



# Session 4: IPCC Inventory Software for National GHG inventories – New Functionalities in the AFOLU Sector

**SBSTA - 56**

*8 June, 2022*

Valentyna Slivinska – Sandro Federici

***IPCC TFI TSU***

**ipcc**

INTERGOVERNMENTAL PANEL ON climate change



# Overview of elements upgraded

- ✓ Land Representation Manager
- ✓ Mineral soil SOC change – Equation 2.25
  - Formulation A
  - Formulation B
- ✓ Stock Difference Method
- ✓ Wetlands Supplement
  - ✓ additional Methods
  - ✓ additional Categories

# Land Representation Manager (LRM)

- New Element of the IPCC Inventory Software
- It manages Land Representation allowing to use any of the three IPCC approaches:
  - Approach 1 (no land use change identification)
  - Approach 2 (land use change identification)
  - Approach 3 (land use change identification and tracking across time)
- It ensures consistency of land representation through tracing of units of land,
- Unit of land: an area homogenous per
  - physical conditions –i.e. *climate/vegetation zone and soil type*- and
  - current and historical socio-economic functions –i.e. *land use and management type*-

# LRM – Regions Tab

Land Representation Manager

Regions | Land representation table | Annual land representation matrix (Approach 2 & 3)

Whole country area (ha) 19,000,000

Region name	Area (ha)	Approach	Remark
Region 3	17000	Approach 3	
Region 1	1000	Approach 1	
Region 2	1000	Approach 2	
*			
Total	19000,000		

Define single region in case you wish to report for the whole country

Save Undo Close

- A country can be represented in a single set of National data or in a number of Regions
- For each Region the approach applied for the land representation is to be selected

# LRM – Land Representation Tab

Land Representation Manager

Regions Land representation table Annual land representation matrix (Approach 2 & 3)

Region **Region 3** Region area (ha) **17,100,000** Discrepancy (ha) **OK** Approach **3** **1990**

Land use category	Area (1990) (ha)	Remark
Forest Land	14100	
Land use subcategory		
Managed Forest Land	14100	
Current Land use subdivision		
Managed Forest		
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory
MFL-MF-NF-OB-10-c-UFL-P...	Unit 1.1	Unmanaged Forest Land
MFL-MF-NF-OB-18-c-OSL-A...	Unit 6	Settlements (Other)
MFL-MF-NF-OB-21-c-ACL-A...		Cropland Annual Crops
		Annual Crops
Current Land use subdivision		
Managed Forest (drained)		
Plantation (intensive)		
Plantation		
Land use subcategory		
Unmanaged Forest Land	0	
Land use category		
Cropland	2500	
Grassland	500	
Wetlands	0	
Settlements	0	
Other Land	0	

Save Undo Close

- All info on land use and land use changes is to be input in this Tab
- A Table for each Region
- Automatic check of area discrepancy

# LRM – Land Representation Tab

Land Representation Manager

Regions Land representation table Annual land representation matrix (Approach 2 & 3)

Region Region 3 Region area (ha) 17,100.000 Discrepancy (ha) OK Approach 3 1990

Land use category		Area (1990) (ha)		Remark						
Forest Land		14100								
Land use subcategory		Area (1990) (ha)		Remark						
Managed Forest Land		14100								
Current Land use subdivision			Remark							
Managed Forest			✘							
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period (T) (years)	Year of conversion	Area (1990) (ha)	Remark	P	C	M
MFL-MF-NF-OB-10<-UFL-P...	Unit 1.1	Unmanaged Forest Land	Protected area	20	1990	1000 ↔				✘
MFL-MF-NF-OB-18<-OSL-A...	Unit 6	Settlements (Other)	Abandoned	20	1990	1000 ↔				✘
MFL-MF-NF-OB-21<-ACL-A...		Cropland Annual Crops	Annual Crops	20	1981	100 ↔				✘
Current Land use subdivision			Remark							
Managed Forest (drained)			✘							
Plantation (intensive)			✘							
Plantation			✘							
*										
Land use subcategory		Area (1990) (ha)		Remark						
Unmanaged Forest Land		0								
Land use category		Area (1990) (ha)		Remark						
Cropland		2500								
Grassland		500								
Wetlands		0								
Settlements		0								
Other Land		0								

Save Undo Close

- Each unit of land gets assigned a code from the software on the basis of current and previous land use/management
- To ease the work of inventory compilers, an additional user defined code can be assigned to each unit of land



# LRM – Land Representation Tab

Land Representation Manager

Regions Land representation table Annual land representation matrix (Approach 2 & 3)

Region Region 3 Region area (ha) 17,100,000 Discrepancy (ha) OK Approach 3 1990

Land use category		Area (1990) (ha)	Remark							
Forest Land		14100								
Land use subcategory		Area (1990) (ha)	Remark							
Managed Forest Land		14100								
Current Land use subdivision		Area (1990) (ha)	Remark							
Managed Forest										
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period (T) (years)	Year of conversion	Area (1990) (ha)	Remark	P	C	M
MFL-MF-NF-OB-10-c-UFL-P...	Unit 1.1	Unmanaged Forest Land	Protected area	20	1990	1000	↔			✗
MFL-MF-NF-OB-18-c-OSL-A...	Unit 6	Settlements (Other)	Abandoned	20	1990	1000	↔			✗
MFL-MF-NF-OB-21-c-ACL-A...		Cropland Annual Crops	Annual Crops	20	1981	100	↔			✗
Current Land use subdivision						↔				
Managed Forest (drained)										✗
Plantation (intensive)										✗
Plantation										✗
Land use subcategory		Area (1990) (ha)	Remark							
Unmanaged Forest Land		0								
Land use category		Area (1990) (ha)	Remark							
Cropland		2500								
Grassland		500								
Wetlands		0								
Settlements		0								
Other Land		0								

Save Undo Close

- Each unit of land is to be input in the software on the basis of current and previous land use/management
- Data input in the time series is to be done from its first year forward

# LRM – Land Representation Tab

Land Representation Manager

Regions Land representation table Annual land representation matrix (Approach 2 & 3)

Region Region 3 Region area (ha) 17,100.000 Discrepancy (ha) OK Approach 3 1990

Land use category		Area (1990) (ha)		Remark						
Forest Land		14100								
Land use subcategory		Area (1990) (ha)		Remark						
Managed Forest Land		14100								
Current Land use subdivision				Remark						
Managed Forest				✘						
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period (T) (years)	Year of conversion	Area (1990) (ha)	Remark	P	C	M
MFL-MF-NF-OB-10<c-UFL-P...	Unit 1.1	Unmanaged Forest Land	Protected area	20	1990	1000 ↔				✘
MFL-MF-NF-OB-18<c-OSL-A...	Unit 6	Settlements (Other)	Abandoned	20	1990	1000 ↔				✘
MFL-MF-NF-OB-21<c-ACL-A...		Cropland Annual Crops	Annual Crops	20	1981	100 ↔				✘
Current Land use subdivision				Remark						
Managed Forest (drained)										✘
Plantation (intensive)										✘
Plantation										✘
Land use subcategory		Area (1990) (ha)		Remark						
Unmanaged Forest Land		0								
Land use category		Area (1990) (ha)		Remark						
Cropland		2500								
Grassland		500								
Wetlands		0								
Settlements		0								
Other Land		0								

Save Undo Close

- For each conversion: **Transition Period** and **Conversion Year** are to be input
- Once input in an inventory year, the unit of land is copied by the software in all years of the time series updating its “conversion-status” according to the time passed since its conversion



# LRM – Land Representation Tab

Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (1990) (ha)	Remark	P	C	M
MFL-PP-PL-P-4<MGL-P-P...	Approccio 3 esempio	Managed Grassland	Pasture	20	1984	1000				

## Additional functionalities

- **Area entry:** once area of a unit of land is input the user may select the portion of the time series to which that area is to be assigned to the unit

Area update mode

Current inventory year only

Current inventory year and all subsequent inventory years

Current inventory year and all previous inventory years

All inventory years

Update Cancel

- By default, the area is assigned to the current and subsequent years

# LRM – Land Representation Tab

Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (1991) (ha)	Remark	P	C	M
MFL-PP-PL-P-4<MGL-P-P...	Approccio 3 esempio	Managed Grassland	Pasture	20	1984	1000 ↔				
*						↔				

## Additional functionalities

- Button “P” (Pools) to assign to each C pool the method to estimate C stock changes i.e. **IPCC default method** vs **Stock-Difference method**

Land Unit Parameters

C pools / Methods

Biomass change Gain & Loss

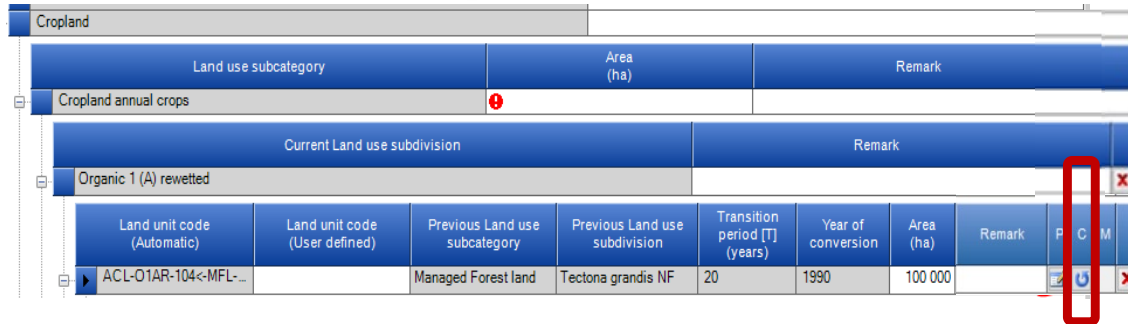
DOM - Deadwood Gain & Loss

DOM - Litter Gain & Loss

SOM - Mineral Default

Save Cancel

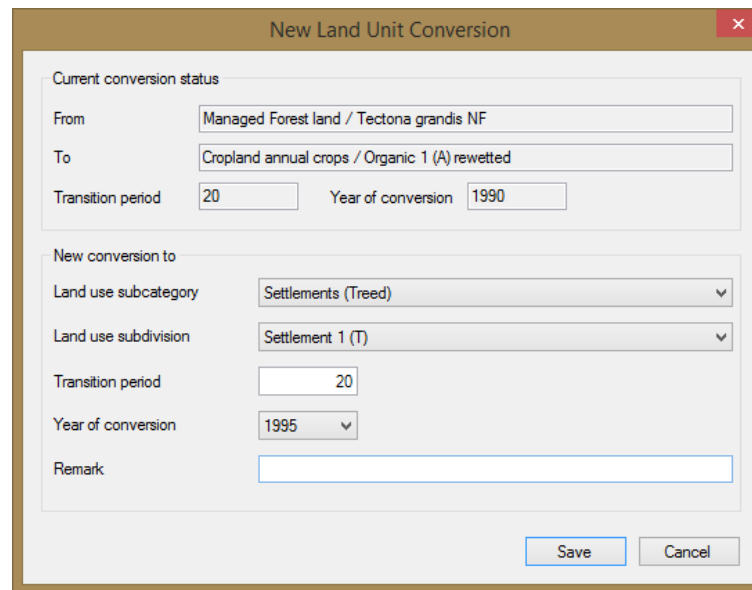
# LRM – Land Representation Tab



Land use subcategory		Area (ha)	Remark							
Cropland annual crops										
Current Land use subdivision		Remark								
Organic 1 (A) rewetted										
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (ha)	Remark	P	C	M
ACL-O1AR-104<-MFL-...		Managed Forest land	Tectona grandis NF	20	1990	100 000				

## Additional functionalities

- **Button “C”** (Conversion) to input a further conversion to a unit of land that is still undergoing a conversion (*no 20-year period passed since the previous conversion*)



**New Land Unit Conversion**

Current conversion status

From: Managed Forest land / Tectona grandis NF

To: Cropland annual crops / Organic 1 (A) rewetted

Transition period: 20      Year of conversion: 1990

New conversion to

Land use subcategory: Settlements (Treed)

Land use subdivision: Settlement 1 (T)

Transition period: 20

Year of conversion: 1995

Remark:

Save      Cancel

*It is available in Approach 3 land representation only*

# LRM – Land Representation Tab

Land use subcategory		Area (1991) (ha)	Remark					
Managed Forest Land		120						
Current Land use subdivision			Remark					
Pine plantation								
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (1991) (ha)	Remark	M
MFL-PP-PL-P-23		Managed Forest Land	Pine plantation	NA	NA	100 (↔)		
MFL-PP-PL-P-24<MGL-P-P...		Managed Grassland	Pasture	20	1990	10 (↔)		
MFL-PP-PL-P-25		Managed Forest Land	Pine plantation	NO	NO	10 (↔)		

## Additional functionalities

- **Button “M”** (Merge) to merge a unit of land that has completely undergone through the transition period.

*Merging is allowed with any other unit with identical land use (category/subcategory/subdivision) as well as with identical climate/vegetation zone and soil type.*

Merge Land Unit

Source Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Pine plantation

Land unit: MFL-PP-PL-P-25

Area [ha]: 10

Target Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Pine plantation

Land unit: MFL-PP-PL-P-23

Area [ha]: 100 +10 [ha]

Merge Cancel

*It is available in Approaches 2 and 3 land representation only*

# LRM – Example – Approach 3

Land Representation of 3 units of land tracked across 1989-2009

UL	Tracking info [FL - Forest Land; GL – Grassland]	AREA (ha) Inventory year		
		2000	2008	2009
7.1	FL - Forest Plantation (from Managed FL in 1989): a) In 2008, half unit of land is converted to UL7.3; b) In 2009, remaining portion is merged with UL7.2;	3,000	1,500	0
7.2	Forest Plantation (for any known years)	5,000	5,000	6,500
7.3	GL from 2008, from conversion of a portion of UL7.1	0	1,500	1,500
<b>Total area of Land Representation</b>		<b>8,000</b>	<b>8,000</b>	<b>8,000</b>

# LRM – EXAMPLE – Approach 3 – 2000

## First data input

Land Representation Manager

Regions | Land representation table | Annual land representation matrix (Approach 2 & 3)

Region: Region 3 | Region area (ha): 16,000,000 | Discrepancy (ha): OK | Approach 3 | 2000

Land use category	Area (2000) (ha)	Remark								
Forest Land	13000									
Managed Forest Land	13000									
Current Land use subdivision										
Managed Forest		X								
Managed Forest (drained)		X								
Plantation (intensive)		X								
Plantation		X								
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period (T) (years)	Year of conversion	Area (2000) (ha)	Remark	P	C	M
MFL-P-PL-P-20	Unit 7.2	Managed Forest Land	Plantation	NA	NA	5000 (↔)				X
MFL-P-PL-P-41c-MFL-MF	Unit 7.1	Managed Forest Land	Managed Forest	20	1989	3000 (↔)				X
Current Land use subdivision										
Other Managed Forest (drained)										X
Land use subcategory			Area (2000) (ha)		Remark					
Unmanaged Forest Land			0							
Land use category	Area (2000) (ha)	Remark								
Cropland	2500									
Grassland	500									
Wetlands	0									
Settlements	0									
Other Land	0									

Save | Undo | Close



# LRM – EXAMPLE – Approach 3 – 2008

## Splitting (new Input) and Conversion of the Unit of Land

Land Representation Manager

Regions Land representation table Annual land representation matrix (Approach 2 & 3)

Region Region 3 Region area (ha) 16,000,000 Discrepancy (ha) OK Approach 3 2008

Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (2008) (ha)	Remark			
MFL-P-PL-P-20	Unit 7.2	Managed Forest Land	Plantation	NA	NA	5000				
MFL-P-PL-P-40<MFL-MF-	Unit 7.1 (remaining part)	Managed Forest Land	Managed Forest	20	1989	1500				
Current Land use subdivision		Remark								
Other Managed Forest (drained)										
Land use subcategory		Area (2008)				Remark				
Unmanaged Forest Land										
Land use category						Remark				
Cropland										
Grassland										
Land use subcategory						Remark				
Managed Grassland										
Current Land use subdivision		Remark								
Managed (pasture)										
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (2008) (ha)	Remark	P	C	M
MGL-MP-PR-13<UGL-U-S		Unmanaged Grassland	Unmanaged	20	1990	500				
MGL-MP-PR-41<MFL-P-P	Unit 7.1	Managed Forest Land	Plantation	20	2008	1500				
Previous Land use subcategory		Previous Land use subdivision		Transition period [T] (years)		Year of conversion		Remark		
Managed Forest Land		Managed Forest		20		1989				

Area update mode

- Current inventory year only
- Current inventory year and all subsequent inventory years
- Current inventory year and all previous inventory years
- All inventory years

Update Cancel

Area update mode

- Current inventory year only
- Current inventory year and all subsequent inventory years
- Current inventory year and all previous inventory years
- All inventory years

Update Cancel

Save Undo Close

year: 2008 | base year for assessment of uncertainty in trend: 1990 | CO2 Equivalents: SAK GWPs (100 year time horizon) | Database file: (H:\Shared drives\IPCC-13U\inventory\_software\ipcc2006.accdb)

# LRM – EXAMPLE – Approach 3 – 2008

## Conversion Tab used for Unit 7.1

The screenshot displays the 'Land Representation Manager' interface. A 'New Land Unit Conversion' dialog box is open, showing the following details:

- Current conversion status:**
  - From: Managed Forest Land / Managed Forest
  - To: Managed Forest Land / Plantation
  - Transition period: 20
  - Year of conversion: 1989
- New conversion to:**
  - Land use subcategory: Managed Grassland
  - Land use subdivision: Managed (pasture)
  - Transition period: 20
  - Year of conversion: 2008

The background interface shows a tree view of land use categories and a table of land units. The table includes columns for 'Year of conversion', 'Area (2008) (ha)', 'Remark', 'P', 'C', and 'M'. A red arrow points from the 'Managed (pasture)' selection in the dialog to the 'Approach 3' label in the top right corner of the main window.

# LRM – EXAMPLE – Approach 3 – 2007

## Adjustment of UL area in the previous inventory year

Land Representation Manager

Regions | Land representation table | Annual land representation matrix (Approach 2 & 3)

Region: Region 3 | Region area (ha): 16,000,000 | Discrepancy (ha): OK | Approach 3 | 2007

Land use category	Area (2000) (ha)	Remark								
Forest Land	13000									
Managed Forest Land	13000									
Current Land use subdivision		Remark								
Managed Forest										
Managed Forest (drained)										
Plantation (intensive)										
Plantation										
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (2000) (ha)	Remark	P	C	M
MFL-P-PL-P-20	Unit 7.2	Managed Forest Land	Plantation	NA	NA	5000				
MFL-P-PL-P-40<-MFL-MF-...	Unit 7.1 (remaining part)	Managed Forest Land	Managed Forest	20	1989	0				
MFL-P-PL-P-41<-MFL-MF-...	Unit 7.1	Managed Forest Land	Managed Forest	20	1989	0				
*										
Other Managed Forest (drained)										
*										
Land use subcategory										
Unmanaged Forest Land										
*										
Land use category										
Cropland						2500				
Grassland						500				
Wetlands						0				
Settlements						0				
Other Land						0				

Area update mode

- Current inventory year only
- Current inventory year and all subsequent inventory years
- Current inventory year and all previous inventory years
- All inventory years

Update Cancel

Save Undo Close

# LRM – EXAMPLE – Approach 3 – 2009

## Merging ULs

Land Representation Manager

Regions Land representation table Annual land use

Region Region 3

Approach 3 2009

Land use category

- Forest Land
  - Land use subcategory
    - Managed Forest Land
      - Managed Forest
      - Managed Forest (drained)
      - Plantation (intensive)
      - Plantation

Land unit code (Automatic) (User defined) subcategory subdivision (years) Year of conversion Area (2009) (ha) Remark P C M

MFL-P-PL-P-20	Unit 7.2	Managed Forest Land	Plantation	NA	NA	5000	↔				✗
MFL-P-PL-P-40	Unit 7.1 (remaining part)	Managed Forest Land	Plantation	NO	NO	1500	↔				✗
*							↔				✗

Current Land use subdivision Remark

Other Managed Forest (drained)											✗
*											

Land use subcategory Area (2009) (ha) Remark

Unmanaged Forest Land		0		
-----------------------	--	---	--	--

Land use category Area (2009) (ha) Remark

Cropland		3500		
Grassland		1500		
Wetlands		0		
Settlements		0		

Merge Land Unit

Source Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Plantation

Land unit: Unit 7.1 (remaining part)

Area [ha]: 1500

Target Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Plantation

Land unit: Unit 7.2

Area [ha]: 1500 (ha)

Merge Cancel

Year: 2009 | Base year for assessment of uncertainty in trend: 1990 | CO2 Equivalents: SAR GWPs (100 year time horizon) | Database file: (H:\Shared drives\IPCC-TSU\inventory software\ipcc2006.accd.b)

Save Undo Close



# LRM – EXAMPLE – Approach 3 – 2009

## Final Status

Land Representation Manager

Regions | Land representation table | Annual land representation matrix (Approach 2 & 3)

Region: Region 3 | Region area (ha): 16,000,000 | Discrepancy (ha): OK | Approach 3 | 2009

Current Land use subdivision		Previous Land use subcategory		Transition period [T] (years)	Year of conversion	Area (2009) (ha)	Remark	P	C	M
Managed Forest (drained)		Managed Forest Land		NA	NA	6500				X
Plantation (intensive)		Plantation								X
Plantation		Plantation								X
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (2009) (ha)	Remark	P	C	M
MFL-P-PL-P-20	Unit 7.2	Managed Forest Land	Plantation	NA	NA	6500				X
Current Land use subdivision		Previous Land use subcategory		Transition period [T] (years)	Year of conversion	Area (2009) (ha)	Remark	P	C	M
Other Managed Forest (drained)		Unmanaged Forest Land				0				X
Land use subcategory		Area (2009) (ha)		Remark						
Unmanaged Forest Land		0								
Land use category		Area (2009) (ha)		Remark						
Cropland		3500								
Grassland		1500								
Land use subcategory		Area (2009) (ha)		Remark						
Managed Grassland		1500								
Current Land use subdivision		Previous Land use subcategory		Transition period [T] (years)	Year of conversion	Area (2009) (ha)	Remark	P	C	M
Managed (pasture)		Managed Forest Land		20	2008	1500				X
Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition period [T] (years)	Year of conversion	Area (2009) (ha)	Remark	P	C	M
MGL-MP-PR-41<-MFL-P-P...	Unit 7.1	Managed Forest Land	Plantation	20	2008	1500				X

# Annual land representation matrix

Land Representation Manager

Regions | Land representation table | Annual land representation matrix (Approach 2 & 3)

Region: Region 3 | Region area (ha): 17,100,000 | Approach: 3 | 2000

Final	Initial	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		Final Area (ha)	Net change (ha)
		Managed Forest Land	Unmanaged Forest Land	Cropland Annual Crops	Cropland Perennial Crops	Managed Grassland	Unmanaged Grassland	Managed Wetlands	Unmanaged Wetlands	Settlements (Treed)	Settlements (Other)	Managed Other Land	Unmanaged Other Land		
Forest Land	Managed Forest Land	14100												14100	0
	Unmanaged Forest Land													0	0
Cropland	Cropland Annual Crops			500										500	0
	Cropland Perennial Crops				2000									2000	0
Grassland	Managed Grassland					500								500	0
	Unmanaged Grassland													0	0
Wetlands	Managed Wetlands													0	0
	Unmanaged Wetlands													0	0
Settlements	Settlements (Treed)													0	0
	Settlements (Other)													0	0
Other Land	Managed Other Land													0	0
	Unmanaged Other Land													0	0
	Initial Area (ha)	14100	0	500	2000	500	0	0	0	0	0	0	0	17100	0

Close

No data Input, just for verification (not exportable yet)



# Mineral soil SOC change – Equation 2.25

## BOX 2.1 (UPDATED)

### ALTERNATIVE FORMULATIONS OF EQUATION 2.25 FOR APPROACH 1 ACTIVITY DATA VERSUS APPROACH 2 OR 3 ACTIVITY DATA WITH TRANSITION MATRICES

Two alternative formulations are possible for Equation 2.25 depending on the Approach used to collect activity data, including

#### Formulation A (Approach 1 for Activity Data Collection)

$$\Delta C_{Mineral} = \frac{\left[ \sum_{c,s,i} \left( SOC_{REF_{c,s,i}} \cdot F_{LU_{c,s,i}} \cdot F_{MG_{c,s,i}} \cdot F_{I_{c,s,i}} \cdot A_{c,s,i} \right) \right]_0 - \left[ \sum_{c,s,i} \left( SOC_{REF_{c,s,i}} \cdot F_{LU_{c,s,i}} \cdot F_{MG_{c,s,i}} \cdot F_{I_{c,s,i}} \cdot A_{c,s,i} \right) \right]_{(0-T)}}{D}$$

#### Formulation B (Approaches 2 and 3 for Activity Data Collection)

$$\Delta C_{Mineral} = \frac{\sum_{c,s,p} \left[ \left\{ \left( SOC_{REF_{c,s,p}} \cdot F_{LU_{c,s,p}} \cdot F_{MG_{c,s,p}} \cdot F_{I_{c,s,p}} \right)_0 - \left( SOC_{REF_{c,s,p}} \cdot F_{LU_{c,s,p}} \cdot F_{MG_{c,s,p}} \cdot F_{I_{c,s,p}} \right)_{(0-T)} \right\} \cdot A_{c,s,p} \right]}{D}$$

Where:

$p$  = a parcel of land representing an individual unit of area over which the inventory calculations are performed.

- The software applies the 2 formulations according to the approach for land representation selected for the Region to which the unit of land belongs

# SOC change – Formulation A - LRM

The screenshot shows the 'Land Representation Manager' interface. At the top, it displays 'Regions: Land representation table | Annual land representation matrix (Approach 2 & 3)'. Below this, there are fields for 'Region' (Region 1), 'Region area (ha)' (1,000,000), 'Discrepancy (ha)' (1990: OK; 1970: OK), 'Approach 1', and '1990'. The main table has columns for 'Land use category', 'Area (1990) (ha)', 'Area (1970) (ha)', and 'Remark'. The table is expanded to show 'Forest Land' (Area 1990: 1000, Area 1970: 1000), 'Managed Forest Land' (Area 1990: 1000, Area 1970: 1000), and 'Pine plantation'. Under 'Pine plantation', there are columns for 'Land unit code (Automatic)', 'Land unit code (User defined)', 'Area (1990) (ha)', 'Area (1970) (ha)', 'Remark', and 'P'. The 'Area (1990) (ha)' and 'Area (1970) (ha)' columns for the 'Pine plantation' row are highlighted with red boxes. The 'Area (1990) (ha)' column shows '1000' and the 'Area (1970) (ha)' column shows '1000'. There are also arrows and a red 'X' icon in the 'Remark' column for the 'Pine plantation' row.

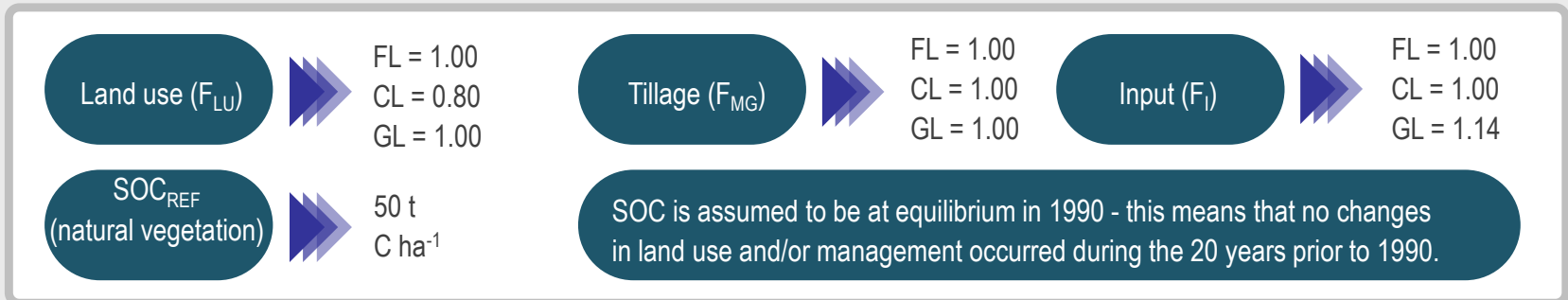
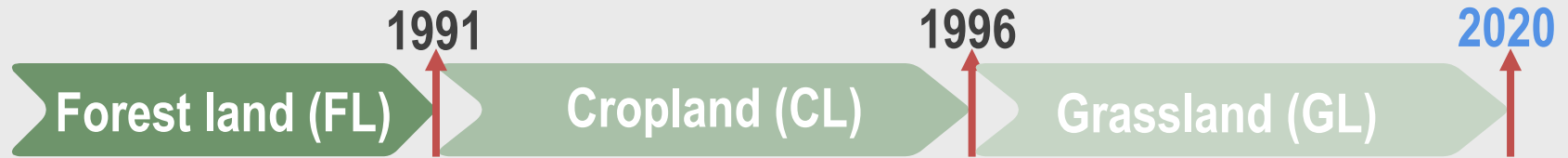
Land use category	Area (1990) (ha)	Area (1970) (ha)	Remark
Forest Land	1000	1000	
Managed Forest Land	1000	1000	
Current Land use subdivision			
Pine plantation			
Land unit code (Automatic)	Land unit code (User defined)	Area (1990) (ha)	Area (1970) (ha)
MFL-PP-PL-P-22		1000	1000

Approach 1 does not identify land-use conversions, thus:

- ✓ SOC changes are estimated by comparison of total SOC stock across the land representation (Region/Country) in the inventory year and 20 years before the inventory year
- ✓ The Land Representation Manager requires for each unit of land to input the area in the inventory year as well as the area of 20 years before

# SOC change – Example

A unit of land of 1 ha has been converted twice over a 20-year period.



Year	1990	1995	2000	2005	2010	2015	2020
Land Use Category	FL	CL	GL	GL	GL	GL	GL
FL area (ha)	1	0	0	0	0	0	0
CL area (ha)	0	1	0	0	0	0	0
GL area (ha)	0	0	1	1	1	1	1

# SOC change – Example – Formulation A

A unit of land of 1 ha has been converted twice over a 20-year period.



Formulation A							
Year	1990	1995	2000	2005	2010	2015	2020
Land Use Category	FL	CL	GL	GL	GL	GL	GL
FL area (ha)	1	0	0	0	0	0	0
CL area (ha)	0	1	0	0	0	0	0
GL area (ha)	0	0	1	1	1	1	1
SOC <sub>0_GHGI</sub> (t C)	50.00	40.00	57.00	57.00	57.00	57.00	57.00
SOC <sub>(0-T)_GHGI</sub> (t C)	50.00	50.00	50.00	50.00	50.00	40.00	57.00
ΔC (t C yr <sup>-1</sup> )	0.00	<b>-0.50</b>	+0.35	+0.35	+0.35	<b>+0.85</b>	0.00

# SOC change – Formulation A – Example

Calculation is made at “Region” level, in **1995** in our case we have:

- a hypothetical SOC loss in FL,

Worksheet  
**Sector:** Agriculture, Forestry and Other Land Use  
**Category:** Forest Land  
**Subcategory:** 3.B.1.a - Forest land Remaining Forest land  
**Sheet:** SOC Changes in mineral soils - Approach 1 (Information item)  
 1995

Data  
 Region: SOC test (Formulation A) - Approach 1

Land use category			Equation 2.25 - A		
Land unit code	Land use during reporting year		Soil organic carbon stock in mineral soils in year 1995 (tonnes C / ha)	Soil organic carbon stock in mineral soils in year 1975 (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)
			SOC(1995)	SOC(1975)	$\Delta C_{\text{mineral}} = ((\text{SOC}(1995) - \text{SOC}(1975)) / 20)$
MFL-ST-NF-TG-26	Managed Forest Land	SOC test	0	50	-2.5
Total			0	50	-2.5

- a hypothetical SOC gain in CL,

Worksheet  
**Sector:** Agriculture, Forestry and Other Land Use  
**Category:** Cropland  
**Subcategory:** 3.B.2.a - Cropland Remaining Cropland  
**Sheet:** SOC Changes in mineral soils - Approach 1 (Information item)  
 1995

Data  
 Region: SOC test (Formulation A) - Approach 1

Land use category			Equation 2.25 - A		
Land unit code	Land use during reporting year		Soil organic carbon stock in mineral soils in year 1995 (tonnes C / ha)	Soil organic carbon stock in mineral soils in year 1975 (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)
			SOC(1995)	SOC(1975)	$\Delta C_{\text{mineral}} = ((\text{SOC}(1995) - \text{SOC}(1975)) / 20)$
ACL-ST-28	Cropland Annual Crops	SOC test	40	0	2
Total			40	0	2

- that correspond to a total real net SOC loss of **0.5 t C ha yr<sup>-1</sup>**

# SOC change – Formulation A – Example

Calculation is made at “Region” level, in **2015** in our case we have:

- an artefact SOC loss in CL,

Worksheet  
**Sector:** Agriculture, Forestry and Other Land Use  
**Category:** Cropland  
**Subcategory:** 3.B.2.a - Cropland Remaining Cropland  
**Sheet:** SOC Changes in mineral soils - Approach 1 (Information item) 2015

Data  
**Region** SOC test (Formulation A) - Approach 1

Land use category			Equation 2.25 - A		
Land unit code	Land use during reporting year		Soil organic carbon stock in mineral soils in year 2015 (tonnes C / ha)	Soil organic carbon stock in mineral soils in year 1995 (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)
			SOC(2015)	SOC(1995)	$\Delta C_{\text{mineral}} = ((\text{SOC}(2015) - \text{SOC}(1995)) / 20)$
ACL-ST-28	Cropland Annual Crops	SOC test	0	40	-2
Total			0	40	-2

- an artefact SOC gain in GL,

Worksheet  
**Sector:** Agriculture, Forestry and Other Land Use  
**Category:** Grassland  
**Subcategory:** 3.B.3.a - Grassland Remaining Grassland  
**Sheet:** SOC Changes in mineral soils - Approach 1 (Information item) 2015

Data  
**Region** SOC test (Formulation A) - Approach 1

Land use category			Equation 2.25 - A		
Land unit code	Land use during reporting year		Soil organic carbon stock in mineral soils in year 2015 (tonnes C / ha)	Soil organic carbon stock in mineral soils in year 1995 (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)
			SOC(2015)	SOC(1995)	$\Delta C_{\text{mineral}} = ((\text{SOC}(2015) - \text{SOC}(1995)) / 20)$
MGL-ST-SA-30	Managed Grassland	SOC test	57	0	2.85
Total			57	0	2.85

- thus, a total net SOC gain of **0.85 t C ha yr<sup>-1</sup>**



# SOC change – Example – Formulation B

A unit of land of 1 ha has been converted twice over a 20-year period.



Formulation B							
Year	1990	1995	2000	2005	2010	2015	2020
Land Use Category	FL	CL	GL	GL	GL	GL	GL
FL area (ha)	1	0	0	0	0	0	0
CL area (ha)	0	1	0	0	0	0	0
GL area (ha)	0	0	1	1	1	1	1
SOC <sub>0_GHGI</sub> (t C)	50.000	47.500	49.875	52.250	54.625	57.000	57.000
SOC <sub>(0-T)_GHGI</sub> (t C)	50.000	50.000	47.500	49.875	52.250	54.625	57.000
$\Delta C$ (t C ha <sup>-1</sup> yr <sup>-1</sup> )	0.000	<b>-0.500</b>	<b>+0.475</b>	+0.475	+0.475	+0.475	0.000

# SOC change – Formulation B – Example

Calculation is made at “Region” level, on the basis of the actual SOC stock in the SOM for each inventory year (land tracking). The unit of land “SOC test” has:

- In 1995, a net SOC loss of **0.5 tC ha yr<sup>-1</sup>**
- In 2000, a net SOC gain of **0.475 tC ha yr<sup>-1</sup>**

Worksheet  
Sector: Agriculture, Forestry and Other Land Use  
Category: Cropland  
Subcategory: 3.B.2.b.i - Forest Land converted to Cropland  
Sheet: Annual net C stock change in soil organic matter of mineral soils - Approach 2 and Approach 3 (Default method)  
Data  
Region: SOC TEST (formulation B) - Approach 3

1995

Land use category				Equation 2.25 - B									
Land unit code	Initial land use	Land use during reporting year	Area (ha)	Reference carbon stock for the climate and soil combination (tonnes C / ha)	Time dependence of stock change factors (D) or number of years over a single inventory time period (T) (yr)	Stock change factor for land-use system for the subdivision in the current inventory year (-)	Stock change factor for management regime for the subdivision in the current inventory year (-)	Stock change factor for C input for the subdivision in the current inventory year (-)	Soil organic carbon stock in mineral soils at equilibrium for the current subdivision (tonnes C / ha)	Soil organic carbon stock in mineral soils for the subdivision at conversion (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)		
			National statistics or international data sources	Tables 2.3 / 5.2 WS	Default value is 20	National statistics or international data sources	National statistics or international data sources	National statistics or international data sources	$SOC(0) = SOC_{ref} * F_{lu}(0) * F_{mg}(0) * F_i(0)$		$\Delta C_{mineral} = ((SOC(0) - SOC(c)) * A) / D$		
			A	SOCref	D	F <sub>lu</sub> (0)	F <sub>mg</sub> (0)	F <sub>i</sub> (0)	SOC(0)	SOC(c)	ΔC <sub>mineral</sub>		
SOC Test	Managed F...	SOC Test	Cropland An...	SOC Test	1	50	20	0.8	1	1	40	50	-0.5
Total					1								-0.5

2000

Land use category				Equation 2.25 - B									
Land unit code	Initial land use	Land use during reporting year	Area (ha)	Reference carbon stock for the climate and soil combination (tonnes C / ha)	Time dependence of stock change factors (D) or number of years over a single inventory time period (T) (yr)	Stock change factor for land-use system for the subdivision in the current inventory year (-)	Stock change factor for management regime for the subdivision in the current inventory year (-)	Stock change factor for C input for the subdivision in the current inventory year (-)	Soil organic carbon stock in mineral soils at equilibrium for the current subdivision (tonnes C / ha)	Soil organic carbon stock in mineral soils for the subdivision at conversion (tonnes C / ha)	Annual change in carbon stocks in mineral soils (tonnes C / yr)		
			National statistics or international data sources	Tables 2.3 / 5.2 WS	Default value is 20	National statistics or international data sources	National statistics or international data sources	National statistics or international data sources	$SOC(0) = SOC_{ref} * F_{lu}(0) * F_{mg}(0) * F_i(0)$		$\Delta C_{mineral} = ((SOC(0) - SOC(c)) * A) / D$		
			A	SOCref	D	F <sub>lu</sub> (0)	F <sub>mg</sub> (0)	F <sub>i</sub> (0)	SOC(0)	SOC(c)	ΔC <sub>mineral</sub>		
SOC Test	Cropland A...	SOC test	Managed Gr...	SOC test	1	50	20	1	1.14	1	57	47.5	0.475
Total					1								0.475

# SOC change – Example

Across the entire timeseries both formulations count for the same quantity of **net SOC gain of 7 tC ha** from a tropical dry forest to an improved grassland

Comparison								
Year (5-year periods)	1990	1995	2000	2005	2010	2015	2020	TOTAL
	t C yr <sup>-1</sup>							t C
Formulation A	0.000	-0.500	+0.350	+0.350	+0.350	+0.850	0.000	+7.000
Formulation B	0.000	-0.500	+0.475	+0.475	+0.475	+0.475	0.000	+7.000

# Stock-Difference Method

- Can be selected in the **Land Representation Manager** for each C pool (biomass/DOM/SOM) of each unit of land
- Each land use category has dedicated C-pool-specific worksheets for the Stock-Difference method, units of land for which the Stock-Difference method has been selected for a C pool are automatically displayed in the Stock-difference-Worksheet of that C pool

# SD Method – Example – 2000

Same units of land as per Land Representation example

Biomass increase (GAL 1/4) Biomass loss (GAL 2/4) Biomass loss (GAL 3/4) Biomass loss (GAL 4/4) **Biomass change (SD)** Biomass change (Abrupt) DOM (GAL 1/1) DOM (SD 1/1) SOM Mineral (Approach 1 - Information item) SOM Mineral (Approach 2.3) SOM Mineral (SD) SOM Organic Drained SOM Organic Rewetted

Worksheet  
Sector: Agriculture, Forestry and Other Land Use  
Category: Forest Land  
Subcategory: 3.B.1.a - Forest land Remaining Forest land  
Sheet: Annual net C stock change in biomass - Stock difference method  
Data

Region: Region 3 - Approach 3

Land use category					Equation 2.8														
Land unit code	Initial land use	Land use during reporting year			Area (ha)	Biomass conversion and expansion factor for standing stock (t d.m. / m <sup>3</sup> volume)	Biomass expansion factor for conversion of merchantable volume to above-ground biomass (t d.m. / m <sup>3</sup> fr)	Basic wood density (t d.m. / m <sup>3</sup> fresh volume)	Merchantable growing stock volume at the beginning of the inventory period (t1) (m <sup>3</sup> / ha)	Total initial above-ground biomass (t d.m. / ha)	Merchantable growing stock volume at the end of the inventory period (t2) (m <sup>3</sup> / ha)	Total final above-ground biomass (t d.m. / ha)	Ratio of below-ground biomass to above-ground biomass (R) (t t <sub>bg</sub> d.m. / t ag d.m.)	Biomass carbon fraction (tonnes C / tonne d.m.)	Total initial biomass C stock (tonne C / ha)	Total final biomass C stock (tonne C / ha)	Time period between two inventories (Year)	Annual change in carbon stocks in biomass (tonnes C / yr)	
					National statistics or international data sources	BCEFs=BEF2 *D or specified	Table 3.A.1.10 / National statistics or international data sources	Tables 4.13 / 4.14 / 4.6.WS / National statistics or international data sources	National statistics or international data sources	AB(t1)=V(t1)*BCEFs or specified	National statistics or international data sources	AB(t2)=V(t2)*BCEFs or specified	Zero (0) or Table 4.4 / 4.5.WS / National statistics or international data sources	0.47 / Table 4.3 / 0.451 WS mangroves	CB(t1) = AB(t1) * (1+R) * CF	CB(t2) = AB(t2) * (1+R) * CF	T = t2 - t1	ΔCB = (CB(t2) - CB(t1)) / T * A	
				A	A	BEF2	D	V(t1)	AB(t1)	V(t2)	AB(t2)	R	CF	CB(t1)	CB(t2)	T	ΔCB		
Unit 7.1	Managed For...	Managed Forest	Managed Fore...	Plantation	3000	1			Specified	0		Specified	44	0.29	0.51	0	28.9476	11	7894.8
Unit 7.2	Plantation	Plantation	Plantation	5000	1				Specified	60		Specified	64	0.29	0.51	39.474	42.1056	1	13158
															39.474	71.0532		21052.8	

# SD Method – Example – 2008

Worksheet: Biomass increase (GAL 1/4) Biomass loss (GAL 2/4) Biomass loss (GAL 3/4) Biomass loss (GAL 4/4) **Biomass change (SD)** Biomass change (Abrupt) DOM (GAL 1/1) DOM (SD 1/1) SOM Mineral (Approach 1 - Information item) SOM Mineral (Approach 2.3) SOM Mineral (SD) SOM Organic Drained SOM Organic Rewetted

Sector: Agriculture, Forestry and Other Land Use  
 Category: Forest Land  
 Subcategory: 3.B.1.a - Forest land Remaining Forest land  
 Sheet: Annual net C stock change in biomass - Stock difference method  
 Data

Region: Region 3 - Approach 3

Land use category					Equation 2.8														
Land unit code	Initial land use	Land use during reporting year			Area (ha)	Biomass conversion and expansion factor for standing stock (t d.m. / m <sup>3</sup> volume)	Biomass expansion factor for conversion of merchantable volume to above-ground biomass (t d.m. / m <sup>3</sup> fr)	Basic wood density (t d.m. / m <sup>3</sup> fresh volume)	Merchantable growing stock volume at the beginning of the inventory period (t1) (m <sup>3</sup> / ha)	Total initial above-ground biomass (t d.m. / ha)	Merchantable growing stock volume at the end of the inventory period (t2) (m <sup>3</sup> / ha)	Total final above-ground biomass (t d.m. / ha)	Ratio of below-ground biomass to above-ground biomass (R) (t bg d.m. / t ag d.m.)	Biomass carbon fraction (tonnes C / tonne d.m.)	Total initial biomass C stock (tonne C / ha)	Total final biomass C stock (tonne C / ha)	Time period between two inventories (Year)	Annual change in carbon stocks in biomass (tonnes C / yr)	
					National statistics or international data sources	BCEFs=BEF2 <sup>D</sup> or specified	Table 3.A.1.10 / National statistics or international data sources	Tables 4.13 / 4.14 / 4.6 WS / National statistics or international data sources	National statistics or international data sources	AB(t1)=V(t1)*BCEFs or specified	National statistics or international data sources	AB(t2)=V(t2)*BCEFs or specified	Zero (0) or Table 4.4 / 4.5 WS / National statistics or international data sources	0.47 / Table 4.3 / 0.451 WS mangroves	CB(t1) = AB(t1) * (1+R) * CF	CB(t2) = AB(t2) * (1+R) * CF	T = t2 - t1	ΔCB = (CB(t2) - CB(t1)) / T * A	
					A	BCEFs	BEF2	D	V(t1)	AB(t1)	V(t2)	Δ(t2)	R	CF	CB(t1)	CB(t2)	T	ΔCB	
Unit 7.1 (remain...)	Managed For.	Managed Forest	Managed For.	Plantation	1500	1			Specified	44		Specified	76	0.29	0.51	28 9476	50 000	8	3947.4
Unit 7.2	Plantation	Plantation			5000	1			Specified	92		Specified	96	0.29	0.51	60 5268	63 158	1	13158
															89 4744	113 1588		17105.4	

1,500 ha clearcut and converted to grassland (no woody biomass)  
 Abrupt change within the Gain and Loss Method

Worksheet: Biomass change - Perennial (GAL) Biomass change - Annual (GAL) Biomass change (SD) **Biomass change (Abrupt)** DOM (GAL 1/1) DOM (SD 1/1) SOM Mineral (Approach 2.3) SOM Mineral (SD) SOM Organic Drained SOM Organic Rewetted

Sector: Agriculture, Forestry and Other Land Use  
 Category: Grassland  
 Subcategory: 3.B.3.b.i - Forest Land converted to Grassland  
 Sheet: Initial change in biomass carbon stocks on land converted to another land category (abrupt change)  
 Data

Region: Region 3 - Approach 3

Land use category					Equation 2.16									
Land unit code	Initial land use	Land use during reporting year			Area (ha)	Unit	Above-ground biomass before the conversion (t U / ha)	Above-ground biomass after the conversion (t U / ha)	Ratio of below-ground biomass to above-ground biomass (R) (t bg U / t ag U)	Biomass carbon fraction (tonnes C / tonne d.m.)	Biomass C stocks before the conversion (tonne C / ha)	Biomass C stocks after the conversion (tonne C / ha)	Annual change in carbon stocks in biomass (tonnes C / yr)	
					National statistics or international data sources	d.m. or C	National statistics or international data sources	National statistics or international data sources	Zero (0) or Table 4.4 / 4.5 WS / National statistics or international data sources	0.47 / Table 4.3 / 0.451 WS mangroves	CB(b) = AB(b) * (1+R) * CF	CB(a) = AB(a) * (1+R) * CF	ΔCB = (CB(a) - CB(b)) * ΔA	
					ΔA	U	AB(b)	AB(a)	R	CF	CB(b)	CB(a)	ΔCB	
Unit 7.1	Managed Forest Land	Plantation	Managed Grassland	Managed (pasture)	1500	d.m.		72	0.29	0.51	0	47 3688	71053.2	
											0	47 3688	71053.2	



# SD Method – Example – 2009

5,000 ha clearcut at the beginning of the year

Biomass increase (GAL 1/4) | Biomass loss (GAL 2/4) | Biomass loss (GAL 3/4) | Biomass loss (GAL 4/4) | **Biomass change (SD)** | Biomass change (Abrupt) | DOM (GAL 1/1) | DOM (SD 1/1) | SOM Mineral (Approach 1 - Information item) | SOM Mineral (Approach 2.3) | SOM Mineral (SD) | SOM Organic Drained | SOM Organic Rewetted

Worksheet  
Sector: Agriculture, Forestry and Other Land Use  
Category: Forest Land  
Subcategory: 3.B.1.a - Forest land Remaining Forest land  
Sheet: Annual net C stock change in biomass - Stock difference method  
Data

Region: Region 3 - Approach 3

Land use category				Equation 2.8												
Land unit code	Initial land use	Land use during reporting year	National statistics or international data sources	BCEFs <sup>a</sup> =BEF2 <sup>b</sup> or specified	Biomass expansion factor for conversion of merchantable volume to above-ground biomass (t d.m. / m <sup>3</sup> fr)	Basic wood density (t d.m. / m <sup>3</sup> fresh volume)	Merchantable growing stock volume at the beginning of the inventory period (t1) (m <sup>3</sup> /ha)	Total initial above-ground biomass (t d.m. / ha)	Merchantable growing stock volume at the end of the inventory period (t2) (m <sup>3</sup> /ha)	Total final above-ground biomass (t d.m. / ha)	Ratio of below-ground biomass to above-ground biomass (R) (t bg d.m. / t ag d.m.)	Biomass carbon fraction (tonnes C / tonne d.m.)	Total initial biomass C stock (tonne C / ha)	Total final biomass C stock (tonne C / ha)	Time period between two inventories (Year)	Annual change in carbon stocks in biomass (tonnes C / yr)
				BCEFs	BEF2	D	V(t1)	AB(t1)=V(t1)*BCEFs or specified	V(t2)	AB(t2)=V(t2)*BCEFs or specified	R	GF	CB(t1)	CB(t2)	T = t2 - t1	ΔCB = (CB(t2) - CB(t1)) / T * A
Unit 7.2	Managed For... Plantation	Managed Fore... Plantation	6500	1				Specified 91.4		Specified 18.5	0.29	0.51	60.13206	12.17115	1	-311745.915
													60.13206	12.17115		-311745.915

# Wetlands Supplement

- All elements sourced from the **2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands** are clearly identifiable because of the **lilac color** has been used.

In particular, following **methods** have been added:

- ✓ CO<sub>2</sub> emissions from Dissolved Organic Carbon (DOC) in drained Organic soils, in each land use category (3.B)
- ✓ CO<sub>2</sub> removals in rewetted organic soils, in each land use category (3.B)
- ✓ SOM loss from excavation of coastal wetlands (3.B.4/5)
- ✓ SOM burning in peatlands (3.C.1)
- ✓ N<sub>2</sub>O emissions from rewetted organic soils (3.C.4)

# Wetlands Supplement

- All elements sourced from the **2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands** are clearly identifiable because of the **lilac color** has been used.

In particular, following **categories** have been added:

- ✓ 3.C.8 CH<sub>4</sub> emissions from Drained Inland organic soils
- ✓ 3.C.9 CH<sub>4</sub> emissions from Drainage Ditches in Drained Inland organic soils
- ✓ 3.C.10 CH<sub>4</sub> emissions from Rewetting of Inland organic soils
- ✓ 3.C.11 CH<sub>4</sub> emissions from Rewetting of Mangroves and Tidal Marshes
- ✓ 3.C.12 N<sub>2</sub>O emissions from Aquaculture
- ✓ 3.C.13 CH<sub>4</sub> emissions from Rewetted and Created Wetlands on Inland Wetland mineral soils



# Thank you

<https://www.ipcc-nggip.iges.or.jp/index.html>

ipcc

INTERGOVERNMENTAL PANEL ON climate change

