ensure that they reflect the country's conditions because inappropriate default values increase uncertainty.

Where higher tiers are used, check estimates against local sources for activity data, emissions factors, and other variables. Check scientific literature for any new scientific information.

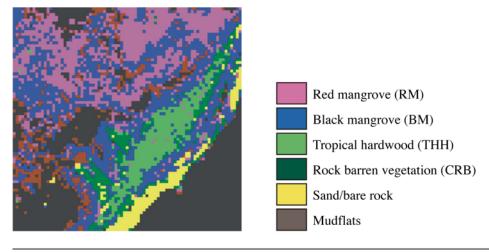
Computer models can be validated against field measurements and resulting differences should be included in the calculation of uncertainty (Section 7.2.1). The validation measure can be a correlation of predicted and measured values (Figure 7.2; Miehle *et al.*, 2006), fractional agreement of modelled and observed data (Figure 7.3; Chadwick, 2011), or other variable. Separate the data set used for calibration of a model from the data set used for validation of the model. When more than one model is available for a particular parameter, intercomparison of model output can provide indications of the robustness of individual models. Comparison of Tier 3 models with estimates using Tier 1 and Tier 2 methods can serve that same purpose. IPCC (2011) provides numerous specific examples of model development, calibration, and validation.

Figure 7.2 Example of validation of a model for quality control



Values of aboveground biomass derived from field measurements of *Eucalyptus globulus* in Australia (x-axis) provide data to validate the accuracy of output from the Forest-Denitrification decomposition (DNDC) model (y-axis) (Miehle *et al.*, 2006). The correlation coefficient (r) and significance probability (not shown) are validation measures of the model. More observed values and a wider range of carbon densities would improve the validation.

Figure 7.3 Example of validation of remote sensing data for quality control



Class	RM	ВМ	ТНН	CRB	Sand/ Rock	Mudflats	Asphalt	Omission (%)
(a) IKONOS o	classificati	on: overall	accuracy	= 83.3%;	kappa coe	fficient = 0	.79	
RM	82.0	10.3	6.2	0.43	0	1.1	0	18.0
BM	3.6	77.6	2.3	9.9	0.33	6.3	0	22.4
THH	7.1	6.9	73.8	11.7	0.48	0	0	26.2
CRB	0	3.3	1.3	93.4	2.0	0	0	6.6
Sand/Rock	0	0	0	0	100	0	0	0
Mudflat	1.5	1.5	O	1.4	6.0	89.6	0	10.5
Asphalt	0	0	0	0	13.51	0	86.5	13.5
Commission (%)	9.9	27.2	11.4	22.3	10.3	28.6	0	

The map shows wetlands cover in part of Florida, USA, derived from an Ikonos satellite image (Chadwick, 2011). The table is an error matrix that shows the fraction of pixels (%) where the Ikonos-derived wetlands cover class (columns) matches the class directly observed in the field (rows). The overall accuracy (83%) is the validation measure. The column 'omission' gives the fraction of observed pixels that the Ikonos cover classification missed. The row 'commission' gives the fraction of Ikonos-derived wetlands cover pixels that the classification incorrectly identified.

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ANNEX 7A.1

WORKSHEETS

This annex provides worksheets for use in estimating greenhouse gas emissions and removals based on Tier 1 methods given in the *Wetlands Supplement*. Most of the worksheets included in this annex are new ones that are not included in Annex 1, Volume 4 of the 2006 IPCC Guidelines. However, the following 6 worksheets update or replace the existing worksheets in Annex 1, Volume 4 of the 2006 IPCC Guidelines.

• Worksheet for Land Remaining in a Land-use Category or Land Converted to a New Land-use Category: Annual On-site Carbon Emissions and Removals from Drained Inland Organic Soils (Page 7.26)

This sheet replaces the existing worksheets for Annual Change in Carbon Stocks in Organic Soils for the six land-use categories (e.g. existing worksheets on pages A1.23 and A1.27, Annex 1, Volume 4) in the 2006 IPCC Guidelines.

• Worksheet for Direct N₂O Emissions from Managed Soils (Page 7.29)

This sheet updates the existing worksheet for Direct N_2O Emissions from Managed Soils on page A1.58, Annex 1, Volume 4 of the 2006 IPCC Guidelines.

Worksheet for Cropland Remaining Cropland: Annual change in carbon stocks in mineral soils (Page 7.44)

This sheet updates the existing worksheet for Annual Change in Carbon Stocks in Mineral Soils for Cropland Remaining Cropland on page A1.22, Annex 1, Volume 4 of the 2006 IPCC Guidelines.

• Worksheet for Land (non-Cropland) remaining in a Land-use Category: Annual change in carbon stocks in mineral soils (Page 7.45)

This sheet updates the existing worksheets for Annual Change in Carbon Stocks in Mineral Soils for land remaining in the same land use category for land use category other than Cropland (e.g. existing worksheet on page A1.28, Annex 1, Volume 4) in the 2006 IPCC Guidelines.

Worksheet for Land Converted to a Cropland: Annual change in carbon stocks in mineral soils (Pages 7.46-7.47)

This sheet updates the existing worksheet on Annual Change in Carbon Stocks in Mineral Soils for Land Converted to Cropland on page A1.26, Annex 1, Volume 4 of the 2006 IPCC Guidelines.

• Worksheet for Land Converted to a New Land-use Category (non-Cropland): Annual change in carbon stocks in mineral soils (Page 7.48)

This sheet updates the existing worksheets for Annual Change in Carbon Stocks in Mineral Soils for land converted to a new land use category other than Cropland (e.g. existing worksheet on page A1.32, Annex 1, Volume 4) in the 2006 IPCC Guidelines.

CHAPTER 2—DRAINED INLAND ORGANIC SOILS

	Sector	Agriculture, Foresti	ry and Other Land Us	se			
	Category		Land Remaining in a Land-use Category OR Land Converted to a New Land-use Category ¹ : Annual on-site carbon emissions and removals from drained Inland				
	Category code	[To be specified by	the inventory compi	ler] ²			
	Sheet	2 of 3 (earlier was 2	2 of 2)				
	Equation	Equation 2.2 (2006 IPCC Guidelines)		Equation 2.3 (Wetlands Supplement)			
Land-use	category	Subcategories for reporting year	Land area of drained inland organic soils in a land-use category in climate domain c, nutrient status n, and drainage class d	Emission factors for drained inland organic soils, by climate domain c, nutrient status n, and drainage class d	Annual on-site CO ₂ -C emissions/removals from drained inland organic soils		
			(ha)	(tonnes C ha ⁻¹ yr ⁻¹)	(tonnes C yr ⁻¹)		
Initial land use ³	Land use during reporting year			Table 2.1 of the Wetlands Supplement	CO ₂ -C _{soil-onsite} = A * EF		
			Α	EF	CO ₂ -C _{soil-onsite}		
		(c)					
	Total						

¹ Sub-totals of emissions for each land pre-conversion land-use category will have to be calculated for conversion categories.
² This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

³ For conversion categories, if data by initial land use are not available, use only "non-LU" in this column.

Sector Agriculture, Forestry and Other Land Use								
	Category	Land Remaining in a Land-use Category OR Land Converted to a New Land-use Category: Annual off-site emissions from drained inland organic soils						
Cate	gory code	[To be specified by the inver	ntory compiler] ¹					
	Sheet	3 of 3						
	Equation	Equation 2.2 (2006 IPCC Equation 2.5 (Wetlands Supplement)						
Land-use	category	Subcategories for reporting	Land area of drained inland organic soils in a land-use category in climate zone c and nutrient status n	Emission factors for annual CO ₂ emissions due to DOC export from drained inland organic soils, by climate zone c and nutrient status n	Annual off-site CO ₂ -C emissions from drained inland organic soils			
Initial	Land use during	year	(ha)	(tonnes C ha ⁻¹ yr ⁻¹)	(tonnes C yr ⁻¹)			
land use	reporting year			Table 2.2 of the Wetlands Supplement				
			Α	EF	CO_2 - C_{DOC} = A * EF			
		(a)						
		(b)						
		(c)						
		Total						

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

	Sector	Agriculture, Forestry and Other Land Use									
	Category	Land Remaining in a Land-use Category OR Land Converted to a New Land-use Category¹: Annual CH₄ emissions from drained inland organic soils [To be specified by the inventory compiler]² 1 of 1									
Cate	gory code										
	Sheet										
Equation		Equation 2.2 (2006 IPCC Guidelines)		Equation 2.6 (Wetlands Supplement)							
Land-use category		Subcategories for reporting year	Land area of drained inland organic soils in a land-use category in climate zone c, nutrient status n and peatland type p	Fraction of the total area of drained inland organic soil which is occupied by ditches ⁴	Emission factors for direct CH₄ emissions from drained organic soils, by climate zone c and nutrient status n	Emission factors for CH₄ emissions from drainage ditches, by climate zone c and peatland type p	Annual CH ₄ -C loss from drained inland organic soils				
			(ha)	(dimensionless)	(tonnes CH ₄ ha ⁻¹ yr ⁻¹)	(tonnes CH ₄ ha ⁻¹ yr ⁻¹)	(tonnes CH ₄ yr ⁻¹)				
Initial land use ³	Land use during				Table 2.3 of the Wetlands Supplement	Table 2.4 of the Wetlands Supplement					
iana use	reporting year		А	Frac _{ditch}	EF _{CH4_land}	EF _{CH4_ditch}	CH_4 - $C_{organic} = A * [(1-Frac_{ditch})*EF_{CH4_land} + Frac_{ditch}*EF_{CH4_ditch}]$				
		(a)	· · · · · · · · · · · · · · · · · · ·	·							
		(b)									
		(c)									
	Total										

Sub-totals of emissions for each land pre-conversion land-use category will have to be calculated for conversion categories.

This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

For conversion categories, if data by initial land use are not available, use only "non-LU" in this column.

Table 2.4, Chapter 2 of the Wetlands Supplement contains indicative values of Frac_{ditch}

	Sector	Agriculture, Forestry and Other Land Use								
	Category	Direct N₂O Emissions from Managed Soils								
	Category code 3C4									
	Sheet	2 of 2								
	Equation		Equation	on 11.1 of 2006 IPCC	Guidelines and Ed	quation 2.7 of the M	etlands Supplement			
		Annual area of managed/drained organic soils	Emission factor for N₂O emissions from drained/managed organic soils	Annual direct N ₂ O-N emissions produced from managed organic soils	Amount of urine and dung N deposited by grazing animals on pasture, range and paddock	Emission factor for N₂O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals	Annual direct N₂O emissions from urine and dung inputs to grazed soils	Annual direct N₂O emissions from urine and dung inputs to grazed soils		
Anthropogenic	N input type ^{1,2}	(ha)	(kg N₂O-N ha ⁻¹ yr ⁻¹)	(kg N₂O-N yr ⁻¹)	(kg N yr ⁻¹)	[kg N₂O-N (kg N input) ⁻¹]	(kg N₂O-N yr ⁻¹)	(kg N₂O-N vr ⁻¹)		
			Table 11.1 (2006 IPCC Guidelines) and Table 2.5 (Wetlands Supplement)	$N_2O-N_{OS} = F_{OS} * EF_2$	(i.g. v.): /	Table 11.1	$N_2O-N_{PRP} = F_{PRP} * EF_{3PRP}$	$N_2O_{Direct}-N = N_2O-N_{N input} + N_2O-N_{OS} + N_2O-N_{PRP}$		
		Fos	EF ₂	N₂O-N _{os}	F_{PRP}	EF _{3PRP}	N ₂ O-N _{PRP}	N ₂ O _{Direct} -N		
	CG, Bor									
	CG, Temp									
	CG, Trop									
Managed	F, Bor, NR									
organic soils	F, Bor, NP									
	F, Temp, NR									
	F, Temp, NP									
	F, Trop									
Urine and dung inputs to grazed	CPP									
soils	SO									
To				<u> </u>	and (Tana) Newsians D	inh (NID) and New in a C	4	and a second		

¹ The area must be disaggregated by Cropland and Grassland (CG), Forest (F), Temperate (Temp), Tropical (Trop), Nutrient Rich (NR), and Nutrient Poor (NP) categories, respectively, see Equation 11.1 in Volume 4 of the 2006 IPCC Guidelines.

² The amount must be disaggregated by CPP and SO, which refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively. See Equation 11.1 in Volume 4 of the 2006 IPCC Guidelines.

	Sector	Agriculture, F	Agriculture, Forestry and Other Land Use											
	Category	Emissions from Burning of Drained Inland Organic Soils in a Land-use Category (Land Remaining in a Land-use Category OR Land Convergery) New Land-use Category)												
Category code [To be specified by the inventory compiler] ¹														
	Sheet	1 of 1												
	Equation	Equation 2.2 (2006 IPCC Guidelines)	Equation 2.8 (Wetlands Supplement)											
Land-use category			Area burnt	Mass of fuel available for combustion ⁴	Combustion factor ⁴	_	sion factor for ach GHG	CO ₂ emissions from fire	CH ₄ emissions from fire	CO emissions from fire				
	Land	Subcategories for reporting year ³	(ha)	(tonnes ha ⁻¹)	(-)		[g GHG dm burnt) ⁻¹]	(tonnes CO ₂)	(tonnes CH ₄)	(tonnes CO)				
Initial land use ²	use during reporting year			Table 2.6 of the Wetlands Supplement	Table 2.6 of the Wetlands Supplement		le 2.7 of the ds Supplement	L_{fire} - $CO_2 =$ $A * M_B * C_f * G_{ef} * 10^{-3}$	L_{fire} -CH ₄ = A * M _B * C _f * G _{ef} * 10 ⁻³	L _{fire} -CO = A * MB * Co * Gef * 10 ⁻³				
			Α	M _B	C _f		G_{ef}	L _{fire} -CO ₂	L _{fire} -CH ₄	L _{fire} -CO				
		(a)				CO ₂								
						CH₄								
						СО								
						CO ₂								
		(b)				CH₄								
						СО								
						CO ₂								
	Total					CH ₄								
				D. Inventory compilers abo		CO			rahaat ia waad ta aalawlat					

This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

For conversion categories, similar tables should be completed separately for each initial land use, and subtotals must be added up. If data by initial land use are not available, use only "non-LU" in this column.

³ For each subcategory, use separate lines for each non-CO₂ greenhouse gas.
⁴ Where data for M_B and C_f are not available, a default value for the amount of fuel actually burnt (M_B * C_f) can be used (Table 2.6 of *Wetlands Supplement*). In this case, M_B takes the value taken from the table, whereas C_f must be 1.

CHAPTER 3—REWETTED ORGANIC SOILS

	Sector	Sector Agriculture, Forestry and Other Land Use									
	Category	Annual carbon emis	ssions or removals in	n rewetted organic so	oils						
	Category code [To be specified by the inventory compiler] ¹										
	Sheet 1 of 2 : CO ₂ -C										
Equation				Equation 3.4 (Wet	lands Supplement)	Equation 3.5 (Wes	Equation 3.3 (Wetlands Supplement)				
Land-use category			Area of rewetted organic soils by nutrient status and climate zone	Emission/removal factor for on-site CO ₂ -C by nutrient status and climate zone	On-site CO ₂ -C emissions or removals in rewetted organic soils	Emission factor for DOC	Off-site CO ₂ -C emissions from DOC in rewetted organic soils	Annual CO ₂ -C emissions or removals by rewetted organic soils			
	Land use during reporting year	Subcategories for reporting year	(ha)	(tonnes CO ₂ -C ha ⁻¹ yr ⁻¹)	(tonnes CO ₂ -C yr ⁻¹)	(tonnes CO ₂ -C ha ⁻¹ yr ⁻¹)	(tonnes CO ₂ -C yr ⁻¹)	(tonnes CO ₂ -C yr ⁻¹)			
Initial land use				Table 3. 1	= A * EF _{CO2}	Table 3. 2	= A * EF _{DOC_REWETTED}	= CO ₂ -C _{composite} + CO ₂ -C _{DOC}			
			Α	EF _{CO2}	CO ₂ -C _{composite}	EF _{DOC_REWETTED}	CO ₂ -C _{DOC}	CO ₂ -C _{rewetted org soil}			
		(a)									
		(b)			_						
		(c)									
	Total										

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

	Sector	Agriculture, Forestry and Other Land Use								
	Category	Annual carbon emissions or removals in rewetted organic soils								
	Category code	[To be specified by the inventory compiler] ¹								
	Sheet	2 of 2 : CH ₄								
	Equation		Equation 3.8 (Wetlands Supplement)							
Land-use	category	Subcategories for reporting year	Area of rewetted organic soils by nutrient status and climate zone	Emission factor for CH ₄ -C by nutrient status and climate zone	On-site CH ₄ -C emissions or removals in rewetted organic soils	On-site CH ₄ emissions or removals in rewetted organic soils				
	Land use during reporting year	reporting year	(ha)	(kg CH ₄ -C ha ⁻¹ yr ⁻¹)	(tonnes CH ₄ -C yr ⁻¹)	(tonnes CH ₄)				
Initial land use				Table 3. 3	= A * EF _{CH4} / 1000	= CH ₄ -C _{soil} * 16/12				
			A	EF _{CH4}	CH ₄ -C _{soil}	CH _{4 rewetted org soil}				
		(a)								
		(b)								
		(c)								
	Total			propriato catogory codo bor		_				

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

CHAPTER 4—COASTAL WETLANDS

	Sector	or Agriculture, Forestry and Other Land Use								
	Category	Coastal wetlan	d with woody perenr	nial biomass or Fores	st Land					
Ca	Category code [To be specified by the inventory compiler] ¹									
	Sheet	1 of 5								
	Equation		Equation 2.9 (2006 IPCC Guidelines)	Equation	Equation 2.9 (2006 IPCC Guidelines)					
Land-use	Land-use category		Area	Average annual aboveground biomass growth	Ratio of belowground biomass to aboveground biomass	Average annual biomass growth above- and belowground	Carbon fraction of dry matter	Annual increase in biomass carbon stocks due to biomass growth		
		Subcategories for reporting	(ha)	(tonnes dm ha ⁻¹ yr ⁻¹)	[tonnes bg dm (tonne ag dm) ⁻¹]	(tonnes dm ha ⁻¹ yr ⁻¹)	[tonnes C (tonne dm) ⁻¹]	(tonnes C yr ⁻¹)		
Initial land use	Land use during reporting year	year	National statistics or international data sources	Table 4.4	Table 4.5	G _{TOTAL} = GW * (1+R)	Table 4.2	ΔC _G = A * G _{TOTAL} *		
			Α	Gw	R	G _{TOTAL}	CF	ΔC_{G}		
		(a)								
		(b)								
		(c)								
	Total									

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

	Sector	Agriculture, Forestr	re, Forestry and Other Land Use						
	Category	Coastal wetland wit	th woody perennial biomass or Forest Land: Loss of carbon from wood removals						
	Category code	[To be specified by	the inventory compiler] ¹						
	Sheet	2 of 5							
	Equation		Equation	on 2.12 (2006 IPCC G	<i>uidelines</i>) + Equatior				
Land-use	category		Annual wood removal	Biomass expansion factor and wood density for conversion of removals in merchantable volume to total biomass removals (including bark)	Ratio of belowground biomass to aboveground biomass	Carbon fraction of dry matter	Annual carbon loss due to biomass removals		
		Subcategories for reporting year	(m³ yr ⁻¹)	BEF * wood density = [tonnes of biomass removals (m³ of removals) -1]	[tonnes bg dm (tonne ag dm) ⁻¹]	[tonnes C (tonne dm) ⁻¹]	(tonnes C yr ⁻¹)		
Initial land use	Land use during reporting year		National statistics or international data sources	Table 3A.1.10 (<i>2003 GPG</i>) and Table 4.6	Table 4.5	Table 4.2	L _{wood-removals} = H * BCEF _R * (1+R) * CF		
			Н	BCEF	R	CF	L _{wood-removals}		
		(a)							
		(b)							
		(c)							
1	Total			proprieto estegory codo l					

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

	Sector	Agriculture, Fo	Agriculture, Forestry and Other Land Use									
	Category	Coastal wetland	d with woody perenr	nial biomass or Fores	t Land: Loss of c	arbon from fuelwo	ood removals					
Cat	egory code	[To be specified	d by the inventory co	ompiler] ¹								
	Sheet	3 of 5										
	Equation	Equation 2.2 (2006 IPCC Guidelines)	Equation 2.13 (2006 IPCC Guidelines) + Equation 4.1 (Wetlands Supplement)									
Land-use category		Subcategories	Annual volume of fuelwood removal of whole trees	Biomass expansion factor and wood density for conversion of removals in merchantable volume to total biomass removals (including bark)	Ratio of belowground biomass to aboveground biomass	Annual volume of fuelwood removal as tree parts	Basic wood density	Carbon fraction of dry matter	Annual carbon loss due to fuelwood removal			
Initial land	Land use during	for reporting year	(m³ yr ⁻¹)	BEF * wood density = [tonnes of biomass removals (m³ of removals) -1]	[tonnes bg dm (tonne ag dm)	(m³ yr-¹)	tonnes m ⁻³	[tonnes C	(tonnes C yr ⁻¹)			
use	reporting year			FAO or other statistics	Table 3A.1.10 (2003 GPG) and Table 4.6	Table 4.5	FAO or other statistics	Table 4.6	Table 4.2	$L_{fuelwood} = [FG_{trees} *$ $BCEF_R * (1+R) +$ $FG_{part} * D] * CF$		
			FG _{trees}	BCEF	R	FG _{part}	D	CF	L _{fuelwood}			
		(a)										
		(b)										
		(c)										
	Total											

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

	Sector	Agriculture, Forestry and Other Land Use									
	Category	Coastal wetland with woody perennial biomass or Forest Land: Loss of carbon from disturbance									
Ca	tegory code	[To be specified by the inventory compiler] ¹									
	Sheet										
	Equation		Equation 2.14 (2006 IPCC Guidelines)								
Land-use	category		Area affected by disturbances	Average aboveground biomass of areas affected	Ratio of belowground biomass to aboveground biomass	Carbon fraction of dry matter	Annual other losses of carbon	Annual decrease in carbon stocks due to biomass loss			
		ng ting	(ha)	(tonnes dm ha ⁻¹)	[tonnes bg dm (tonne ag dm) ⁻¹]	[tonnes C (tonne dm) ⁻¹]	(tonnes C yr ⁻¹)	(tonnes C yr ⁻¹)			
Initial land use	Land use during reporting year		National statistics or international data sources	Table 4.3	Table 4.5	Table 4.2	L _{disturbances} = A * B _W * (1+R) * CF * fd	ΔC _L =L _{wood} - removals + L _{fuelwood} + L _{disturbances}			
			Adisturbance	Bw	R	CF	Ldisturbances	ΔCL			
		(a)									
		(b)									
		(c)									
	Total	Lant's d'atomba	a standardar	- Code 20129 - 0-6	(1.4) 12-2-2-2	and a section of the section of	a may anly ramaya a nar	1:22 (2.22 (1.2.22)			

Note: fd = fraction of biomass lost in disturbance; a stand-replacing disturbance will kill all (fd = 1) biomass while an insect disturbance may only remove a portion (e.g. fd = 0.3) of

the average biomass C density.

This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

Sector	Agriculture, F	orestry and Other Lar	nd Use			
Category	Initial change production po		ocks due to extraction a	ctivities (excavation, co	onstruction of aquacultu	re ponds, construction of salt
Category code	[To be specifi	ed by the inventory co	ompiler] ¹			
Sheet	5 of 5					
Equation				Equation 4.4 (Wetland	ds Supplement)	
		Area converted ²	Biomass C stock after conversion	Biomass C stock before converstion	Carbon fraction	Initial change in carbon stocks in biomass
	Sub- categories	(ha)	(tonnes dm ha ⁻¹)	(tonnes dm ha ⁻¹)	tonnes C (tonnes dm) ⁻¹	Gg C yr⁻¹
Activity	for reporting year (vegetation type)		default value is zero (0) or national statistics and Table 4.5 (R)	Table 4.3 and Table 4.5 (R) or national statistics	Table 4.2 or national statistics	$\Delta C_{B\text{-}CONVERSION} = (B_{AFTER} * (1+R) - B_{BEFORE} * (1+R)) * CF * A_{CONVERTED} * 10^3$
		A _{CONVERTED}	B _{AFTER} ∗ (1+R)	B _{BEFORE} * (1+R)	CF	$\Delta extsf{C}_ extsf{B-CONVERSION}$
	Mangrove		0			
Excavation	Tidal Marsh ³		0			
	Seagrass Meadow ³		0			
	Mangrove		0			
Construction of	Tidal Marsh ³		0			
aquaculture ponds	Seagrass Meadow ³		0			
	Mangrove	_	0		_	
Construction of salt	Tidal Marsh ³		0			
production ponds	Seagrass Meadow ³		0			
Total						

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code. Inventory compilers may choose "3C14" if this activity takes place outside the national total area.

²Report zero if activity or vegetation type does not occur.

³Tier 2 and referring to Tables 4.9 and 4.10 to for R value.

Sector	Agriculture, F	orestry and Other Lar	nd Use										
Category		in DOM carbon stock		vities (excavation, cons	truction of aquaculture								
Category code	[To be specifi	ied by the inventory co	ompiler] ¹										
Sheet	1 of 1												
Equation		Equation 4.5 (Wetlands Supplement)											
		Area converted ²	DOM _{AFTER}	DOM_{BEFORE}	Initial change in carbon stocks in DOM								
	Sub- categories	(ha)		(tonnes C ha ⁻¹)	(tonnes C ha ⁻¹)	Gg C yr ⁻¹							
Activity	year (vegetation type)		default value is zero (0)	Table 4.7 or national statistics	ΔC _{DOM-CONVERSION} = (DOM _{AFTER} - DOM _{BEFORE}) * ACONVERTED * 10 ⁻³								
		Aconverted	DOM _{AFTER}	DOM _{BEFORE}	$\Delta extsf{C}_{ extsf{DOM-CONVERSION}}$								
Excavation	Mangrove		0										
Construction of aquaculture ponds	Mangrove		0										
Construction of salt production ponds	Mangrove		0										
Total					Tan avaranta vakan thia								

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code. Inventory compilers may choose "3C14" if this activity takes place outside the national total area.

² Report zero if activity or vegetation type does not occur.

Sector	Agriculture, Forestr	y and Other Land U	se	
Category			oves and tidal marsh	es
Category code	3C11			
Sheet	1 of 1			
		Equatio	n 4.9 (Wetlands Supp	lement)
		Area of land of rewetted soils	Emission factor for rewetted soils	Annual CH ₄ emissions from rewetted soils
	Subcategories for	(ha)	(kg CH₄ ha ⁻¹ yr ⁻¹)	(kg CH ₄ yr ⁻¹)
	reporting year		Table 4.14 (organic and mineral soils)	CH _{4SO-REWET} = (A _{REWET} * EF _{REWET})
		A _{REWET}	EF _{REWET}	CH _{4SO-REWET}
	Tidal freshwater marsh			
	Tidal salt marsh and mangrove ¹			
Tota	1			
¹ Apply same EF for tidal bra	ackish marsh			

Sector	Agriculture, Forest	ry and Other Land Use	
Category	N ₂ O emissions from	m aquaculture	
Category code	3C12		
Sheet	1 of 1		
		Equation 4.10 (Wetl	ands Supplement)
	Amount of fish production (F)	Emission factor for N ₂ O emissions from fish produced (F) in aquaculture use	Annual N₂O emissions from aquaculture use
	(kg fish yr ⁻¹) [kg N ₂ O-N (kg fish) ⁻¹]		(kg N₂O-N yr ⁻¹)
		Table 4.15	$N_2O-N_{AQ} = F * EF$
	F _F	EF _F	N ₂ O _{AQ}
Total			

Sector	Agriculture, Fo	orestry and Other Land Use									
Category	Initial change ponds)	in soil carbon stocks due to ex	traction actvities (excavation, co	nstruction of aquaculture ponds,	construction of salt production						
Category code	[To be specifie	ed by the inventory compiler]1									
Sheet	1 of 3										
Equation		Equation 4.6 (Wetlands Supplement)									
		Area converted ²	SO _{AFTER}	SO _{BEFORE}	Initial change in carbon stocks in soil						
Activity	Sub- categories for reporting	(ha)	(tonnes C ha ⁻¹)	(tonnes C ha ⁻¹)	Gg C yr ⁻¹						
Activity	year (vegetation type)		default value is zero (0)	Table 4.11 or national statistics	$\Delta C_{SO-CONVERSION} = (SO_{AFTER} - SO_{BEFORE}) * A_{CONVERTED} * 10^{-3}$						
		A _{CONVERTED}	SO _{AFTER}	SO _{BEFORE}	$\Delta \mathbf{C}_{SO-CONVERSION}$						
	Mangrove		0								
Excavation	Tidal Marsh		0								
ZXXXXXXX	Seagrass Meadow		0								
	Mangrove		0								
Construction of	Tidal Marsh		0								
aquaculture ponds	Seagrass Meadow		0								
	Mangrove		0								
Construction of salt	Tidal Marsh		0								
production ponds	Seagrass Meadow		0								
Total											

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code. Inventory compilers may choose "3C14" if this activity takes place outside the national total area.

²Report zero if activity or vegetation type does not occur.

	Sector	Agriculture, Forestr	y and Other Land Us	se					
	Category	CO ₂ -C emissions from	om rewetting, revege	etation and creation					
	Category code	[To be specified by	the inventory compi	ler] ¹					
	Sheet	2 of 3							
	Equation		Equation 4.7 (Wetlands Supplement)						
Land-use	ecategory		Area of land in rewetting ²	Emission factors for CO ₂ -C in rewetting	Area of land in rewetting, revegetation and creation ²	Emission factors for CO ₂ -C in rewetting, revegetation and creation	CO ₂ -C emissions from rewetting, revegetation and creation		
	Land use during reporting year	Subcategories for reporting year	(ha)	(tonnes C ha ⁻¹ yr ⁻¹)	(ha)	(tonnes C ha ⁻¹ yr ⁻¹)	Gg C yr ⁻¹		
Initial land use		(vegetation type)		default value is zero or national data		Table 4.12 or national data	CO ₂ .C _{-SO-RE} = (A _{RE_1} * EF _{RE_1} + A _{RE_2} * EF _{RE_2}) * 10 ⁻³		
			A _{RE_1}	EF _{RE_1}	A _{RE_2}	EF _{RE_2}	CO ₂ -C _{-SO-RE}		
		Mangrove							
		Tidal marsh							
		Seagrass meadow							
1=	Total					this workshoot is used to			

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code. Inventory compilers may choose "3C14" if this activity takes place outside the national total area.

² Depending on how the activity is applied, either rewetting or rewetting, revegetation and creation data can be applied, providing national circumstances and country's available data.

	Sector	Agriculture, Forestr	y and Other Land Us	se					
	Category	CO ₂ -C emissions fr	om drainage in coas	tal wetlands					
	Category code	[To be specified by the inventory compiler] ¹							
	Sheet	3 of 3	3 of 3						
	Equation		Equation 4.8 (Wet	lands Supplement)					
Land-use	category		Area of land in drainage	Emission factors for CO ₂ -C in drainage	CO ₂ -C emissions from drainage				
		Subcategories for reporting year	(ha)	(tonnes C ha ⁻¹ yr ⁻¹)	Gg C yr⁻¹				
Initial land use	Land use during reporting year	(vegetation type)		Table 4.13 or national data	CO ₂ -C _{-SO-DR} = (A _{DR} * EF _{DR}) * 10 ⁻³				
			A _{DR}	EF _{DR}	CO ₂ -C _{-SO-DR}				
		Tidal marsh and mangrove							
1	Total								

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code. Inventory compilers may choose "3C14" if this activity takes place outside the national total area.

CHAPTER 5—INLAND WETLAND MINERAL SOILS

	Sector	Agriculture, F	orestry and	Other Land	Use						
	Category	Cropland Ren	naining Cro	pland: Annu	al change in carbon	stocks in mineral se	oils				
Cate	gory code	[To be specifi	ed by the in	ventory con	npiler] ¹						
	Sheet	1 of 4									
	Equation	Equation 2.2 (2006 IPCC Guidelines)			Equatio	n 2.25, Formulation	A in Box 2.1 of Section 2	.3.3.1 (2006 IPCC Guide	lines)		
	nd-use tegory		Area in the last year of an inventory period	Area at the beginning of an inventory period	Reference carbon stock in the last year of an inventory period	Reference carbon stock at the beginning of an inventory period	Time dependence of stock change factors (D) or number of years over a single inventory time period (T)	Stock change factor for land-use system or sub-system	Stock change factor for manageme nt regime	Stock change factor for input of organic matter	Annual change in carbon stocks in mineral soils
		Sub-	(ha)	(ha)	(tonnes C ha ⁻¹)	(tonnes C ha ⁻¹)	(yr)	(-)	(-)	(-)	(tonnes C yr ⁻¹)
Initial land use	Land use during reporting year	categories for reporting year			Table 2.3 of 2006 IPCC Guidelines for non-IWMS; Table 5.2 of Wetlands Supplement for IWMS ^{2, 4}	Table 2.3 of 2006 IPCC Guidelines for non-IWMS; Table 5.2 of Wetlands Supplement for IWMS ^{2, 4}	(default is 20 yr; if T>D then use the value of T)	Table 5.5 of 2006 IPCC Guidelines for non- IWMS; Table 5.5 of 2006 IPCC Guidelines and Table 5.3 of Wetlands Supplement for IWMS ^{3,4}	Table 5.5 of 2006 IPCC Guidelines	Table 5.5 of 2006 IPCC Guidelines	ΔC _{Mineral} as in Equation 2.25 (2006 IPCC Guidelines)
			A ₍₀₎	A _(0-T)	SOC _{ref(0)}	SOC _{ref(T-0)}	D	F _{LU}	F_{MG}	Fı	$\Delta C_{Mineral}$
		(a)					20				
CL _{non} -	CL _{non-}	(b)					20				
IWMS	IWMS	(c)					20				
		Subtotal									
		(a)					20 20				
CL _{IWMS}	CL _{IWMS}	(b)					20				
		Subtotal					20				
	Tota										

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

² Table 5.2, Chapter 5 of the Wetlands Supplement contains the revised default reference SOC stocks (SOC_{REF}) for Inland Wetland Mineral Soils.

³ Table 5.3, Chapter 5 of the *Wetlands Supplement* contains the new values of stock change factors for land-use (FLU) for Inland Wetland Mineral Soils.
⁴ IWMS = Inland Wetland Mineral Soils

	Sector	Agriculture, F	orestry and Ot	ther Land Use							
	Category	Land (non-Cr	opland) remair	ning in a Land-	use Category: A	nnual change in	carbon stocks i	n mineral soils	i		
Cat	tegory code	[To be specif	ied by the inve	ntory compiler	·] ¹						
	Sheet	2 of 4									
	Equation	Equation 2.2 (2006 IPCC Guidelines)									
Land-use category		Cuth	Area in the last year of an inventory period	Area at the beginning of an inventory period	Reference carbon stock in the last year of an inventory period	Reference carbon stock at the beginning of an inventory period	Time dependence of stock change factors (D) or number of years over a single inventory time period (T)	Stock change factor for land-use system or sub-system	Stock change factor for management regime	Stock change factor for input of organic matter	Annual change in carbon stocks in mineral soils
		Sub- categories	(ha)	(ha)	(tonnes C ha ⁻¹)	(tonnes C ha ⁻¹)	(yr)	(-)	(-)	(-)	(tonnes C yr ⁻¹)
Initial land use	Land use during reporting year	for reporting year			Table 2.3 of 2006 IPCC Guidelines for non-IWMS; Table 5.2 of Wetlands Supplement for IWMS ^{2, 3}	Table 2.3	(default is 20 yr; if T>D then use the value of T)	Table 5.5	Table 5.5	Table 5.5	ΔC _{Mineral} as in Equation 2.25
			A ₍₀₎	A _(0-T)	SOC _{ref(0)}	SOC _{ref(T-0)}	D	FLU	F _{MG}	Fı	$\Delta C_{Mineral}$
		(a)					20				
		(b)					20				
		(c)					20				
	Total										

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

² Table 5.2, Chapter 5 of the *Wetlands Supplement* contains the revised default reference SOC stocks (SOC_{REF}) for Inland Wetland Mineral Soils.

³ IWMS = Inland Wetland Mineral Soils

	Sector	Agriculture, F	riculture, Forestry and Other Land Use and Converted to a Cropland: Annual change in carbon stocks in mineral soils											
	Category	Land Convert	ed to a Cropla	and: Annual c	hange in carbo	n stocks in m	ineral soils							
Cate	egory code	[To be specifi	ed by the inv	entory compil	er] ¹									
	Sheet	3 of 4												
	Equation	Eq. 2.2 (2006 IPCC Guidelines)	Equation 2.25, Formulation B in Box 2.1 of Section 2.3.3.1 (2006 IPCC Guidelines) delines)											
Land-use	ecategory	Subcategories	Area for land-use change by climate and soil combination	Reference carbon stock for the climate/soil combination	Time dependence of stock change factors (D) or number of years over a single inventory time period (T)	Stock change factor for land-use system in the last year of an inventory time period	Stock change factor for management regime in last year of an inventory period	Stock change factor for C input in the last year of the inventory period	Stock change factor for land- use system at the beginning of the inventory time period	Stock change factor for management regime at the beginning of the inventory time period	Stock change factor for C input at the beginning of the inventory time period	Annual change in carbon stocks in mineral soils		
		of unique climate, soil, land-use change and	(ha)	(tonnes C	(yr)	(-)	(-)	(-)	(-)	(-)	(-)	(tonnes C yr ⁻¹)		
Initial land use ²	Land use during reporting year	management combinations		Table 2.3; Chap 2, Sec. 2.3.3.1 of 2006 IPCC Guidelines & Table 5.2 of Wetlands Supplement for IWMS ^{3,5}	(default is 20 yr; if T>D then use the value of T)	Table 5.5 of 2006 IPCC Guidelines & Table 5.3 of Wetlands Supplement for IWMS ^{4,5}	Table 5.5 of 2006 IPCC Guidelines	Table 5.5 of 2006 IPCC Guidelines	Table 5.10 of 2006 IPCC Guidelines	Table 5.10 of 2006 IPCC Guidelines	Table 5.10 of 2006 IPCC Guidelines	ΔC _{Mineral} as in Equation 2.25 (2006 IPCC Guidelines)		
			A ₍₀₎	SOC _{ref}	D	F _{LU(0)}	FMG(0)	F _{I(0)}	F _{LU(0-T)}	F _{MG(0-T)}	F _{I(0-T)}	$\Delta C_{Mineral}$		
FL	CL	(a)			20									
FL	CL	(b)			20									
	Sub-total													
GL	CL	(a)			20									
GL	CL	(b)			20									
	Sub-total													
WL	CL	(a)			20									
V V L	OL	(b)			20									

	Sub-total							
SL	CL	(a)		20				
SL	CL	(b)		20				
Sub-total Sub-total								
OL	CL	(a)		20				
OL	CL	(b)		20				
Sub-total								
Total			1 00 1					

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

² If data by initial land use are not available, use only "non-CL" in this column.

³ Table 5.2, Chapter 5 of the Wetlands Supplement contains the revised default reference SOC stocks (SOC_{REF}) for Inland Wetland Mineral Soils.

⁴ Table 5.3, Chapter 5 of the Wetlands Supplement contains new values of default stock change factors for land-use (F_{LU}) for Inland Wetland Mineral Soils.

⁵ IWMS = Inland Wetland Mineral Soils

	Sector	Agriculture, F	orestry and	Other Land Use								
	Category	Land Converte	ed to a New	Land-use Category (ı	non-Cropland): <i>A</i>	Annual change	in carbon stock	s in mineral	soils			
Cate	egory code	[To be specific	ed by the ir	ventory compiler] ¹								
	Sheet	4 of 4										
	Equation	Equation 2.2 (2006 IPCC Guidelines)			Equation 2.25, Fo		n Box 2.1 of Sec	tion 2.3.3.1 (2006 IPCC Gui	idelines)		
Land-u	se category	Subcategories of unique climate, soil,	Area for land-use change by climate and soil combination	Reference carbon stock for the climate and soil combination	Time dependence of stock change factors (D) or number of years over a single inventory time period (T)	Stock change factor for land-use system in the last year of an inventory time period	Stock change factor for management regime in last year of an inventory period	Stock change factor for C input in the last year of the inventory period	Stock change factor for land- use system at the beginning of inventory time period	Stock change factor for management regime at the beginning of the inventory time period	Stock change factor for C input at the beginning of the inventory time period	Annual change in carbon stocks in mineral soils
		land-use	(ha)	(tonnes C ha ⁻¹)	(yr)	(-)	(-)	(-)	(-)	(-)	(-)	(tonnes C yr ⁻¹)
Initial Iand use ²	land during	change and management combinations		Table 2.3; Chap. 2, Sec. 2.3.3.1 of 2006 IPCC Guidelines & Table 5.2 of Chapter 5 of the Wetlands Supplement for IWMS ^{3,6}	(default is 20 yr; if T>D then use the value of T)	Table XX ⁵ of in Volume 4 of 2006 IPCC Guidelines	Table 6.2	Table 6.2	Table 5.5 and Table 5.3 of the Wetlands Supplement ⁴ (Cropland); 1 for other uses	Table 5.5 (Cropland); 1 for other uses	Table 5.5 (Cropland); 1 for other uses	$\Delta C_{ ext{Mineral}}$ as in Equation 2.25
			A ₍₀₎	SOC _{ref}	D	F _{LU(0)}	F _{MG(0)}	F _{I(0)}	F _{LU(0-T)}	F _{MG(0-T)}	F _{I(0-T)}	$\Delta C_{Mineral}$
		(a)			20							
		(b)			20							
		(c)			20							
	Sub-tota	al										
1	Total			BB. Inventory compilers sh			da bass Es		and also at the			

¹ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

² If data by initial land use are not available, use only "non-GL" in this column.

³ Table 5.2, Chapter 5 of the Wetlands Supplement contains the revised default reference SOC stocks (SOCREF) for Inland Wetland Mineral Soils.

⁴ Table 5.3, Chapter 5 of the Wetlands Supplement contains new values of default stock change factors for land-use (FLU) for Inland Wetland Mineral Soils.

⁵ Relevant tables from the land-use category chapters in Volume 4 of the 2006 IPCC Guidelines.

⁶ IWMS = Inland wetland mineral soils

Sec	ctor	Agriculture Forestry and Other Land Use (AFOLU)					
Cate	gory	Annual CH ₄ emissions from restored and created wetlands on managed lands with IWMS ^{1,2}					
Catego	ry code	[To be specified by the inventory compiler] ³					
Sh	eet	1 of 1					
Equa	ation	Eq. 2.2 (2006 IPCC Guidelines)	Equation 5.1 (Wet	lands Supplement)			
			Area of managed lands with IWMS	Emission factor from managed lands with IWMS where water level has been raised in climate region			
Initial land use	Land use during	Subcategories for reporting year ⁴	(ha)	(kg CH₄ ha ⁻¹ yr ⁻¹)			
	reporting year			Table 5.4 (Wetlands Supplement)			
			A _{IWMS}	EF _{CH4-IWMS}			
		(a)					
		(b)					
		(c)					
		Total					

¹ IWMS = Inland wetland mineral soils

This worksheet is to be used for CH₄ emissions from managed lands with IWMS other than rice cultivation areas. For CH₄ emissions from rice cultivation please use the worksheets for the category 3C7 (Rice Cultivation) in the 2006 IPCC Guidelines.

³ This worksheet can be used for any category under 3B. Inventory compilers should specify an appropriate category code here. For example, when this worksheet is used to calculate emissions to be reported in the category Forest Land Remaining Forest Land, "3B1a" should be entered as category code.

⁴ Can be stratified according to climate domains for Tier 1 methods.

CHAPTER 6—CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT

Sector	Waste	Waste				
Category	Domestic Wastewater Trea	Domestic Wastewater Treatment and Discharge				
Category Code	4D1	4D1				
Sheet	1 of 3 Estimation of Organ	1 of 3 Estimation of Organically Degradable Material in Domestic Wastewater Treated in Constructed Wetlands				
		STEP 1				
	А	В	С	D		
Type of constructed wetland	Population whose wastewater treated in constructed wetlands	Degradable organic component	Correction factor for industrial BOD discharged in sewers	Organically degradable material in wastewater		
	(P _i)	(BOD)	(I) ²	(TOW _j)		
	cap	(kg BOD cap ⁻¹ yr ⁻¹) ¹		(kg BOD yr ⁻¹)		
				$D = A \times B \times C$		
Surface Flow						
Vertical Subsurface Flow						
Horizontal Subsurface Flow						
Hybrid type						
Semi-natural Treatment Wetlands						
			Total			

 $^{^{1}}$ g BOD cap $^{-1}$ day $^{-1}$ x 0.001 x 365 = kg BOD cap $^{-1}$ yr $^{-1}$

² Correction factor for additional industrial BOD discharged into sewers, (for collected the default is 1.25, for uncollected the default is 1.00) (see page 6.14).

Sector	Waste					
Category	Domestic Wastewater Treatment an	Domestic Wastewater Treatment and Discharge				
Category Code	4D1					
Sheet	2 of 3 Estimation of CH ₄ Emission I	Factor for Domestic Wastewater Treated	d in Constructed Wetlands			
	5	STEP 2				
	Α	В	С			
Type of constructed wetland	Maximum methane producing capacity	Methane correction factor	Emission factor			
	(B _o)	(MCF _j)	(EF _i)			
	(kg CH ₄ kg BOD ⁻¹)		(kg CH₄ kg BOD⁻¹)			
			$C = A \times B$			
Surface Flow						
Vertical Subsurface Flow						
Horizontal Subsurface Flow						
Hybrid type						
Semi-natural Treatment Wetlands						
Note: MCF for hybrid type can be estimated as	area-weighted average of the MCFs of the construc	cted wetland types in hybrid system				

Sector	Waste	Waste				
Category	Domestic Wastewater Treatment	Domestic Wastewater Treatment and Discharge				
Category Code	4D1					
Sheet	3 of 3 Estimation of CH ₄ Emissio	ns from Domestic Wastewater Treated in Cons	structed Wetlands			
		STEP 3				
	А	В	С			
Type of constructed wetlands	Emission factor	Organically degradable material in wastewater	Methane emissions			
	(EF _j)	(TOW _i)	(CH ₄)			
	(kg CH₄ kg BOD ⁻¹)	(kg BOD yr ⁻¹)	(kg CH₄ yr ⁻¹)			
	Sheet 2 of 3	Sheet 1 of 3	C=A x B			
Surface Flow						
Vertical Subsurface Flow						
Horizontal Subsurface Flow						
Hybrid type						
Semi-natural Treatment Wetlands						
		Total				

Sector	Waste						
Category	Industrial Wastewater Treatment and Di	dustrial Wastewater Treatment and Discharge					
Category Code	4D2						
Sheet	1 of 3 Total Organic Degradable Materia	al in Industrial Wastewater Treated in C	onstructed Wetlands				
		STEP 1					
	A	В	С				
Industrial Sector	Yearly flow rate of industrial wastewater treated by constructed wetland	Chemical Oxygen Demand	Total organic degradable material in industrial wastewater treated in constructed wetland				
	(W _{i,j})	(COD _i)	$(TOW_{i,j})$				
	(m³ yr-¹)	(kg COD m ⁻³)	(kg COD yr ⁻¹)				
			C=A x B				
Industrial sector 1							
Industrial sector 2							
Industrial sector 3							
add as needed							
		Total					
Note: Emissions from collected runof	f from agricultural land and landfill leachate treated in c	onstructed wetlands should be reported in this works	heet				

Sector	Waste					
Category	Industrial Wastewater Treatment and Disc	Industrial Wastewater Treatment and Discharge				
Category Code	4D2					
Sheet	2 of 3 Estimation of CH ₄ Emission Factor	for Industrial Wastewater Treated in	Constructed Wetlands			
	STEP 2					
	A	В	С			
Type of constructed wetland	Maximum methane producing capacity	Methane correction factor	Emission factor			
	(Bo)	(MCF _i)	(EF _j)			
	(kg CH₄ kg COD ⁻¹)	(-)	(kg CH₄ kg COD⁻¹)			
			$C = A \times B$			
Surface Flow						
Vertical Subsurface Flow						
Horizontal Subsurface Flow						
Hybrid type						
Semi-natural Treatment Wetlands						
Note: MCF for hybrid type can be estimated as a	area-weighted average of the MCFs of the constructed wetla	and types in hybrid system				

Sector	Waste					
Category	Industrial Wastewater Treatm	ndustrial Wastewater Treatment and Discharge				
Category Code	4D2					
Sheet	3 of 3 Estimation of CH ₄ Emis	ssions from Industrial Wastewater Treated in	n Constructed Wetlands			
		STEP 3				
	A	В	С			
Industrial Sector	Emission Factor	Organically degradable material in wastewater	Methane emissions			
	(EF _j)*	(TOW _{i,j})	(CH ₄)			
	(kg CH₄ kg COD ⁻¹)	(kg COD yr ⁻¹)	(kg CH₄ yr ⁻¹)			
	Sheet 2 of 3	Sheet 1 of 3	C=A x B			
Industrial sector 1						
Industrial sector 2						
Industrial sector 3						
add as needed						
		Total				
*If more than one type of CW is used in an in	dustrial sector the EF would be TOWi,j-w	eighted average of EFs of the CWs used.				

Sector	Waste					
Category	Domestic Waste	Domestic Wastewater Treatment and Discharge				
Category Code	4D1					
Sheet	1 of 2 Estimatio	n of Nitrogen in Eff	luent Treated in Cons	tructed Wetlands		
			STEP1			
	А	В	С	D	E	F
Type of constructed wetlands	Population whose wastewater treated in constructed wetlands	Per capita protein consumption	Fraction of nitrogen in protein	Fraction of non- consumed protein	Fraction of industrial and commercial codischarged protein	Total nitrogen in effluent
	(P _j) (people)	(Protein) (kg/person yr ⁻¹)	(F _{NPR}) (kg N kg protein ⁻¹)	(F _{NON-CON}) (-)	(F _{IND-COM}) (-)	(N) (kg N yr ⁻¹) F = A x B x C x D x E
Surface Flow						
Vertical Subsurface Flow						
Horizontal Subsurface Flow						
Hybrid type						
Semi-natural Treatment Wetlands						
					Total	

Sector	Waste				
Category	Domestic Wastewater Treatment and Discharge				
Category Code	4D1				
Sheet	2 of 2 Estimation of N ₂ O Emi	ssions from Domestic Was	tewater Treated in Constructed	d Wetlands	
		STEP 2			
	A	В	С	D	
Type of constructed wetlands	Total nitrogen in effluent	Emission Factor	Conversion factor	Total N₂O emissions	
	(N _j)	(EF _j)	44/28	(kg N ₂ O yr ⁻¹)	
	(kg N yr ⁻¹)	(kg N₂O-N kg N⁻¹)			
	Sheet 1 of 2			D= A x B x C	
Surface Flow					
Vertical Subsurface Flow					
Horizontal Subsurface Flow					
Hybrid type					
Semi-natural Treatment Wetlands					
			Total		
Note: EF for hybrid type can be estimated as ar	ea-weighted average of the EFs of the co	onstructed wetland types in hybrid sy	ystem		

Sector	Waste						
Category	Industrial Wastewater Treatment and	ndustrial Wastewater Treatment and Discharge					
Category Code	4D2						
Sheet	1 of 2 Estimation of N in Effluent Trea	ated in Constructed Wetlands					
	STE	P1					
	A	В	С				
Industrial Sector	Total nitrogen concentration in industrial wastewater treated by constructed wetlands	Yearly flow rate of industrial wastewater treated by constructed wetland	Total nitrogen effluent				
	constructed wetlands	wettand	$(N_{i,j})^*$				
	(TN _i)	(W _{i,j})*	(kg N yr ⁻¹)				
	(kg N m ⁻³)	(m³ yr-¹)	C=A x B				
Industrial sector 1							
Industrial sector 2							
Industrial sector 3							
add as needed							
		Total					

Note: Indirect N_2O emissions from N leaching and runoff from agricultural land are considered in Chapter 11, Volume 4 of the 2006 IPCC Guidelines and the amount of nitrogen in collected runoff from agricultural land treated in constructed wetlands must be subtracted to avoid double counting

*If more than one type of CW is used in an industrial sector, Wij and Ni,j are sum of the Wi,j and Ni,j of the CWs used, respectively.

Sector	Waste						
Category	Industrial Wastewater Treatmer	dustrial Wastewater Treatment and Discharge					
Category Code							
Sheet	2 of 2 Estimation of N₂O Emiss	ions from Industrial Wastewat	er Treated in Constructed Wetla	nds			
		STEP 2					
	A	В	С	D			
Industrial sector	Total nitrogen in effluent	Emission Factor	Conversion factor	Total N ₂ O emissions			
	(N _{i,j})	(EF _j)*	44/28	(kg N ₂ O/year)			
	(kg N yr ⁻¹)	(kg N₂O-N kg N⁻¹)					
	Sheet 1 of 2			D= A x B x C			
Industrial sector 1							
Industrial sector 2							
Industrial sector 3							
add as needed							
			Total				

Note: EF for hybrid type can be estimated as area-weighted average of the EFs of the constructed wetland types in hybrid system

*If more than one type of CW is used in an industrial sector the EF would be Ni,j-weighted average of EFs of CWs used

ANNEX 7A.2

REPORTING TABLES

The Wetlands Supplement has only minor impacts on the Reporting Tables in Annex 8A.2 of Volume 1 of the 2006 IPCC Guidelines. This annex includes the reporting tables, namely the Sectoral AFOLU Table 3 and Background Tables 3.2, 3.3, 3.4, 3.7 and 3.9, which have been updated to take into account the methodological guidance in the Wetlands Supplement. The changes are explained in Section 7.2.1.

Table 3 AFOLU Sectoral Table (1 of 2)

Categories 3 AFOLU 3A Livestock 3A1 Enteric Fermentation 3A1a Cattle 3A1ai Dairy Cows	emissions/ removals	CH ₄	N₂O (Gạ	NO _x	со	NMVOCs
3 AFOLU 3A Livestock 3A1 Enteric Fermentation 3A1a Cattle 3A1ai Dairy Cows	removals		(G _i	g)	I	
3A1 Enteric Fermentation 3A1a Cattle 3A1ai Dairy Cows					1	
3A1 Enteric Fermentation 3A1a Cattle 3A1ai Dairy Cows						
3A1a Cattle 3A1ai Dairy Cows						
3A1ai Dairy Cows						
3A1aii Other Cattle						
3A1b Buffalo						
3A1c Sheep						
3A1d Goats						
3A1e Camels						
3A1f Horses						
3A1g Mules and Asses						
3A1h Swine						
3A1j Other (please specify)						
3A2 Manure Management (1)						_
3A2a Cattle						
3A2ai Dairy Cows 3A2aii Other Cattle						
3A2b Buffalo						+
3A2c Sheep						
3A2d Goats						
3A2e Camels						+
3A2f Horses						+
3A2g Mules and Asses						
3A2h Swine						
3A2i Poultry						
3A2j Other (please specify)						
3B Land ⁽²⁾						
3B1 Forest Land						
3B1a Forest Land Remaining Forest Land						
3B1b Land Converted to Forest Land						
3B1bi Cropland Converted to Forest Land						
3B1bii Grassland Converted to Forest Land						
3B1biii Wetlands Converted to Forest Land						
3B1biv Settlements Converted to Forest Land						
3B1bv Other Land Converted to Forest Land						
3B2 Cropland						
3B2a Cropland Remaining Cropland						
3B2b Land Converted to Cropland			-		1	-
3B2bi Forest Land Converted to Cropland			-		-	+
3B2bii Grassland Converted to Cropland			-			+
3B2biii Wetlands Converted to Cropland 3B2biv Settlements Converted to Cropland						+
3B2bv Other Land Converted to Cropland			1		1	+
3B3 Grassland						+
3B3a Grassland Remaining Grassland			<u> </u>		1	
3B3b Land Converted to Grassland					1	+
3B3bi Forest Land Converted to Grassland			1			+
3B3bii Cropland Converted to Grassland						
3B3biii Wetlands Converted to Grassland						+
3B3biv Settlements Converted to Grassland						+
3B3bv Other Land Converted to Grassland						+

Table 3 AFOLU Sectoral Table (2 of 2)

	3 AFOLU Sectoral Table (2 of 2	Net CO ₂			Emission	s	
Categori	es	emissions/ removals	CH₄	N₂O	NO _x	СО	NMVOCs
		Telliovais		(G			
3B4	Wetlands			,-			
3B4a	Wetlands Remaining Wetlands						
3B4ai	Peat Extraction remaining Peat Extraction						
	Flooded Land Remaining Flooded Land						
	Other Wetlands Remaining Other Wetlands						
3B4b	Land Converted to Wetlands						
3B4bi	Land Converted for Peat Extraction						
3B4bii	Land Converted to Flooded Land						
3B4biii	Land Converted to Other Wetlands						
3B5	3B5 Settlements						
3B5a	Settlements Remaining Settlements						
3B5b	Land Converted to Settlements						
3B5bi	Forest Land Converted to Settlements						
	Cropland Converted to Settlements						
	Grassland Converted to Settlements						
	Wetlands Converted to Settlements						
	Other Land Converted to Settlements						
3B6	3B6 Other Land						
3B6a	Other Land Remaining Other Land						
3B6b	Land Converted to Other Land						
	Forest Land Converted to Other Land						
	Cropland Converted to Other Land						
	Grassland Converted to Other Land						
	Wetlands Converted to Other Land					1	
	Settlements Converted to Other Land						
	egate Sources and Non-CO ₂ Emissions						
Sour	ces on Land (3)						
3C1	Burning						
3C1a	Burning in Forest Land						
3C1b	Burning in Cropland						
3C1c	Burnings in Grassland						
3C1d	Burnings in All Other Land						
3C2	Liming						
3C3	Urea Fertilization						
3C4	Direct N ₂ O Emissions from Managed Soils (4)						
3C5	Indirect N ₂ O Emissions from Managed Soils						
3C6	Indirect N₂O Emissions from Manure						
	Management						
3C7	Rice Cultivations						
3C8	CH₄ from Drained Organic Soils				-		
3C9	CH ₄ from Drainage Ditches on Organic Soils						
3C10	CH ₄ from Rewetting of Organic Soils						
3C11	CH ₄ Emissions from Rewetting of Mangroves and Tidal Marshes						
3C12	N₂O Emissions from Aquaculture						
3C13	CH ₄ Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils						
3C14	Other (please specify)						
3D Othe							
3D1	Harvested Wood Products						
3D2	Other (please specify)						İ

⁽¹⁾ Indirect N_2O emissions are not included here (see category 3C6).

⁽²⁾ Net CO₂ emissions/removals from land may include emissions from coastal wetlands that are not part of the total land area of the reporting country.

⁽³⁾ If CO_2 emissions from Biomass Burning are not already included in Table 3.2 (Carbon stock changes background table), they should be reported here.

⁽⁴⁾ Countries may report by land categories if they have the information.

ocumentation box			

Table 3.2 AFOLU Background Table: 3B Carbon stock changes, emissions, and removals in AFOLU (1 of 2)

		S	urface Are	ea	Net carbon stock change and CO ₂ emissions/removals							-		
						Bi	omass		Dead	organic ma	tter	Sc	oils	
Categori	ies	Mineral soils	Organic soils ⁽¹⁾	Total	In- crease	Decrease	Carbon emitted as CH ₄ and CO from fires ⁽²⁾	Net carbon stock change	Net carbon stock change	Carbon emitted as CH ₄ and CO from fires ⁽²⁾	Net carbon stock change	Net carbon stock change in mineral soils	Net carbon emissions /removals in organic soils ⁽³⁾	Net CO ₂ emissions
			(ha)						(Gg C)					(Gg CO ₂)
3B Land	(4)													
3B1	Forest Land													
3B1a	Forest Land Remaining Forest Land													
3B1b	Land Converted to Forest Land													
3B1bi	Cropland Converted to Forest Land													
3B1bii	Grassland Converted to Forest Land													
3B1biii	Wetlands Converted to Forest Land													
3B1biv	Settlements Converted to Forest Land													
3B1bv	Other Land Converted to Forest Land													
3B2	Cropland													
3B2a	Cropland Remaining Cropland													
3B2b	Land Converted to Cropland													
3B2bi	Forest Land Converted to Cropland													
3B2bii	Grassland Converted to Cropland													
3B2biii	Wetlands Converted to Cropland													
3B2biv	Settlements Converted to Cropland													
3B2bv	Other Land Converted to Cropland													
3B3	Grassland													
3B3a	Grassland Remaining Grassland										·			
3B3b	Land Converted to Grassland													
3B3bi	Forest Land Converted to Grassland													
3B3bii	Cropland Converted to Grassland													
3B3biii	Wetlands Converted to Grassland													
3B3biv	Settlements Converted to Grassland													
3B3bv	Other Land Converted to Grassland													

Table 3.2 AFOLU Background Table: 3B Carbon stock changes, emissions, and removals in AFOLU (2 of 2)

		S	urface Are	ea			Net carb	on stock c	hange and Co	O ₂ emission	s/removals			
						Bi	omass		Dead	organic ma	atter	Sc	oils	
Categor	ies	Mineral soils	Organic soils ⁽¹⁾	Total	In- crease	Decrease	Carbon emitted as CH ₄ and CO from fires ⁽²⁾	Net carbon stock change	Net carbon stock change	Carbon emitted as CH ₄ and CO from fires ⁽²⁾	Net carbon stock change	Net carbon stock change in mineral soils	Net carbon emissions /removals in organic soils ⁽³⁾	Net CO ₂ emissions
			(ha)						(Gg C)					(Gg CO ₂)
3B4	Wetlands (5)													
3B5	Settlements													
3B5a	Settlements Remaining Settlements													
3B5b	Land Converted to Settlements													
3B5bi	Forest Land Converted to Settlements													
3B5bii	Cropland Converted to Settlements													
3B5biii	Grassland Converted to Settlements													
3B5biv	Wetlands Converted to Settlements													
3B5bv	Other Land Converted to Settlements													
3B6	Other Land													
3B6a	Other Land Remaining Other Land													
3B6b	Land Converted to Other Land													
3B6bi	Forest Land Converted to Other Land													
3B6bii	Cropland Converted to Other Land													
3B6biii	Grassland Converted to Other Land													
3B6biv	Wetlands Converted to Other Land													
3B6bv	Settlements Converted to Other Land													

⁽¹⁾ Areas of organic soils include drained, rewetted, and restored organic soils as well as coastal wetlands with organic soils. Details of the subdivision and related emission/removal factors should be given in the national inventory report.

Documentation box:		

⁽²⁾ Where the carbon contained in the emissions of CH₄ and CO is significant part of the sectoral emissions, this should be copied from the corresponding columns in the Sectoral Background Table 3.4. This amount of carbon emitted as CH₄ and CO is then subtracted from carbon stock change to avoid double counting (see Volume 4, Section 2.2.3).

⁽³⁾ The net loss/gain from all types of organic soils should be reported here (see also footnote 1).

⁽⁴⁾ Net carbon stock change and CO₂ emissions/removals from land may include emissions from coastal wetlands that are not part of the total land area of the reporting country. Land areas should be specified as included or not included in the total land area. The sum of the land areas for the six land-use categories included only those areas which are part of the total land area of the country.

Table 3.3 AFOLU Background Table: Emissions in Wetlands (3B4)

	Activity data	Net emissions/ removals	Emiss	sions
Categories	Area	CO ₂	CH₄	N ₂ O
	(ha)			
3B4 Wetlands				
3B4a Wetlands Remaining Wetlands				
3B4ai Peat Extraction remaining Peat Extraction				
3B4aii Flooded Land Remaining Flooded Land				
3B4aiii Other Wetlands Remaining Other Wetlands ¹				
3B4b Land Converted to Wetlands				
3B4bi Land Converted for Peat Extraction				
3B4bii Land Converted to Flooded Land				
3B4biii Land Converted to Other Wetlands (1)				

(1) Detailed information on Other Wetlands should be included in the national inventory report.

Documentation box:		

Table 3.4 AFOLU Background Table: Burning (3C1) (1 of 2)

Table 3.4 AFOLO Backgro		Activity data		-5 (°	Emissions								Carbor	nation item: n emitted as and CO ⁽⁵⁾		
Categories (1)	Des-	Unit	Value	Bio- mass	CO ₂ ⁽³⁾	SOM (6)	Bio- mass	CO ⁽⁴⁾	SOM (6)	Bio- mass	CH ₄ ⁽⁴⁾	SOM (6)	NO _x	N ₂ O	Bio- mass	DOM
	tion ⁽²⁾	(ha or kg d.m.)			(Gg)							(Gg C)			
3C1 Burning																
Burning in Forest Land																
Controlled Burning																
Wildfires																
Burning in Cropland																
Burning in Cropland Remaining Cropland																
Controlled Burning																
Wildfires																
Burning in Forest Land Converted to Cropland																
Controlled Burning																
Wildfires																
Burning in Non Forest Land Converted to Cropland																
Controlled Burning																
Wildfires																
Burning in Grassland																
Burning in Grassland Remaining Grassland																
Controlled Burning																
Wildfires																
Burning in Forest Land Converted to Grassland																
Controlled Burning																
Wildfires																

Table 3.4 AFOLU Background Table: Burning (3C1) (2 of 2)

Table 3.4 AT OLO Backgro		Activity data				•			ssions						Carbor	ation item: emitted as and CO ⁽⁵⁾
Categories (1)				CO ₂ ⁽³⁾		CO ⁽⁴⁾				CH ₄ (4)				Bio-		
	Des- crip- tion ⁽²⁾	Unit	Value	Bio- mass	DOM	SOM (6)	Bio- mass	DOM	SOM (6)	Bio- mass	DOM	SOM (6)	NO _x	N ₂ O	mass	DOM
	tion ⁽²⁾	(ha or kg d.m.) (Gg)							(Gg C)							
Burning in Non Forest Land Converted to Grassland																
Controlled Burning																
Wildfires																
Burning in All Other Land																
Burning in Other Land Remaining All Other Land																
Controlled Burning																
Wildfires																
Burning in Forest Land Converted to All Other Land																
Controlled Burning																
Wildfires																
Burning in Non Forest Land Converted to All Other Land																
Controlled Burning																
Wildfires																

- (1) Parties should report both Controlled/Prescribed Burning and Wildfires emissions, where appropriate, in a separate manner.
- (2) For each land type data should be selected between area burned or biomass/soil carbon burned. Units for area will be hectares (ha) and, for biomass/soil carbon burned, kilograms dry matter (kg d.m.).
- (3) If CO₂ emissions from burning are not already included in Table 3.2 and 3.3 (Carbon stock changes background table), they should be reported here. Carbon stock changes associated with burning should not also be reported in Table 3.2 and 3.3 to avoid double-counting.
- (4) CO₂, CH₄ and CO emissions from biomass burning, DOM and SOM are reported separately.
- (5) Where the carbon contained in the emissions of CH₄ and CO is a significant part of the sectoral emissions, this should be transferred to the corresponding columns in the Sectoral Background Table 3.2. This amount of carbon emitted as CH₄ and CO is then subtracted from carbon stock change to avoid double-counting. The conversion factors to convert CH₄ and CO to C (as input to Table 3.2) are 12/16 for CH₄ and 12/28 for CO. (see Volume 4, Section 2.2.3).
- (6) Emissions from soil organic matter are occurring when organic soils and peatlands are burned but are not relevant for mineral soils.

Documentation box:			

Table 3.7 AFOLU Background Table: Direct N₂O emissions from Managed Soils (3C4)

		<u> </u>
	Activity data	Emissions
Categories (1)	Total amount of nitrogen applied	N₂O
	(Gg N yr ⁻¹)	(Gg)
3C4 Direct N₂O Emissions from Managed Soils		
Inorganic N fertilizer application		
Forest Land		
Cropland		
Grassland		
Wetlands		
Settlements		
Other Land		
Organic N applied as fertilizer (manure and sewage sludge)		
Forest Land		
Cropland		
Grassland		
Wetlands		
Settlements		
Other Land		
Urine and dung N deposited on pasture, range and paddock by grazing animals (2)		
N in crop residues (3)		
	Area	
	(ha)	
N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils		
Drainage/management of organic soils (i.e. Histosols)		

⁽¹⁾ Countries will report at the aggregation level if their activity data allows them within each category. If country has disaggregated data by land use, reporting is also possible using this table.

⁽²⁾ Only for Grassland.

⁽³⁾ Only for Cropland.

Table 3.9 AFOLU Background Table: Non-CO₂ GHG emissions not included elsewhere (3C7 to 3C14)

Categories	- Activity data	Emissions	
		CH₄	N ₂ O
	(ha)	(Gg)	
3C7 Rice Cultivations (1)			
3C8 CH₄ from Drained Organic Soils ⁽²⁾			
3C9 CH₄ from Drainage Ditches on Organic Soils ⁽²⁾			
3C10 CH₄ from Rewetting of Organic Soils ⁽²⁾			
3C11 CH ₄ Emissions from Rewetting of Mangroves and Tidal Marshes ⁽²⁾			
3C12 N₂O Emissions from Aquaculture ⁽²⁾			
3C13 CH₄ Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils ⁽²⁾			
3C14 Other (please specify)			

⁽¹⁾ If a country wishes to report direct N₂O emissions from N fertilizer application to rice field, it should be reported here. Otherwise, in Table 3.7.

Documentation box:		

⁽²⁾ Use appropriate subcategories highlighting e.g. land-use category and/or other relevant specifications.