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 used 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 (CH_4) and nitrous oxide (N_2O) emissions from managed land in the Agriculture, Forestry and Other Land Use (AFOLU) Sector, and CH_4 and N_2O emissions from wastewater treatment (constructed wetlands) 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]

[1] The Common Reporting Framework (CRF) tables used by Annex I Parties in reporting of greenhouse gas emissions and removals under 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.

7.2.1.1 DRAINED INLAND ORGANIC SOILS

Carbon dioxide (CO_2)

The guidance in Chapter 2 in the *Wetlands Supplement* for estimation of CO_2 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 covered 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 CO_2 emission/removal factors according to land-use 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 CO_2 emission factors for peat extraction. New guidance is provided for estimation of off-site CO_2 emissions from water-borne dissolved organic carbon (DOC), losses from drained organic soils and soil CO_2 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 soil pool for organic soils (see Annex 7A.2 in this chapter).

Non-CO_2

The *2006 IPCC Guidelines* did not provide a methodology for the estimation of CH_4 emissions associated with drainage, whereas Chapter 2 provides a methodology to address CH_4 emissions from the land surface of drained organic soils and drainage ditches. The emission factors for CH_4 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 CH_4 from drainage ditches are also given by land-use category and climate zone and for grasslands by drainage depth (shallow or deep). A default CH_4 emission factor for drainage ditches is provided separately for peat extraction. The estimation of CH_4 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 CH_4 emissions would be reported in Table 3.9 under new categories (3C8 *CH_4 from drained organic soils* and 3C9 *CH_4 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 N_2O 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 N_2O emissions from organic soils should be reported as aggregated to N_2O emissions from managed soils. If data are available, the emissions can be provided by land-use category. The N_2O emissions from drainage/management of organic soils are reported under category 3C4 (*Direct N_2O Emissions from Managed Soils*). An exception to this are direct N_2O emissions on peat extraction lands which are reported in category 3B4ai (*Peat Extraction Remaining Peat Extraction*[2]) or 3B4bi (*Land Converted for Peat Extraction*), depending if the peat extraction lands remain in the category, or are converted to it.

Chapter 2 in the *Wetlands Supplement* provides guidance on estimating CO_2, CH_4 and CO emissions from soil organic matter during fires on drained organic soils. N_2O 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 CO_2, CH_4 and N_2O 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 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 CH_4 emissions from rewetted organic soils. N_2O emissions from rewetted organic soils are considered negligible and assumed to be zero under Tier 1. Fires on

[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 *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.

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 the Background Table 3.2 and Table 3.3, which have been modified to allow also reporting of removals from organic soils. CH_4 should be included in Table 3.9 (*Non-CO_2 greenhouse gas emissions not included elsewhere*), under category 3C10 (*CH_4 from rewetting of organic soils*). When N_2O 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 CO_2, CH_4 and N_2O 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 CO_2 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 CH_4 emissions from rewetting of mangroves and tidal marshes and N_2O emissions from aquaculture.

These wetlands can occur in any of the six IPCC land-use categories but also in coastal areas which are not part of the total land area of the country. For example, a mangrove wetland with trees may be classified as Forest land, while a tidal marsh used for grazing may be classified as Grassland. Emissions/removals in coastal areas that take place in areas which are not part of the total land area should be reported separately for areas included and not-included in the total land area. For example, forest management activities in mangrove areas may need to be split between areas included in the total land area, and those coming from areas that are not part of the total land area. Only areas which are part of the total land areas would be included in the land-use matrix[3]. In the example above, the reporting of the emissions from forest management in mangrove areas would be part of the emissions from Forest Land but the respective mangrove areas would be included as Forest land areas only for the part which is included in the total land area. Similar logic would be applied to e.g. CO_2 emissions from aquaculture or salt production in tidal marsh or seagrass meadow areas, the likely land-use category to be used in reporting would be category 3B4aiii (*Other Wetlands Remaining Other Wetlands*). The precise details of classification of emissions/removals from coastal wetlands are country specific. Appropriate subcategories should be used in the reporting, to reflect the specific land use and management as well as an indication 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. Additional information on C stock changes on these lands should be provided in the Background Tables 3.2 and 3.3. CH_4 and N_2O emissions from coastal wetlands would be included in the 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.

7.2.1.4 INLAND WETLAND MINERAL SOILS

In Volume 4 of the *2006 IPCC Guidelines,* generic guidance for estimating CO_2 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

[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. Also unmanaged land areas are included in the matrix. The sum of the areas should match thet total land area. Areas which 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 for this reason.

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 wetland rewetting on Cropland with IWMS. In addition, Chapter 5 provides data on CH_4 emissions from IWMS under any land-use category that has undergone wetland 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. CH_4 emissions from inland wetland mineral soils should be included in Background Table 3.9, under category 3C13 (*CH_4 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 wetland systems for wastewater treatment are human-made wetlands and engineered systems, which apply various technologies, using natural wetland processes, wetland hydrology, soils, microbes and plants to assist in treating wastewater. In addition to constructed wetlands, 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 (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 in the constructed wetlands.

The areas of constructed wetlands would be reported as part of areas under Settlements, Wetlands, or other land-use categories, as appropriate. If the establishment of the constructed wetland 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.

7.2.2 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*.

TABLE 7.1
MAPPING BETWEEN THE CATEGORIES AND GUIDANCE IN THE *2006 IPCC GUIDELINES* AND THE CHANGES TO THOSE INTRODUCED BY THE *WETLANDS SUPPLEMENT*.

Source of emissions/ sink for removals	2006 IPCC Guidelines		Wetlands Supplement	
	Category	**Guidance by**	**Category**	**Guidance by**
Drained inland 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 lands remaining peat extraction lands*, 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 *Biomass burning*	• pool excluding the soil organic matter	Category 3C1 renamed to *Burning* 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 source: 3C8 *CH_4 from drained organic soils*	• land-use category • climate zone • drainage class (drained, shallow, deep) • nutrient status
CH4	-	-	New source: 3C9 *CH_4 from drainage ditches on organic soils*	• land-use category • climate zone • drainage class (drained, shallow, deep)
N_2O	3C4 *Drainage/ management of organic soils (i.e., Histosols)*	• drained organic soils	3C4 *Drainage/ management of organic soils (i.e., Histosols)*	• land-use category • climate zone • drainage class (drained, shallow, deep) • nutrient status

Rewetted organic 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_2O	-	-	N_2O emissions from rewetted organic soils (only when higher-tier methods available) To be reported under 3C14 Other (Non-CO_2 GHG emissions not included elsewhere)	
Coastal Wetlands					
	CO_2,	-	-	New sources/sinks under 3B1 to 3B6 Forest land, Cropland, Grassland, Wetlands, Settlements and Other land from following activities: • forest management in mangroves • extraction in mangroves, tidal marshes and seagrass meadows (including excavation, aquaculture and salt production) • rewetting in mangroves, tidal marshes and sea grass meadows • soil drainage in mangroves and tidal marches A new subcategory under Wetlands would need to created to cover all potential reporting options: 3B4aiii (Other wetlands remaining wetlands) or	• climate zone/region • vegetation type • salinity (where applicable/ available) • management activity

			3B4biii (Land converted to other wetlands) NOTE: When activities and emissions occur on areas which are not included in the total land area of the country, the reporting should be split in to two parts: areas included in the total land area and areas not included in the total land area. The land-use change matrix should include only those areas which are part of the total land area.	
CH_4	-	-	New category: 3C11 *CH_4 emissions from rewetting of mangroves and tidal marshes*	• wetland type • salinity
N_2O	-	-	New category: 3C12 *N_2O emissions from aquaculture*	• fish-produced or N-fed
Inland Wetland Mineral Soils (IWMS)				
CO_2	Guidance for estimating C stock changes in soils including 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 ropland with IWMS	• climate zone • moisture regime
CH_4	-	-	3C13 *CH_4 from rewetted or created wetlands on inland wetland mineral soils*	• climate zone
Constructed wetlands for wastewater treatment				
CH_4, N_2O	4 D Wastewater treatment and discharge	• wastewater type (domestic or industrial) • BOD/COD load • treatment and disposal type	New treatment types under 4 D Wastewater treatment and discharge	• wastewater type (domestic or industrial) • BOD/COD load • treatment and disposal type including constructed wetlands and semi-natural treatment

					wetlands • flow type in constructed wetlands for wastewater treatment
	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*

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 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-CO_2 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 CO_2 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 below-ground 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 e.g. the impact of grazing on rewetted soils in the estimation of N_2O emissions from these lands should show that the nitrogen input is not calculated also under category 3A2 (*Manure management*). Livestock emissions (CH_4 from enteric fermentation and N_2O 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 which 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 3.1, 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, are presented above in Sections 7.2.2 and 7.2.3 by chapter of this *Wetlands Supplement*.

7.2.5 Worksheets

Annex 7A.1 provides also worksheets for each sub-category 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, 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 sub-categories described in Chapters 2 to 6 of this *Wetlands Supplement*, and assess methods across the wetlands 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

$$U_{total} = \frac{\sqrt{\left(U_1 \times x_1\right)^2 + \left(U_2 \times x_2\right)^2 + \ldots + \left(U_n \times x_n\right)^2}}{\left|x_1 + x_2 + \ldots + x_n\right|}$$

Where:

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

U_i = uncertainty (95% CI) of a variable

x_i = value of a variable.

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

EQUATION 7.2
ALGEBRAIC COMBINATION OF UNCERTAINTIES – MULTIPLICATION

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2}$$

Where:

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

U_i = 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 organic soils. The definitions of wetland sub-categories 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 4 in Volume 4) or climate zone, this *Wetlands Supplement* stratifies wetlands into sub-categories based on wetlands characteristics and human activities. The following list summarises particular sources of uncertainty for the sub-categories and new tables that provide inventory compilers with default uncertainty values.

- **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 CH_4 emissions, and high spatial and temporal variability of N_2O 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 CO_2, CO, and other gases, and estimates of burned area and fuels.
  - Table 2.1 - Tier 1 CO_2 emission/removal factors for drained organic soils in all land-use categories

- Table 2.2 - Default dissolved organic carbon (DOC) emission factors for drained peatlands and organic soils
- Table 2.3 - Tier 1 CH_4 emission/removal factors for drained organic soils in all land-use categories
- Table 2.4 - Default CH_4 emission factors for drainage ditches
- Table 2.5 - Tier 1 N_2O emission/removal factors for drained organic soils in all land-use categories
- Table 2.6 - Peat fuel consumption values for fires in a range of peatland types
- Table 2.7 - Emission factors for peat 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 CO_2-C by rewetted organic soils (all values in tonnes CO_2-C ha^{-1} yr^{-1})
  - Table 3.2 - Default DOC emission factors ($EF_{DOC\_REWETTED}$ in tonnes CO_2-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 inter-annual variation of vegetation production.
  - Table 4.2 - Carbon fraction of aboveground mangrove forest biomass (tonnes C (tonnes d.m.)$^{-1}$)
  - Table 4.3 - Aboveground biomass in mangrove forests (tonnes d.m. ha^{-1})
  - Table 4.4 - Aboveground biomass growth in mangrove forests (tonnes d.m. ha^{-1} yr^{-1})
  - Table 4.5 - Ratio of belowground biomass to aboveground biomass (R) in mangroves forests
  - Table 4.6 - Average density (tonnes m^{-3}) mangrove wood
  - Table 4.7 - Tier 1 default values for litter and dead wood carbon stocks
  - Table 4.8 - Summary of Tier 1 estimation of initial changes in C pools for extraction activities
  - Table 4.9 - Ratio of belowground biomass to aboveground biomass (R) for tidal marshes
  - Table 4.10 - Ratio of belowground biomass to aboveground biomass (R) for seagrass meadows
  - Table 4.11 - Soil C stocks for mangrove and tidal marsh on organic soils (tonnes C ha^{-1}) for extraction activities
  - Table 4.12 - Annual emission factors (EF) associated with rewetting (EF_{REWET}) on aggregated organic and mineral soils (tonnes C ha^{-1}) at initiation of vegetation reestablishment
  - Table 4.13 - Annual emission factors (EF) associated with drainage (EF_{DR}) on aggregated organic and mineral soils (tonnes C ha^{-1} yr^{-1})
  - Table 4.14 - Emission factors for Tier 1 estimation of rewetted land previously vegetated by tidal marshes and mangroves
  - Table 4.15 - Emission factor (EF_F) for N_2O emission from aquaculture in mangroves, tidal marshes and seagrass meadows

Inland wet mineral soils – Emissions are a function of time under management.

- Table 5.2 - Default reference soil organic carbon stocks for wetland mineral soils under native vegetation
- Table 5.3 - Relative stock change factors for land-use for long term cultivation on cropland with inland wet mineral soils (over 20 years) and wetland restoration of cropland with inland wet mineral soils (over 20 years and 40 years)
- Table 5.4 - Default emission factors for CH_4 from managed lands with inland wet mineral soils 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 CH_4 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.

- Table 6.2 - Influent total organic carbon (TOC) and total nitrogen (TN) values, relevant CH_4-C and N_2O-N emissions, and share (%) of CH_4-C and N_2O-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 WITH PUBLISHED ESTIMATES OF UNCERTAINTIES OF PARAMETERS USED IN ESTIMATING GREENHOUSE GAS EMISSIONS AND REMOVALS

Continent	Country	Wetland	Reference
Africa	Botswana	Okavango Delta	Mladenov *et al.*, 2005
	Madagascar	estuary	Ralison *et al.*, 2008
	Senegal	estuary area	Sakho *et al.*, 2011
Asia	China	constructed wetland	Chen *et al.*, 2011
	Indo-Pacific	mangroves	Donato *et al.*, 2011
	Indonesia	peat swamps and oil palms	Murdiyarso *et al.*, 2010
North America	Canada	restored wetlands	Badiou *et al.*, 2011
	Costa Rica	tropical inland wetlands	Bernal and Mitsch. 2008
	USA	streams and rivers	Butman and Raymond, 2011
South America	Argentina	river marsh	Vicari *et al.*, 2011
	Brazil	Pantanal	Schöngart *et al.*, 2011
	Peru	Amazonian peatland	Lähteenoja *et al.*, 2012
Global	Global	coastal ecosystems	Mcleod *et al.*, 2011
	Global	freshwater wetlands	Kayranli *et al.*, 2010
	Global	freshwater wetlands methane	Bastviken *et al.*, 2011
	Global	mangroves	Breithaupt *et al.*, 2012
	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 1of 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 realizations 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 2.5 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 realizations effectively combines the uncertainties of individual variables.

EQUATION 7.3
MONTE CARLO ANALYSIS – GENERAL FORM OF A VARIABLE

$$x_i = mean_x + \left(random_i \times SE_x\right)$$

Where:

x_i = value of realization *i* of a variable,

i = statistically significant number of realizations, typically 100 – 10 000

$mean_x$ = mean value of a variable

$random_i$ = random number for realization *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 CO_2 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 CH_4 emission associated with land-use change, and nutrient-enriched soils that are a legacy of past land use.
- **Rewetted peatlands** – CO_2 and CH_4 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 CH_4 production, and transport by vegetation of CH_4 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 CO_2 emissions (carbon stock changes) is to distinguish 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 CO_2 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 sub-categories 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 sub-categories affected by the *Wetlands Supplement* should be assessed using the generic rule that a sub-category 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 deforestation, 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 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
- changes in wetland management technologies
- 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 sub-categories 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 sub-categories addressed in this *Wetlands Supplement*. It presents the information by the tiers that inventory compilers already use to estimate emissions and removals.

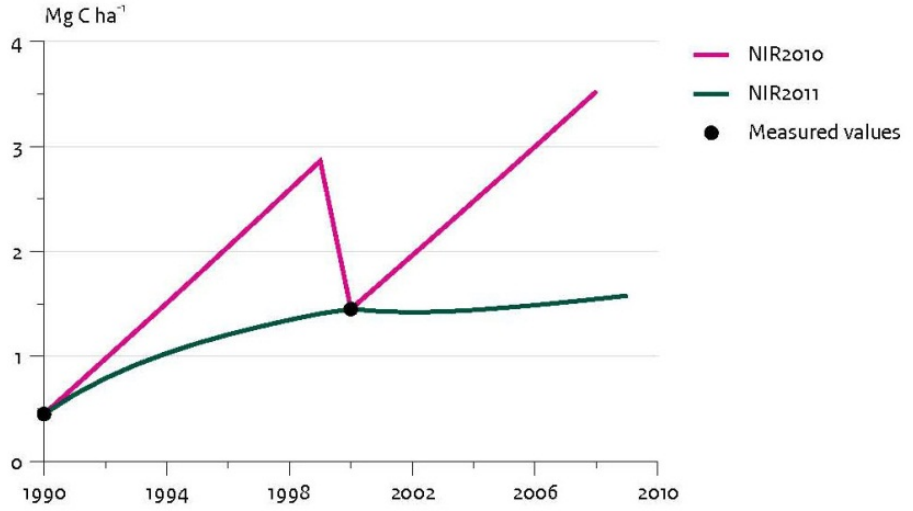
All tiers - Recalculate an entire data series when changing from the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, *2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry*, and *2006 IPCC Guidelines* to the *Wetlands Supplement*, when methods are refined due to scientific advances, new data become available, QC finds errors in previous estimates, or a land classification changes (e.g., reporting mangroves as wetlands rather than forests). 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 CO_2 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.

Figure 7.1 Example of recalculation of a time series.



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 technical activities to assess and 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. 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*. This section presents the information by the tiers that inventory compilers already use to estimate emissions and removals.

7.7.2 Quality assurance and quality control methods

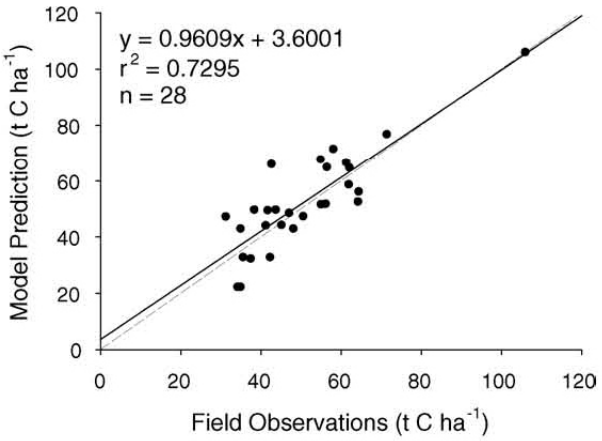
All tiers – Provide routine and consistent checks to ensure data integrity, correctness, and completeness. Identify and address errors and omissions. Document and archive inventory material and record all QC activities. Check labelling, transcription, and other clerical issues related to data entry (See 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.

Tier 1 - Double-check that correct default values were used.

Tier 2 - Double-check data sheets against local data sources for activity data, emissions factors, and other variables. Check scientific literature for any new scientific information.

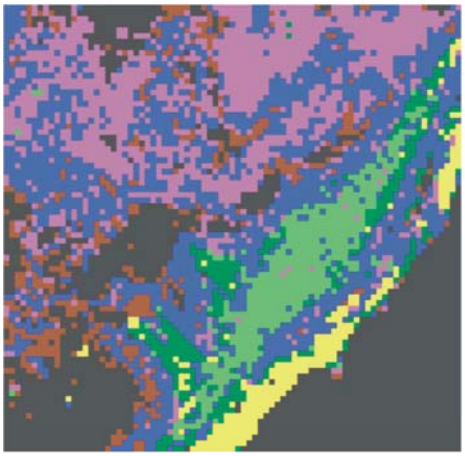
Tier 3 - Validate computer models against field measurements and include the error in the calculation of uncertainty (Section 7.2.1). The validation measure can be a correlation of predicted and measured values (Figure 7.2; Miehle *et al.*, 2006), fractional agreement of modelled and observed data (Figure 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. It is *good practice* to establish a system of repeated monitoring of permanent plots for continued validation of model output against field data over time. When more than one model is available for a particular parameter, inter-comparison 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.

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



Class	RM	BM	THH	CRB	Sand/ Rock	Mudflats	Asphalt	Omission (%)
(*a*) IKONOS classification: overall accuracy = 83.3%; kappa coefficient = 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	0	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	

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

679

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780 # ANNEX 7A.1

781 # WORKSHEETS

782

783 This annex provides worksheets that can be used to estimate greenhouse gas emissions and removals based on
784 Tier 1 methods given in the *Wetlands Supplement*. Most of the worksheets included in this annex are new ones
785 that are not included in Annex 1, Volume 4 of the *2006 IPCC Guidelines*. However, the following 6 worksheets
786 are to update or replace the existing worksheets in Annex 1, Volume 4 of the *2006 IPCC Guidelines*.

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

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

792 • Worksheet for Direct N_2O Emissions from Managed Soils (Page 7.29)

793 This sheet is to update the existing worksheet for Direct N_2O Emissions from Managed Soils on page
794 A1.58, Annex 1, Volume 4 of the *2006 IPCC Guidelines*.

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

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

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

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

803 • Worksheet for Land Converted to a Cropland: Annual change in carbon stocks in mineral soils (Pages 7.46-
804 7.47)

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

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

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

812

CHAPTER 2—DRAINED INLAND ORGANIC SOILS

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 On-site carbon emissions and removals from drained Inland organic soils**			
Category code		**[To be specified by the inventory compiler][1]**			
Sheet		**2 of 3 (earlier was 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, ha	Emission factors for drained inland organic soils, by climate domain c, nutrient status n, and drainage class d, tonnes C_2 C ha^{-1} yr^{-}	Annual on-site CO_2-C emissions/removals from drained inland organic soils
Initial land use[3]	Land use during reporting year		(ha)	(tonnes C ha^{-1} yr^{-1})	(tonnes C yr^{-1})
				Table 2.1 of the Wetlands Supplement	**CO_2-$C_{soil\text{-}onsite}$ = A * EF**
			A	**EF**	**CO_2-$C_{soil\text{-}onsite}$**
		(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.

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

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

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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**			
Category code		**[To be specified by the inventory compiler]**[1]			
Sheet		**3 of 3**			
Equation		**Equation 2.2 (*2006 IPCC Guidelines*)**	**Equation 2.5 (*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 and nutrient status n, ha	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	Land use during reporting year		(ha)	(tonnes C ha^{-1} yr^{-1})	(tonnes C yr^{-1})
				Table 2.2 of the Wetlands Supplement	
			A	**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.

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Sector		**Agriculture, Forestry and Other Land Use**					
Category		**Land Remaining in a Land-use Category OR Land Converted to a New Land-use Category[1]: Annual CH_4 emissions from drained inland organic soils**					
Category code		**T[To be specified by the inventory compiler][2]**					
Sheet		**1 of 1**					
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, ha	Fraction of the total area of drained inland organic soil which is occupied by ditches[4]	Emission factors for direct CH_4 emissions from drained organic soils, by climate zone c and nutrient status n,	Emission factors for CH_4 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 reporting year				Table 2.3 of the Wetlands Supplement	Table 2.4 of the Wetlands Supplement	
			A	$Frac_{ditch}$	EF_{CH4_land}	EF_{CH4_ditch}	$CH_4\text{-}C_{organic} = A * [(1-Frac_{ditch})*EF_{CH4\_land} + Frac_{ditch}*EF_{CH4\_ditch}]$
		(a)					
		(b)					
		(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.

[4] Table 2.4, Chapter 2 of the *Wetlands Supplement* contains indicative values of $Frac_{ditch}$

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Sector	Agriculture, Forestry and Other Land Use						
Category	Direct N_2O Emissions from Managed Soils						
Category code	3C4						
Sheet	2 of 2						
Equation	Equation 11.1 of *2006 IPCC Guidelines* and Equation 2.7 of the *Wetlands Supplement*						
Anthropogenic N input type[1,2]	Annual area of managed/drained organic soils	Emission factor for N_2O emissions from drained/managed organic soils	Annual direct N_2O-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 N_2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals	Annual direct N_2O emissions from urine and dung inputs to grazed soils	Annual direct N_2O emissions from urine and dung inputs to grazed soils
	(ha)	(kg N_2O-N ha^{-1} yr^{-1})	(kg N_2O-N yr^{-1})	(kg N yr^{-1})	[kg N_2O-N (kg N input)$^{-1}$]	(kg N_2O-N yr^{-1})	(kg N_2O-N yr^{-1})
		Table 11.1 (*2006 IPCC Guidelines*) and Table 2.5 (*Wetlands Supplement*)	$N_2O\text{-}N_{OS} = F_{OS} * EF_2$		Table 11.1	$N_2O\text{-}N_{PRP} = F_{PRP} * EF_{3PRP}$	$N_2O_{Direct}\text{-}N = N_2O\text{-}N_{N\ input} + N_2O\text{-}N_{OS} + N_2O\text{-}N_{PRP}$
	F_{OS}	**EF_2**	**$N_2O\text{-}N_{OS}$**	**F_{PRP}**	**EF_{3PRP}**	**$N_2O\text{-}N_{PRP}$**	**$N_2O_{Direct}\text{-}N$**
Managed organic soils – CG, Bor							
Managed organic soils – CG, Temp							
Managed organic soils – CG, Trop							
Managed organic soils – F, Bor, NR							
Managed organic soils – F, Bor, NP							
Managed organic soils – F, Temp, NR							
Managed organic soils – F, Temp, NP							
Managed organic soils – F, Trop							
Urine and dung inputs to grazed soils – CPP							
Urine and dung inputs to grazed soils – SO							
Total							

[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.

[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.

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Sector		**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 Converted to a 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		Subcategories for reporting year[3]	Area burnt	Mass of fuel available for combustion[4]	Combustion factor[4]	Emission factor for each GHG		CO_2 emissions from fire	CH_4 emissions from fire	CO emissions from fire
Initial land use[2]	Land use during reporting year		(ha)	(tonnes ha^{-1})	(-)	[g GHG (kg dm burnt)$^{-1}$]		(tonnes CO_2)	(tonnes CH_4)	(tonnes CO)
				Table 2.6 of the Wetlands Supplement	Table 2.6 of the Wetlands Supplement	Table 2.7 of the Wetlands 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 = $A * MB * Cf * Gef * 10^{-3}$
			A	**M_B**	**C_f**	**G_{ef}**		**L_{fire}-CO_2**	**L_{fire}-CH_4**	**L_{fire}-CO**
		(a)				CO_2				
						CH_4				
						CO				
		(b)				CO_2				
						CH_4				
						CO				
Total						CO_2				
						CH_4				
						CO				

[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] 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-CO_2 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.

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826 # CHAPTER 3—REWETTED ORGANIC SOILS

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		**1 of 2 : CO_2-C**						
Equation				**Equation 3.4 (*Wetlands Supplement*)**		**Equation 3.5 (*Wetlands Supplement*)**		**Equation 3.3 (Wetlands Supplement)**
Land-use category		Subcategories for reporting year	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
Initial land use	Land use during 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})
				Table 3. 1	**= A * EF_{CO2}**	Table 3. 2	**= A * $EF_{DOC\_REWETTED}$**	**= CO_2-$C_{composite}$ + CO_2-C_{DOC}**
			A	**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.

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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
Initial land use	Land use during reporting year		(ha)	(kg CH_4-C ha^{-1} yr^{-1})	(tonnes CH_4-C yr^{-1})	(tonnes CH_4)
				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						

[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.

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CHAPTER 4—COASTAL WETLANDS

Sector		**Agriculture, Forestry and Other Land Use**						
Category		**Coastal wetland with woody perennial biomass or Forest Land**						
Category code		**[To be specified by the inventory compiler][1]**						
Sheet		**1 of 5**						
Equation			**Equation 2.9 (*2006 IPCC Guidelines*)**	**Equation 2.10 (*2006 IPCC Guidelines*)**			**Equation 2.9 (*2006 IPCC Guidelines*)**	
Land-use category		Subcategories for reporting year	Area	Average annual above-ground biomass growth	Ratio of below-ground biomass to above-ground biomass	Average annual biomass growth above- and below-ground	Carbon fraction of dry matter	Annual increase in biomass carbon stocks due to biomass growth
Initial land use	Land use during reporting year		(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})
			National statistics or international data sources	Table 4.4	Table 4.5	G_{TOTAL} = GW * (1+R)	Table 4.2	$\Delta C_G = A * G_{TOTAL} * CF$
			A	**G_W**	**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.

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Sector		**Agriculture, Forestry and Other Land Use**					
Category		**Coastal wetland with 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 2.12 (*2006 IPCC Guidelines*) + Equation 4.1 (*Wetlands Supplement*)**				
Land-use category		Subcategories for reporting year	Annual wood removal	Biomass expansion factor and wood density for conversion of removals in merchantable volume to total biomass removals (including bark)	Ratio of below-ground biomass to above-ground biomass	Carbon fraction of dry matter	Annual carbon loss due to biomass removals
Initial land use	Land use during reporting year		(m^3 yr^{-1})	BEF * wood density = [tonnes of biomass removals (m^3 of removals) $^{-1}$]	[tonnes bg dm (tonne ag dm)$^{-1}$]	[tonnes C (tonne dm)$^{-1}$]	(tonnes C yr^{-1})
			National statistics or international data sources	Table 3A.1.10 (*2003 GPG*) and Table 4.6	Table 4.5	Table 4.2	$L_{wood\text{-}removals}$ = H * $BCEF_R$ * (1+R) * CF
			H	**BCEF**	**R**	**CF**	**$L_{wood\text{-}removals}$**
		(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.

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Sector		**Agriculture, Forestry and Other Land Use**							
Category		**Coastal wetland with woody perennial biomass or Forest Land: Loss of carbon from fuelwood removals**							
Category code		**[To be specified by the inventory compiler][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 for reporting year	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 below-ground biomass to above-ground 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 use	Land use during reporting year		(m^3 yr^{-1})	BEF * wood density = [tonnes of biomass removals (m^3 of removals) $^{-1}$]	[tonnes bg dm (tonne ag dm)$^{-1}$]	(m^3 yr^{-1})	tonnes m^{-3}	[tonnes C (tonne dm)$^{-1}$]	(tonnes C yr^{-1})
			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.

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Sector	Agriculture, Forestry and Other Land Use						
Category	Coastal wetland with woody perennial biomass or Forest Land: Loss of carbon from disturbance						
Category code	[To be specified by the inventory compiler][1]						
Sheet	4 of 5						
Equation		**Equation 2.14 (*2006 IPCC Guidelines*)**					**Equation 2.11 (*2006 IPCC Guidelines*)**
Land-use category		Subcategories for reporting year	Area affected by disturbances	Average above-ground biomass of areas affected	Ratio of below-ground biomass to above-ground biomass	Carbon fraction of dry matter	Annual other losses of carbon	Annual decrease in carbon stocks due to biomass loss
Initial land use	Land use during reporting year		(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})
			National statistics or international data sources	Table 4.3	Table 4.5	Table 4.2	$L_{disturbances} = A * B_W * (1+R) * CF * fd$	$\Delta C_L = L_{wood\text{-}removals} + L_{fuelwood} + L_{disturbances}$
			$A_{disturbance}$	**B_W**	**R**	**CF**	**$L_{disturbances}$**	**ΔC_L**
		(a)						
		(b)						
		(c)						
Total								

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.

[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.

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Sector	**Agriculture, Forestry and Other Land Use**					
Category	**Initial change in biomass carbon stocks due to extraction actvities (excavation, construction of aquaculture ponds, construction of salt production ponds)**					
Category code	**[To be specified by the inventory compiler][1]**					
Sheet	**5 of 5**					
Equation		**Equation 4.4 (*Wetlands Supplement*)**				
Activity	Sub-categories for reporting year (vegetation type)	Area converted[2]	Biomass C stock after conversion	Biomass C stock before converstion	Carbon fraction	Initial change in carbon stocks in biomass
		(ha)	(tonnes dm ha^{-1})	(tonnes dm ha^{-1})	tonnes C (tonnes dm)$^{-1}$	Gg C yr^{-1}
			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	**$\Delta C_{B\text{-}CONVERSION}$**
Excavation	Mangrove		0			
	Tidal Marsh[3]		0			
	Seagrass Meadow[3]		0			
Construction of aquaculture ponds	Mangrove		0			
	Tidal Marsh[3]		0			
	Seagrass Meadow[3]		0			
Construction of salt production ponds	Mangrove		0			
	Tidal Marsh[3]		0			
	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.

[2] report zero if activity or vegetation type does not occur

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

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Sector	**Agriculture, Forestry and Other Land Use**				
Category	**Initial change in DOM carbon stocks due to extraction activities (excavation, construction of aquaculture ponds, construction of salt production ponds)**				
Category code	**[To be specified by the inventory compiler][1]**				
Sheet	**1 of 1**				
Equation		**Equation 4.5 (*Wetlands Supplement*)**			
Activity	Sub-categories for reporting year (vegetation type)	Area converted[2]	DOM_{AFTER}	DOM_{BEFORE}	Initial change in carbon stocks in DOM
		(ha)	(tonnes C ha^{-1})	(tonnes C ha^{-1})	Gg C yr^{-1}
			default value is zero (0)	Table 4.7 or national statistics	$\Delta C_{DOM\text{-}CONVERSION} = (DOM_{AFTER} - DOM_{BEFORE}) * A_{CONVERTED} * 10^{-3}$
		$A_{CONVERTED}$	DOM_{AFTER}	DOM_{BEFORE}	**$\Delta C_{DOM\text{-}CONVERSION}$**
Excavation	Mangrove		0		
Construction of aquaculture ponds	Mangrove		0		
Construction of salt production ponds	Mangrove		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..
[2]report zero if activity or vegetation type does not occur

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Sector	Agriculture, Forestry and Other Land Use			
Category	CH_4 emissions from rewetting of mangroves and tidal marshes			
Category code	3C11			
Sheet	1 of 1			
		Equation 4.9 (Wetlands Supplement)		
	Subcategories for reporting year	Area of land of rewetted soils	Emission factor for rewetted soils	Annual CH_4 emissions from rewetted soils
		(ha)	(kg CH_4 ha^{-1} yr^{-1})	(kg CH_4 yr^{-1})
			Table 4.14 (organic and mineral soils)	$CH_{4SO\text{-}REWET}$ = (A_{REWET} * EF_{REWET})
		A_{REWET}	**EF_{REWET}**	**$CH_{4SO\text{-}REWET}$**
	Tidal freshwater marsh			
	Tidal salt marsh and mangrove[1]			
Total				

[1] Apply same EF for tidal brackish marsh

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Sector	Agriculture, Forestry and Other Land Use		
Category	N_2O emissions from aquaculture		
Category code	3C12		
Sheet	1 of 1		
		Equation 4.10 (Wetlands Supplement)	
	Amount of fish production (F)	Emission factor for N2O emissions from fish produced (F) in aquaculture use	Annual N2O emissions from aquaculture use
	(kg fish yr-1)	[kg N_2O-N (kg fish)-1]	(kg N_2O-N yr^{-1})
		Table 4.15	N_2O-N_{AQ} = F * EF
	F_F	**EF_F**	**N_2O_{AQ}**
Total			

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Sector	Agriculture, Forestry and Other Land Use				
Category	Initial change in soil carbon stocks due to extraction actvities (excavation, construction of aquaculture ponds, construction of salt production ponds)				
Category code	[To be specified by the inventory compiler][1]				
Sheet	1 of 3				
Equation		**Equation 4.6 (*Wetlands Supplement*)**			
Activity	Sub-categories for reporting year (vegetation type)	Area converted[2]	SO_{AFTER}	SO_{BEFORE}	Initial change in cabon stocks in soil
		(ha)	(tonnes C ha^{-1})	(tonnes C ha^{-1})	Gg C yr^{-1}
			default value is zero (0)	Table 4.11 or national statistics	$\Delta C_{SO\text{-}CONVERSION} = (SO_{AFTER} - SO_{BEFORE}) * A_{CONVERTED} * 10^{-3}$
		$A_{CONVERTED}$	SO_{AFTER}	SO_{BEFORE}	$\Delta C_{SO\text{-}CONVERSION}$
Excavation	Mangrove		0		
	Tidal Marsh		0		
	Seagrass Meadow		0		
Construction of aquaculture ponds	Mangrove		0		
	Tidal Marsh		0		
	Seagrass Meadow		0		
Construction of salt production ponds	Mangrove		0		
	Tidal Marsh		0		
	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.
[2]report zero if activity or vegetation type does not occur

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Sector		**Agriculture, Forestry and Other Land Use**					
Category		**CO_2-C emissions from rewetting and revegetation**					
Category code		**[To be specified by the inventory compiler][1]**					
Sheet		**2 of 3**					
Equation		**Equation 4.7 (*Wetlands Supplement*)**					
Land-use category		Subcategories for reporting year (vegetation type)	Area of land in rewetting[2]	Emission factors for CO_2-C in rewetting	Area of land in rewetting and revegetation[2]	Emission factors for CO_2-C in rewetting and revegetation	CO_2-C emissions from rewetting and revegetation
Initial land use	Land use during reporting year		(ha)	(tonnes C ha^{-1} yr^{-1})	(ha)	(tonnes C ha^{-1} yr^{-1})	Gg C yr^{-1}
				default value is zero or national data		Table 4.12 or national data	$CO_{2}\text{-}C_{\text{-SO-REWET}} = (A_{REWET} * EF_{REWET} + A_{REWET\text{-}RVG} * EF_{REWET\text{-}RVG}) * 10^{-3}$
			A_{REWET}	**EF_{REWET}**	**$A_{REWET\text{-}RVG}$**	**$EF_{REWET\text{-}RVG}$**	**$CO_{2}\text{-}C_{\text{-SO-REWET}}$**
		Mangrove					
		Tidal marsh					
		Seagrass meadow					
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.

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

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Sector		**Agriculture, Forestry and Other Land Use**			
Category		**CO_2-C emissions from drainage in coastal wetlands**			
Category code		**[To be specified by the inventory compiler][1]**			
Sheet		**3 of 3**			
Equation			**Equation 4.8 (*Wetlands Supplement*)**		
Land-use category		Subcategories for reporting year (vegetation type)	Area of land in drainage	Emission factors for CO_2-C in drainage	CO_2-C emissions from drainage
Initial land use	Land use during reporting year		(ha)	(tonnes C ha^{-1} yr^{-1})	Gg C yr^{-1}
				Table 4.13 or national data	$CO_2\text{-}C_{\text{-SO-DR}} = (A_{DR} * EF_{DR}) * 10^{-3}$
			A_{DR}	**EF_{DR}**	**$CO_2\text{-}C_{\text{-SO-DR}}$**
		Tidal marsh and mangrove			
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.

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CHAPTER 5—INLAND WETLAND MINERAL SOILS

Sector		**Agriculture, Forestry and Other Land Use**										
Category		**Cropland Remaining Cropland: Annual change in carbon stocks in mineral soils**										
Category code		**[To be specified by the inventory compiler][1]**										
Sheet		**1 of 4**										
Equation		**Equation 2.2 (*2006 IPCC Guidelines*)**	**Equation 2.25, Formulation A in Box 2.1 of Section 2.3.3.1 (*2006 IPCC Guidelines*)**									
Land-use category		Sub-categories for reporting year	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
Initial land use	Land use during reporting year		(ha)	(ha)	(tonnes C ha^{-1})	(tonnes C ha^{-1})	(yr)	(-)	(-)	(-)	(tonnes C yr^{-1})
					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*	$\Delta C_{Mineral}$ 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}**	**F_I**	**$\Delta C_{Mineral}$**
$CL_{non-IWMS}$	$CL_{non-IWMS}$	(a)					20				
		(b)					20				
		(c)					20				
		Subtotal									
CL_{IWMS}	CL_{IWMS}	(a)					20				
		(b)					20				
		(c)					20				
		Subtotal									
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] 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

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Sector		**Agriculture, Forestry and Other Land Use**									
Category		**Land (non-Cropland) remaining in a Land-use Category : Annual change in carbon stocks in mineral soils**									
Category code		**[To be specified by the inventory compiler][1]**									
Sheet		**2 of 4**									
Equation		**Equation 2.2 *(2006 IPCC Guidelines*)**	**Equation 2.25, Formulation A in Box 2.1 of Section 2.3.3.1**								
Land-use category		Sub-categories for reporting year	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
Initial land use	Land use during reporting year		(ha)	(ha)	(tonnes C ha^{-1})	(tonnes C ha^{-1})	(yr)	(-)	(-)	(-)	(tonnes C yr^{-1})
					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	$\Delta C_{Mineral}$ as in Equation 2.25
			$A_{(0)}$	**$A_{(0-T)}$**	**$SOC_{ref(0)}$**	**$SOC_{ref(T-0)}$**	**D**	**F_{LU}**	**F_{MG}**	**F_I**	**$\Delta C_{Mineral}$**
LU	LU	(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

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Sector		**Agriculture, Forestry and Other Land Use**										
Category		**Land Converted to a Cropland: Annual change in carbon stocks in mineral soils**										
Category code		**[To be specified by the inventory compiler][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*)**									
Land-use category		Subcategories of unique climate, soil, land-use change and management combinations	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
Initial land use[2]	Land use during reporting year		(ha)	(tonnes C ha^{-1})	(yr)	(-)	(-)	(-)	(-)	(-)	(-)	(tonnes C yr^{-1})
				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*	$\Delta C_{Mineral}$ as in Equation 2.25 (*2006 IPCC Guidelines*)
			$A_{(0)}$	**SOC_{ref}**	**D**	**$F_{LU(0)}$**	**$F_{MG(0)}$**	**$F_{I(0)}$**	**$F_{LU(0-T)}$**	**$F_{MG(0-T)}$**	**$F_{I(0-T)}$**	**$\Delta C_{Mineral}$**
FL	CL	(a)			20							
		(b)			20							
Sub-total												
GL	CL	(a)			20							

		(b)			20							
Sub-total												
WL	CL	(a)			20							
		(b)			20							
Sub-total												
SL	CL	(a)			20							
		(b)			20							
Sub-total												
OL	CL	(a)			20							
		(b)			20							
Sub-total												
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] 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

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Sector		**Agriculture, Forestry and Other Land Use**										
Category		**Land Converted to a New Land-use Category (non-Cropland): Annual change in carbon stocks in mineral soils**										
Category code		**[To be specified by the inventory compiler][1]**										
Sheet		**4 of 4**										
Equation		**Equation 2.2 (*2006 IPCC Guidelines*)**	**Equation 2.25, Formulation B in Box 2.1 of Section 2.3.3.1 (*2006 IPCC Guidelines*)**									
Land-use category		Subcategories of unique climate, soil, land-use change and management combinations	Area for land-use change by climate and soil comb-ination	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
Initial land use[2]	Land use during reporting year		(ha)	(tonnes C ha^{-1})	(yr)	(-)	(-)	(-)	(-)	(-)	(-)	(tonnes C yr^{-1})
				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 *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	$\Delta C_{Mineral}$ as in Equation 2.25
			$A_{(0)}$	**SOC_{ref}**	**D**	**$F_{LU(0)}$**	**$F_{MG(0)}$**	**$F_{I(0)}$**	**$F_{LU(0-T)}$**	**$F_{MG(0-T)}$**	**$F_{I(0-T)}$**	**$\Delta C_{Mineral}$**
L	non-CL	(a)			20							
		(b)			20							
		(c)			20							
Sub-total												
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] 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 (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] Relevant tables from the land-use category chapters in the *2006 IPCC Guidelines*

[6] IWMS = Inland wetland mineral soils

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Sector		**Agriculture Forestry and Other Land Use (AFOLU)**		
Category		**Annual CH_4 emissions from restored and created wetlands on managed lands with IWMS[1,2]**		
Category code		**[To be specified by the inventory compiler][3]**		
Sheet		**1 of 1**		
Equation		**Eq. 2.2 (*2006 IPCC Guidelines*)**	**Equation 5.1 *(Wetlands Supplement)***	
Initial land use	Land use during reporting year	Subcategories for reporting year[4]	Area of managed lands with IWMS	Emission factor from managed lands with IWMS where water level has been raised in climate region
			(ha)	(kg CH_4 ha^{-1} yr^{-1})
				Table 5.4 (*Wetlands Supplement*)
			A_{IWMS}	**$EF_{CH4-IWMS}$**
		(a)		
		(b)		
		(c)		
Total				

[1] IWMS = Inland wetland mineral soils
[2] This worksheet is to be used for CH_4 emissions from managed lands with IWMS other than rice cultivation areas. For CH_4 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.

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CHAPTER 6—CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT

Sector	**Waste**
Category	**Domestic Wastewater Treatment and Discharge**
Category Code	**4D1**
Sheet	**1 of 3 Estimation of Organically Degradable Material in Domestic Wastewater Treated in Constructed Wetlands**

STEP 1

Type of constructed wetland	A Population whose wastewater treated in constructed wetlands (P_i) cap	B Degradable organic component (BOD) (kg BOD/cap/yr) [1]	C Correction factor for industrial BOD discharged in sewers (I) [2]	D Organically degradable material in wastewater (TOW_i) (kg BOD/yr) D = A x B x C
Surface Flow				
Vertical Subsurface Flow				
Horizontal Subsurface Flow				
Hybrid type				
Semi-natural Treatment Wetlands				
			Total	

[1] g BOD/cap/day x 0.001 x 365 = kg BOD/cap/yr

[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).

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Sector	**Waste**
Category	**Domestic Wastewater Treatment and Discharge**
Category Code	**4D1**
Sheet	**2 of 3 Estimation of CH_4 Emission Factor for Domestic Wastewater Treated in Constructed Wetlands**

STEP 2			
Type of constructed wetland	A	B	C
	Maximum methane producing capacity (B_o) (kg CH_4/kg BOD)	Methane correction factor (MCF_i)	Emission factor (EF_i) (kg CH_4/kg BOD) C = A x 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 constructed wetland types in hybrid system			

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Sector	**Waste**		
Category	**Domestic Wastewater Treatment and Discharge**		
Category Code	**4D1**		
Sheet	**3 of 3 Estimation of CH_4 Emissions from Domestic Wastewater Treated in Constructed Wetlands**		
STEP 3			
Type of constructed wetlands	A	B	C
	Emission factor (EF_j) (kg CH_4/kg BOD) Sheet 2 of 3	Organically degradable material in wastewater (TOW_j) (kg BOD/yr) Sheet 1 of 3	Methane emissions (CH_4) (kg CH_4/yr) C=A x B
Surface Flow			
Vertical Subsurface Flow			
Horizontal Subsurface Flow			
Hybrid type			
Semi-natural Treatment Wetlands			
		Total	

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Sector	Waste		
Category	Industrial Wastewater Treatment and Discharge		
Category Code	4D2		
Sheet	1 of 3 Total Organic Degradable Material in Industrial Wastewater Treated in Constructed Wetlands		
STEP 1			
Industrial Sector	A	B	C
	Yearly flow rate of industrial wastewater treated by constructed wetland ($W_{i,j}$) (m^3/yr)	Chemical Oxygen Demand (COD_i) (kg COD/m^3)	Total organic degradable material in industrial wastewater treated in constructed wetland ($TOW_{i,j}$) (kg COD/yr) C=A x B
Industrial sector 1			
Industrial sector 2			
Industrial sector 3			
add as needed			
		Total	
Note: Emissions from collected runoff from agricultural land and landfill leachate treated in constructed wetlands should be reported in this worksheet			

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Sector	**Waste**
Category	**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			
Type of constructed wetland	A	B	C
	Maximum methane producing capacity (Bo) (kg CH_4/kg COD)	Methane correction factor (MCF_i) (-)	Emission factor (EF_i) (kg CH_4/kg COD)
			C = A x 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 constructed wetland types in hybrid system			

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Sector	**Waste**		
Category	**Industrial Wastewater Treatment and Discharge**		
Category Code	**4D2**		
Sheet	**3 of 3 Estimation of CH_4 Emissions from Industrial Wastewater Treated in Constructed Wetlands**		
STEP 3			
Industrial Sector	A Emission Factor (EF_j)* (kg CH_4/kg COD) Sheet 2 of 3	B Organically degradable material in wastewater ($TOW_{i,j}$) (kg COD/yr) Sheet 1 of 3	C Methane emissions (CH_4) (kg CH_4/yr) 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 industrial sector the EF would be TOWi,j-weighted average of EFs of the CWs used.			

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Sector	Waste					
Category	Domestic Wastewater Treatment and Discharge					
Category Code	4D1					
Sheet	1 of 2 Estimation of Nitrogen in Effluent Treated in Constructed Wetlands					
STEP1						
Type of constructed wetlands	A	B	C	D	E	F
	Population whose wastewater treated in constructed wetlands (P_i) (people)	Per capita protein consumption (Protein) (kg/person/year)	Fraction of nitrogen in protein (F_{NPR}) (kg N/kg protein)	Fraction of non-consumed protein ($F_{NON-CON}$) (-)	Fraction of industrial and commercial co-discharged protein ($F_{IND-COM}$) (-)	Total nitrogen in effluent (N) (kg N/year) 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	

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Sector	**Waste**			
Category	**Domestic Wastewater Treatment and Discharge**			
Category Code	**4D1**			
Sheet	**2 of 2 Estimation of N_2O Emissions from Domestic Wastewater Treated in Constructed Wetlands**			
STEP 2				
Type of constructed wetlands	A	B	C	D
	Total nitrogen in effluent (N_j) (kg N/year) Sheet 1 of 2	Emission Factor (EF_j) (kg N_2O- N/kg N)	Conversion factor 44/28	Total N_2O emissions (kg N_2O/year) 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 area-weighted average of the EFs of the constructed wetland types in hybrid system				

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Sector	**Waste**		
Category	**Industrial Wastewater Treatment and Discharge**		
Category Code	**4D2**		
Sheet	**1 of 2 Estimation of N in Effluent Treated in Constructed Wetlands**		
STEP 1			
Industrial Sector	A	B	C
	Total nitrogen concentration in industrial wastewater treated by constructed wetlands (TN_i) (kg N/m^3)	Yearly flow rate of industrial wastewater treated by constructed wetland ($W_{i,j}$)* (m^3/yr)	Total nitrogen effluent ($N_{i,j}$)* (kg N/yr) 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, W_{ij} and $N_{i,j}$ are sum of the Wi,j and Ni,j of the CWs used, respectively.

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Sector	**Waste**			
Category	**Industrial Wastewater Treatment and Discharge**			
Category Code	**4D2**			
Sheet	**2 of 2 Estimation of N_2O Emissions from Industrial Wastewater Treated in Constructed Wetlands**			
	STEP 2			
Industrial sector	A	B	C	D
	Total nitrogen in effluent ($N_{i,j}$) kg N/year) Sheet 1 of 2	Emission Factor (EF_j)* (kg N_2O- N/kg N)	Conversion factor 44/28	Total N_2O emissions (kg N_2O/year) 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				

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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	Net CO_2 emissions/ removals	Emissions				
		CH_4	N_2O	NO_x	CO	NMVOCs
	(Gg)					
3 AFOLU						
3A Livestock						
3A1 Enteric Fermentation						
3A1a Cattle						
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[1]						
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						

[1] Net CO_2 emissions/removals from land may include emissions from coastal wetlands which are not part of the total land area of the reporting country.

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Table 3 AFOLU Sectoral Table (2 of 2)

Categories		Net CO_2 emissions/ removals	Emissions				
			CH_4	N_2O	NO_x	CO	NMVOCs
		(Gg)					
3B4	**Wetlands**						
3B4a	Wetlands Remaining Wetlands						
3B4ai	Peat Extraction remaining Peat Extraction						
3B4aii	Flooded Land Remaining Flooded Land						
3B4aiii	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						
3B5bii	Cropland Converted to Settlements						
3B5biii	Grassland Converted to Settlements						
3B5biv	Wetlands Converted to Settlements						
3B5bv	Other Land Converted to Settlements						
3B6	**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						
3C	**Aggregate Sources and Non-CO_2 Emissions Sources on Land** [(2)]						
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_2O Emissions from Managed Soils** [(3)]						
3C5	**Indirect N_2O Emissions from Managed Soils**						
3C6	**Indirect N_2O Emissions from Manure Management**						
3C7	**Rice Cultivations**						
3C8	**CH_4 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	**N_2O emissions from aquaculture**						
3C13	**CH_4 emissions from rewetted and created wetlands on inland wetland mineral soils**						
3C14	**Other (please specify)**						
3D	**Other**						
3D1	**Harvested Wood Products**						
3D2	**Other (please specify)**						

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

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

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

928 * Cells to report emissions of NO_x, CO, and NMVOC have not been shaded although the physical potential for emissions is
929 lacking for some categories.

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

Categories	Surface Area			Net carbon stock change and CO_2 emissions/removals									Net CO_2 emissions
				Biomass				Dead organic matter			Soils		
	Mineral soils	Organic soils[4]	Total	Increase	Decrease	Carbon emitted as CH_4 and CO from fires [(1)]	Net carbon stock change	Net carbon stock change	Carbon emitted as CH_4 and CO from fires [(1)]	Net carbon stock change	Net carbon stock change in mineral soils [(2)]	Net carbon emissions /removals in organic soils[5]	
	(ha)			(Gg C)									(Gg CO_2)
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													
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													

[2] Net carbon stock change and CO_2 emissions/removals from land may include emissions from coastal wetlands which 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 3.2 AFOLU Background Table: 3B Carbon stock changes, emissions, and removals in AFOLU (1 of 2)

Categories		Surface Area			Net carbon stock change and CO_2 emissions/removals									Net CO_2 emissions
					Biomass				Dead organic matter			Soils		
		Mineral soils	Organic soils[4]	Total	Increase	Decrease	Carbon emitted as CH_4 and CO from fires (1)	Net carbon stock change	Net carbon stock change	Carbon emitted as CH_4 and CO from fires (1)	Net carbon stock change	Net carbon stock change in mineral soils (2)	Net carbon emissions /removals in organic soils[5]	
		(ha)			(Gg C)									(Gg CO_2)
3B4	**Wetlands (3)**													
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													

(1) Where the carbon contained in the emissions of CH_4 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 CH_4 and CO is then subtracted from carbon stock change to avoid double counting (see Volume 4, Section 2.2.3).

(2) The activity data used for this column correspond to the difference between the column Area and the Area of organic soils.

(3) CO_2 Emissions from Wetlands are reported in a separate background table (Table 3.3) that includes all gases emitted from Wetlands.

(4) 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.

(5) The net loss/gain from all types of organic soils should be reported here (see also footnote 4).

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

Categories	Activity data	Net emissions/removals	Emissions	
	Area	CO_2	CH_4	N_2O
	(ha)	(Gg)		
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]				

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

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Table 3.4 AFOLU Background Table: Burning (3C1)

Categories [1]	Activity data			Emissions											Information item: Carbon emitted as CH_4 and CO [5]	
				CO_2 [3]			CO [4]			CH_4 [4]			NO_x	N_2O		
	Description [2]	Unit	Values	Bio-mass	DOM	SOM [6]	Bio-mass	DOM	SOM [6]	Bio-mass	DOM	SOM [6]			Biomass	DOM
		(ha or kg dm)		(Gg)											(C Gg)	
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																
Burning in Non Forest Land Converted to Grassland																

Table 3.4 AFOLU Background Table: Burning (3C1)

Categories [1]	Activity data			Emissions											Information item: Carbon emitted as CH_4 and CO [5]	
				CO_2 [3]			CO [4]			CH_4 [4]			NO_x	N_2O		
	Description [2]	Unit	Values	Biomass	DOM	SOM [6]	Biomass	DOM	SOM [6]	Biomass	DOM	SOM [6]			Biomass	DOM
		(ha or kg dm)		(Gg)											(C Gg)	
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 in hectare (ha) and for biomass/soil carbon burned in kilogram dry matter (kg dm).

(3) If CO_2 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) CO_2, CH_4 and CO emissions from biomass burning, DOM and SOM are reported separately.

(5) Where the carbon contained in the emissions of CH_4 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 CH_4 and CO is then subtracted from carbon stock change to avoid double counting. The conversion factors to convert CH_4 and CO to C (as input to Table 3.2) are 12/16 for CH_4 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.

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Table 3.7 AFOLU Background Table: Direct N_2O emissions from Managed Soils (3C4)

Categories [(1)]	Activity data	Emissions
	Total amount of nitrogen applied	N_2O
	(Gg N/yr)	(Gg)
3C4 Direct N_2O 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)		

962

963 (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
964 possible using this table.

965 (2) Only for Grassland.

966 (3) Only for Cropland.

967

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Table 3.9 AFOLU Background Table: Non-CO_2 GHG emissions not included elsewhere (3C7 to 3C14)

Categories	Activity data	Emissions	
		CH_4	N_2O
	(ha)	(Gg)	
3C7 Rice Cultivations [(1)]			
3C8 CH_4 from drained organic soils[(2)(3)]			
3C9 CH_4 from drainage ditches on organic soils[(2)]			
3C10 CH_4 from rewetting of organic soils[(2)]			
3C11 CH_4 emissions from rewetting of mangroves and tidal marshes[(2)]			
3C12 N_2O emissions from aquaculture[(2)]			
3C13 CH_4 emissions from rewetted and created wetlands on inland wetland mineral soils[(2)]			
3C14 Other (please specify)			

971

972 (1) If a country wishes to report direct N_2O emissions from N fertilizer application to rice field, it should be reported here. Otherwise, in Table 3.7.

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

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