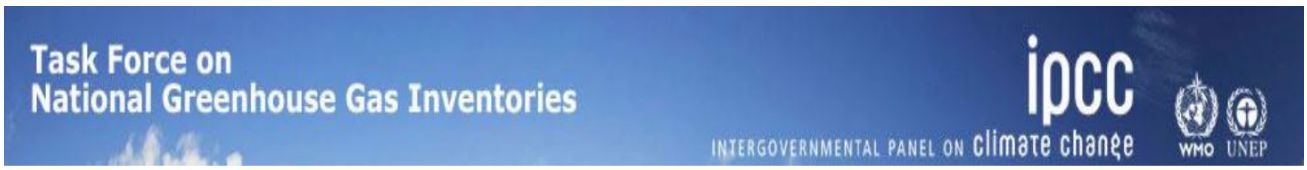

Version 1.1
as of 6 February 2024

LAND REPRESENTATION USERS' GUIDEBOOK

IPCC Inventory Software, version 2.901

Compiled by:

Technical Support Unit
IPCC Task Force on National Greenhouse Gas Inventories

This Guidebook is prepared by IPCC TFI TSU
It has not been a subject to the formal IPCC review process
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Introduction

Data Input in the IPCC Inventory Software -hereafter *Software*- to estimate GHG emissions and removals from Land (3.B) categories in a National Greenhouse Gas Inventory (NGHGI)[1] follows these steps:

Step 1. Enter in the **Land Use Manager** all **land-use subdivisions**

Step 2. Enter in the **Land Representation Manager** all **Regions** that compose the territory to which the GHG inventory applies

Step 3. For each Region, enter a **consistent and independent time-series of activity data** in the **Land Representation Manager**

Step 4. For each **C pool**, enter **C stock gains and losses or C stocks at different points in time** *(depending on methods selected)*

In this **Guide** to **Land Representation**, guidance to implement Steps 1 to 3 is provided by the Technical Support Unit of the IPCC Task Force on National Greenhouse Gas Inventories (TFI TSU).). Guidance on Step 4 are instead provided in the Guidebook for 3.B Land Categories.

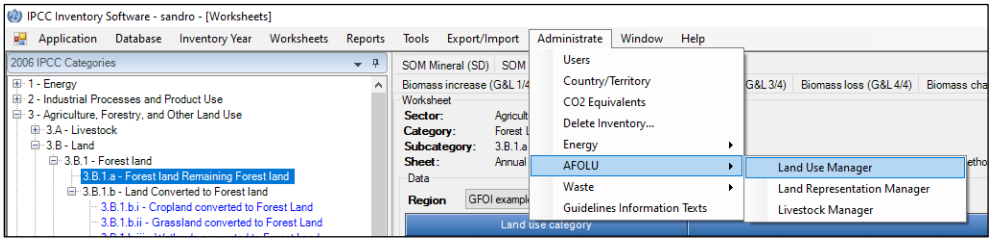
Software users must be familiar with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (*2006 IPCC Guidelines*) methods and read the *Software manual* (downloadable from the *Help* menu) before going through this guide. This guide does not replace guidance provided in the *2006 IPCC Guidelines*.

Throughout this guide, text entered in lilac color represents category information taken from the *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands - (Wetlands Supplement)*

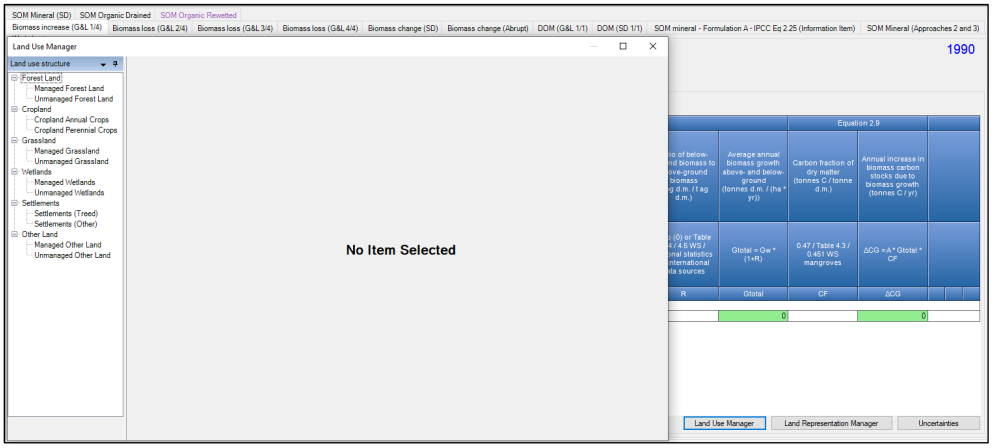
[1] Same guidance applies to the use of the *Software* for sub-national entities.

Land Use Manager (LUM)

Land Use Manager is a tabbed dialog window. Users can open it from **Administrate** main menu, **AFOLU** sub-menu



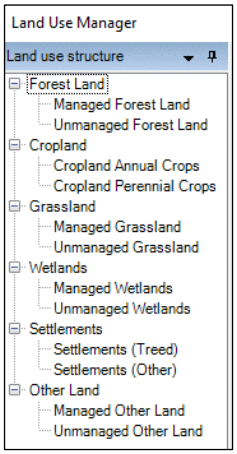
or from the bottom of any worksheets of 3.B categories



On the left-hand side, the **Land Use Manager** shows the **6 IPCC land use categories**

- Forest land
- Cropland
- Grassland
- Wetlands
- Settlements
- Other land

and **12 subcategories** (2 for each Land use category)

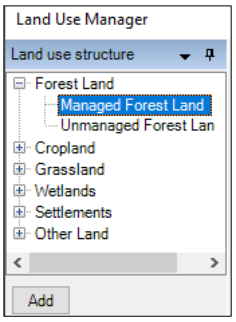


While Forest land, Grassland, Wetlands and Other land categories are disaggregated in subcategories depending on whether those are managed[2] or unmanaged[3] lands -since GHG emissions and removals from unmanaged land are

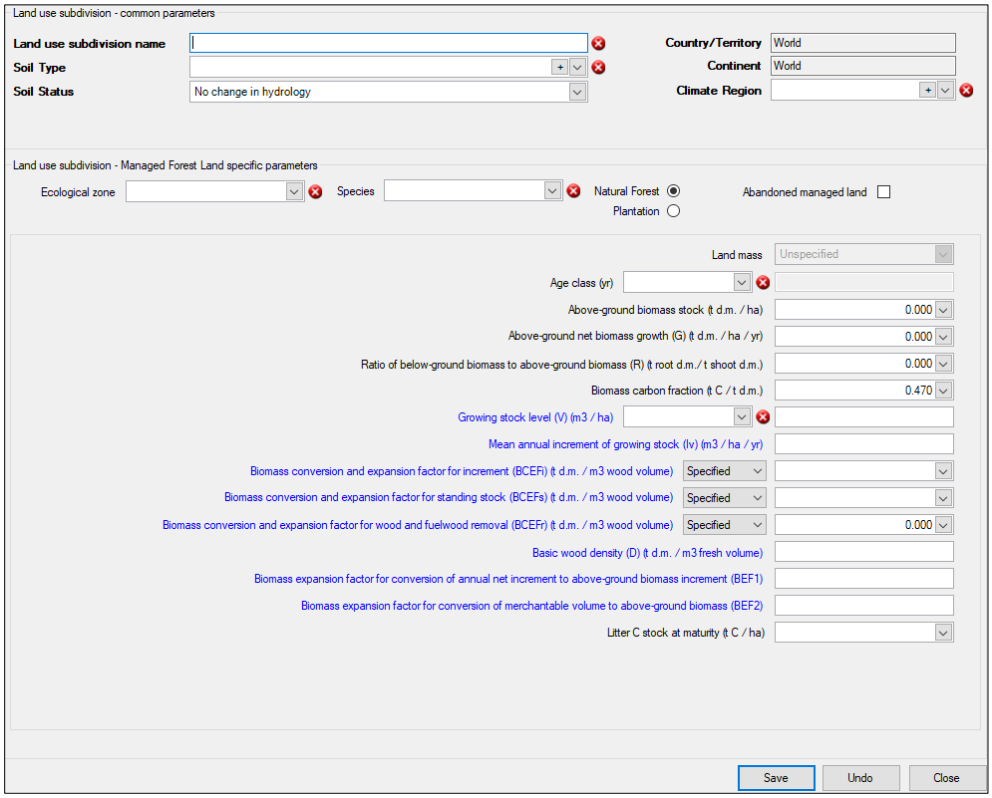
[2] Managed land is land where human interventions and practices have been applied to perform production, ecological or social functions.
[3] Unmanaged land is a land not qualified as managed.

excluded from the NGHGI- while Cropland and Settlements are disaggregated depending on the presence of perennial biomass stocks -since the IPCC methodological approach to estimate GHG emissions and removals from perennial biomass significantly differ from that applied to annual biomass.

To add a land subdivision, select the relevant subcategory and click button **Add** at the bottom of the window.

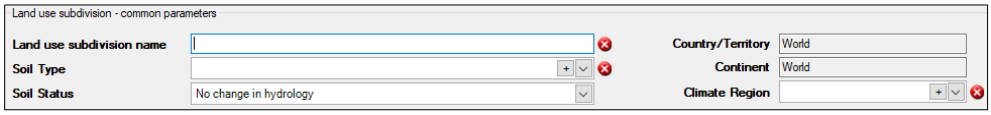


Doing so a window mask opens where to enter those data in the relevant fields that the *Software* requires, at minimum, to estimate C stock changes in relevant C pools at selected Tier level. As for instance:

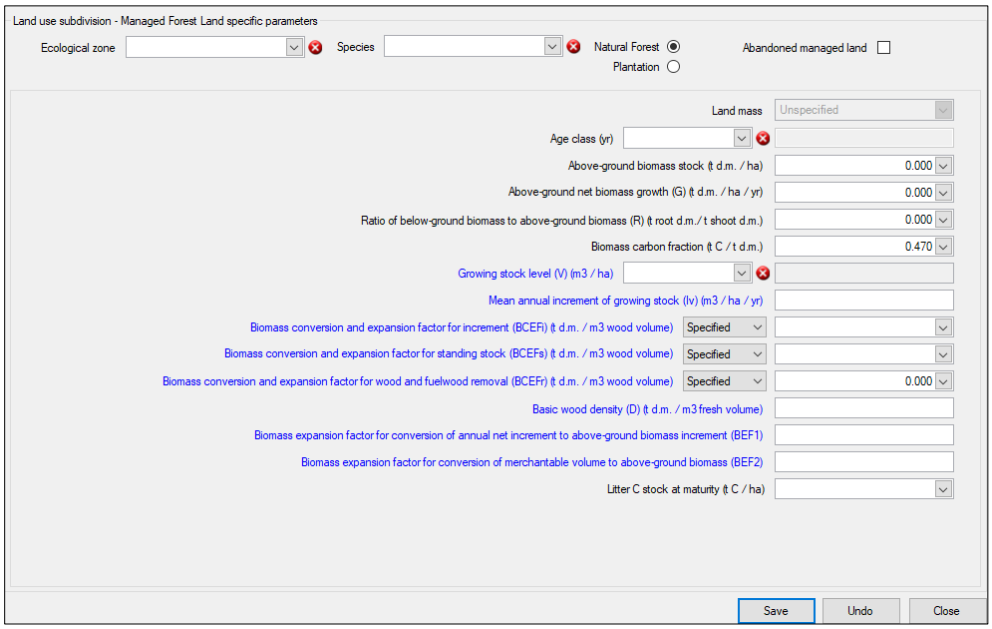


The **Land use subdivision** mask is composed of 2 parts:

✓ the **Top**, which contains parameters common to any subcategory [with labels in **bold**]:

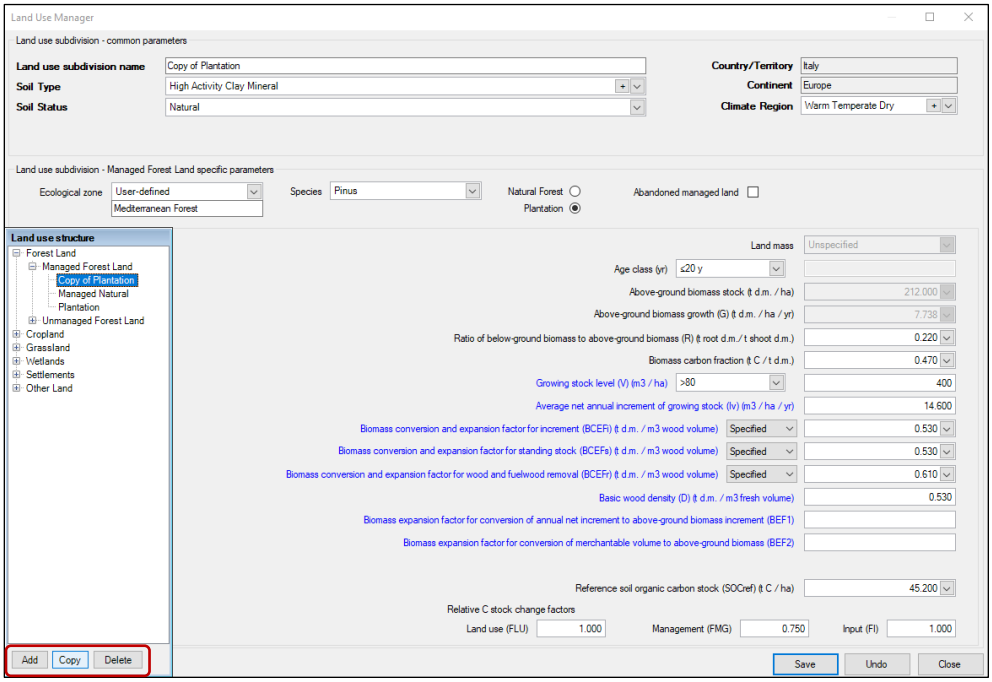


✓ the **Bottom**, which contains subcategory specific information:



Labels in blue are applied to information relevant for the implementation of IPCC Tier 2 methods.

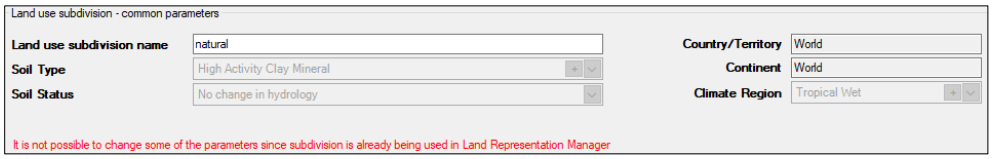
Where the subdivision to add is a variation of a subdivision already entered (e.g. a different age class) a speedy way, which also minimizes potential errors, is to make a copy of the selected subdivision and then change the information according to the new subdivision that is to be entered. This is done by clicking the *Copy* button at the bottom of the *Land use structure* window, as shown below:



Subdivisions are generally used to distinguish different types of vegetation, as well as different management systems and/or age classes; although those are a stratification that can be applied to any other users' need.

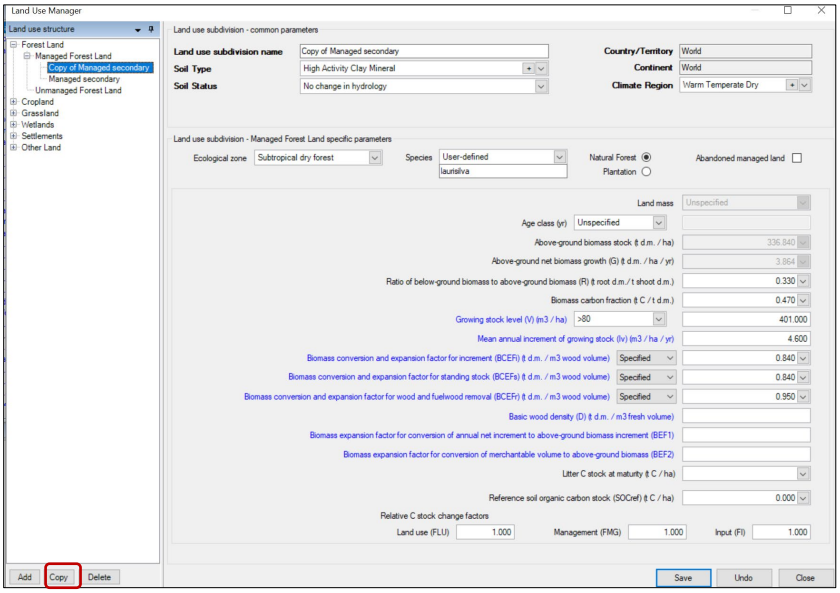
Note: You must press the button **Save** to record in the DataBase (DB) every info entered.

Tip: Once the subdivision is applied to one or more units of land in the **Land Representation Manager**, the following fields: *Soil type*, *Soil Status*, *Climate Region*, cannot be changed anymore.

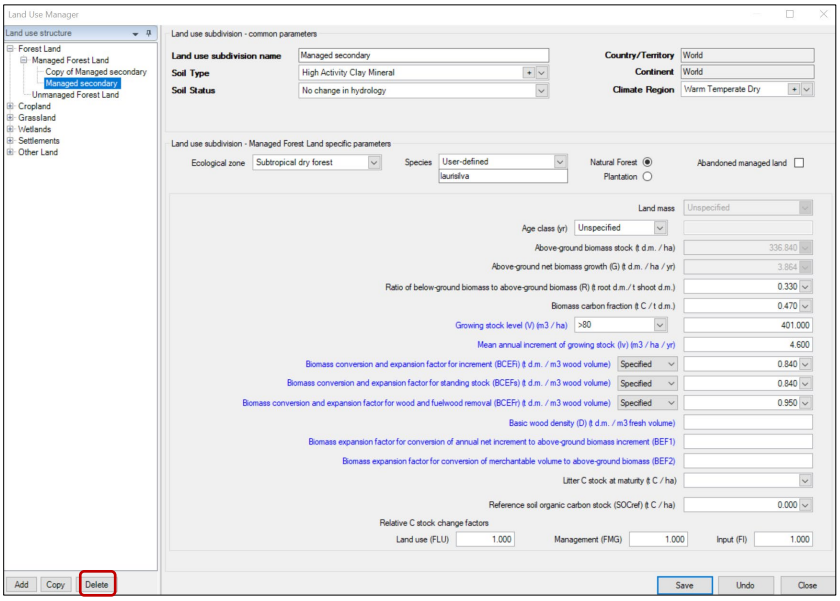


Where an error is identified in any of those fields, the Land subdivision (and its data) is to be deleted -to do so users can:

1. first create a copy of the subdivision (to minimize the time to be spent to re-enter data), to do select the subdivision and click on button **Copy** at the bottom of the window:

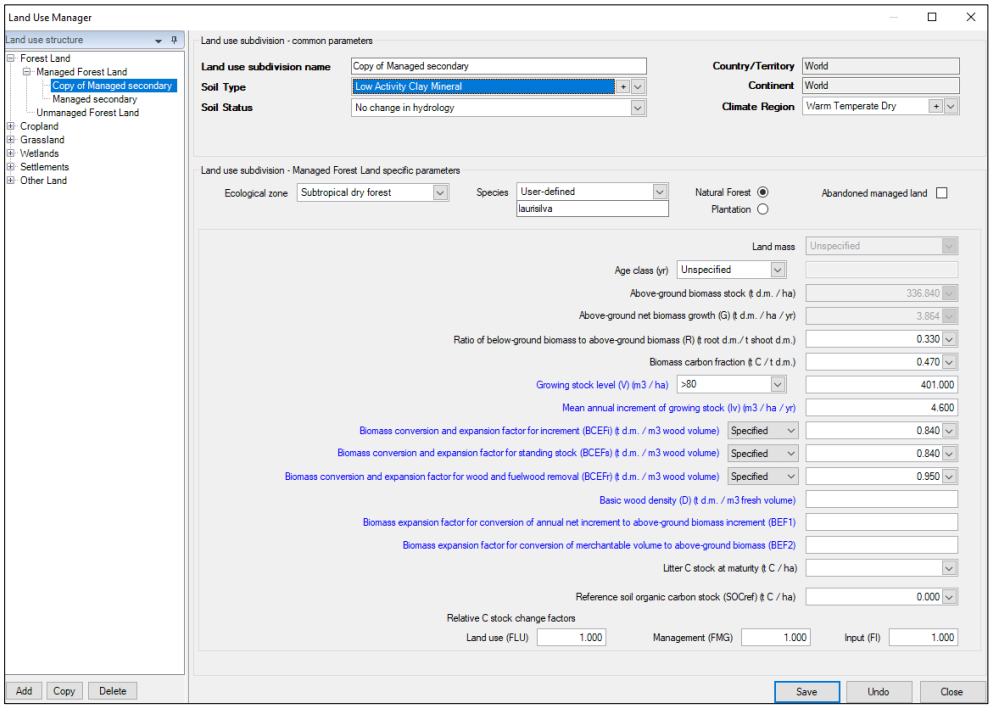


2. then Delete the original subdivision, to do select the subdivision and click on button **Delete** at the bottom of the window:

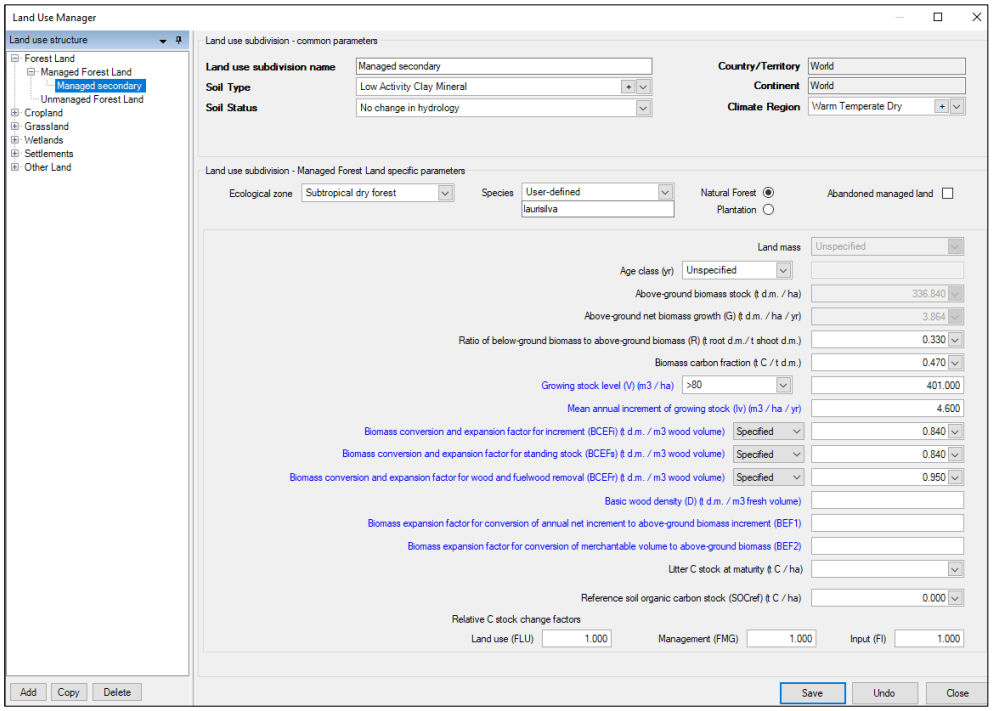


Note that all units of land that had this original subdivision are also deleted in the Land representation Manager and thus need to be re-entered with the new subdivision.

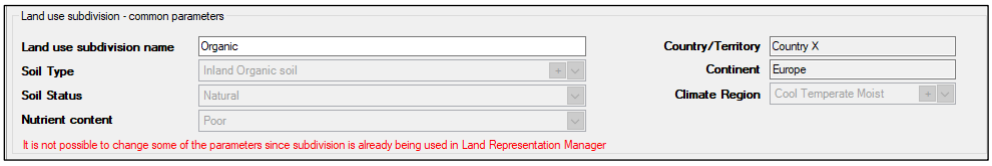
3. then information to be changed is to be re-entered:



4. the subdivision name can be modified as needed (in this case the old subdivision name is used again)



Land use subdivision mask, top section



The top section contains up to 7 fields. 5 fields are present in each and every subdivision -Land use subdivision name, Soil Type, **Country/Territory**, **Continent**, Climate Region- while other 2 are provided for some of the subdivisions -Soil Status, **Nutrient content**.

Land use subdivision name

This is a field where unique information is to be entered -i.e. 2 subdivisions cannot have the same alphanumerical combination in the name-. Given that in the land representation manager subdivisions are listed by the name, it is suggested to provide in the name information that can easily recall the characteristics specific of that subdivision.

Soil Type

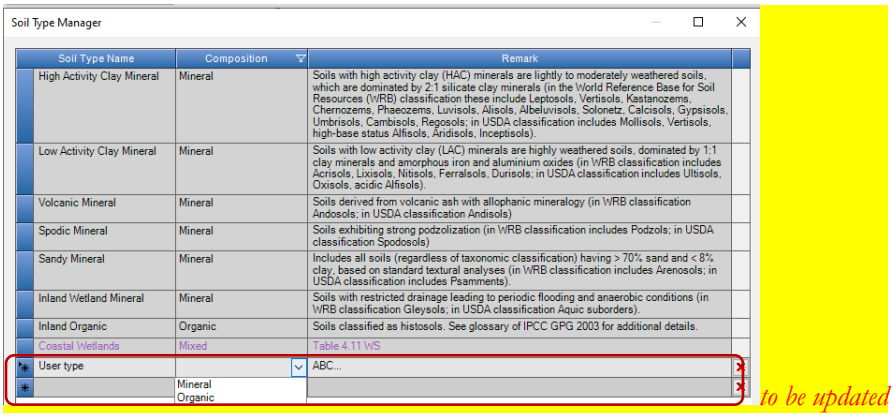
The *Software* provides in a dropdown menu the complete list of IPCC soil types listed in Chapter 2 of the AFOLU Volume, plus Coastal Wetlands soil (Chapter 4, *Wetlands Supplement*). Namely:

- **Mineral soils**:
  - ✓ High Activity Clay (HAC)
  - ✓ Low Activity Clay (LAC)
  - ✓ Volcanic
  - ✓ Spodic
  - ✓ Sandy
  - ✓ Inland Wetland mineral
  - ✓ Coastal Wetlands
- **Organic soils**:
  - ✓ Inland Organic
  - ✓ Coastal Wetlands
- **Mixed soils**:
  - ✓ Coastal Wetlands

FullName	Composition	Remark
Coastal Wetlands	Mixed	Table 4.11 WS
Inland Wetland Mineral	Mineral	Soils with restricted drainage leading to periodic flooding and anaerobic conditions (in WRB classification Gleysols; in USDA classification Aquic suborders).
Low Activity Clay Mineral	Mineral	Soils with low activity clay (LAC) minerals are highly weathered soils, dominated by 1:1 clay minerals and amorphous iron and aluminium oxides (in WRB classification includes Acrisols, Lixisols, Nitisols, Ferralsols, Durisols; in USDA classification includes Ultisols, Oxisols, acidic Alfisols).
High Activity Clay Mineral	Mineral	Soils with high activity clay (HAC) minerals are lightly to moderately weathered soils, which are dominated by 2:1 silicate clay minerals (in the World Reference Base for Soil Resources (WRB) classification these include Leptosols, Vertisols, Kastanozems, Chernozems, Phaeozems, Luvisols, Alisols, Albeluvisols, Solonetz, Calcisols, Gypsisols, Umbrisols Cambisols, Regosols; in USDA classification includes Mollisols, Vertisols, high-base status Alfisols, Aridisols, Inceptisols).
Spodic Mineral	Mineral	Soils exhibiting strong podzolization (in WRB classification includes Podzols; in USDA classification Spodosols)
Volcanic Mineral	Mineral	Soils derived from volcanic ash with allophanic mineralogy (in WRB classification Andosols; in USDA classification Andisols)
Inland Organic	Organic	Soils classified as histosols. See glossary of IPCC GPG 2003 for additional details.
Sandy Mineral	Mineral	Includes all soils (regardless of taxonomic classification) having > 70% sand and < 8% clay, based on standard textural analyses (in WRB classification includes Arenosols; in USDA classification includes Psamments).

to be updated

In addition, by clicking on the symbol [+] users open a dialog tab where user-specific soil types of either *Mineral* or *Organic* composition[4] can be entered:



to be updated

In subdivisions with a user-specific soil type the *Software* does not provide IPCC default values in the dropdown menu of relevant parameters.

.

[4] Users cannot have user-specific mixed soils.

Soil Status

The *Software* provides in a dropdown menu 4 options:

- **No change in hydrology** -this is the default option applied by the *Software*-,
- **Drained** -it applies to organic and mixed soils as well as to *inland wetland mineral* soils-,
- **Rewetted** -it applies to organic and mixed soils as well as to *inland wetland mineral* soils previously drained-,
- **Extracted**[5] -it applies to soils that have been removed to build infrastructures -e.g. port, harbor and marina construction, aquaculture ponds, salt production ponds. An extracted soil has 0 SOC-.

  Extraction implies that all C stocks are removed in the year in which excavation occurs. Thus, to estimate C stock losses associated with extraction users will:

  1. **first** generate a dedicated land use subdivision -e.g. shrimp pond in *Coastal Wetlands*- in the **Land Use Manager** with C stocks set to zero in each C pool,
  2. **second** report the conversion of the unit of land -e.g. from mangrove to shrimp pond[6]- in the *Land representation table* of the **Land Representation Manager**, and assign the Stock-Difference method to each C pool,
  3. **calculate** C stock losses in **Biomass (G&L -Abrupt)**, in **DOM (SD – Approaches 2&3)** and in **SOM (SD – Approaches 2&3)**.

  Note: Given *Extraction* determines total loss of C stocks:

  A. the C stock at time **t2** in each of the C pools is to be set to 0
  B. the C stock loss shall be counted in the year of conversion only, even if the unit of land may be reported by the software in the calculation worksheets in the following years[7]

  Recall: Given *Extraction* is a conversion of a land to a new use and/or management it **SHALL NOT** be applied to **Approach 1 Land representation**.

[5] This status does not apply to peat extraction activities. A soil subject to peat extraction activities has a soil status *Drained*; while a soil that has been subject to peat extraction activities and it is currently abandoned has soil status either *Drained*, if the drainage system is still working, or *Rewetted* if it is not anymore working or it has been purposely reverted.
Although it has been introduced by the *Wetlands Supplement* for *Coastal Wetlands*, it is applicable in the *Software* to all soil types to report the complete excavation of SOM from the land (first 30 cm of depth of soils as per IPCC default). The *Software* thus applies the Stock Difference approach to calculate the SOC change by setting to zero (0) the value of SOC at time 2, SOC_{t2}.

[6] Either as a *Settlement (Other)* or as a *Wetlands Managed* (*Other Wetlands – Coastal wetlands user-specific shrimp pond*)

[7] Units of land with soil status Extracted not undergoing a conversion are reported by the Software in the relevant calculation worksheets. Although, given that an *Extracted* unit of land has 0 C stocks, no further C stock changes shall be estimated, unless a new conversion occur to a land use category with significant C stocks.

Soil status options do not apply evenly to all soil types under all land use sub-categories. Tables 1 to 5 show occurrence of soil types and possible soil statuses of those as available in the **Land Use Manager**.

Table 1 shows *Soil status* options available for different *Soil Types*

Table 2 shows the occurrence of soils of *Organic* composition -with the exception of *Coastal Wetlands* soil- in each land use sub-category as well as which soil statuses those *Soil Types* can have under each land-use subcategory

Table 3 shows the occurrence of soils of *Mineral* composition -with the exception of *Inland Wetland* and *Coastal Wetlands* soil- in each land use sub-category as well as which soil statuses those *Soil Types* can have under each land-use subcategory

Table 4 shows the occurrence of *Inland Wetland* soil in each land use sub-category as well as which soil statuses *Inland Wetland* soils can have under each land-use subcategory:

Table 5 shows the occurrence of *Coastal Wetlands* soils in each land use sub-category as well as which soil statuses *Coastal Wetlands* soils can have under each land-use subcategory:

Table 1 *Soil Status* options of different soil types

Soil Status	Soil composition											
	Mineral[8]								Organic[9]			Mixed
	Soil type											
	High Activity Clay	Low Activity Clay	Volcanic	Spodic	Sandy	Inland Wetland	Coastal Wetlands	*any user-specific*	Inland	Coastal Wetlands	*any user-specific*	Coastal Wetlands
No change in hydrology	NR	NR	NR	NR	NR	Y	Y		Y	Y	Y	Y
Drained	NA	NA	NA	NA	NA	X	Y	NA	Y	Y	Y	Y
Rewetted	NA	NA	NA	NA	NA	X	Y	NA	Y	Y	Y	Y
Extracted	1	1	1	1	1	1	Y	1	1	Y	1	Y

NR - Although the option is available, it is Not Relevant for all soils of mineral composition, with the exception of *Inland Wetland* mineral soil.

Y - The option is Applicable.

NA - The option is Not Applicable.

1 - Any soil type can have *Extracted* status which simply means that the entire volume of SOM has been removed; associated SOC total loss is estimated in the relevant calculation worksheet **SOM (SD – Approaches 2&3)**, given the *Software* always applies the Stock-Difference method.

[8] All soils with *Mineral* composition have no *soil status* by default, or *Extracted* if selected from dropdown menu

[9] All soils with *Organic* or *Mixed* composition have *soil status* by default *Drained*, or *Extracted* if selected from dropdown menu.

Table 2 Occurrence and *Soil Status* options for *Organic* soils[10]

	Land use category													
	Forest land		Cropland		Grassland		Wetlands				Settlements		Other land	
	Managed	*Unmanaged*	*Annual*	*Perennial*	*Managed*	*Unmanaged*	*Peatlands extraction*	*Flooded*	*Managed*	*Unmanaged*	*Treed*	*Other*	*Managed*	*Unmanaged*
Occurrence	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y[A]	NO
Soil Status														
No change in hydrology	Y	Y	NA	NA	Y	Y	NA	Y	Y	Y	NA	NA	NA	NO
Drained	Y	NA	Y	Y	Y	NA	Y	NA	NA	NA	Y	Y	Y	
Rewetted	Y	NA	NA	NA	NA	NA	Y	NA	Y	NA	NA	NA	NA	
Extracted	NA	NA	NA	NA	NA	NA	NA	NA	Y	NA	NA	Y	Y	

[A] limited to units of land in conversion

Y - Soil type occurring, and Soil status option is Applicable;

NA - Soil type occurring but Soil status option is NOT Applicable

NO - Soil type NOT occurring so NO Soil status

Table 3 Occurrence and *Soil Status* options for *Mineral* soils[11]

	Land use category													
	Forest land		Cropland		Grassland		*Wetlands*				Settlements		Other land	
	Managed	*Unmanaged*	*Annual*	*Perennial*	*Managed*	*Unmanaged*	*Peatlands extraction*	*Flooded*	*Managed*	*Unmanaged*	*Treed*	*Other*	*Managed*	*Unmanaged*
Occurrence	Y	Y	Y	Y	Y	Y	NO	Y	NO	NO	Y	Y	Y	NO
Soil Status														
No change in hydrology[B]	NR	NR	NR	NR	NR	NR	NO	NA	NO	NO	NR	NR	NR	NO
Drained	NA	NA	NA	NA	NA	NA		NA			NA	NA	NA	
Rewetted	NA	NA	NA	NA	NA	NA		NA			NA	NA	NA	
Extracted	NA	NA	NA	NA	NA	NA		Y			NA	Y	Y	

[B] With the exception of *Inland Wetland* soil type, this option is not informative for mineral soils although it is retained by the *Software* as a default option.

NR - Although the option is available, it is Not Relevant for all soils of mineral composition, with the exception of *Inland Wetland* mineral soil.

Y - *Soil type* occurring, and *Soil status* option is Applicable;

NA - *Soil type* occurring but *Soil status* option is NOT Applicable

NO - *Soil type* NOT occurring, so NO *Soil status*

[10] excluding *Coastal Wetlands* soils

[11] excluding *Inland Wetland* & *Coastal Wetlands*

Table 4 Occurrence and *Soil Status* options for *Inland Wetland* soil

	Land use category													
	Forest land		Cropland		Grassland		*Wetlands*				Settlements		Other land	
	Managed	*Unmanaged*	*Annual*	*Perennial*	*Managed*	*Unmanaged*	*Peatlands extraction*	*Flooded*	*Managed*	*Unmanaged*	*Treed*	*Other*	*Managed*	*Unmanaged*
Occurrence	Y	Y	Y	Y	Y	Y	NO	Y	Y	Y	Y	Y	Y	NO
Soil Status														
No change in hydrology[c]	Y	Y	NA	NA	Y	Y	NO	NA	Y	Y	NA	NA	NA	NO
Drained	Y	Y	Y	Y	Y	NA		NA	NA	NA	Y	Y	Y	
Rewetted	Y	Y	Y	NA	NA	NA		NA	Y	NA	NA	NA	NA	
Extracted	NA	NA	NA	NA	NA	NA		Y	Y	NA	NA	Y	Y	

Y - *Soil type* occurring, and *Soil status* option is Applicable;

NA - *Soil type* occurring but *Soil status* option is NOT Applicable

NO - *Soil type* NOT occurring, so NO *Soil status*

Table 5 Occurrence and *Soil Status* for *Coastal Wetlands* soils

	Land use category													
	Forest land		Cropland		Grassland		*Wetlands*				Settlements		Other land	
	Managed	*Unmanaged*	*Annual*	*Perennial*	*Managed*	*Unmanaged*	*Peatlands extraction*	*Flooded*	*Managed*[c]	*Unmanaged*[c]	*Treed*	*Other*	*Managed*	*Unmanaged*
Occurrence	Y	Y	Y	Y	Y	NO	NO	NO	Y	Y	Y	Y	Y	NO
Soil Status														
No change in hydrology	Y	Y	NA	NA	NA	NO	NO	NO	Y	Y	NA	NA	NA	NO
Drained	Y	NA	Y	Y	Y				NA	NA	Y	Y	Y	
Rewetted	Y	NA	NA	NA	NA				Y	NA	NA	NA	NA	
Extracted	NA	NA	NA	NA	NA				Y	NA	NA	Y	Y	

[c] Limited to *Other Wetlands* that are *Coastal Wetlands*.

Note: IPCC default values for GHG emissions/removals from *Coastal Wetlands* soils, provided for the aggregation of mineral and organic soils, are offered by the *Software* to *Coastal Wetlands* soils of mineral or organic composition.

According to the *soil status*, the *Software* populates units of land of the relevant subdivisions in the calculation worksheets of AFOLU categories for **Drainage** and **Rewetting** and **Extraction**, to calculate the relevant GHG as:

For CO_2:

- **3.B Land Use Categories**:
  - ✓ SOM Organic Drained
  - ✓ SOM Organic Rewetted
  - ✓ SOM (SD - Approaches 2&3) → *Extraction*

For N_2O:

- **3.C.4 Managed soils**:
  - ✓ Drainage of managed organic soils
  - ✓ Rewetting of managed organic soils

For CH_4:

- **3.C.8 Drained Organic Soils**
- **3.C.9 Drainage Ditches**
- **3.C.10 Rewetting of Organic Soils**
- **3.C.11 Rewetting of Mangroves and Tidal marshes**
- **3.C.11 Rewetted and Created Wetlands in Inland Wetland Mineral Soils**

For more information see Area Data Transfer to Calculation Worksheets.

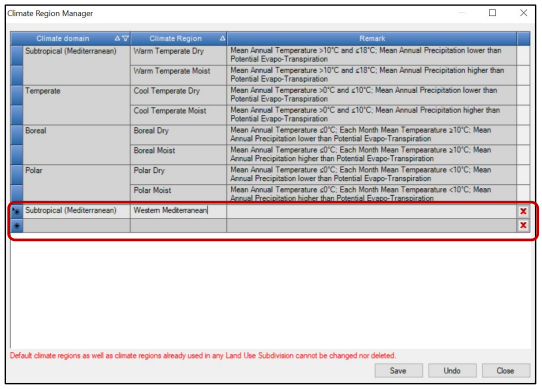
Climate Region

The *Software* provides in a dropdown menu the list of IPCC Climate Regions listed in Table 4.1 (AFOLU Volume, *2006 IPCC Guidelines*. A partial snapshot is shown below:

Domain	Region
Tropical	Tropical Wet
	Tropical Moist
	Tropical Dry
	Tropical Montane
Subtropical (Mediterranean)	Warm Temperate Moist
	Warm Temperate Dry
Temperate	Cool Temperate Moist
	Cool Temperate Dry
Boreal	Boreal Moist
	Boreal Dry
Polar	Polar Moist
	Polar Dry

The selection of the *Climate Region* determines the IPCC default values that the *Software* populates in the dropdown menus of the parameters.

By clicking on the symbol + users open a dialog tab where user-specific climate regions can be entered:



In subdivisions with a user-specific climate region the *Software* does not provide IPCC default values in the dropdown menu of relevant parameters.

Land use subdivision mask, bottom section

Hereafter the bottom section of the mask for each land use subcategory is shown with guidance for the data compilation. As a general rule, where applicable, the *Software* provides in a dropdown menu the IPCC default values applicable to the subdivision, while users can always enter their own user-specific values regardless the provision by the *Software* of the IPCC default value.

Parameters populating the mask are limited to those needed to estimate C stock change. Although, not necessarily all parameters needed to estimate C stock changes are populated in the mask, instead data on additional parameters are to be entered directly into the calculation worksheets; this also allow more flexibility to deal with rapidly changing parameters of units of land.

Parameters to estimate non-CO_2 emissions are generally entered directly in the calculation worksheets.

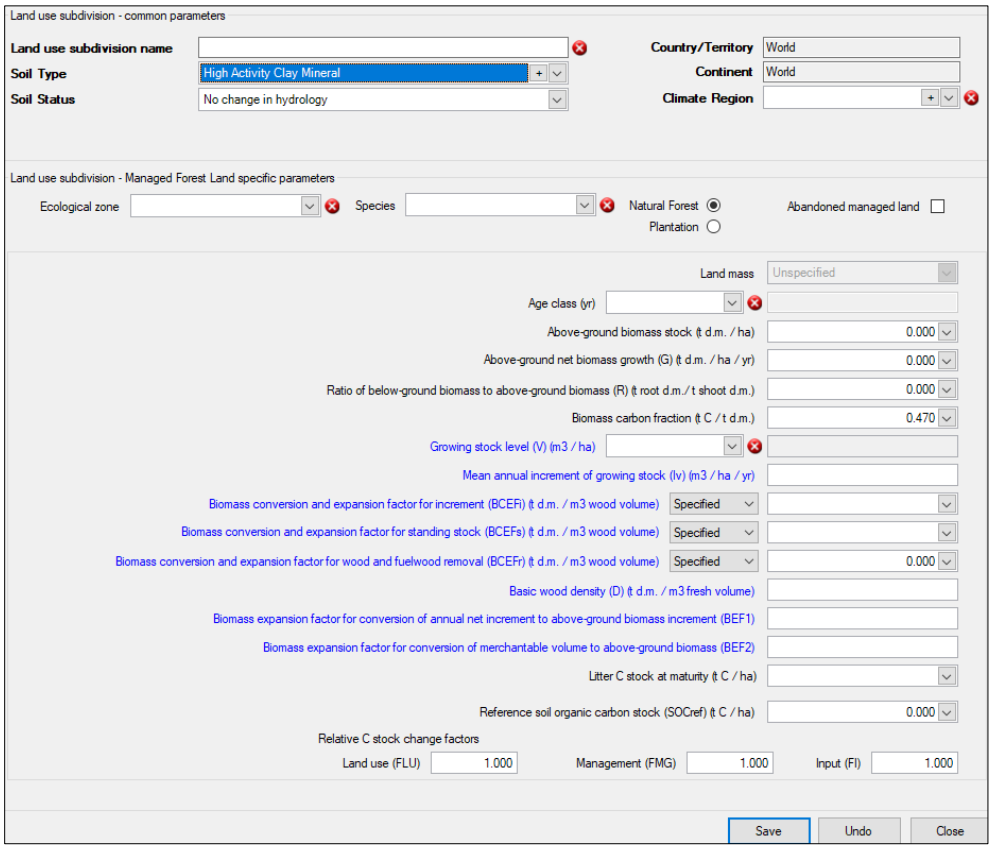
Finally, parameters in black ink are needed for Tier 1, although can be used at higher tiers too, while parameters in blue ink are needed for Tier 2, either in substitution of Tier 1 parameters or additionally to those.

Common parameter across Land use subcategories:

Given conversion of land use and/or management occurs between land subdivisions with same combination of *Soil Type* and *Climate Region*, and given that the **Reference soil organic carbon stock (SOCref)**, depends on the combination of *Soil Type* and *Climate Region* , **users shall enter in every subdivision of a determined combination of *Soil Type* and *Climate Region* the same identical value of *SOCref*.**

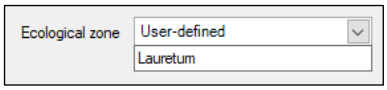
Value to be entered in the **Reference soil organic carbon stock (SOCref)** can be either selected in the dropdown menu -i.e. IPCC default value- for the combination of mineral *Soil Type* and *Climate Region* selected, and for unmanaged forests the SOC_{REF} is not further adjusted through stock-change factors since no management occurs/occurred. This parameter is not provided for subdivisions that have instead soils of *Organic* composition.

Forest land

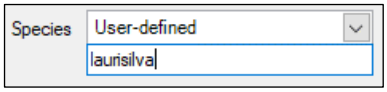


Forest land subdivisions have 3 specific parameters to be entered:

Ecological zone, the dropdown menu presents the IPCC default zones, as shown in the *2006 IPCC Guidelines* figure 4.1, relevant for the climate region selected. Users can enter a user-specific species by selecting *User-defined*, see below.



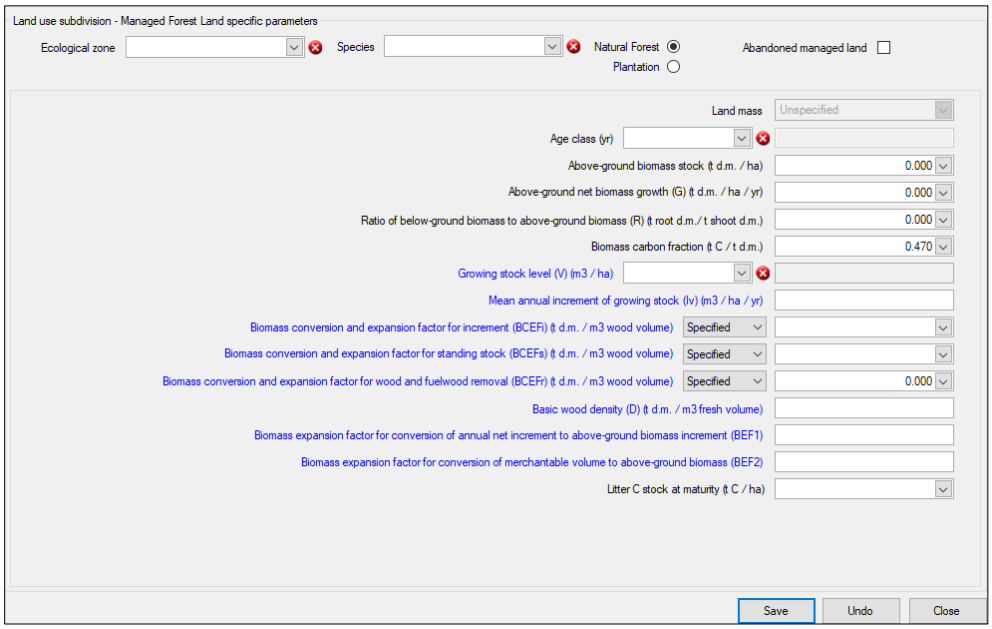
Species, the dropdown menu presents the list of species for which IPCC provides default values for parameters to be entered in the mask. Users can enter a user-specific species by selecting *User-defined*, see below.



This parameter does not necessarily require to enter a tree species, it can more likely be used to enter forest types e.g. *Laurisilva*.

Land mass is active only for Asian countries since the *2006 IPCC Guidelines* tables 4.7 and 4.9 provides different default values for Asia (Continental) vs Asia (Insular); thus, accordingly to the territory to be inventoried users shall select among *Insular* or *Continental* or *Unspecified*. The selection of *Insular* or *Continental* determines that the *Software* provides associated IPCC default values in the dropdown of parameters Aboveground biomass stock and Aboveground biomass growth. While selecting *Unspecified* both sets of IPCC default values are present in the dropdown menu of those parameters.

Unmanaged Forest land

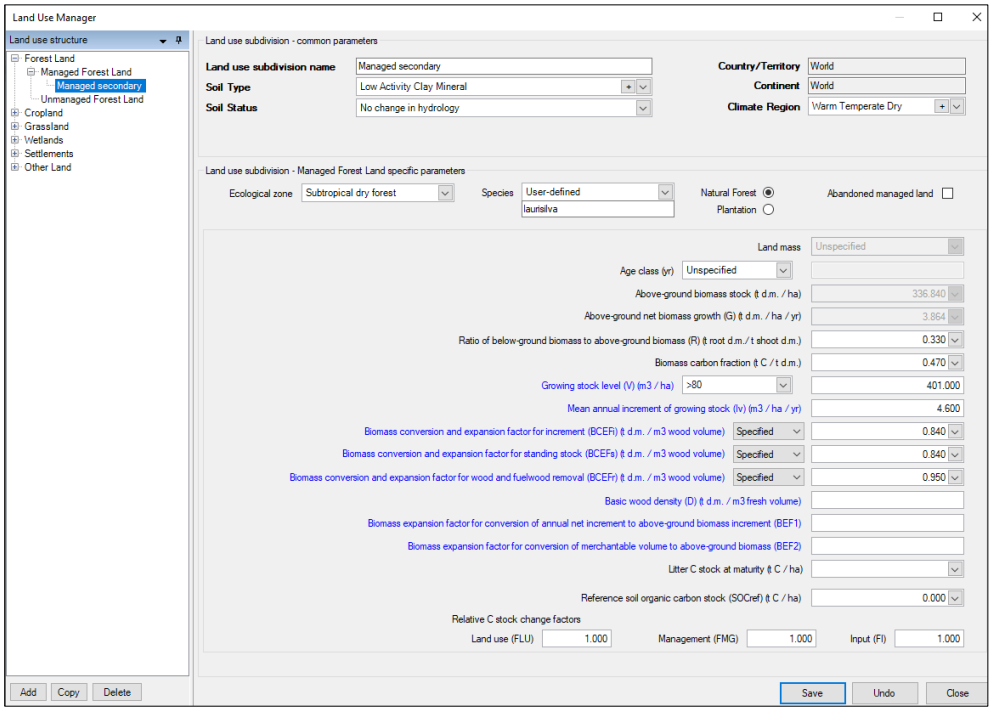


Since C stock changes in unmanaged land are considered not anthropogenic, parameters to be entered in the bottom portion of the land use subdivision mask defines the biomass C stock that, in case of conversion to other land uses can be lost. In particular:

- Aboveground biomass stock, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It applies to Tier 1 only. In case a value is entered in *Growing stock level* then this parameter is greyed out, and data enter is not allowed; although the *Software* calculates the *Aboveground biomass stock* as the product of the *Growing stock level* by the *Biomass conversion and expansion factor for standing stock* or by *BEF2*D*.
- Ratio of below-ground biomass to above-ground biomass, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It applies to all tiers.
- Biomass carbon fraction, the dropdown menu provides IPCC default value, although users can enter their own data. It applies to all tiers.
- Growing stock level, the dropdown menu provides IPCC default value, although users can enter their own data in the field next to it. The *Growing stock level* is also used by the *Software* to select the relevant BCEF value to present in the dropdown menu, if available.
- Biomass conversion and expansion factor for standing stock, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It can be either *Specified*, and in such a case the value is entered in the field, or *Calculated* as *BEF2*D* and consequently values of *Basic wood density* and of *Biomass expansion factor of merchantable volume to above-ground biomass* are to be entered.
- Basic wood density, if *BEF2*D* is selected for *Biomass conversion and expansion factor for standing stock*, then a value is to be entered by users; otherwise is left blank.
- Biomass expansion factor of merchantable volume to above-ground biomass, if *BEF2*D* is selected for *Biomass conversion and expansion factor for standing stock*, then a value is to be entered by users; otherwise is left blank.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

Managed Forest land



Natural Forest vs **Plantation** given that the *2006 IPCC Guidelines* provide different default values for Plantations for the following parameters: *Above-ground biomass*, *Above-ground net biomass growth*, *Mean Annual Increment*; selecting the forest typology allows the *Software* to populate the dropdowns of those parameters with relevant IPCC default values.

Abandoned managed land, is relevant for reporting under the UNFCCC with non-Annex I Reporting Tables 1 and 2 (Decision 17/CP.8). Thus, it is to be checked if the subdivision is a formerly managed land and only if users wish to use such reporting tables; otherwise, leave it unchecked.

Note: Do not check this box if you are using the *Software* to generate a JSON file to upload data into the UNFCCC ETF reporting tool.

Additionally to parameters described for *Unmanaged Forest land*, *Managed Forest land* requires the following parameters:

- Age class, the dropdown menu provides IPCC default age classification in *older than 20-year* and *from 0 to 20 years*, which selection determines the IPCC default values that the *Software* populates in the dropdown menus of the biomass stand and biomass growth parameters.

Age class (yr)	Remark
≤20 y	
>20 y	
Unspecified	
User-defined range	

Otherwise, users can select *Unspecified* or *User-defined range*. For the latter, users enter, in the next field the user-defined range, e.g.:

The selection of a non-IPCC age class prevents IPCC default values to be present in the dropdown menu of parameters. It applies to all tiers.

- Aboveground biomass growth, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It applies to Tier 1 only, thus in case a value is entered in *Mean Annual Increment* then this parameter is greyed out, and no data enter is allowed; although the *Software* calculates the *Aboveground biomass growth* as the product of the *Mean Annual Increment* by the *Biomass conversion and expansion factor for increment* or by *BEF1*D*.

- Mean Annual Increment, the value to enter is the increment[12], either the current increment, the average current increment, or the mean increment, where all correspond to the gross increment minus the natural background mortality[13].
- Biomass conversion and expansion factor for increment, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It can be either *Specified*, and in such a case users enter the value in the field next to it, or *Calculated* as *BEF1*D* and consequently users enter values of *Basic wood density* and of *Biomass expansion factor of annual net increment to above-ground biomass increment*.
- Biomass expansion factor of annual net increment to above-ground biomass increment, if *BEF1*D* is selected for *Biomass conversion and expansion factor for standing stock*, then users enter the value otherwise is left blank.
- Biomass conversion and expansion factor for wood and fuelwood removal, the dropdown menu provides IPCC default value, if available, although users can enter their own data. It can be either *Specified*, and in such a case the value is entered in the field next to it, or *Calculated* as *BEF2*D* and consequently values of *Basic wood density* and of *Biomass expansion factor of merchantable volume to above-ground biomass* are to be entered.
- Relative C stock change factors, at Tier 1 are by IPCC default all equal to 1, given that forest SOC is considered to be the reference for all other land use categories. Users can enter a user-specific value according to data collected. **Note**: In Forest land the F_{LU} stock-change factor is used to adjust SOC by the natural disturbance regime[14] i.e. F_D.

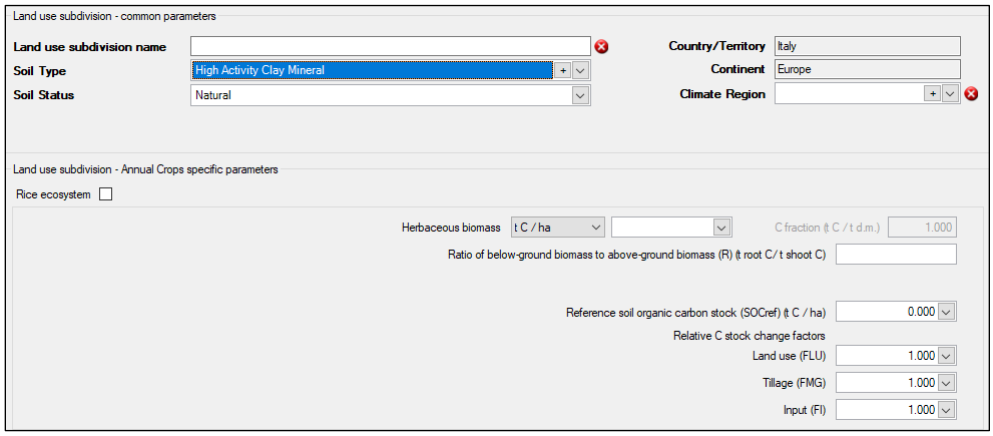
Tier 3, depending on data used, is to be accommodated in the above listed variables.

[12] The type of increment likely depends on the breadth of age class
[13] This does not include mortality/losses caused by disturbances
[14] See page Tier 2 for SOC mineral at page 4.24, Volume 4 of *2006 IPCC Guidelines*

Cropland

Cropland methods provided by IPCC significantly differ depending on the type of biomass present in the land. Thus, Cropland is subdivided in 2 subcategories, one dealing with that land with annual biomass only the other one dealing with land with perennial biomass, although the latter subcategory may also include an annual biomass component.

Annual Cropland



Rice ecosystem is to be checked in order to instruct the *Software* to report units of land with the rice ecosystem subdivision in relevant worksheets for 3.C.7 (*Rice Cultivation*).

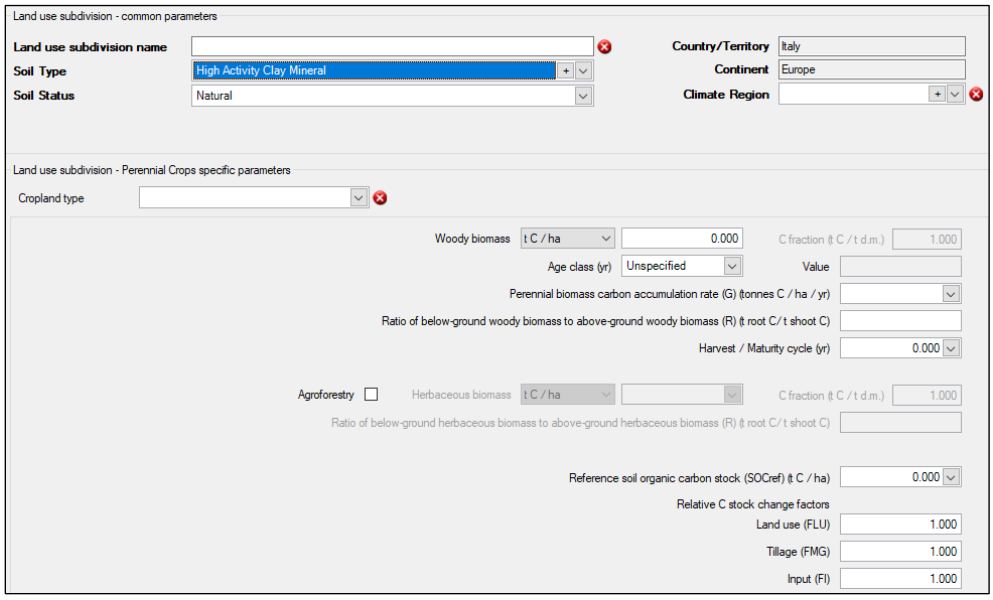
Herbaceous biomass can be entered either in *tonne of C* per hectare, and in such a case the IPCC default value can be selected from the drop-down menu -although a user-specific value can either be entered-, or in *tonne of dry matter* per hectare.

In the latter case, there is not an IPCC default value and the C fraction of dry matter is to be enter, see below:

For all other parametes see *Managed Forest land*.

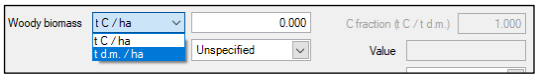
Tier 3, depending on data used, is to be accommodated in the above listed variables.

Perennial Cropland

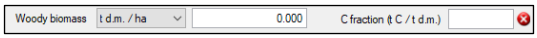


Cropland type provides IPCC default types of perennial crop systems. Users can enter a user-specific species by selecting *User-defined*, see below.

Woody biomass can be entered either in *tonne of C* per hectare or in *tonne of dry matter* per hectare.



In the latter case, the C fraction of dry matter is to be entered as well, see below:



The value to be entered as *Woody biomass* is the total biomass at maturity (i.e. before the final harvest). If a value is entered in *Woody biomass*, then no values shall be entered in: *Age class*.

Alternatively, instead of entering the value of *Woody biomass*, users enter values for *Age class*, and for the parameters *Perennial biomass carbon accumulation rate* and the *Harvest/Maturity cycle* following parameters:

- Age class, users first select "User defined", then enter a single value in the field.
- Perennial biomass carbon accumulation rate, to ensure mass conservation, it is to be calculated as $= \frac{Woody\ biomass\ (t\ C\ ha^{-1})}{Harvest/Maturity\ cycle\ (yrs)}$, and its unit is thus t C ha^{-1} yr^{-1}).
- Harvest/Maturity cycle, the dropdown menu provides IPCC default value, if available, although users can enter their own value.

Note: if a value is entered for the *Age class*, then the *Software* grays out the field of *Woody biomass*, although it calculates its value, which is shown in grey in the field, as the *Perennial biomass carbon accumulation rate* multiplied by the *Age class*.

Agroforestry is to be checked if an annual biomass component is to be added to the estimates. For parameters of annual biomass component see *Annual Cropland*.

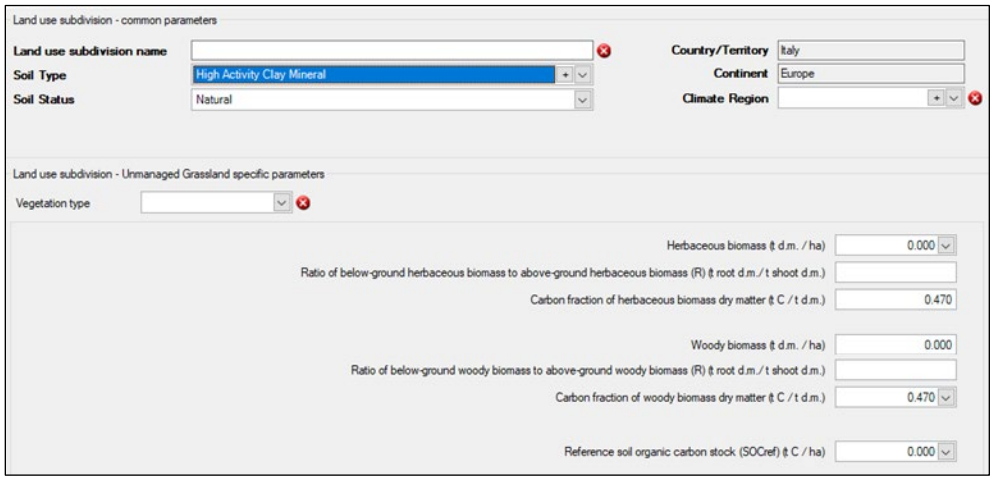
For all other parametes see *Managed Forest land*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

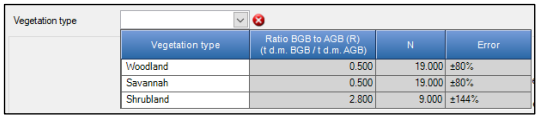
Grassland

Different types of vegetation can be classified under Grassland, ranging from land covered by grass only and managed, e.g. pastures, to land with significant woody vegetation that, although does not meet the forest thresholds, largely determines the C dynamic of the land.

Unmanaged Grassland



Vegetation type is to be selected from a dropdown menu containing IPCC default types corresponding to the climate region selected.



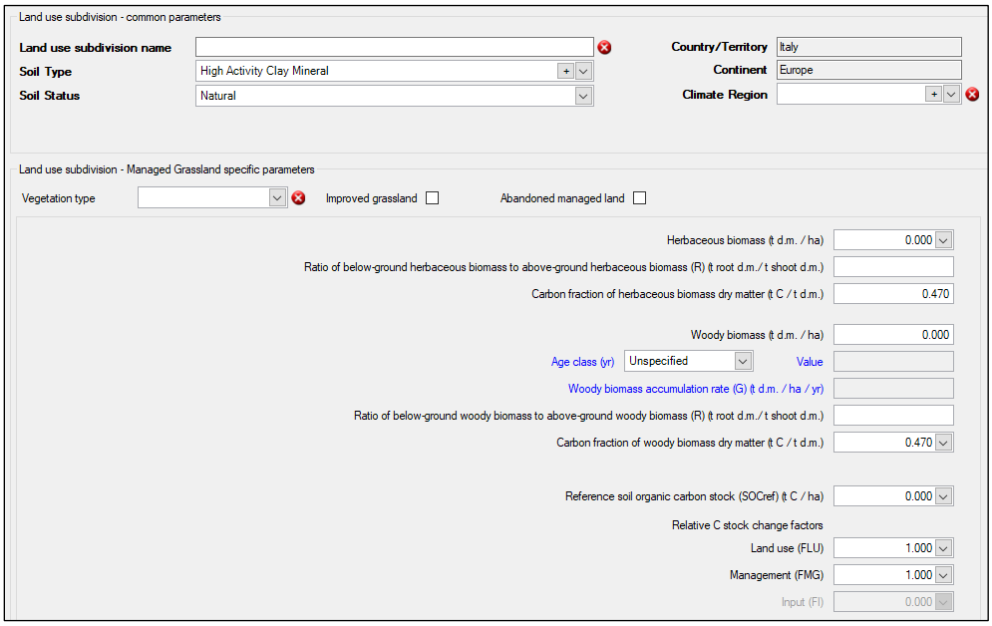
The selection of the vegetation type determines the value of the *root-to-shoot ratio* the *Software* shows in the relevant fields (either for *annual biomass* or for *perennial biomass*), although users can overwrite that default value with their own data.

For all other parametes for annual biomass see *Annual Cropland*, while for those of woody biomass see *Perennial Cropland*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

Note: As with *Unmanaged Forest land*, the *Reference soil organic carbon stock* (SOC_{REF}) is not further adjusted through stock-change factors since no management occurs.

Managed Grassland



Improved grassland is to be checked if the subdivision is subject to additional input of organic matter, e.g. manure and/or sludge application. Otherwise, FI is greyed out and any data entry from users is not allowed.

Abandoned managed land, is relevant for reporting under the UNFCCC with non-Annex I Reporting Tables 1 and 2 (Decision 17/CP.8). Thus, it is to be checked if the subdivision is a formerly managed land and only if users wish to use such reporting tables; otherwise, leave it unchecked.

Note: Do not check this box if you are using the *Software* to generate a JSON file to upload data into the UNFCCC ETF reporting tool.

Differently[15] than in *Unmanaged Grassland*, in *Managed Grassland* users can enter data for the parameters *Age class* and *Woody biomass accumulation rate* instead of for *Woody biomass*. While if *Woody biomass* is entered the *Age class* and *Woody biomass accumulation rate* fields will remain greyed.

- Age class, users first select "User defined", then enter a single value in the next field;
- Woody biomass accumulation rate, is the average net accumulation[16] of carbon during the time period determined by the *Age class* value entered. Accordingly, if a value is entered for *Age class* then the *Software* grays out the field of *Woody biomass*, although it calculates a value, which is shown in grey in the field, as the *Woody biomass accumulation rate* multiplied by the *Age class*.

  Note: Given that unlimited accumulation of biomass is not possible, this parameter is an active parameter only if the *Age-class* is entered. Further, if a *Woody biomass accumulation rate* is entered then biomass losses shall also be estimated in the relevant calculation worksheet **Biomass change (G&L)**.

For all other parametes for annual biomass and SOC see *Annual Cropland*, while for those of perennial biomass see *Perennial Cropland*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

[15] This corresponds to a Tier 2 IPCC methodological approach
[16] Gross increment minus mortality

Wetlands

IPCC disaggregates *Wetlands* in four types:

- **Peatlands under peat extraction**
- **Peatlands abandoned (former extraction)**
- **Flooded land**
- **Other Wetlands**, including **Coastal Wetlands**

For *Costal Wetlands* types, users first check **Other Wetlands** box and then check **Coastal Wetlands** box, and select the vegetation type. For *Managed Wetlands* only users can enter a user-specific vegetation type:

While *Peatlands under peat extraction*, *Peatlands abandoned (former extraction)*, *Flooded land* are always managed systems, *Other Wetlands* may include unmanaged and managed land.

Soil types can be applied to subdivisions of *Wetlands* as shown in Tables 6 and 7 below.

Table 6 possible soil types and soil statuses under managed *Wetlands* subdivisions

Soil Status	Soil composition						
	Mineral			Organic			Mixed
	Soil type						
	Inland Wetland[17]	*any user-specific*	Coastal Wetlands	Inland	*any user-specific*	Coastal Wetlands	Coastal Wetlands
	Soil Status						
Peatlands under peat extraction	NA	NA	NA	Drained		NA	NA
Peatlands abandoned (former extraction)	NA	NA	NA	Drained or Rewetted		NA	NA
Flooded land	NA or Extracted[17,18]			NA or Extracted[18]			NA or Extracted[18]
Other Wetlands	No change in hydrology Rewetted Extracted	NA	NA	No change in hydrology Rewetted Extracted	No change in hydrology Rewetted Extracted	NA	NA
Other Wetlands: Coastal Wetlands	NA	NA	No change in hydrology Rewetted Extracted	NA	NA	No change in hydrology Rewetted Extracted	No change in hydrology Rewetted Extracted

Table 7 possible soil types and soil statuses under unmanaged *Wetlands* subdivisions

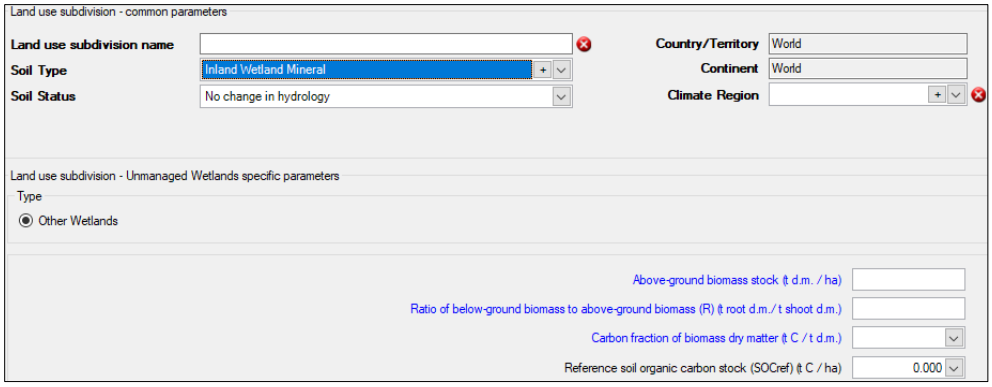
Soil Status	Soil composition						
	Mineral			Organic			Mixed
	Soil type						
	Inland Wetland	*any user-specific*	Coastal Wetlands	Inland	*any user-specific*	Coastal Wetlands	Coastal Wetlands
	Soil Status						
Other Wetlands	No change in hydrology	NA	NA	No change in hydrology	No change in hydrology	NA	NA
Other Wetlands: Coastal Wetlands	NA	NA	No change in hydrology	NA	NA	No change in hydrology	No change in hydrology

[17] For *Flooded land* any mineral soil type can be applied
[18] Where the land is converted to flooded land, SOM may first be removed

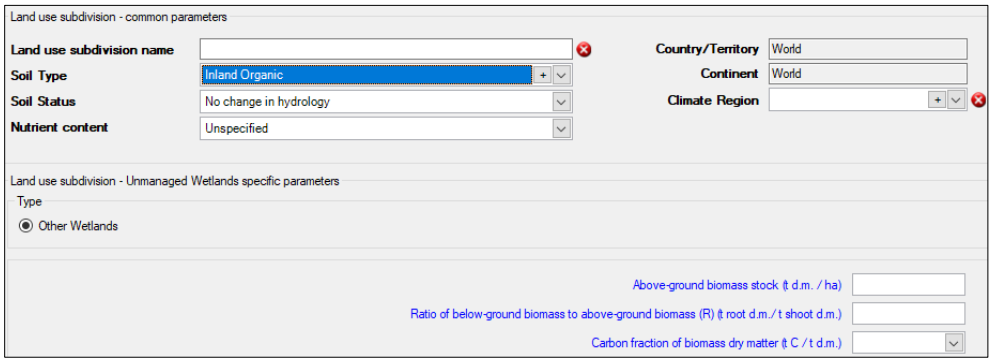
Unmanaged Wetlands

Unmanaged Wetlands can occur under only one of the land subdivision types: **Other Wetlands**, although *soil composition* can be *mineral*, *organic* or *mixed***.** Parameters differ according to the soil composition:

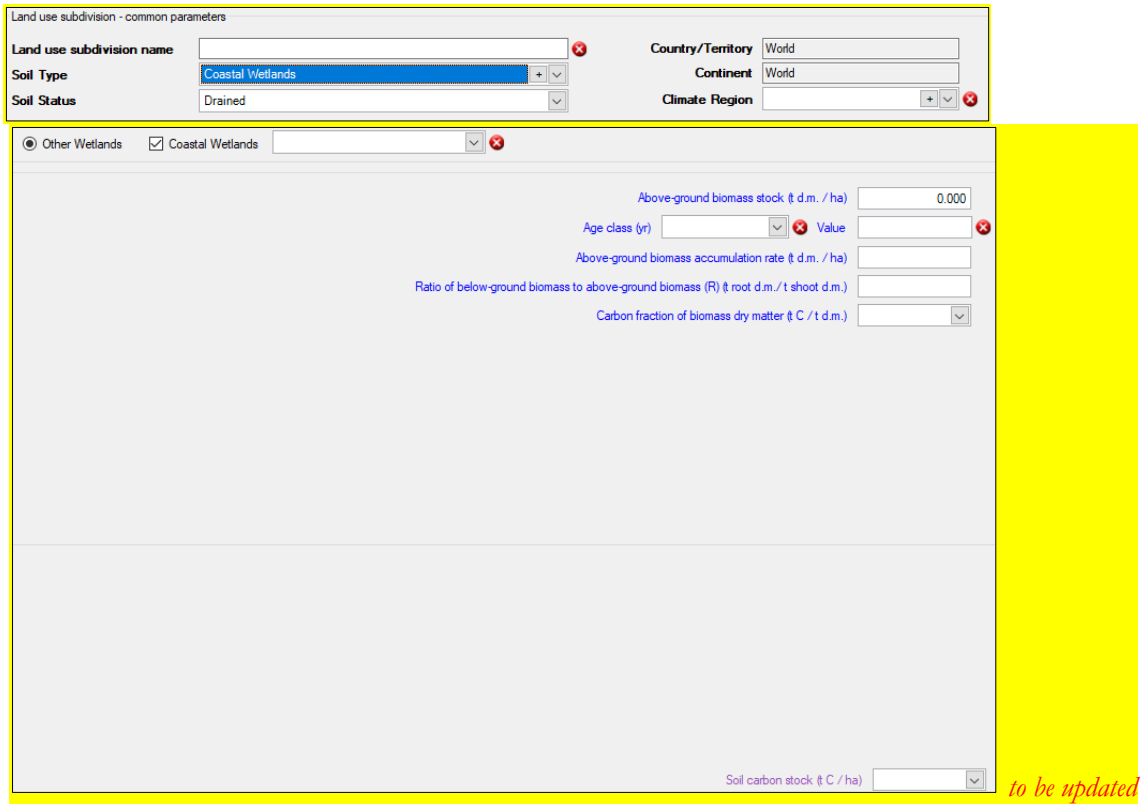
✓ Mineral composition, for which *SOCref* is needed:



✓ Organic composition, for which *SOCref* is not needed:



✓ Coastal Wetlands, for which *SOC* is needed:



to be updated

For parametes for biomass see *Unmanaged Forest land*.

Depending on the soil type selected the mask shows a different parameter.

For *Inland Organic* soils no *Reference SOC* is needed.

For *Wetland Mineral* soils the *Reference SOC* that, likewise *Unmanaged Forest land*, is not further adjusted through stock-change factors since no management occurs.

For *Coastal Wetlands* soils:

- Soil carbon stock, the dropdown menu provides IPCC default values, as sourced from the *Wetlands Supplement*, although users can enter their own data. *Coastal Wetlands* soils include a mix of mineral and organic soils and depending on the activity to which the land is subject (see *Extracted soil status*) the total SOC is needed to estimate associated SOC losses.

Type is not to be selected since there is only 1 *Wetland*s type in *Unmanaged Wetlands*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

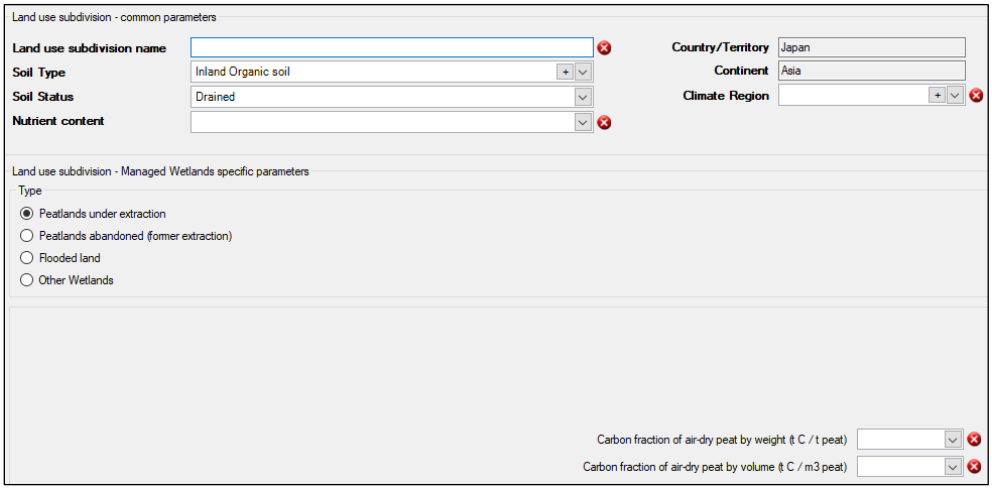
Managed Wetlands

Depending on the Wetlands type selected the mask shows a different set of parameters.

Type is to be selected from the dropdown menu among 4 IPCC types. Type selection determines what type of activities is reported and thus what relevant parameter

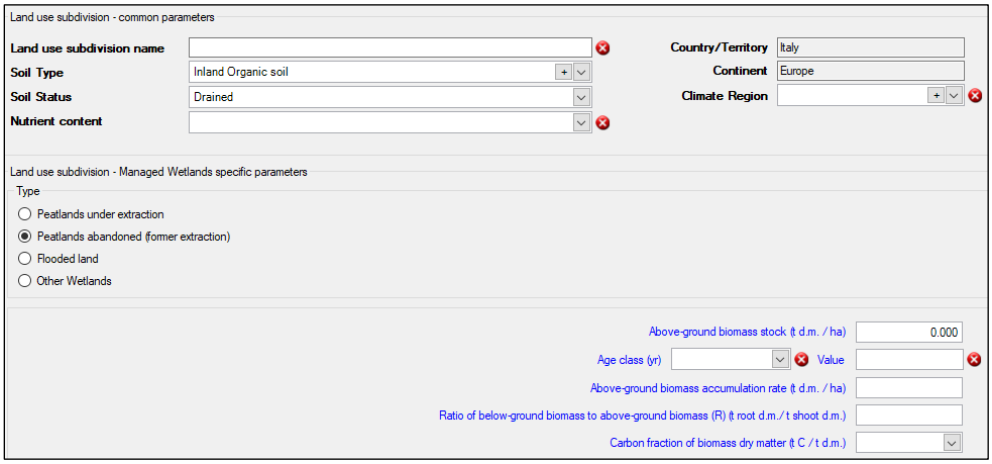
s are provided in the mask.

- Peatlands under extraction where the 2 parameters are mutually exclusive (users have to compile one of the two):



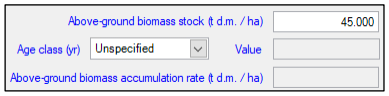
  - ✓ Carbon fraction of air-dry peat by weight, the dropdown menu provides IPCC default values, if available, although users can enter their own data.
  - ✓ Carbon fraction of air-dry peat by volume, the dropdown menu provides IPCC default values, if available, although users can enter their own data.

- Peatlands abandoned (former extraction) where 5 relevant parameters are provided to be compiled only if users wish to estimate vegetation re-installment after abandonment:



The first three: *Above-ground biomass stock*, *Age class* and *Woody biomass accumulation rate* are correlated to each other. Indeed, users can either enter the *Above-ground biomass stock* or the *Age class* and *Above-ground biomass accumulation rate*.

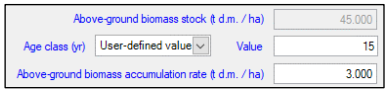
If *Above-ground biomass stock* is entered the *Age class* and *Above-ground biomass accumulation rate* field s will remain greyed.



Otherwise,

- ✓ Age class, users first select "User defined", then enter a single value in the next field;

✓ Above-ground biomass accumulation rate, is the average net accumulation[19] of carbon during the time period determined by the *Age class* value entered. Accordingly, if a value is entered for *Age class* then the *Software* grays out the field of *Above-ground biomass stock*, although it calculates a value, which is shown in grey in the field, as the *Above-ground biomass accumulation rate* multiplied by the *Age class*.



Note: Given that unlimited accumulation of biomass is not possible, this parameter is an active parameter only if the *Age-class value* is entered. Further, if an *Above-ground biomass accumulation rate* is entered then biomass losses shall also be estimated in the relevant calculation worksheet **Biomass change (G&L)**.

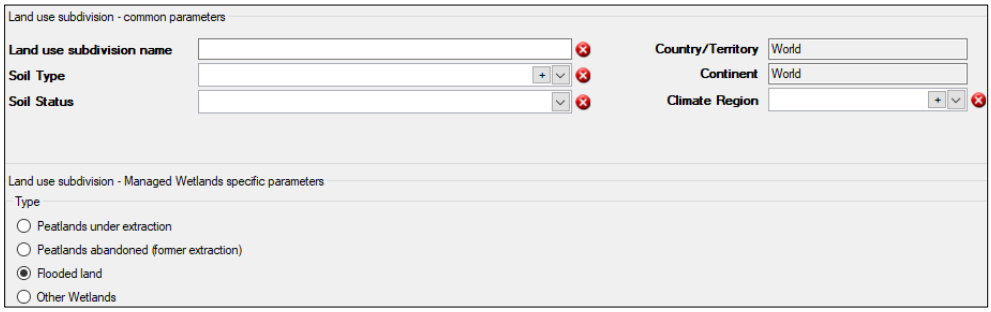
The final two parameters are the *Ratio of below-ground biomass to above-ground biomass*, to be entered directly by users, and the *carbon fraction of biomass dry matter*, where users may select from the dropdown or enter user-specific information.

Note: units of land that are Peatlands abandoned are mapped:

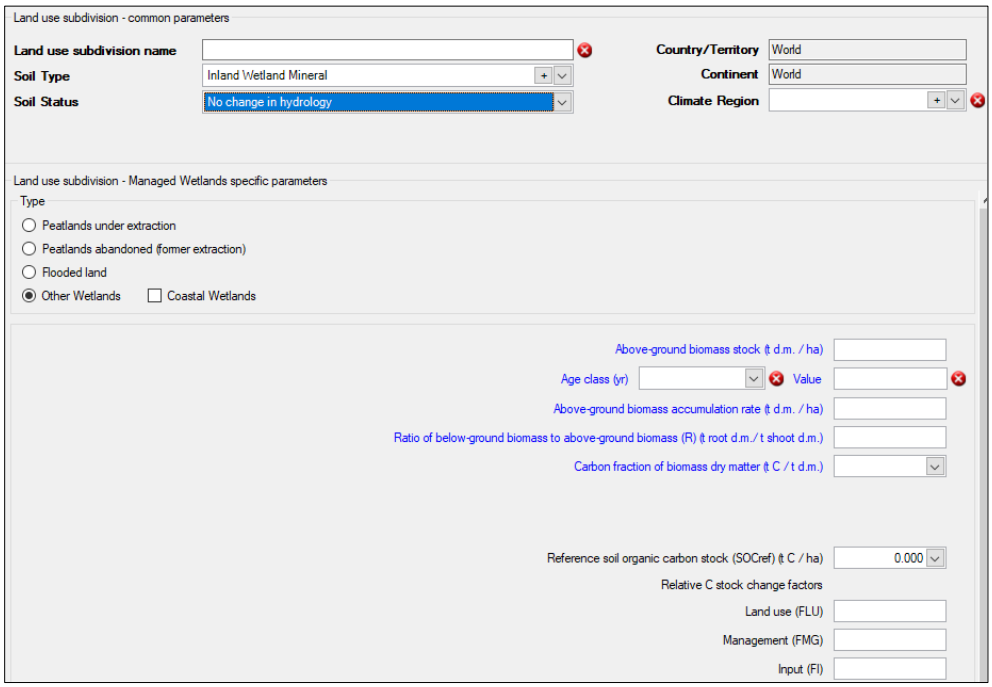
a. to *Peat extraction remaining Peat extraction* or to *Land converted to Peat extraction* (if the land is still undergoing a conversion), if the *Soil status* is *Drained*

b. to *Other Wetlands remaining Other Wetlands* or to *Land converted to Other Wetlands* (if the land is still undergoing a conversion), if the *Soil status* is *Rewetted*

➢ Flooded land does not entail calculation of C stock changes, so no parameters are needed:



➢ Other Wetlands:



[19] Gross increment minus mortality

If Inland Wetland mineral soil is selected, the SOC stock change factors have to be entered. IPCC does not provide default values for *Managed Wetlands*, although guidance for land under conversions is provided in Chapter 5 of the *Wetlands Supplement*.

Note: Chapter 5 of the *Wetlands Supplement* provides refined SOC_{REF} values for *Inland Wetland mineral* soil as well as revised values for Carbon-Stock-Change factors dedicated to *Inland Wetland mineral* soil.

For biomass parametes see *Peatlands abandoned (former extraction)*.

Settlements

IPCC provides methodological guidance to estimate biomass C stock changes at Tier 2 only (Equations 8.2 and 8.3). While SOC change estimates, at Tier 1 and 2, depend on the proportion of land that is:

- paved
- covered by turfgrass
- cultivated
- treed

Thus, the *Software* has 2 subcategories for *Settlements*:

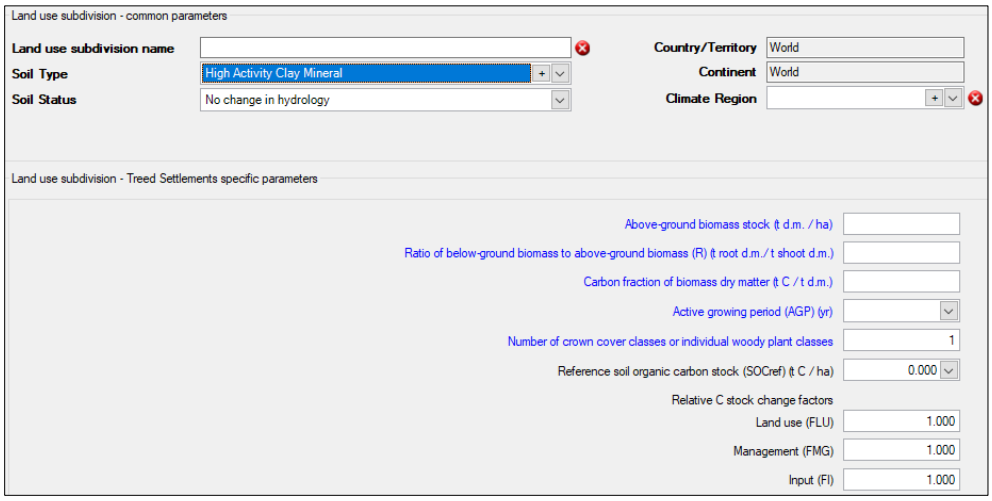
- **Settlements (Treed)**
- **Settlements (Other)**

Settlements (Treed) encompasses the portion covered by trees only[20], while *Settlements (Other)* encompasses the other 3 land cover types.

Thus, users shall share the total area of settlement between the 2 subcategories and for the subcategory *Settlements (Other)* users shall further estimate the proportion of area covered by each of the non-tree cover types.

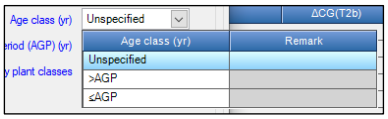
[20] It does not include other land cover types mixed within trees.

Settlements (Treed)



Parameters specific for this subdivision are:

- Age class intends to distinguish those treed land where trees are still in an active growing period (AGP), parameter for which IPCC assumes a 20-years default, and those that are not. For those that are in an active growing period -i.e. Age class ≤ AGP- the net growth is to be estimated in the relevant worksheet, for those that are not -i.e. Age class > AGP- no biomass changes are to be estimated.



  Where *Unspecified* is selected, the *Software* allows an unlimited carbon accumulation in the biomass C pool for the *Gain&Loss* method, thus *Unspecified* is to be selected only if the *Stock-Difference* method is applied to the biomass C pool to the unit of land under this land subdivision.

- Active growing period, users can select the IPCC default value -i.e. 20 years- from dropdown or enter their user-specific value.
- Number of crown cover or individual woody plant classes both IPCC equations -8.2 and 8.3) calculate biomass C stock changes as the sum of stock changes occurring on a subset of the tree population i.e. the class. The use of classes deals with variability in growth rates among different sub-population (e.g. different age for same tree species) or differences in the tree species or group of species.

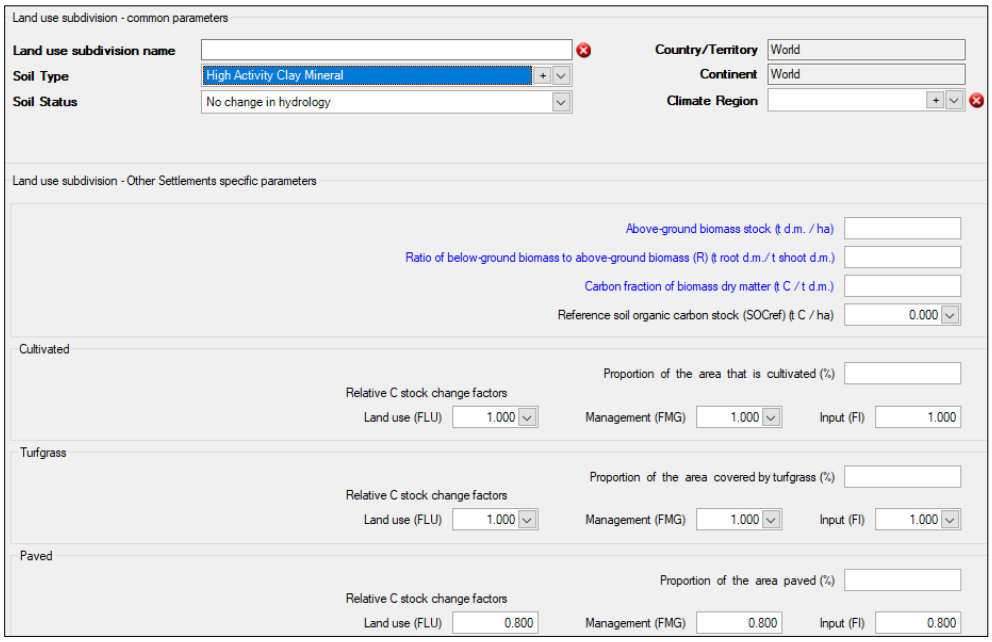
  Users have three variables: *land subdivision*, *age class*, *number of crown cover or individual woody plant classes* to deal with variability in the net accumulation rate, although the *Gain&Loss* method allows to estimate net C gain only and only until the vegetation achieve its long-term biomass C stock. Thus, where losses are to be estimated the *Stock-Difference* method is to be applied between C stock estimates at time 1 and a time 2, where C stock at time 2 is to be calculated by users -the *Software* does not implement such calculation of C stock at time 2- as C stock at time 1 plus C stock gains between time 1 and 2 minus C stock losses between time 1 and 2.

- For *Settlements (Treed)* the Tier 1 value for all Relative SOC change factors provided in the *Software* is equal to 1 for F_{LU} and F_{MG} while for F_I the value of , users can enter any alternative value.

For all other parametes for biomass see *Managed Wetlands*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

Settlements (Other)



Parameters specific for this subdivision are:

- Proportion of the area that is cultivated, Proportion of the area covered by turfgrass, Proportion of the area paved data entered shall sum up to 100%.

  Users can instead apportion the area of non-treed settlements among three subdivisions[21] each of one dealing with a single land cover, and thus assign 100% to the proportion of the relevant land cover.

- For *Settlements (Other)* the IPCC Tier 1 values of the *Relative SOC change factors* are:
  - ✓ For *Cultivated*, are those for *Cropland*[22], with no-till F_{MG} values and F_I equal to 1
  - ✓ For *Turfgrass*, are those for *Improved Grassland*,[23] with no-till F_{MG} values and F_I equal to 1
  - ✓ For *Paved*, the product of F_{LU}, F_{MG} and F_I is 0.8 times the corresponding product for the previous land use and/or management (i.e., 20% of SOC of previous land use and/or management will be lost as a result of disturbance, removal or relocation of soil).

    The current version of the *Software* does not have the capacity to compile the Relative SOC change factors as 0.8 of those of the previous land subdivision. To deal with this, the only option currently available is to create *land-conversion-specific* subdivisions for *Paved* areas in *Settlements (Other)*., in such a way the F_{LU}, F_{MG} and F_I can be entered as 80% of the value of the previous subdivision. For example, a subdivision named *forest land converted to paved land* has the value of 0.8 for each of the 3 *Relative SOC change factors*.

For all other parametes for biomass see *Managed Wetlands*.

Tier 3, depending on data used, is to be accommodated in the above listed variables.

[21] E.g. "paved", "turfgrass", "cultivated"

[22] AFOLU Table 5.5 – F_{LU} value according to climate regions: Temperate/Boreal Dry = 0.80; Temperate/Boreal Moist = 0.69 Tropical Dry = 0.58; Tropical Moist/Wet = 0.48; Tropical montane = 0.64; F_{MG} = value according to climate regions: Temperate/Boreal Dry = 1.10; Temperate/Boreal Moist = 1.15; Tropical Dry = 1.17; Tropical Moist/Wet = 1.22; Tropical montane = 1.16

[23] AFOLU Table 6.2 – F_{LU} = 1; F_{MG} = value according to climate regions: Temperate/Boreal = 1.14; Tropical = 1.17; Tropical montane = 1.16

Other land

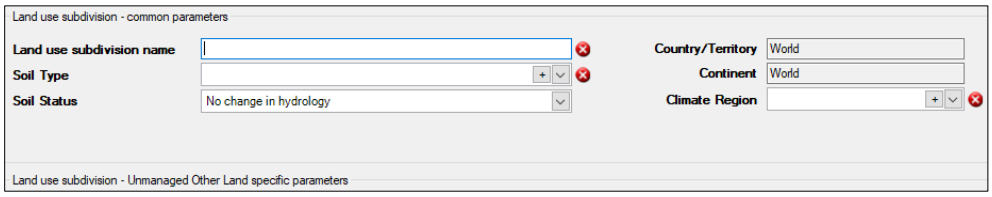
It includes all land without significant C stocks. This means that *Other land remaining Other land* has no significant C stock changes and thus the *Software* does not provide any calculation worksheets for category 3.B.6.a.; furthermore, every conversion to *Other land* results in the complete loss of C stocks resident in the land according to its previous use and/or management. Note that for organic soils, such a complete loss can be modelled through *Drained* soils status (by selecting in *Land Unit Parameter* the *IPCC default* method for *SOM organic*) or more efficiently through a stock-difference loss of the entire SOC (by selecting in *Land Unit Parameter* the *Stock difference* method for *SOM organic*).

Note: *Coastal Wetlands* soils under *Other land* are always *extracted* (no alternative *soil status* available)

Unmanaged Other land

Managed Other land

Given that *Other land* has not significant resident C stocks, no C stock parameters are present in the *Unmanaged Other land* mask as well as in the *Managed Other land* mask.



Reporting requirement for C pools at Tier 1 and Tier 2

Table 8 Mandatory C pools as per Tier 1 or Tier 2 of the 2006 IPCC Guidelines

C pool		Forest land		Cropland		Grassland		Wetlands		Settlements		Other land	
		R	C	R	C	R	C	R	C	R	C	R	C
Biomass	Aboveground	X	X	X[2]	X	X	X	---	X	X	X		X
	Belowground	X[1]	X	X[2]	X	X	X	---	X	X	X		X
DOM	Dead Wood	X	X[3]	X	X[3]	X	X[3]	---	X[3]	X	X[3]		X[3]
	Litter	X	X	X	X[4]	X	X[4]	---	X[4]	X	X[4]		X[4]
Soil Organic Matter	mineral	X	X	X	X	X	X	---	---	X	X		X
	organic[5,6]	X	X	X	X	X	X	X[7]	X[7,8]	X	X		X
Harvested Wood Product		X											

A **black X** *indicates that according to Tier 1 C stock changes in the relevant C pool are to be estimated, and a* **blue X** *indicates those C stock changes to be additionally estimated according to Tier 2. Tier 3 applied to any C pool in any land use category requires users to estimate annual C stock changes in that C pool (either as net change between times or as a sum of all gains and losses).*

R *indicates subcategories where land is not undergoing a change in use, while* **C** *indicates those where land is undergoing a change.*

Notes: 1. although IPCC provides default values of **R** *(root:to:shoot ratio) and so users may estimate changes in belowground biomass at Tier 1 too; 2. limited to perennial biomass; 3. Given that the 2006 IPCC Guidelines do not provide default values for Dead Wood users estimate changes in Dead Wood at Tier 2 or 3 only; 4. Limited to conversion from forest land; 5. where organic soils are drained, IPCC default method applies; 6. the Wetlands Supplement extends IPCC default methodology to rewetted soils; 7. including due to peat extraction; 8. the Wetlands Supplement extends to those soils in Coastal Wetlands that are a mix of mineral and organic origin*

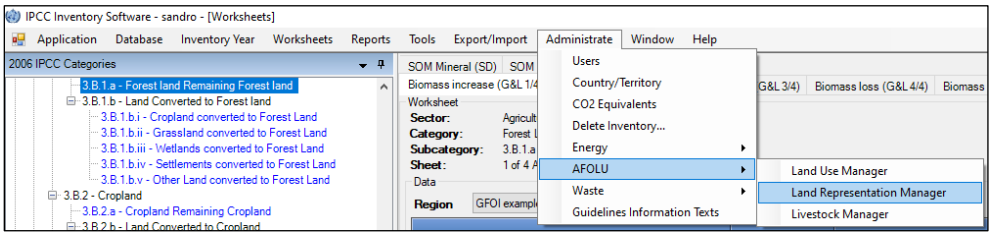
Note: Failing in reporting C stock changes for those C pools for which 2006 IPCC Guidelines provides a Tier 1 method impairs completeness of reporting and is to be noted as "NE" (Not Estimated) in the reporting tables.

Land Representation Manager (LRM)

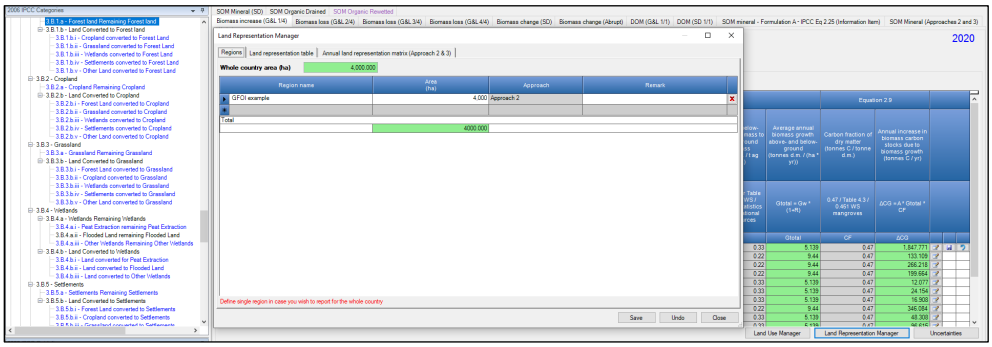
Land Use Representation Manager is a tabbed dialog window containing 3 tabs:

- ✓ Regions,
- ✓ Land Representation table,
- ✓ Annual land representation matrix *(limited[24] to Approaches 2 & 3 for land representation).*

Users can open it from **Administrate** main menu, **AFOLU** sub-menu



or from the bottom of any worksheets of 3.B categories

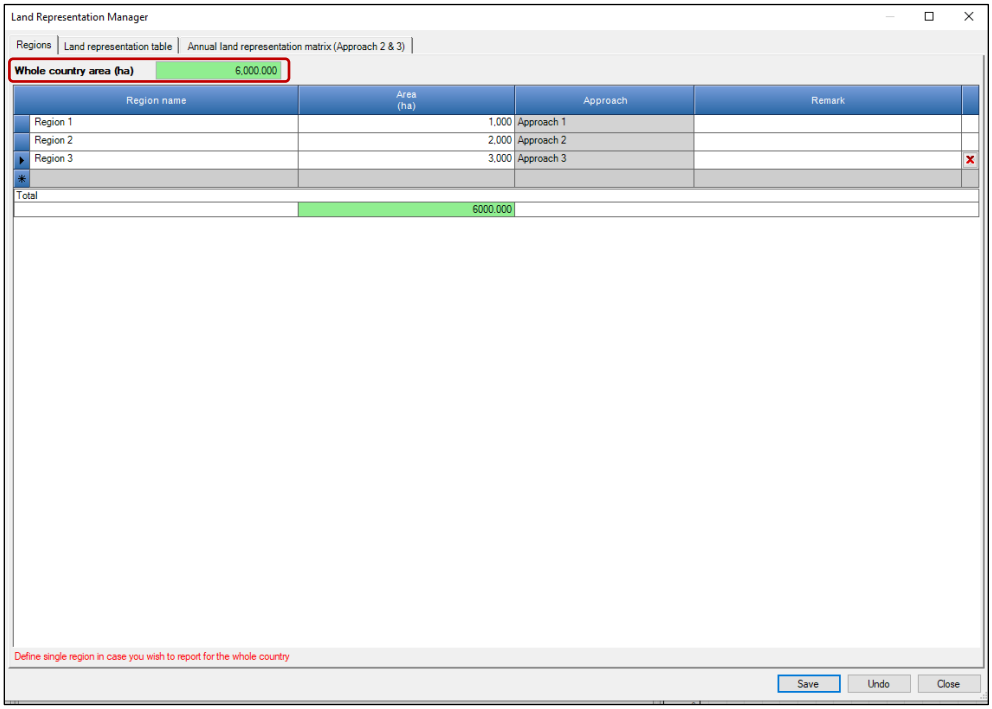


All information shown in the 3 tabs is relative to currently chosen inventory year.

[24] Given Approach 1 for Land Representation does not identify land use changes the matrix cannot be built.

Regions Tab

This tab allows subnational representation of land by stratifying the national territory in subnational units, here defined as **Regions**. It requires entering the total area of the country, although apportioned among Regions, as well as selecting for each Region the approach for the land representation.



users can either enter a single Region that covers the entire territory, for which the GHG inventory is prepared, or a number of Regions. In the latter case, for each Region an independent and consistent time series of activity data is to be entered by users in the Tab *Land representation table*.

Whole country area: Users must enter total area of the territory for which the GHG inventory is prepared.

The area value entered is saved automatically (no need to press **Save**) and can be changed through a new data entry.

The field has a background color that indicates:

- Green – sum of areas across defined regions matches whole country area.
- Orange – sum of areas across defined regions is less than whole country area.
- Red – sum of areas across defined regions is greater than whole country area.

Note: the area value cannot have more than three decimals, given that area values entered in the *Land representation table* can only have three decimals.

Tip: In case of Orange/Red color, placing mouse pointer over the field shows tooltip with a warning and the area difference between the total and the sum of areas entered in the Regions fields.

Table: Users can define one or more regions with the following attributes:

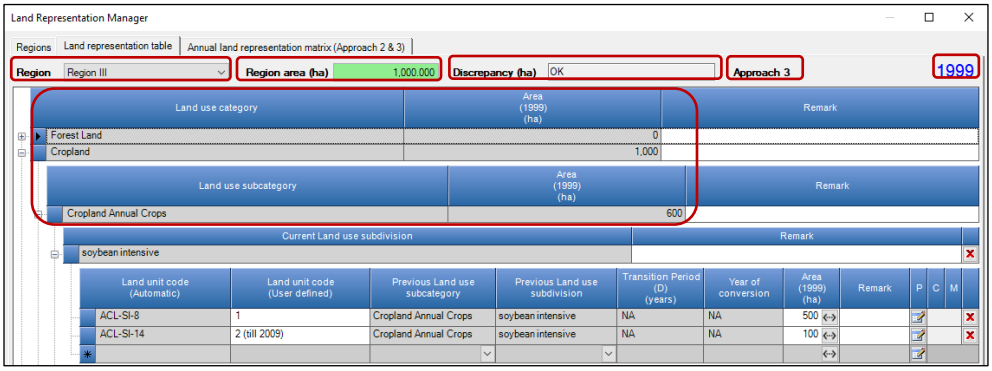
- ✓ **Region name** – to be entered.
- ✓ **Area** – area of the region in ha – to be entered.
- ✓ **Approach** – 1, 2, 3 – **for land representation** – to be selected.
- ✓ **Remark** – users can enter here notes relevant for the row of data *(information is neither transferred to reporting tables nor can be printed)*

Note: the area value cannot have more than three decimals, given that area values entered in the *Land representation table* can only have three decimals.

Tip: to record info entered in the DataBase (DB) press the button Save. Once saved the information cannot be changed anymore. Where an error is identified in information entered, the Region (and its data) is to be deleted. To do so click the red **x** on the right hand of the table- and enter again information.

Land representation table Tab

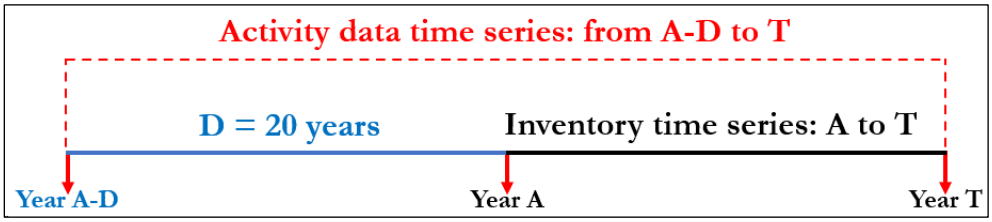
Allows defining units of land for the selected Region according to Region's defined Approach for land representation.



The **Land representation table** requires users to enter a consistent land representation. Where a consistent land representation is a time series of annual area estimates of units of land, as disaggregated according to stratification, that:

- ✓ reports the total area of the territory constant across the entire time series
- ✓ classifies land using a consistent methodology across the entire time-series (no artifact land conversions caused by changes in the classification method/background-data)
- ✓ in each year **Y**, all units of land under conversion are reported within the *Land converted to* relevant category until the end of the transition period (**D**)
- ✓ in each year **Y**, all units of land that did not undergo a conversion in the last **Y-D** years are reported within the *Land remaining* relevant category.

Being **A** the first year of a time series and **T** the last one, a Time series of activity data consists of annual area (ha), for each of the units of land, for each year of the inventory time period (**A to T**, composed by a number of years equal to **T-A**) plus for a number of years, prior to year **A**, equivalent to the transition period (**D**) applied to conversions of land use and/or management i.e. **A-D**; which means that the complete time series of data needed for the land representation is equal to **T-D**. For example, **A** is the year 2005, **T** is the year 2024 and **D** is a 20-year period, then the time series of activity data needed is from the year **A-D** (2005-20=1985) to **T** (2024), which means T-D=2024-1985=39 years.



Region – dropdown menu for choosing one of the defined regions to work with. By choosing region, region's area is filled in automatically together with information on the Approach defined for that region in the tab *Regions*. Multi-level table below is automatically filled with data on IPCC land use categories and associated area (as the sum of areas entered for the units of land belonging to the category/sub-category).

Region can be any level of stratification of the territory users wish to apply, e.g. administrative regions, ecological zones, parks, land subject to specific project activities, as well as a mix of those. *Nevertheless, it is suggested to use the stratification in "Regions" to aggregate all land that has the same soil type and climate region while subject to different land use and/or management.* Other levels of disaggregation -e.g. administrative, ownership, management systems- can be managed through the use of land-use subdivisions as well as of units of land[25]. For each Region the *Software* requires an independent[26] and consistent Land Representation.

Region area – background color meaning:

- Green – sum of areas across land use subcategories equals region's total area.

[25] A unit of land is an area homogenous per climatic and pedologic characteristic as well as per current and past use/management.
[26] No land transfer allowed among different Regions

- Orange – sum of areas across land use subcategories is less than region's total area.
- Red – sum of areas across land use subcategories is greater than region's total area.

Discrepancy – In case of Orange/Red color, shows the area difference between Region's total area and area entered in the *Land representation table* for that Region. Negative value means that the area entered in the *Land representation table* is larger than the area entered for the Region in the *Regions tab*; a positive value vice versa indicates that the area entered in the *Land representation table* is smaller than the area entered for the Region in the *Regions tab*. Otherwise, the zero value means no discrepancy.

Current inventory year is indicated on the right-hand side.

Table levels

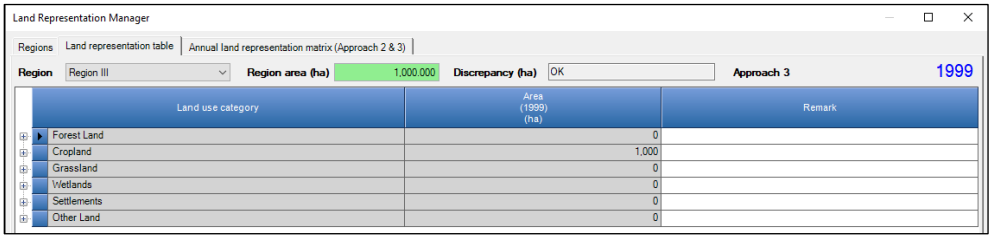
The Multi-level table contains all 6 IPCC land use categories as well as all 12 land use subcategories, where users can enter 4 levels of information for each unit of land:

- 1st level, where to select the current land use category of the unit of land
- 2nd level, where to select the current land use subcategory of the unit of land
- 3rd level, where to select the current land use subdivision of the unit of land
- 4th level, where to enter all information that qualifies the unit of land conversion status, the area and the methods applied to estimate C stock changes in each C pool.
- 5th level, information on historical conversions of the land is stored.

NOTE: Units of land SHALL be entered from the first year of the inventory time series onwards

1st level

Contains the 6 IPCC land use categories:



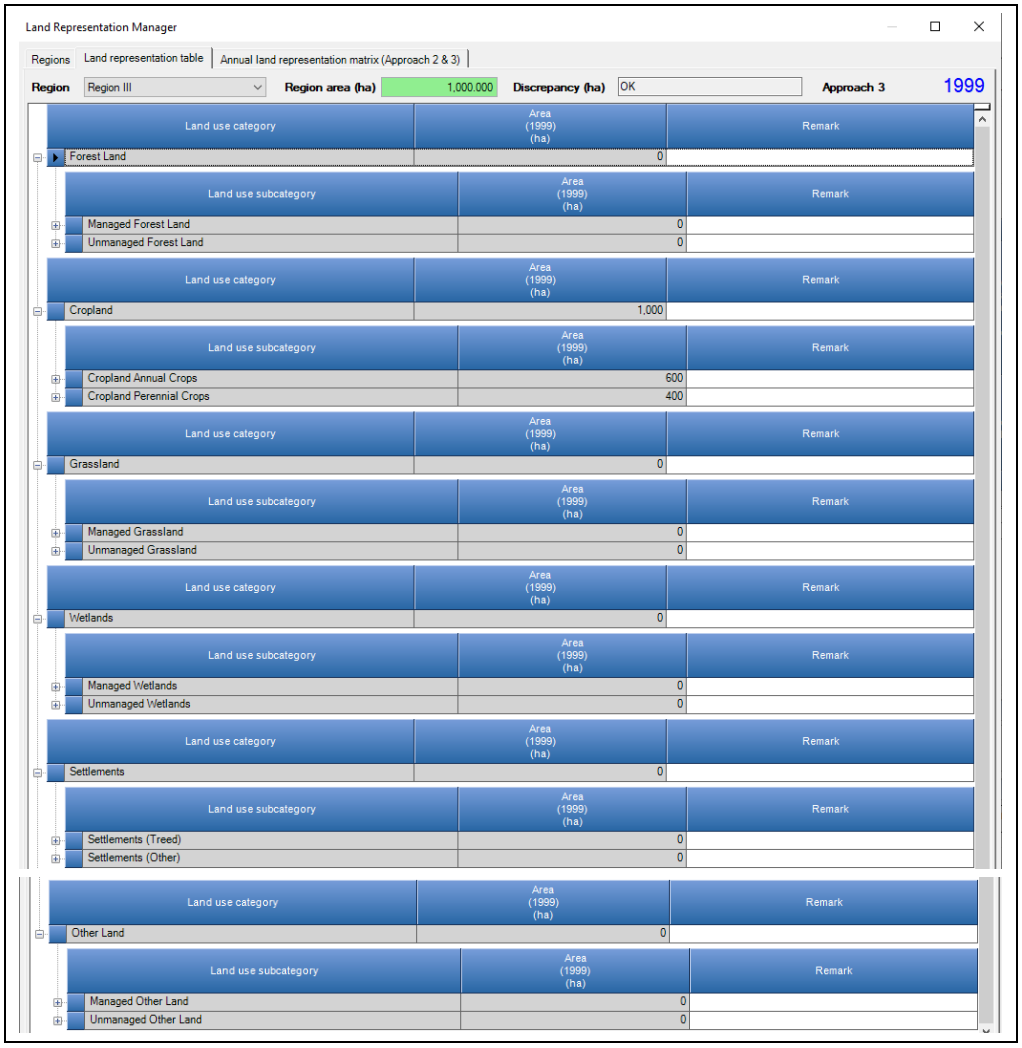
In **Remark**, users can enter notes relevant for the entire category *(information is neither transferred to reporting tables nor can be printed)*

Clicking on the element , on the right-hand side of the TAB, the lower level of the relevant category opens. So, to enter a unit of land click on the of its current use.

Tip: in case of Approach 3, in the first inventory year of the inventory time series i.e. year **A**, the land use category to be selected for a unit of land may not be the actual land use and/or management in the first inventory year; it could instead be the land use and/or management in the time period **A-D** to **A** if any use and/or management change occurred in that time period *[section on 5th level]*.

2nd level

Contains **12 land use subcategories**, a pair for each IPCC land use category. While for Land-Cover-based categories -i.e. Forest land, Grassland, Wetlands and Other land- the variable determining the split in the pairs is the presence of human activity -i.e., Managed vs Unmanaged land- for those categories that are purely Land-Use-based the variable determining the split in the pairs is on the presence of woody biomass -i.e. for Cropland, annual vs perennial crops; Settlements, treed vs other-:



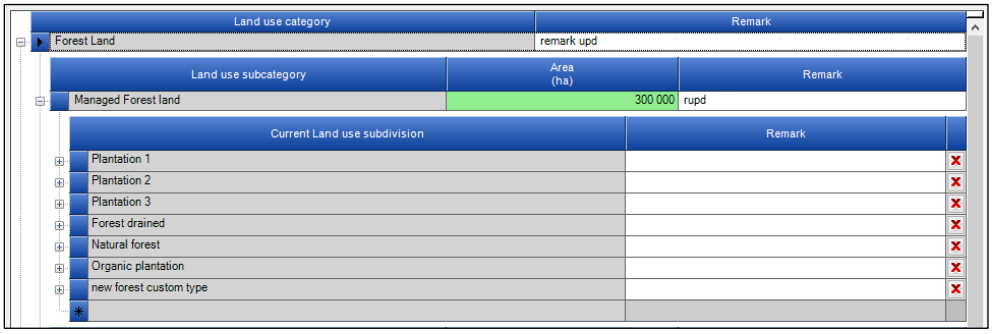
Area – specified area of the subcategory for a chosen inventory year.

In **Remark**, users can enter notes relevant for the entire subcategory *(information is neither transferred to reporting tables nor can be printed)*

Clicking on the lower level of the relevant subcategory opens. So, to enter a unit of land click on the of its current use.

3rd level

Contains all land use subdivisions entered by users in the Land Use Manager (LUM) for the relevant subcategory:



In **Remark**, users can enter notes relevant for the entire subdivision *(information is neither transferred to reporting tables nor can be printed)*

Clicking on the lower level of table opens where information on previous use and/or management of the unit of land as well as its area is to be entered. So, to enter a unit of land click on the of its current type.

Tip: placing mouse pointer over any subdivision shows tooltip with information on that subdivision as entered in the Land Use Manager.

4th level

Allows entering Units of land, according to the Approach for the Land Representation selected for the Region. The set of guidance to enter information on units of land is subdivided in 2 subsets:

- ✓ Data input guidance to create a new unit of land. *Note that some steps do not apply to all Approaches, as indicated*
- ✓ Data input guidance to add/modify information of a unit of land

Note: although all possible combinations of subdivisions[27] are available in dropdown menu of relevant land use subcategories, users need to add information (areas) for those actually occurring only.

[27] as entered by users in the **Land Use Manager**

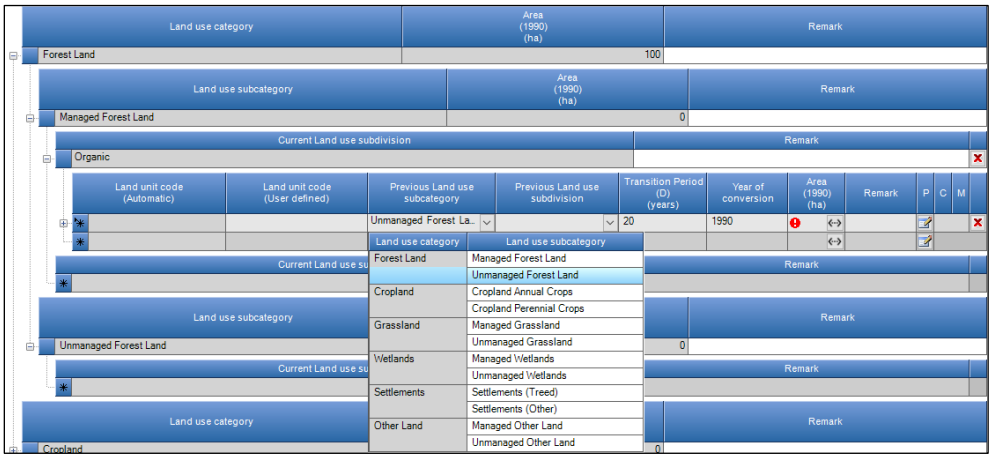
Data input guidance to create a new unit of land

For each unit of land, when first entered in the representation, the following step-by-step procedure applies:

- **first step** selecting, from dropdown menu, **previous land use subcategory**. *It does not apply to Approach 1*
- **second step** selecting, from dropdown menu, **previous land use subdivision**. *It does not apply to Approach 1*
- **third step** adding **user-defined land unit code**[28]
- **fourth step** adding **Transition period**. *It does not apply to Approach 1*
- **fifth step** adding **Year of conversion**. *It does not apply to Approach 1*
- **sixth step** adding **Area**. *For Apporach 1 only, the area of the unit of land 20-year before is to be added too*
- **seventh step** selecting, from Land Unit Parameters table under column "P", **method to** be applied to **estimate C stock changes** in each C pool
- **eighth step** adding any notes in *Remark* field
- **ninth step** save unit of land by clicking button **Save**

[28] Users can insert an alphanumerical code to track, and so recognize, the unit of land across the entire inventory time series.

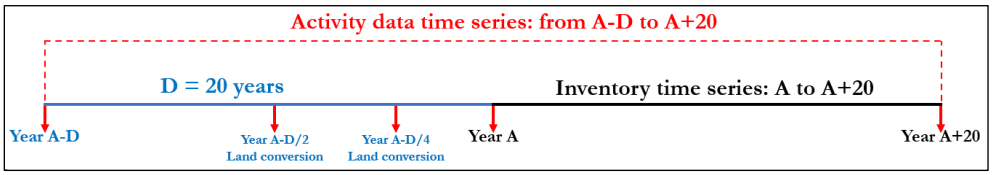
First step, select, from the dropdown menu, the land use subcategory the unit of land had in the previous inventory year:



Note: In a consistent land representation, the time-series of land activity data needed begins **D** years before the first inventory year, where **D is the transition period applied to land use and/or management conversions**. Nevertheless, units of land are entered in the *Software* from the first inventory year onwards only. Consequently, given the first year of an inventory time series **A**, where users are adding a unit of land:

- When **Approach 2** is applied: the information to be entered as previous subcategory is the subcategory to which the unit of land belonged in the year **A-D**. Where the **previous land use subcategory** or **previous land use subdivision** is different than the current one, a conversion occurred and thus users are required to enter the length of the Transition period D [*Fourt step*] as well as the year of conversion [*Fifth step*]
- When **Approach 3** is applied: the unit of land may have undergone multiple land use and/or management chanages in the period from year **A-D** to year **A**, and consequently multiple changes need to be entered for the same unit of land. In such a case, moving from the year **A-D** onwards, users shall select as current land use category/subcategory and subdivision the category/subcategory and subdivision the land had after the conversion, even if the land in the first inventory year has a different current land use; same applies for subsequent land use and/or management changes that occurred before the first inventory year. Where the **previous land use subcategory** or **previous land use subdivision** is different than the current one, a conversion occurred and thus users are required to enter the length of the Transition period D [*Fourt step*] as well as the year of conversion [*Fifth step*]. For example:

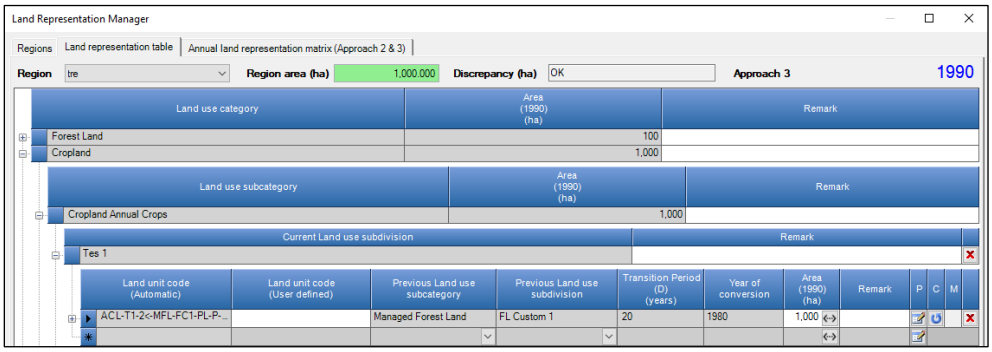
  For an inventory time series from year **A** to year **A+20**, a times series of activity data for the period **A-D** to **A+20** is needed. The activity data time series of unit of land **X** shows a first conversion -*managed forest land to annual cropland*- in the year **A-(D/2)** and a second conversion -*annual cropland to managed grassland*- in the year **A-(D/4)**; no conversion in inventory year **A** and in any following inventory years occurred.



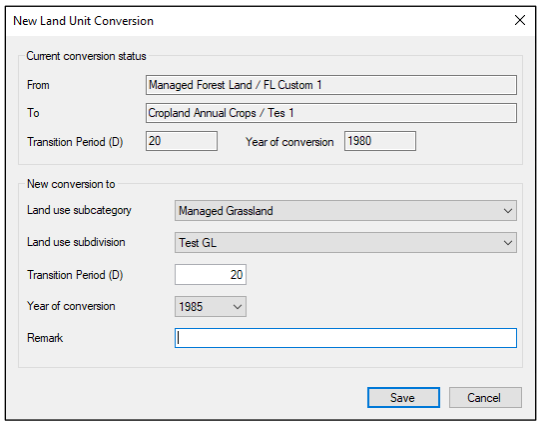
Given that:

- ✓ data input shall start from the first inventory year -i.e. year **A**- onwards, and
- ✓ data input of land use and/or management changes occurring before the first inventory year shall also be made be made from the first yearof that period -i.e. year **A-D**- onwards, data input in the inventory year **A** in the land representation manager follows the following steps:

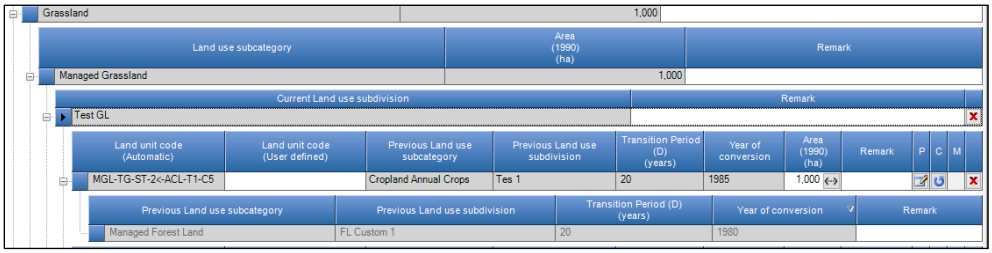
  1. first, enter the conversion from *managed forest land* to *annual cropland* occurred in the year **A-(D/2)**, where *annual cropland* is the *current land use subcategory* and *managed forest land* is the *previous land use subcategory*:



2. second, enter the conversion from *annual cropland* to *managed grassland* occurred in the year **A-(D/4)**, where *managed grassland* is the *current land use subcategory* and *annual cropland* is the *previous land use subcategory*. This is done by using the functionality for "further conversion" "C" that is available when Approach 3 for land representation is applied *[section on "Data input guidance limited to units of land under Approach 3 for land representation"]*



Thus, in the first inventory year **A** the unit of land is shown in the land representation manager as:

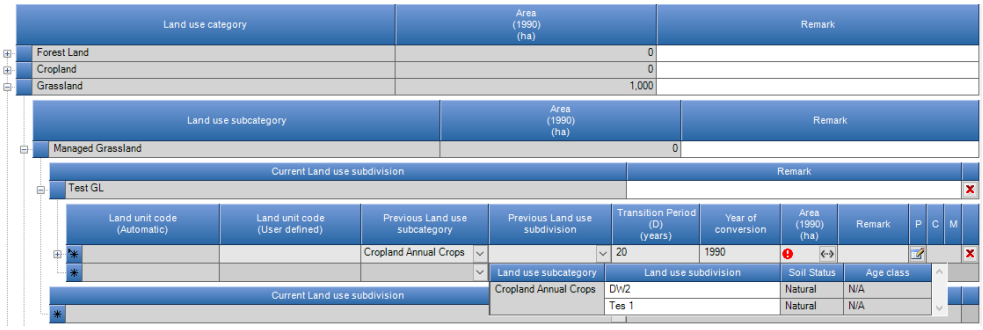


which means that the unit of land was first classified under cropland and finally classified under grassland; although information on first conversion remains associated with the unit of land, but shown in gray to indicate that such dynamic isn't anymore ongoing in the year **A**.

NOTE: data entry for conversions of a unit of land is to be done from the first year of the inventory time series forward; trying to enter data in the reverse order -i.e. from the latest inventory year backward- does not work.

In case of **Approach 1** for land representation, this **first step** does not apply since land use and/or management changes are neither identified nor tracked.

Second step, select, from the dropdown menu, the land use subdivision the unit of land had in the previous inventory year:



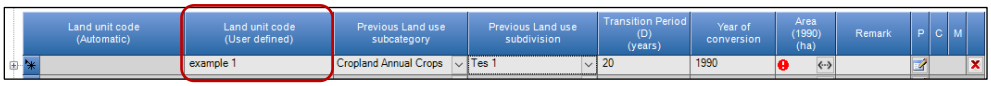
Note: see **Note** at **first step**. Same applies here.

In case of **Approach 1** for land representation, this **second step** does not apply since land use and/or management changes are neither identified nor tracked.

Tip: Within each region, conversions from one subdivision to another subdivision is restricted by the following rules:

- ✓ cannot convert any subdivisions of managed subcategories -Managed Forest land [MFL], Cropland (both subcategories) [CL], Managed Grassland [MGL], Managed Wetlands [MWL], Settlements (both subcategories) [SL], Managed Other land [MOL]- to any subdivisions of unmanaged subcategories -Unmanaged Forest land [UFL], Unmanaged Grassland [UGL], Unmanaged Wetlands [UWL], Unmanaged Other land [UOL]-
- ✓ soil type in previous and current land subdivision shall be the same *[Land Use Manager]*
- ✓ climate region in previous and current land subdivision shall be the same *[Land Use Manager]*
- ✓ for Forest land only, ecological zone in previous and current land subdivision shall be the same *[Land Use Manager]*

Third step, enter the **user-defined land unit code**, while the *Software* compiles the **automatic land unit code** *[section on "Automatic unit of land codes"]*.



Although this is not a mandatory information to enter, it is recommended to do so in order to facilitate users in data entry in the calculation Worksheets for C stock changes and associated GHG emissions and removals. Indeed, in those worksheets a number of units of land are visualized together and the **land unit code** allows to distinguish among those.

Automatic unit of land codes

In any given point of time, the automatic code is generated from Current land use subdivision under which the unit of land is classified. In case there is an ongoing transition, automatic code also contains a code of the subdivision from which the unit of land is being converted together with indication of the age of conversion (using "Cx" suffix, which means *xth year in conversion* (relative to current inventory year, see picture below):

Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition Period (D) (years)	Year of conversion	Area (2010) (ha)	Remark	P	C	M
PCL-AP-UD-10	3	Cropland Perennial Crops	agroforestry - pepper	NA	NA	400				
PCL-AP-UD-15<-ACL-SI-C0	2	Cropland Annual Crops	soybean intensive	20	2010	100				
PCL-AP-UD-18<-ACL-SI-C...	0	Cropland Annual Crops	soybean intensive	20	2000	100				

Coding elements according to land use categories are shown hereafter:

Forest land

[M,U]FL-NAMEabbr-[PL,NF]-FTabbr-LUID

[M,U] = either Managed or Unmanaged

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

[PL,NF] = either Plantation or Natural forest

FTabbr = Forest type name abbreviation (automatically generated from Forest type name)

LUID = unit of land database ID

Example:

MFL-OP-PF-TG-48 = Managed Forest land - Organic plantation - planted forest - *Tectona grandis* - 48 DB ID

Cropland

[P,A]CL-NAMEabbr-[CTp,RE]-LUID

[P,A] = either Perennial or Annual

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

[CTp,RE] = CTp – either crop type abbreviation (for perennial) or RE in case of rice ecosystem (for annual)

LUID = unit of land database ID

Example:

PCL-BF-OP-62 = Perennial cropland – Belvedere Farm - Oil palm - 62 DB ID

Grassland

[M,U]GL-NAMEabbr-VegType-[IMP]-LUID

[M,U] = either Managed or Unmanaged

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

VegType = vegetation type

IMP – only in case of improved grassland

LUID = land unit database ID

Example:

MGL-TG-ST-IMP-67 = Managed GL - Test grassland – Steppe – improved - 67 DB ID

Wetlands

[M,U]WL-NAMEabbr-[P,F,O]-LUID

[M,U] = either Managed or Unmanaged

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

[P,F,O] = either Peatlands (P) or Flooded land (F) or Other land (O)

LUID = unit of land database ID

Example:

MWL-P2-P-82 = Managed WL - Peatlands 2 – Peatlands - 82 DB ID

Settlements

[T,O]SL-NAMEabbr-LUID

[T,O] – either Treed or Other

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

LUID = land unit database ID

Example:

TSL-S1-59 = Treed SL - Settlements 1 - 59 DB ID

Other land

[M,U]OL-NAMEabbr-LUID

[M,U] = either Managed or Unmanaged

NAMEabbr = Subdivision name abbreviation (automatically generated from Subdivision name)

LUID = unit of land database ID

Example:

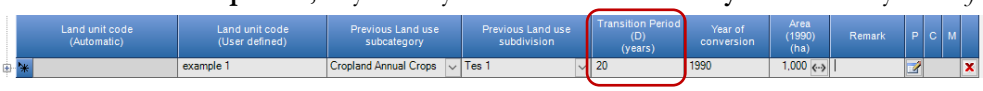
MOL-OL1-67 = Managed OL - Other land 1 – 67 DB ID

Additional Suffix (Approach 2 and 3 only)

Relative to current inventory year: Cx (where x indicates the x^{th} year in which the land is under conversion.

Note: the x^{th} year in which the conversion occurs has number 1

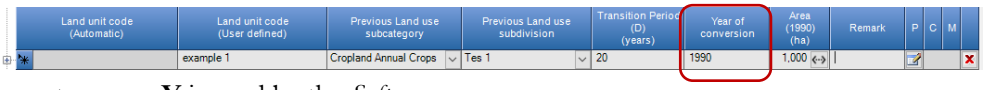
Fourth step, enter the **Transition period**, in years. By default the value of **20-year** is used by the *Software*:



The **Transition period** is the time period according to which the *Software* tracks the previous land use subcategory/subdivision of a unit of land undergoing a land use subcategory/subdivision conversion.

In case of **Approach 1** for land representation, this **fourth step** does not apply since land use and/or management changes are neither identified nor tracked.

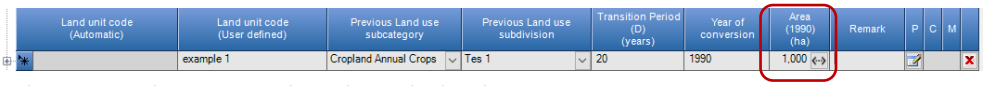
Fifth step, select the **Year of conversion** from a dropdown menu populated by the *Software* with all years of the time period **Y-D**:



By default the inventory year **Y** is used by the *Software*.

In case of **Approach 1** for land representation, this **fifth step** does not apply since land use and/or management changes are neither identified nor tracked.

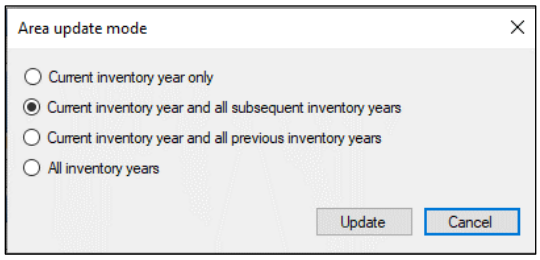
Sixth step, enter the **Area**, in hectares (ha), of the unit of land in the relevant inventory year.



Note: the area value cannot have more than three decimals.

Once the **area** is entered, users select to which time period of the inventory timeseries the area value entered applies.

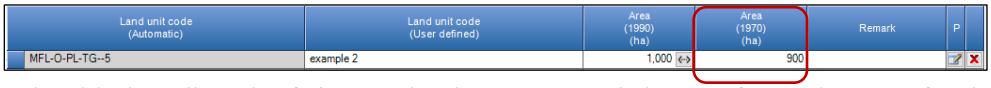
To do so, users open a dialog window by clicking on element next to the Area column, and then select the desired option:



The Dialog Window contains 4 options. By default the option **Current inventory year and all subsequent inventory years** applies, which means that if this is the option users wish to apply, no action will be needed.

Approach 1 specific rule

In case of **Approach 1** for land representation, this **sixth step** requires to add the area for a year equal to **Y-20**, where **Y** is the inventory year for which information is being entered. For example data entry for a unit of land in the year 1990 for an Approach 1 Land representation requires to enter the area that that same unit had in 1970:

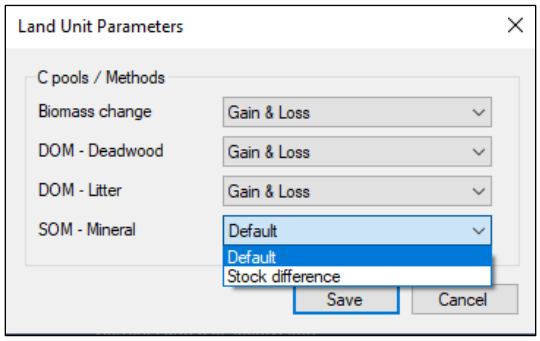


This information is critical to allow the *Software* to implement Formulation A of Equation 2.25 for the calculation of SOC changes

Note: even if the area of the unit of land area in a given year Y is 0 (zero) the area of 20 years before must be entered

Seventh step, select the methodology to be applied to each C pool to calculate the C stock changes. IPCC provides 2 methodological approaches to estimate C stock changes in C pools (*Section 2.2.1 - Overview of carbon stock change estimation*): the Gain & Loss method and the Stock-Difference method.

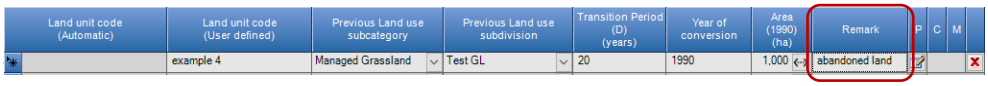
To do so, users open a dialog window by clicking on element symbol under letter (Pools):



The Dialog Window contains 4 Carbon pools: **Biomass**, **Dead Organic Matter – Deadwood**, **Dead Organic Matter – Litter**, **Soil Organic Matter – Mineral**. For each C Pool the methodology is to be selected between the IPCC default methodology[29], which is the **Gain & Loss**, and the IPCC alternative methodology, which is the **Stock-Difference**. For each C pool, by default the option **Gain & Loss** applies, which means that if this is the option users wish to apply, no action will be needed.

[29] To calculate SOC changes in mineral soils, IPCC default method applies equation 2.25, in Formulation A or B according to the Approach applied to the Land representation

Eighth step, enter any information on the unit of land users wish to recall or just to show to future users:

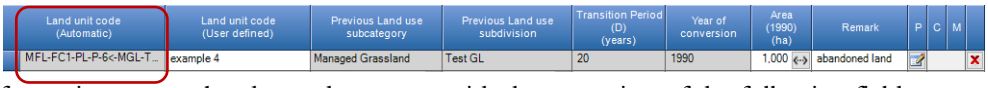


Land unit code (Automatic)	Land unit code (User defined)	Previous Land use subcategory	Previous Land use subdivision	Transition Period (D) (years)	Year of conversion	Area (1990) (ha)	Remark	P	C	M
	example 4	Managed Grassland	Test GL	20	1990	1,000	abandoned land			

In **Remark**, users can enter notes relevant for the entire subdivision *(information is neither transferred to reporting tables nor can be printed)*

.

Ninth step, save the information entered by clicking on the **Save** button (bottom of the window). When saving, the *Software* record all information on the unit of land in the database and assign an **automatic land unit code**.



Once saved, information cannot be changed anymore with the exception of the following fields:

- ✓ **user-defined land unit code**
- ✓ **area**
- ✓ **remark**

In case an error is spotted in any of the other fields, to correct it the entire row of information needs to be deleted -to do so click on the symbol "✖" at the right hand side-, then all information on the unit of land is to be entered again.

Data input guidance to add/modify information of a unit of land

Two additional functionalities are available to modify information entered for a unit of land:

- button **M**, to merge it with another unit of land. *This does not apply to Approach 1*
- button **C**, to add a new conversion to a unit of land that is still undergoing a conversion. *This applies to Approach 3 only*

As noted: information entered in the following fields:

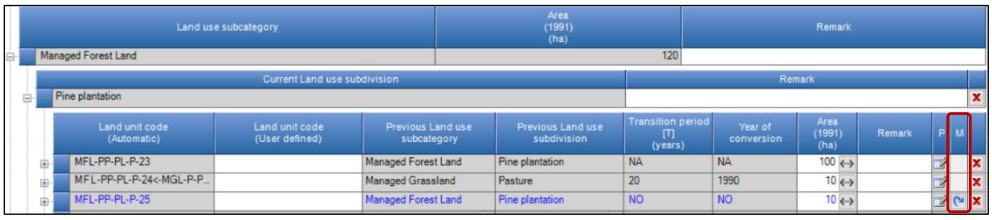
- ✓ **user-defined land unit code**
- ✓ **area**
- ✓ **remark**

can be changed at any time. However, note that a new information entered in the field **user-defined land unit code** or in the field **remark** in any of the inventory years is automatically propagated by the *Software* to the entire time series, while for the area users shall select the time period within the inventory time series to which the new value applies; where no selection is made by default the option **Current inventory year and all subsequent inventory years** will apply.

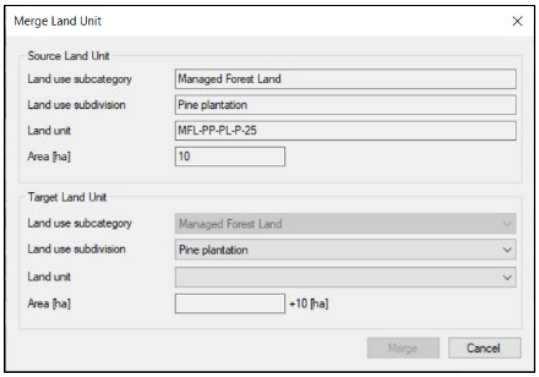
In case an error is spotted in any of the other fields, to correct it the entire row of information needs to be deleted -to do so click on the element at the right-hand side-, then all information on the unit of land is to be entered again.

Button **"M"** is to be clicked in case users wish to merge the unit of land with another unit of land -this makes the *Software* stop tracking the unit of land any further. This functionality applies only to units of land that have undergone completely the transition period of a conversion from one land use category/subdivision to another one, and are therefore shown in blue ink by the *Software*.

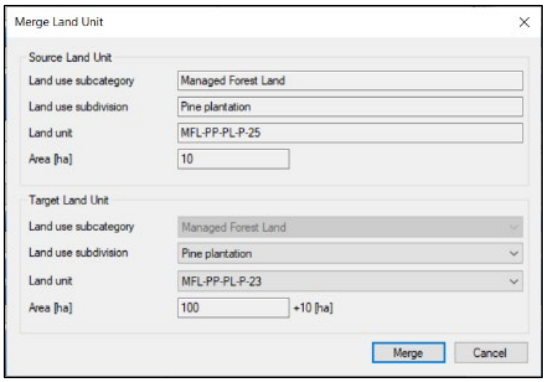
In the example below, the unit of land *MFL-PP-PL-P-25* has completed its conversion to *Managed Forest land – Pine plantation*. Accordingly, the *Software* has changed the associated **Transition period** and **Year of conversion** as NO.



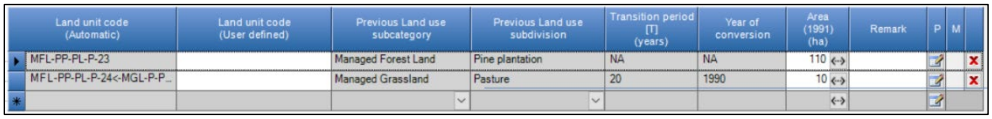
Thus, given that same values for parameters and emission factors apply to unit of land *MFL-PP-PL-P-25* and unit of land *MFL-PP-PL-P-23* users may decide to merge the 2 units. In such a case, by clicking button "M" in the row of the unit of land *MFL-PP-PL-P-25* the following dialog window opens



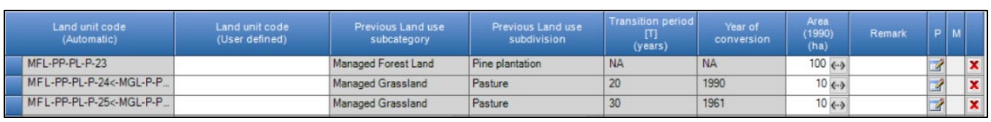
Then, users select the unit of land to which the unit of land is to be merged (in this example, unit of land *MFL-PP-PL-P-23*)



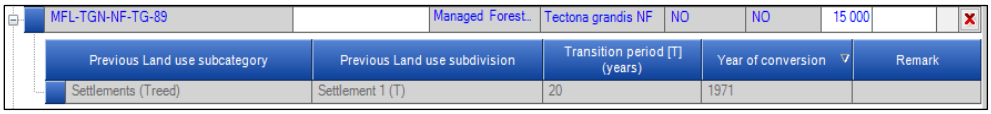
Once merged, the unit of land *MFL-PP-PL-P-25* disappears and its area is added by the *Software* to the area of the unit of land *MFL-PP-PL-P-23* from the year in which the merging is made onward.



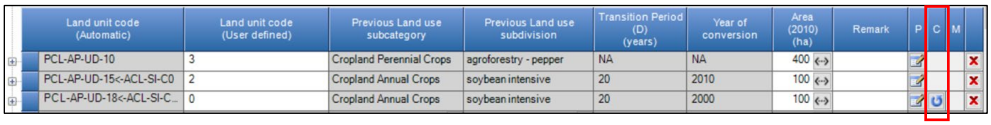
That means that the merging does not occur backward. The following picture is taken from the land representation of the previous year:



In any case, merging is just an option; users may wish to keep reporting the two units of land separated beyond the conversion period (e.g. since belonging to two different administrations). In such a case the previous subcategory/subdivision can still be examined after expanding the next level (conversion history), and it is shown in grey, as in the example below:

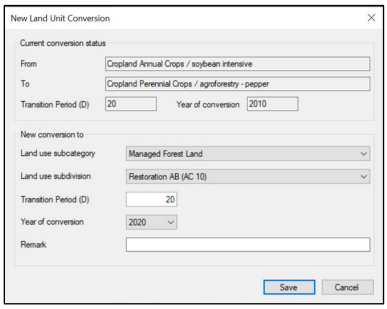


Button **"C"** is to be clicked in case users wish to enter a new conversion for a land that is still under conversion, and thus it applies under Approach 3 for land representation only.



NOTE: data entry for conversions of a unit of land is to be done from the first year of the inventory time series forward; trying to enter data in the reverse order -i.e. from the latest inventory year backward- does not work.

By pressing the button **C** a new dialog window opens:

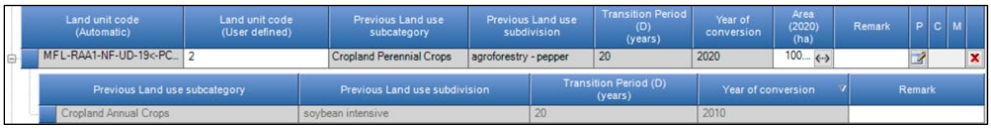


The dialog window is composed of 2 sections:

- The upper section with information, on the *Current conversion status* of the unit of land, as compiled by the *Software*:
  - ✓ Previous land subdivision,
  - ✓ Current land use subdivision
  - ✓ Transition Period
  - ✓ Year of conversion
- The lower section with information, on the *New conversion to* of the unit of land, to be entered by users:
  - ✓ New Land subcategory,
  - ✓ New Land subdivision,
  - ✓ Transition Period
  - ✓ Year of conversion[30]
  - ✓ Remark (if any)

After pressing Save, the unit of land is automatically relocated under the subdivision entered in the *New Conversion to* section and the previous subdivision assigned to the unit by the *Software* is the one that was in the *Current conversion status*. The *Software* navigates to the relocated unit of land automatically.

In this example a land under conversion to cropland is further converted to forest land; consequently, the *Software* relocate the subdivision under forest land:

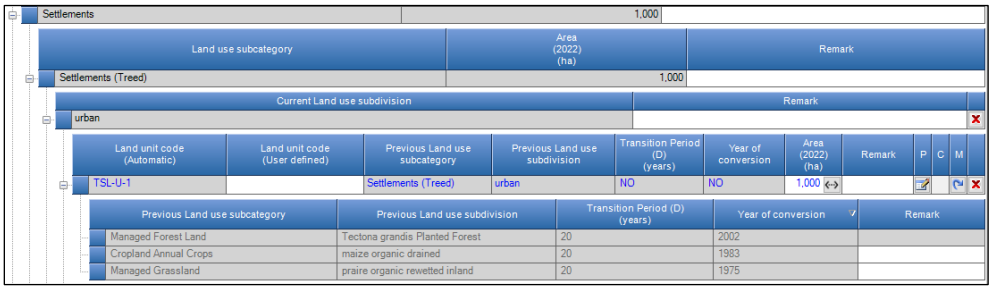


The previous land conversion is shown at a lower lever (5th) in grey.

[30] Year of conversion dropdown contains the list of years from: 'the year of conversion reported under the *Current conversion status* + 1 year' up to the *current inventory year*. In this example, being 2020 the inventory year, the dropdown menu includes the years 2011-2020

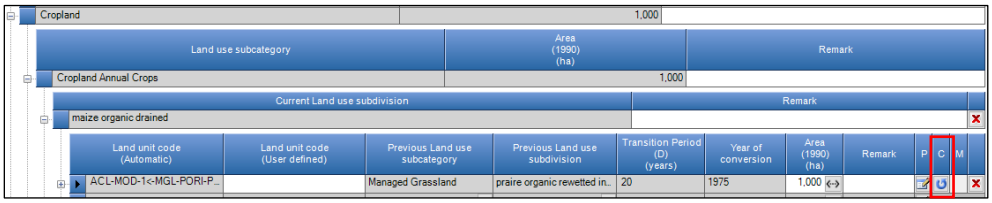
5th level

It shows the complete history of transitions of the unit of land relative to the current inventory year, ordered by year of transition descending and shown in grey (picture below).



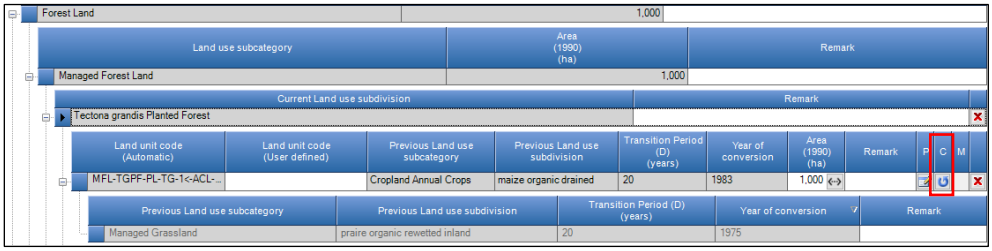
Indeed, the Land unit conversion in a given point of time -i.e. the chosen inventory year- is automatically presented considering current status of land unit together with its history of transitions. For example, a unit of land experiences multiple conversions within the time period analyzed for inventory purposes. Note that although the inventory period is 1990-2022, the inventory compiler has analyzed a time series of data starting in 1971 -i.e. 1971-2022- because of the transition period applied is of 20 years. Then,

in **1975**, the unit of land **transition from** *MGL/praire organic rewetted inland* **to** *ACL/maize organic drained*



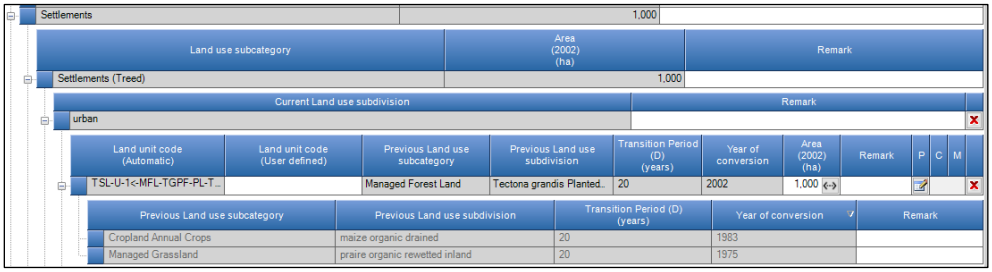
Note: this conversion occurred before the initial year of the inventory time series -i.e. 1990-2020; thus it is entered in the year 1990

in **1983**, the unit of land **transition from** *ACL/maize organic drained* **to** *MFL/Tectona grandis Planted Forest*



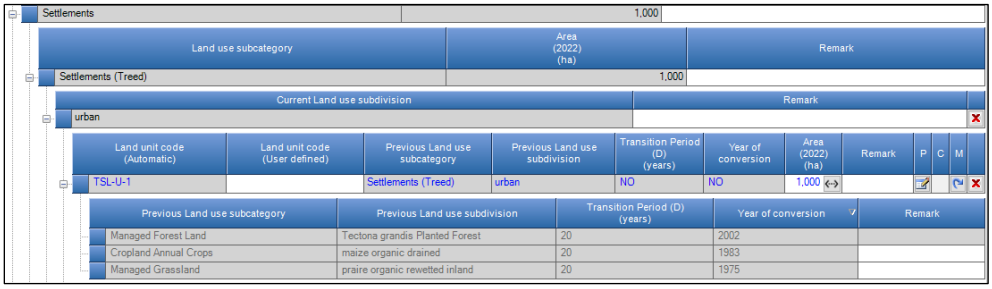
Note: this conversion occurred before the initial year of the inventory time series -i.e. 1990-2020; thus it is entered in the year 1990

in **2002**, the unit of land **transition from** *MFL/Tectona grandis Planted Forest* **to** *TSL/urban*



Note: this is the latest conversion of this unit of land and occurred in the inventory year visualized -i.e. Year of conversion = Inventory year = 2002-, thus the button "C" for intervening new conversion is NOT available.

in **2022**, the land unit has gone through the entire transition period (i.e. 20-year) since the last conversion; thus it has been reclassified by the *Software* as a remaining land -i.e. *NO* is applied by the *Software* for the *Transition period [D]* and for the *Year of Conversion*[31]- and colored in blue. History layer shows all the previous conversions:



Because in 2022 the unit of land is in a *remaining* category, it cannot intervene in any further conversion.

Note: Data entered are recorded in the DB when pressing the **Save** button. Thus, the *Undo* button can be used to discard all changes made since the last save, it does not cancel information that was entered before saving. In case of a data entry saved that is to be corrected, the only way to achieve it is to delete the wrong data entry (by clicking the red X on the extreme right end of the row) and to re-enter the correct one.

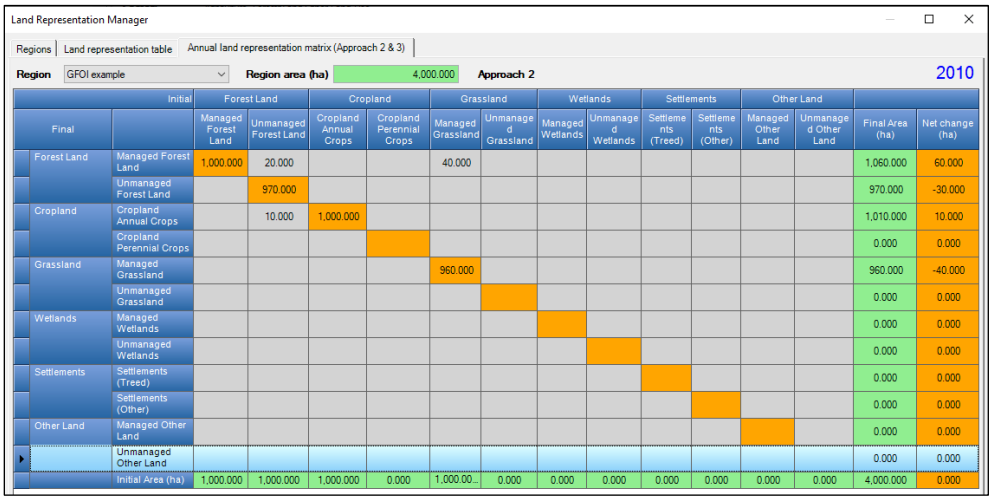
[31] Note that for a unit of land that did not intervene any conversion across the entire time series of the inventory the notation key *NA* is used by the *Software*.

Annual land representation matrix Tab

For land representation approaches 2 and 3, a land matrix Tab provides for the total area of the land representation to be classified either as a land that has not undergone a change between the initial (rows) and final (columns) year of the land-use conversion matrix or as a land that has undergone a change between 2 different subcategories.

Note: that such classification does not correspond to the IPCC categorization in *land remaining under one use/management* and *land under conversion from one use and/or management to another one*. Although a land reported in a matrix as converted from the initial year to the final year is part of the IPCC *land under conversion* categories, such categories include also land that have undergone a change in use and/or management in years before the initial year of the land-use conversion matrix.

For instance,



in the year 2015, 80 ha are reported as converted -from the initial year to 2015- from *managed grassland* to managed forest land. In the year 2015, those 80 hectares are reported, in the national GHG inventory, under *Grassland converted to Forest land*. However, in the same year additional land is reported under *Grassland converted to Forest land* -i.e. in any inventory year Y, any category with conversion lands (*Land converted to Land use X*) sums up all lands converted in the period Y to Y-(D-1)[32] to that category (X)-, for instance the 40 ha reported in the land-use conversion matrix of the year 2010.

[32] Where D is the Transition Period entered by users in the **Land Representation Manager** for the relevant *land conversion* category

Area Data Transfer to Calculation Worksheets

The compilation of data in the **Land Representation Manager** allows the *Software* to populate area data in the relevant calculation worksheets in each of the relevant inventory categories of the AFOLU sector. This also means that area data cannot directly be entered in those calculation worksheets.

The transfer of area data to the relevant worksheets is ruled by the:

- Characterization of the land type, as entered in the **Land Use Manager**
- Land Representation Approach, as selected in the **Land Representation Manager**
- Method to calculate C stock changes in each C pool, as selected in the **Land Representation Manager**

Tables in the section **calculation Worksheets for C stock changes in, and CO_2-C fluxes from/to, C pools** below show how for each C pool in each land use category the *Software* maps Area Data entered in the Land Representation Manager to the relevant calculation worksheets.

Tables in the section **calculation Worksheets for CH_4 and N_2O emissions from land** below show how the *Software* maps Area Data entered in the Land Representation Manager to the relevant calculation worksheets for N_2O and CH_4 emissions estimates.

Calculation Worksheets for C stock changes in, and CO_2-C fluxes from/to, C pools

The calculation worksheet to which the *Software* maps units of land, as well as the time period over which a unit of land is mapped to a specific calculation worksheet, depends on:

- Approach for land representation:
  - ✓ Approach 1, the transition period (D) is fixed to 20 years;

    No conversions are reported, thus units of land are all populated for the entire[33] inventory time series (regardless of its length) in the Land Remaining categories only, -i.e. 3.B.1.a, 3.B.2.a, 3.B.3.a, 3.B.4.a, 3.B.5.a, 3.B.6.a-.
  - ✓ Approaches 2 and 3, users assign the transition period (D) to each unit of land where a use and/or management change occurred (i.e. the current subdivision is different from the previous subdivision). By default the *Software* assigns a 20-year value, and accordingly each unit of land is reported in the relevant calculation worksheets for the entire transition period in a conversion status:
    - either within the relevant Land Conversion category, in case of a land use change (once the conversion period is ended the unit of land is mapped to the relevant Land Remaining category)
    - or within the Land Remaining categories -in case of a management change within the same land use-.

    Although, in case of Land Representation Approach 3 only, in case of a subsequent conversion the unit of land is transferred to the new land category/subcategory/subdivision even if the transition period has not achieved its end.
- The method (see Table 9) selected -in the **Land Representation Table**- for each C pool to estimate associated C stock changes or CO_2-C fluxes:
  - ✓ SOM mineral soils - IPCC Default method: formulation A of IPCC Equation 2.25 is applied to units of land reported under Approach 1 for Land Representation, accordingly those units of land are populated in the calculation worksheet "SOM mineral - Eq. 2.25 Formulation A" (each unit in the category relevant to its subdivision) for the entire[34] inventory time series regardless of its length;
  - ✓ SOM mineral soils - IPCC Default method: formulation B of IPCC Equation 2.25 is applied to units of land reported under Approaches 2 or 3 for Land Representation, accordingly those units of land are populated in the relevant calculation worksheet "SOM mineral - Eq. 2.25 Formulation B" (each unit in the category relevant to its subdivision and conversion status) for the length of the transition period only, or in case of Approach 3 for a shorter period if a new conversion occurs before the transition period is completed;
  - ✓ Biomass/DOM – Gain and Loss method: the units of land are mapped to the relevant calculation worksheets[35] for the entire inventory time series regardless of its length;
  - ✓ SOM/Biomass/DOM - Stock-Difference method: the units of land are mapped to the relevant calculation worksheets[36] for the entire inventory time series regardless of its length;
- The process (see Table 3) for each C pool causing C stock changes/CO_2-C fluxes:
  - ✓ SOM organic/SOM mixed soils: where the soil status is "Drained" or "Rewetted" the units of land are reported in the relevant calculation worksheet "SOM Organic Drained" or "SOM Organic Rewetted" for the entire[37] inventory time series regardless of its length, unless a conversion to the new activity occur[38] (in such a case the unit of land is transferred to the calculation worksheet corresponding to the new activity);
  - ✓ SOM mineral/organic/mixed soils, status is *Extracted* the units of land are reported in the relevant calculation worksheet *SOM (SD - Approach 1)* -for the entire period for which an area is associated to the unit of land, although users SHALL calculate C stock losses in the year of the first occurrence only- and *SOM (SD - Approaches 2&3)*, although the *Software* keep mapping the unit of land in the relevant calculation worksheet in the year of

[33] From the first appearance of the unit of land in the inventory
[34] From the first appearance of the unit of land in the inventory
[35] For each C pool a pair of calculation worksheets is provided to report with stock-difference, one worksheet applies to units of land reported with Approach 1 for Land Representation and the other one to units of land reported with Approaches 2 or 3
[36] For each C pool a pair of calculation worksheets is provided to report with stock-difference, one worksheet applies to units of land reported with Approach 1 for Land Representation and the other one to units of land reported with Approaches 2 or 3
[37] From the onset of the activity onward
[38] e.g. a drained land subsequently rewetted

conversion only (given that thereafter the SOC of extracted soils is 0 and so no emissions/removals will thereafter occur from SOM).

- The combination of process (see Table 3) and method selected. Where the method selected is the IPCC Default and the C pool is
  - ✓ Biomass; in case of conversion, any conversions, that causes an abrupt loss of biomass, the unit of land is mapped to the calculation worksheet "Biomass change (Abrupt)" in the year of conversion only.
  - ✓ DOM; limited to land of *Peatland under extraction*, the unit of land is mapped to the calculation worksheet "DOM (G&L – Abrupt)" in the year of site-clearing only -i.e. the year of the inventory time series in which the unit of land is first reported-.

Table 9 IPCC Default methods to estimate C stock changes/CO2-C fluxes in C pools

C Pool			IPCC default methodology
Biomass	**Above-Ground**		Equation 2.4 - Gain and Loss
	Below-Ground		
Dead Organic Matter	**Dead Wood**		Equation 2.4 - Gain and Loss
	Litter		
Soil Organic Matter	**Mineral soils**	*No change in hydrology*	Equation 2.25
		Drained	
		Rewetted	
		Extracted	Equation 4.6
	Organic soils/ Mixed soils	*No change in hydrology*	NA
		Drained	Equation 2.26 / Equation 2.3
		Rewetted	Equations 3.4/3.5
		Extracted	Equation 4.6

Table 10 Processes causing CSCs in, and CO_2-C fluxes from/to, C pools

Process			C pools					
			Biomass		**Dead Organic Matter (DOM)**		**Soil Organic Matter (SOM)**	
			above ground	*below*[39] *ground*	*Dead Wood*	*Litter*	*Mineral soils*	*Organic*[40] *soils*
C inputs	**Biomass growth**[41] *gross growth minus the losses due to natural mortality*		X	X				
	DOM inputs[42]				X			
	SOM CO_2-C net influx[43]							X
	SOC net input/output						X	
C outputs	**Biomass losses**	**Harvest/Fuelwood collection**	X	X				
		Disturbances[44]	X	X				
	DOM outputs[45]				X			
	SOM CO_2-C net outflux[46]							X

X indicates that the *2006 IPCC Guidelines* and its *Wetlands Supplement* provides guidance to estimate C stock changes or CO_2-C fluxes from the relevant C pool impacted by the relevant process

Tables 11-19 below illustrate the mapping of AD (i.e. areas of land) sourced from the Land Representation Manager to the applicable calculation worksheets, depending on the C pool, its characteristics (e.g. soil status), the method applied to calculate C stock changes and CO_2-C fluxes and the land representation approach.

Each table is composed by 2 parts for each land use category present in the table:

[39] At Tier 1 inventory compilers may exclude belowground biomass gains/losses
[40] this includes mixed -i.e. mineral and organic- soils, like in Coastal Wetlands
[41] this is the gross growth minus the losses due to natural mortality. In other words the net increment
[42] caused by harvest and other disturbances in biomass pool
[43] Due to rewetting
[44] fires, pests, landslides, floodings, etc.
[45] due to decay, fuelwood collection, fires
[46] due to drainage

- **Part 1** "*units of land not converted to and with no management change*", with mapping for every unit of land that has not changed its category/subcategory/subdivision in the last D years, where D is the length, in years, of the transition period.

  Note: for Approach 1 Land Representation all units of land in the NGHGI are reported for the entire time series as *units of land not converted to and with no management change*.

- **Part 2** "*Units of land converted to, or with only a management change*", with mapping for every unit of land that has changed its category/subcategory/subdivision in the last D years, where D is the length, in years, of the transition period, although some of the C stock losses are estimated in the year of category/subcategory/subdivision change only;

  A **X** indicates that the unit of land with the relevant combination of C pool, Method[47], Approach and current and historical land category/subcategory/subdivision is mapped to the calculation worksheet in the table's column.

Tables 11 – 12 map units of land to the calculation worksheets for the Biomass C pools;

Table 13 maps units of land to the calculation worksheets for the DOM C pools;

Tables 14 - 15 map units of land to the calculation worksheets for the SOM mineral soil C pool

Tables 16 - 17 map units of land to the calculation worksheets for the SOM organic and mixed soils C pool

Tables 18 - 19 map units of land to the calculation worksheets for the SOM organic and mixed soils C pool

This means that the corresponding activity data -i.e. area- will only appear in the relevant calculation worksheet if all relevant criteria exist (e.g. soil type/soil status/C pool/Method/Approach). Activity data are all sourced from the **Land Representation Manager** , with the exception of the calculation worksheets to implement the Stock-Difference method with Approach 1 Land Representation (given that the area of the unit of land is not needed there to perform the calculation of the net C stock change).

[47] method applied to calculate C stock changes and CO_2-C fluxes

Table 11 Mapping units of land to calculation TABs for Biomass C pools in *Forest Land, Cropland, Grassland*

Land Representation Manager		Calculation TABs - BIOMASS C POOLS							
Method[48]	Approach[49]	Biomass Gains (G&L 1/4)	Biomass Loss (G&L 2/4)	Biomass Loss (G&L 3/4)	Biomass Loss (G&L 4/4)	Biomass Change (G&L)	Biomass Change (Abrupt)[50]	Biomass SD - Approach 1	Biomass *SD - Approaches 2&3*
Units of land not converted to and with no management change [Forest land remaining Forest land]									
IPCC Default	1	X	X	X	X				
	2 or 3								
Stock-Difference	1							X	
	2 or 3								X
Units of land converted to [Land converted to Forest land], or with only a management change [Forest land remaining Forest land]									
IPCC Default	2 or 3	X	X	X	X		X		
Stock-Difference	2 or 3								X
Units of land not converted to and with no management change [Cropland remaining Cropland]									
IPCC Default	1					X[51]			
	2 or 3								
Stock-Difference	1							X	
	2 or 3								X
Units of land converted to [Land converted to Cropland], or with only a management change [Cropland remaining Cropland]									
IPCC Default	2 or 3					X[52]	X		
Stock-Difference	2 or 3								X
Units of land not converted to and with no management change [Grassland remaining Grassland]									
IPCC Default	1					X			
	2 or 3								
Stock-Difference	1							X	
	2 or 3								X
Units of land converted to [Land converted to Grassland], or with only a management change [Grassland remaining Grassland]									
IPCC Default	2 or 3					X	X		
Stock-Difference	2 or 3								X

[48] Methodological approach applied to estimate annual net C stock change in SOM C pool
[49] Approach applied to Land Representation
[50] In the year of conversion only
[51] Limited to Perennial crops
[52] Including annual crops, although in the year of conversion only

Table 12 Mapping units of land to calculation TABs for Biomass C pools in *Wetlands*, *Settlements*, *Other land*

Land Representation Manager		Calculation TABs - BIOMASS C POOLS			
Method[53]	Approach[54]	Biomass Change (G&L)	Biomass Change (Abrupt)[55]	Biomass (SD - Approach 1)	Biomass (SD – Approaches 2&3)
Units of land not converted to and with no management change [Wetlands remaining Wetlands][56]					
IPCC Default	1	X			
	2 or 3				
Stock-Difference	1			X	
	2 or 3				X
Units of land converted to [Land converted to Wetlands], or with only a management change [Wetlands remaining Wetlands]					
IPCC Default	2 or 3	X[57]	X		
Stock-Difference	2 or 3				X
Units of land not converted to and with no management change [Settlements remaining Settlements]					
IPCC Default	1	X[58]			
	2 or 3				
Stock-Difference	1			X	
	2 or 3				X
Units of land converted to [Land converted to Settlements], or with only a management change [Settlements remaining Settlements]					
IPCC Default	2 or 3	X	X		
Stock-Difference	2 or 3				X
Other land remaining Other land					
IPCC Default	1				
	2 or 3				
Stock-Difference	1				
	2 or 3				
Units of land converted to Other Land					
IPCC Default	2 or 3		X		
Stock-Difference	2 or 3		X[59]		

[53] Methodological approach applied to estimate annual net C stock change in SOM C pool
[54] Approach applied to Land Representation
[55] In the year of conversion only
[56] Limited to Other Wetlands
[57] Limited to Other Wetlands
[58] Treed Settlements only
[59] Even if the Stock-Difference is selected, the units of land will be mapped in the "Biomass Change (Abrupt)" calculation worksheet; and the Stock after conversion is to be set to zero (0).

Table 13 Mapping units of land to calculation TABs for DOM C pools in all land categories

Land Representation Manager		Calculation TABs - DOM C POOLS		
Method[60]	Approach[61]	DOM (G&L)[62]	DOM (SD - A 1)[63]	DOM (SD - A 2)[64]
Units of land not converted to and with no management change [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands[65]; Settlements remaining Settlements]				
IPCC Default	1	X		
	2 or 3			
Stock-Difference	1		X	
	2 or 3			X
Units of land converted to [Land converted to Forest land; Land converted to Cropland; Land converted to Grassland; Land converted to Wetlands; Land converted to Settlements] **Units of land with only a management change** [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands; Settlements remaining Settlements				
IPCC Default	2 or 3	X		
Stock-Difference	2 or 3			X
Other land remaining Other land				
IPCC Default	1			
	2 or 3			
Stock-Difference	1			
	2 or 3			
Units of land converted to Other Land				
IPCC Default	2 or 3			X[66]
Stock-Difference	2 or 3			X

Note: In the Managed Wetlands subcategory, the land use type *Petland under extraction*, both as Land remaining or Land converted, contains 2 additional calculation worksheets to estimate C stock changes associated with the extraction of peat -i.e. *Extraction: on-site CO_2-C emissions*- and its use in horticulture -i.e. *Extraction: off-site CO_2-C emissions*-. Any unit of land in Managed Wetlands subcategory that is part of the subdivision type "Peatland extraction" is mapped to both calculation worksheets in each inventory year from the onset of the activity to its end (if any).

[60] Methodological approach applied to estimate annual net C stock change in SOM C pool
[61] Approach applied to Land Representation
[62] In *Peatland under extraction*, the TAB name is *DOM (G&L – Abrupt)*. Unit of land is mapped to this TAB in the year of site-clearing only -i.e. the year of the inventory time series in which the unit of land is first reported-.
[63] DOM (SD - Approach 1)
[64] DOM (SD - Approaches 2&3)
[65] Limited to "Other Wetlands"
[66] Even if the IPCC method is selected, the units of land will be mapped in the "DOM (SD - Approaches 2&3)" calculation worksheet; and the Stock at time t_2 is to be set to zero (0).

Table 14 Mapping units of land to calculation TABs for SOM mineral soils[67] C pool in *Forest land, Cropland, Grassland, Wetlands, Settlements*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[68]	Approach[69]						
Composition	Status			Eq. 2.25 - A[70]	Eq. 2.25 - B[71]	SD - A 1[72]	SD - A 2&3[73]	Drained[74]	Rewetted[75]
Units of land not converted to and with no management change [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands[76]; Settlements remaining Settlements]									
Mineral Soil	No change in hydrology	IPCC Default	1	X					
			2 or 3						
	Drained[77]	IPCC Default	1	X					
			2 or 3						
	Rewetted[77]	IPCC Default	1	X					
			2 or 3						
	No change in hydrology	Stock-Difference	1			X			
			2 or 3				X		
	Drained[77]	Stock-Difference	1			X			
			2 or 3				X		
	Rewetted[77]	Stock-Difference	1			X			
			2 or 3				X		
	Extracted	NA[78]	1			[79]			
			2 or 3				X		
Units of land converted to [Land converted to Forest land; Land converted to Cropland; Land converted to Grassland; Land converted to Wetlands; Land converted to Settlements] **Units of land with only a management change** [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands[76]; Settlements remaining Settlements]									
Mineral Soil	No change in hydrology	IPCC Default	2 or 3		X				
	Drained[77]	IPCC Default	2 or 3		X				
	Rewetted[77]	IPCC Default	2 or 3		X				
	No change in hydrology	Stock-Difference	2 or 3				X		
	Drained[77]	Stock-Difference	2 or 3				X		
	Rewetted[77]	Stock-Difference	2 or 3				X		
	Extracted	NA[78]	2 or 3				X		

[67] Excluding *Coastal Wetlands* soils
[68] Methodological approach applied to estimate annual net C stock change in SOM C pool
[69] Approach applied to Land Representation
[70] SOM mineral - Eq. 2.25 Formulation A
[71] SOM mineral - Eq. 2.25 Formulation B
[72] SOM (SD - Approach 1)
[73] SOM (SD - Approaches 2&3)
[74] SOM Organic Drained
[75] SOM Organic Rewetted
[76] Limited to "Other Wetlands"
[77] Wetland mineral soils only
[78] Units of land with soil status *Extracted* are mapped to the relevant "SOM (SD - Approach 1)" or "SOM (SD - Approaches 2&3)" TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[79] Soil Status *Extracted* SHALL NOT be applied to Approach 1 Land representation.

Table 15 Mapping units of land to calculation TABs for SOM mineral soils[80] C pool in *Other land*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[81]	Approach[82]						
Composition	Status			Eq. 2.25 - A[83]	Eq. 2.25 - B[84]	SD - A 1[85]	SD - A 2&3[86]	Drained[87]	Rewetted[88]
Other land remaining Other land									
Mineral Soil	NA	IPCC Default	1	No C stock changes are estimated in *Other land remaining Other land* given C pools do not contain significant C stocks					
			2 or 3						
		Stock-Difference	1						
			2 or 3						
	Extracted	NA[89]	1						
			2 or 3						
Units of land converted to Other Land[90]									
Mineral Soil	NA	IPCC Default	2 or 3		X				
		Stock-Difference	2 or 3				X		
	Extracted	NA[89]	2 or 3				X		

[80] Excluding *Coastal Wetlands* soils
[81] Methodological approach applied to estimate annual net C stock change in SOM C pool
[82] Approach applied to Land Representation
[83] SOM mineral - Eq. 2.25 Formulation A
[84] SOM mineral - Eq. 2.25 Formulation B
[85] SOM (SD - Approach 1)
[86] SOM (SD - Approaches 2&3)
[87] SOM Organic Drained
[88] SOM Organic Rewetted

[89] Units of land with soil status *Extracted* are mapped to the relevant "SOM (SD - Approach 1)" or "SOM (SD - Approaches 2&3)" TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[90] Although "Other land" soils do not have a status, units of land in mineral soils are either mapped to "SOM mineral - Eq. 2.25 Formulation B" calculation worksheet, in case the IPCC default method is selected, or to "SOM (SD - Approaches 2&3)"calculation worksheet, in case the Stock-Difference method is selected.

Table 16 Mapping units of land to calculation TABs for SOM organic soils[91] C pool in *Forest Land*, *Cropland*, *Grassland*, *Wetlands*, *Settlements*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[92]	Approach[93]						
Composition	Status			Eq. 2.25 - A[94]	Eq. 2.25 - B[95]	SD - A 1[96]	SD - A 2&3[97]	Drained[98,99]	Rewetted[100]
Units of land not converted to and with no management change [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands; Settlements remaining Settlements]									
Organic Soil	No change in hydrology	IPCC Default	1						
			2 or 3						
	Drained	IPCC Default	1					X	
			2 or 3						
	Rewetted	IPCC Default	1						X
			2 or 3						
	No change in hydrology	Stock-Difference	1			X			
			2 or 3				X		
	Drained	Stock-Difference	1			X			
			2 or 3				X		
	Rewetted	Stock-Difference	1			X			
			2 or 3				X		
	Extracted	NA[101]	1			[102]			
			2 or 3				X		
Units of land converted to [Land converted to Forest land; Land converted to Cropland; Land converted to Grassland; Land converted to Wetlands; Land converted to Settlements] **Units of land with only a management change** [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands; Settlements remaining Settlements]									
Organic Soil	No change in hydrology	IPCC Default	2 or 3						
	Drained	IPCC Default	2 or 3					X	
	Rewetted	IPCC Default	2 or 3						X
	No change in hydrology	Stock-Difference	2 or 3				X		
	Drained	Stock-Difference	2 or 3				X		
	Rewetted	Stock-Difference	2 or 3				X		
	Extracted	NA[101]	2 or 3				X		

[91] Excluding *Coastal Wetlands* soils
[92] Methodological approach applied to estimate annual net C stock change in SOM C pool
[93] Approach applied to Land Representation
[94] SOM mineral - Eq. 2.25 Formulation A
[95] SOM mineral - Eq. 2.25 Formulation B
[96] SOM (SD - Approach 1)
[97] SOM (SD - Approaches 2&3)
[98] SOM Organic Drained
[99] For Wetlands, this is limited to peat extraction sites, either active or abandoned for which the drainage system is still active.
[100] SOM Organic Rewetted
[101] Units of land with soil status *Extracted* are mapped to the relevant *SOM (SD - Approach 1)* or *SOM (SD - Approaches 2&3)* TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[102] Soil Status *Extracted* SHALL NOT be applied to Approach 1 Land representation.

Table 1 Mapping units of land to calculation TABs for SOM organic soils[103] C pool in *Other land*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[104]	Approach[105]						
Composition	Status			Eq. 2.25 - A[106]	Eq. 2.25 - B[107]	SD - A 1[108]	SD - A 2&3[109]	Drained[110]	Rewetted[111]
Other land remaining Other land									
Organic Soil	Drained	IPCC Default	1	**No C stock changes are estimated in *Other land remaining Other land* given C pools do not contain significant C stocks**					
			2 or 3						
		Stock-Difference	1						
			2 or 3						
	Extracted	NA[112]	1						
			2 or 3						
Units of land converted to Other Land[113]									
Organic Soil	Drained	IPCC Default	2 or 3					**X**	
		Stock-Difference	2 or 3				**X**		
	Extracted	NA[112]	2 or 3				**X**		

[103] Excluding *Coastal Wetlands* soils
[104] Methodological approach applied to estimate annual net C stock change in SOM C pool
[105] Approach applied to Land Representation
[106] SOM mineral - Eq. 2.25 Formulation A
[107] SOM mineral - Eq. 2.25 Formulation B
[108] SOM (SD - Approach 1)
[109] SOM (SD - Approaches 2&3)
[110] SOM Organic Drained
[111] SOM Organic Rewetted

[112] Units of land with soil status *Extracted* are mapped to the relevant *SOM (SD - Approach 1)* or *SOM (SD - Approaches 2&3)* TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[113] Although "Other land" soils do not have a status, units of land in organic or mixed soils are either mapped to "SOM organic Drained" calculation worksheet, in case the IPCC default method is selected, or to "SOM (SD - Approaches 2&3)" calculation worksheet, in case the Stock-Difference method is selected

Table 18 Mapping units of land to calculation TABs for SOM C pool of *Coastal Wetlands* soils[114] in *Forest Land, Cropland, Grassland, Wetlands, Settlements*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[115]	Approach[116]						
Type	Status			Eq. 2.25 - A[117]	Eq. 2.25 - B[118]	SD - A 1[119]	SD - A 2&3[120]	Drained[121,122]	Rewetted[123]
Units of land not converted to and with no management change [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands; Settlements remaining Settlements]									
Coastal Wetlands Soil	No change in hydrology	IPCC Default	1						
			2 or 3						
	Drained	IPCC Default	1					X	
			2 or 3						
	Rewetted	IPCC Default	1						X
			2 or 3						
	No change in hydrology	Stock-Difference	1			X			
			2 or 3				X		
	Drained	Stock-Difference	1			X			
			2 or 3				X		
	Rewetted	Stock-Difference	1			X			
			2 or 3				X		
	Extracted	NA[124]	1			[125]			
			2 or 3				X		
Units of land converted to [Land converted to Forest land; Land converted to Cropland; Land converted to Grassland; Land converted to Wetlands; Land converted to Settlements] Units of land with only a management change [Forest land remaining Forest land; Cropland remaining Cropland; Grassland remaining Grassland; Wetlands remaining Wetlands; Settlements remaining Settlements]									
Coastal Wetlands Soil	No change in hydrology	IPCC Default	2 or 3						
	Drained	IPCC Default	2 or 3					X	
	Rewetted	IPCC Default	2 or 3						X
	No change in hydrology	Stock-Difference	2 or 3				X		
	Drained	Stock-Difference	2 or 3				X		
	Rewetted	Stock-Difference	2 or 3				X		
	Extracted	NA[124]	2 or 3				X		

[114] This applies to *Coastal Wetlands* soils of any soil composition i.e. mineral, organic, mixed.
[115] Methodological approach applied to estimate annual net C stock change in SOM C pool
[116] Approach applied to Land Representation
[117] SOM mineral - Eq. 2.25 Formulation A
[118] SOM mineral - Eq. 2.25 Formulation B
[119] SOM (SD - Approach 1)
[120] SOM (SD - Approaches 2&3)
[121] SOM Organic Drained
[122] For Wetlands, this is limited to peat extraction sites, either active or abandoned for which the drainage system is still active.
[123] SOM Organic Rewetted
[124] Units of land with soil status *Extracted* are mapped to the relevant *SOM (SD - Approach 1)* or *SOM (SD - Approaches 2&3)* TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[125] Soil Status *Extracted* SHALL NOT be applied to Approach 1 Land representation.

Table 2 Mapping units of land to calculation TABs for SOM C pool of *Coastal Wetlands* soils[126] in *Other land*

Land Use Manager		Land Representation Manager		Calculation TABs - SOM C POOL					
Soil		Method[127]	Approach[128]						
Type	Status			Eq. 2.25 - A[129]	Eq. 2.25 - B[130]	SD - A 1[131]	SD - A 2&3[132]	Drained[133]	Rewetted[134]
Other land remaining Other land									
Coastal Wetlands Soil	Drained	IPCC Default	1	No C stock changes are estimated in *Other land remaining Other land* given C pools do not contain significant C stocks					
			2 or 3						
		Stock-Difference	1						
			2 or 3						
	Extracted	NA[135]	1						
			2 or 3						
Units of land converted to Other Land[136]									
Coastal Wetlands Soil	Drained	IPCC Default	2 or 3					X	
		Stock-Difference	2 or 3				X		
	Extracted	NA[135]	2 or 3				X		

[126] This applies to *Coastal Wetlands* soils of any soil composition i.e. mineral, organic, mixed.
[127] Methodological approach applied to estimate annual net C stock change in SOM C pool
[128] Approach applied to Land Representation
[129] SOM mineral - Eq. 2.25 Formulation A
[130] SOM mineral - Eq. 2.25 Formulation B
[131] SOM (SD - Approach 1)
[132] SOM (SD - Approaches 2&3)
[133] SOM Organic Drained
[134] SOM Organic Rewetted

[135] Units of land with soil status *Extracted* are mapped to the relevant *SOM (SD - Approach 1)* or *SOM (SD - Approaches 2&3)* TABs regardless of the methodological approach selected in the **Land Representation Table**. **NOTE** that for each unit of land with soil status *Extracted*, users **SHALL** calculate C stock losses in the year of the first occurrence only, although in the relevant calculation worksheet *land remaining under same land use* for the entire period for which an area is associated to the unit of land.
[136] Although "Other land" soils do not have a status, units of land in organic or mixed soils are either mapped to "SOM organic Drained" calculation worksheet, in case the IPCC default method is selected, or to "SOM (SD - Approaches 2&3)" calculation worksheet, in case the Stock-Difference method is selected

Calculation Worksheets for other emissions from land

The calculation worksheet to which the *Software* maps units of land, as well as the time period over which a unit of land is mapped to a specific calculation worksheet, depends on:

- land use category; given 3.C. categories can be land-use-specific;
- activity whose emissions are to be estimated; given 3.C. categories are activity-specific.

The time period over which a unit of land is mapped to a specific calculation worksheet, depends on the activity; given that some activities emits in the year those occur only, while others are assumed to emit from their onset across the entire inventory time series regardless of its length, unless a conversion occur[137] (in such a case the unit of land is transferred to the category corresponding to the new activity).

Tables 11 and 12 map units of land to the calculation worksheets. The corresponding activity data -e.g. area- will only appear in the relevant calculation worksheet if all relevant criteria exist (e.g. soil type/soil status/activity/). Activity data are sourced from the **Land Representation Manager** unless otherwise specified.

[137] This only occurs in case of Approach 3 Land representation

Table 20 Mapping units of land to the calculation TABs for other emissions [categories 3.C.1 – 3.C.5]

IPCC Category		GHG	Calculation Worksheet	Time period	Units of land mapped from
3.C.1[138]	a. Forest land	CO_2[139] CH_4 N_2O	Emissions from burning (1/2)	Inventory Year only	Forest land Remaining Forest land
			Emissions from burning (2/2)		Land converted to Forest land
	b. Cropland		Emissions from burning (1/2)		Cropland Remaining Cropland
			Emissions from burning (2/2)		Land converted to Cropland
	c. Grassland		Emissions from burning (1/2)		Grassland Remaining Grassland
			Emissions from burning (2/2)		Land converted to Grassland
	d. All other land uses		Emissions from burning (1/2)		All other land uses Remaining
			Emissions from burning (2/2)		Land converted to All other land uses
3.C.2	Liming	CO_2	CO_2 emissions from liming	Inventory Year only	The *Software* does not map units of land to this category; although users can select the land use category in which the activity occurs
3.C.3	Urea application		CO_2 emissions from urea	Inventory Year only	The *Software* does not map units of land to this category; although users can select the land use category in which the activity occurs
3.C.4	Direct N_2O emissions from soils	N_2O	Synthetic N applied to managed soils	Inventory Year only	The *Software* does not map units of land to this category; although users can select the land use category in which the activity occurs
			Organic N applied to managed soils		
			N in crop residues		
			Urine and Dung input in grazed soils		
			N in SOM mineralized	Inventory Year only[140]	The *Software* maps units of land for which a negative SOC change has been estimated in the inventory year in the relevant 3.B worksheets
			Drainage of organic soils	Entire inventory time series from activity's onset	The *Software* maps here units of land with organic soil composition and *Coastal Wetlands* type and soil status *Drained*
			Rewetting of organic soils		The *Software* maps here units of land with organic soil composition and *Coastal Wetlands* type and soil status *Rewetted*
3.C.5	Indirect N_2O emissions from soils		Emissions from N volatilized	Inventory Year only	The *Software* maps activity data from 3.C.4, although the user can select the land category and subdivision to which to apply it
			Emissions from N leached/runoff		

[138] Units of land where burning occurred in the inventory year are however selected by users from a drop-down menu containing all units of land of the relevant land use category
[139] CO_2 emissions can be estimated here and then reported within 3.B estimates for the relevant C pool, or directly estimated in the relevant worksheets of 3.B categories
[140] Although the actual period depends on the methods applied to estimate SOC changes in mineral soils and the land representation approach i.e. a single year for Approach 1 and for the Stock-Difference, the transition period for Equation 2.25

Table 3

IPCC Category		GHG	Calculation Worksheet	Time period	Units of land mapped from
3.C.7	Rice Cultivation	CH_4	CH_4 Emissions from Rice	Inventory Year only	The *Software* does not map units of land for this category; although users can select the land subdivision in which the activity occurs
3.C.8	Drainage of organic soils		CH_4 Emissions from drainage of organic soils	Entire inventory time series from activity's onset	The *Software* maps here units of land with organic soil composition[141] and soil status *Drained*
3.C.9	Ditches in drained organic soils		CH_4 Emissions from ditches in drained organic soils		The *Software* maps here units of land with organic soil composition[141] and soil status *Drained*
3.C.10	Rewetting of drained inland organic soils		CH_4 Emissions from rewetted inland organic soils		The *Software* maps here units of land with organic soil composition[141] and soil status *Rewetted*
3.C.11	Rewetting of drained Mangrove or Tidal marsh		CH_4 Emissions from rewetted Mangrove or Tidal marsh		The *Software* maps here units of land in *Other Wetlands* land subdivisions with vegetation either "*Mangrove*" or "*Tidal Marsh*"
3.C.13	Rewetting of drained inland mineral soils	CH_4	CH_4 Emissions from rewetted inland mineral soils	Entire inventory time series from activity's onset	The *Software* maps here units of land that have *Inland Wetland Mineral* soil and have soil status *Rewetted*
3.D.2	Other	CO_2 CH_4 N_2O		Inventory Year only	The *Software* does not map units of land for this category; although users can select the land subdivision in which the activity occurs

[141] Excluding *Coastal Wetlands* soils

Glossary

Category/Subcategory/Subdivision: in the *Software*, category refers to the 6 IPCC land use categories, subcategory refers to the pairs under which subdivisions aggregate in the **Land Use Manager**, subdivision refers to the land use types entered by users in the **Land Use Manager**.

- ✓ **Category**: The 6 IPCC land use categories are broadly defined in Chapter 3 (Volume 4, *2006 IPCC Guidelines*), and it is recognized that these categories are a mixture of land cover (e.g., Forest, Grassland, Wetlands) and land use (e.g., Cropland, Settlements) classes. Within a GHG Inventory, each land use category is composed of 2 reporting sets: *Land remaining in the land category* and *Land converted to the land category*.
- ✓ **Subcategory**: The Software disaggregates the 6 IPCC land use categories in pairs of subcategories -i.e. 12-, depending on the presence of human activity i.e. Forest land, Grassland, Wetlands and Other land, as Managed vs Unmanaged land, or for those categories that are manmade depending on the presence of woody biomass i.e. Cropland, annual vs perennial crops, and Settlements, treed vs other.
- ✓ **Subdivisions**: are those land use types entered by users in the **Land Use Manager** under any of the 12 subcategories. There is not a limit to the number of subdivisions users can enter.

Region: Any stratification of the national territory in subnational units, as defined by users (e.g., administrative regions, ecological zones, parks, land subject to specific project activities, as well as a mix of those). Users can enter any number of user-specific regions. If users wish to report for the entire country, only one region is to be defined.

Unit of land: is an area homogeneous for all relevant variables that qualify a land use subcategory. Under approach 1, homogeneity is limited to the current status of the land; under Approaches 2 and 3 it depends on historical records too. Units of land are entered in the **Land Representation Manager** and then transferred by the *Software* to the relevant calculation worksheets.