Use of the IPCC Inventory Software to Establish the National GHG inventory in the Agriculture, Forestry and Other Land Use (AFOLU) sector

Land Representation

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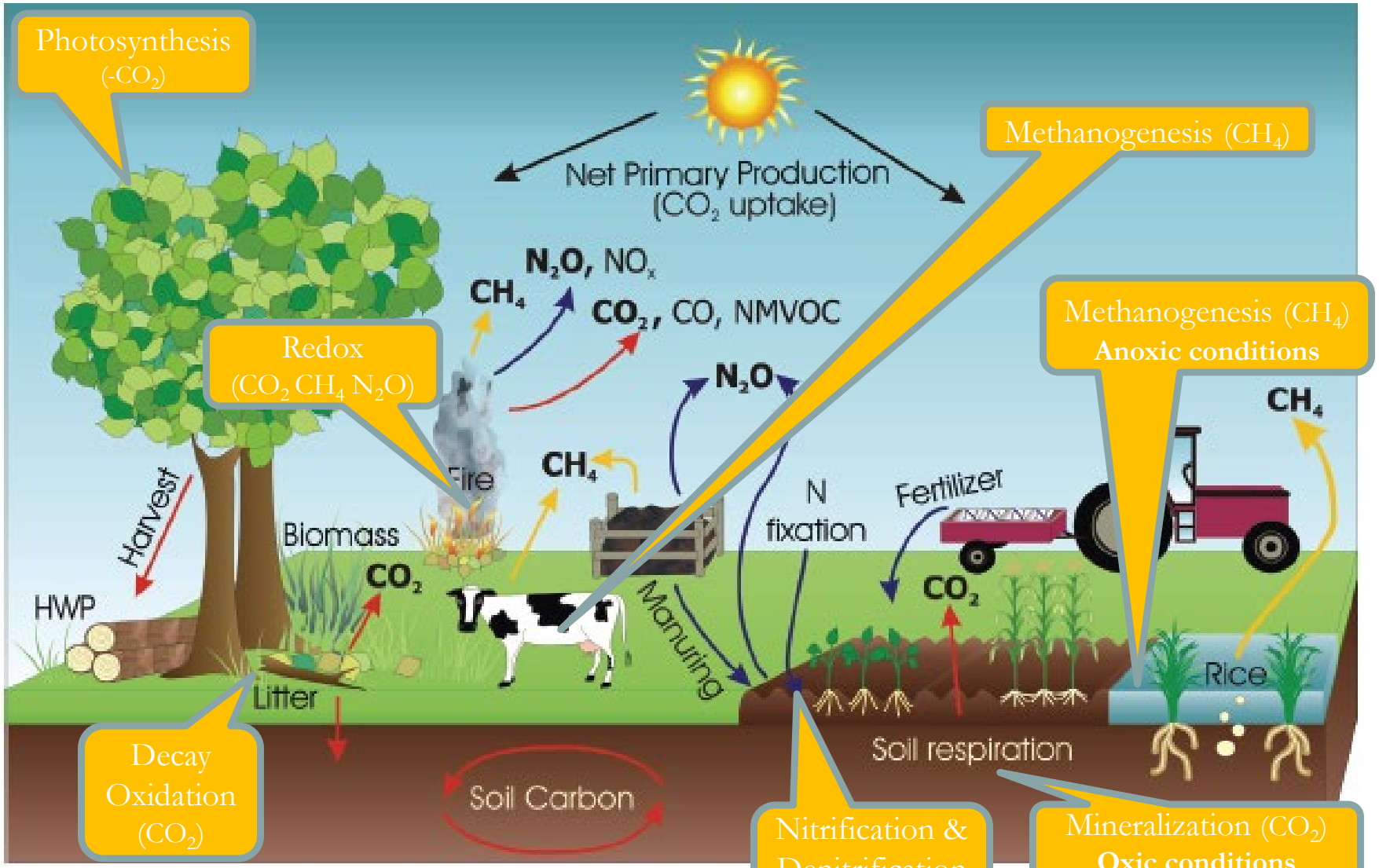
IPCC Guidelines

- **Volume 4 (AFOLU)**, Chapter 3
  - ✓ **2006 IPCC Guidelines**
  - ✓ **2019 Refinement**
- **Wetlands Supplement, Chapter 4**

Processes covered by IPCC Guidance on AFOLU



Organic Matter

- **Organic matter is heterogeneous very complex compound. Generally, as weight, is**
  - 45–55% Carbon
  - 35–45% Oxygen
  - 3–5% Hydrogen
  - 1–4% Nitrogen
- **Organic matter is the component of**
  - Biomass, living organic matter, which can have
    - Either an annual cycle [Growth → Harvest&Consumption or Decay to dead organic matter]
    - Or a multiyear cycle [Growth in plant perennial tissues (wood)] and thus stores Carbon across years
  - Dead organic matter, dead wood, litter, soil organic matter, harvested wood products which stores Carbon across years

Organic Matter

- **Organic matter redox/decay processes timescale**
  - *hours*
  - *within a year*
  - *years/centuries*
  - *centuries/millennia*

- **Organic matter redox/decay results in**
  - CO_2, CH_4, N_2O
  - NH_3/NH_4^+, NO_X
  - H_2O, N_2

Chemicals

- Nitrogen fertilizers => N_2O emissions
- Carbonaceous mineral amendments => CO_2 emissions
- Nitrogen/Carbonaceous fertilizers (Urea) => N_2O + CO_2 emissions

Notations

- **Nitrogen** content of **N_2O is** indicated as **N_2O-N**, and emissions of N_2O-N are **converted** to N_2O emissions multiplying **by 44/28** (proportion of the atomic weight of the two molecules)
- **Carbon** content of **CH_4 is** indicated as **CH_4-C**, and emissions of **CH_4-C** are **converted** to **CH_4** emissions multiplying **by 16/12** (proportion of the atomic weight of the two molecules)
- **Carbon** content of **CO_2 is** indicated as **CO_2-C**, and emissions of **CO_2-C** are **converted** to **CO_2** emissions multiplying **by 44/12** (proportion of the atomic weight of the two molecules)
- Emissions have a positive sign, while CO_2 removals have a negative sign. *This is because the "point of view" of an NGHGI is the atmosphere, so a positive sign means an addition of GHG to the atmosphere, while a negative sign means a subtraction of CO_2 from the atmosphere*
- Carbon stock gains have a positive sign, while Carbon stock losses have a negative sign. *This is because the "point of view" is the C pool to which the C stock pertains, so a positive sign means an addition of Carbon to the C pool, while a negative sign means a subtraction of C stock from the C pool*
- Thus, **converting** a net **C stock** change **to CO_2** net **emission/removal** requires to multiplying the net C stock **by -44/12**, *given that the sign is to be changed*

Stratification of Activity Data

- **Stratification of activity data promotes accuracy and precision since**:
  - ✓ Subdivisions are more homogenous than the whole population, *and thus associated EF are more accurate and precise*
  - ✓ Propagation of random error, as it occurs summing up subdivisions' estimates, tends to cancel those out *-Systematic Errors instead DO NOT cancel out across propagation-*

Systematic Errors instead DO NOT cancel out across propagation, thus, GOOD PRACTICE is to always REMOVING any identified SYSTEMATIC ERROR *-a biased estimate is NOT acceptable in an NGHGI-*; while minimizing RANDOM ERRORS *-these indeed cannot be zeroed!-*.

Random errors do bias neither the level of emissions/removals estimated nor the estimated change across time (mitigation); while Systematic errors do.

Land

Why Land?

- **Anthropogenic Emissions and Removals from AFOLU activities occur on managed land**
- **Managed land is land where human interventions and practices have been applied to perform production, ecological or social functions.**
- The key rationale for this approach is that **the preponderance of anthropogenic effects occurs on managed lands.**
  - ✓ By definition, **all direct human-induced effects** on GHG emissions and removals **occur on managed lands only.** While it is recognized that no area of the Earth's surface is entirely free of human influence *(e.g., CO_2 fertilization)*, **many indirect human influences on GHG** *(e.g., increased N deposition, accidental fire)* **will be manifested predominately on managed lands, where human activities are concentrated.**
- Finally, while local and short-term variability in emissions and removals due to natural causes can be substantial (e.g., emissions from fire), the **natural 'background' of GHG emissions and removals by sinks tends to average out over time and space.**
- **This leaves the GHG emissions and removals from managed lands as the dominant result of human activity.**

Land sources/sinks

- **Main sources** of GHG emissions **and the sinks** of CO_2 removals **over land are** the so-called **C pools**

- **C pools are reservoir -store- of carbon in the form of organic matter:**
  - ✓ either **alive** (aboveground and belowground **biomass**)
  - ✓ or **dead** (**dead wood** and **litter**)
  - ✓ or **further mixed with mineral components** (**soil organic matter**)

- **C pools have limited physical capacity** (carrying capacity) – i.e. maximum C stock level

- **C pools are subject to continuous processes that determine C stock gains and losses**

- **Human activities impact** both:
  - ✓ **C stock annual gains & losses**
  - ✓ **physical capacity of C pool**

The Land Representation - Why

- In a national GHG Inventory, **estimates of land-related GHG emissions and removals are based on the consistent representation of land across the inventory time series**

- Indeed, **Level** and **Dynamic** of C **Stocks** in C pools are **determined by the presence, type and intensity of human activities**, thus **depend on the kind of use of the land**

- Thus, **IPCC methods** are designed according to the use of Land
  - ✓ **presence in the land of significant C stocks in C pools**
  - ✓ **dynamic in the land of those C stocks in C pools.**

The Land Representation – IPCC Guidelines

CHAPTER 3

CONSISTENT REPRESENTATION OF LANDS

2019 Refinement to
the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Volume 4 *(https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol4.html)*

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The Land Representation - What

Land Representation deals with:

I. **Classification of land according to bio-physical** *-climate, soil, vegetation-* **and socio-economic** *-use, management (e.g. age-class)-* **variables** aimed at identifying units of land homogenous for C stocks levels and dynamics

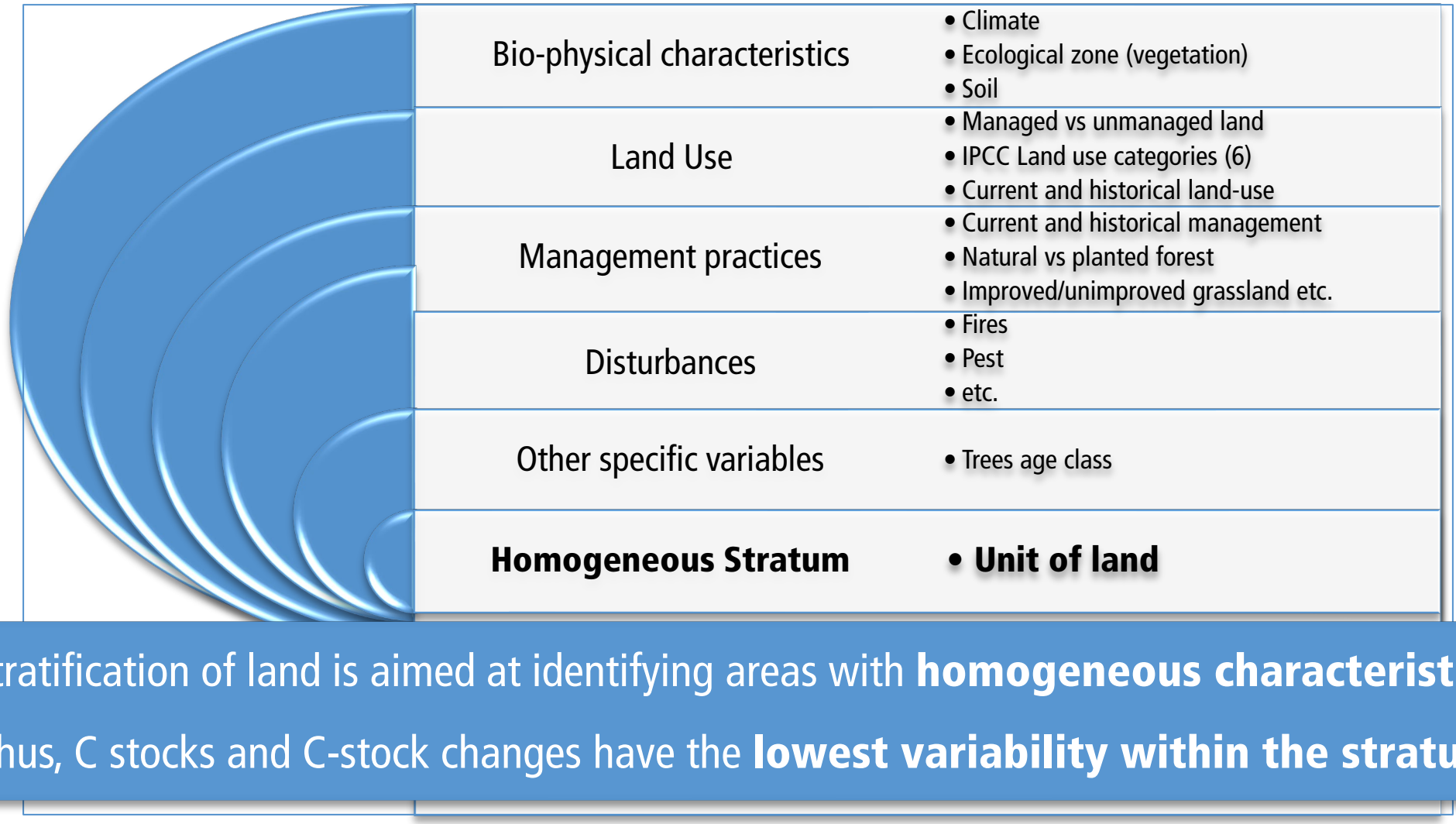
→ [Land use categories/subcategories/subdivisions]

II. **Identification and tracking** across the inventory time series of **units of land** *–i.e. land area homogeneous for variables of interest, including current and historical classification–*

→ [Area data of each unit of land to estimate C stock changes and associated GHG]

Land Representation is a **consistent and complete time series of annual data** of **total area of the NGHGI**, as disaggregated in units of land

Units of land – Variables of stratification



Stratification of land is aimed at identifying areas with **homogeneous characteristics**

Thus, C stocks and C-stock changes have the **lowest variability within the stratum**

Data requirements for a Land Representation

To be used for the GHG inventory, land data needs to be:

- ✓ **adequate,** i.e., capable of representing all land-use/management categories, and conversions between land-use categories *(excluding for Approach 1)*;
- ✓ **consistent**, i.e., capable of representing land-use categories consistently over time, without determining artificial -i.e. due to methodological inconsistencies- discontinuities in time-series data;
- ✓ **complete**, i.e., all land within a country be included, with area increases in some categories balanced by area decreases in other categories, recognizing the bio-physical stratification of land;
- ✓ **transparent**, i.e., data sources, definitions, methodologies, including assumptions, shall be clearly described.

The Land Representation - Classification

6 IPCC land use categories, designed to:

I. **Allow to assign a category to any type of land** *(using a category where any land that doesn't fit any of the other categories can be classified)*

II. **Avoid that a land type fits more than one category** *(hierarchy among categories)*

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**

The Land Representation - Land Use Categories

FOREST LAND, ***all land with woody vegetation consistent with thresholds used to define Forest*** *Land in the national greenhouse gas inventory. It* ***also includes systems*** *with a vegetation structure* ***that*** *currently fall below, but* ***in situ could potentially reach the threshold values*** *used by a country to define the Forest Land category*

CROPLAND, ***cropped land***, *including rice fields,* ***and agro-forestry*** *systems* ***where the vegetation structure falls below the thresholds used for the Forest*** *Land category*

GRASSLAND, ***rangelands and pasture-land that are not considered Cropland***. *It also includes systems with* ***woody vegetation*** *and other non-grass vegetation such as herbs and brushes* ***that fall below the threshold values used in the Forest Land category***. *…all grassland from wild lands to recreational areas as well as agricultural and silvi-pastural systems, consistent with national definitions*

SETTLEMENTS, ***all developed land***, *including transportation infrastructure and human settlements of any size,* ***unless they are already included under other categories***

WETLANDS, ***areas of peat extraction and land that is covered or saturated by water for all or part of the year*** *(e.g., peatlands) and* ***that does not fall into the Forest Land, Cropland,*** *Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions*

OTHER LAND, ***bare soil, rock, ice, and all land areas that do not fall into any of the other five categories.*** *It allows the total of identified land areas to match the national area*

Bio-physical characteristics	• Climate • Ecological zone (vegetation) • Soil
Land Use	• Managed vs unmanaged land • IPCC Land use categories (6) • Current and historical land-use
Management practices	• Current and historical management • Natural vs planted forest • Improved/unimproved grassland etc.
Disturbances	• Fires • Pest • etc.
Other specific variables	• Trees age class
Homogeneous Stratum	**• Unit of land**

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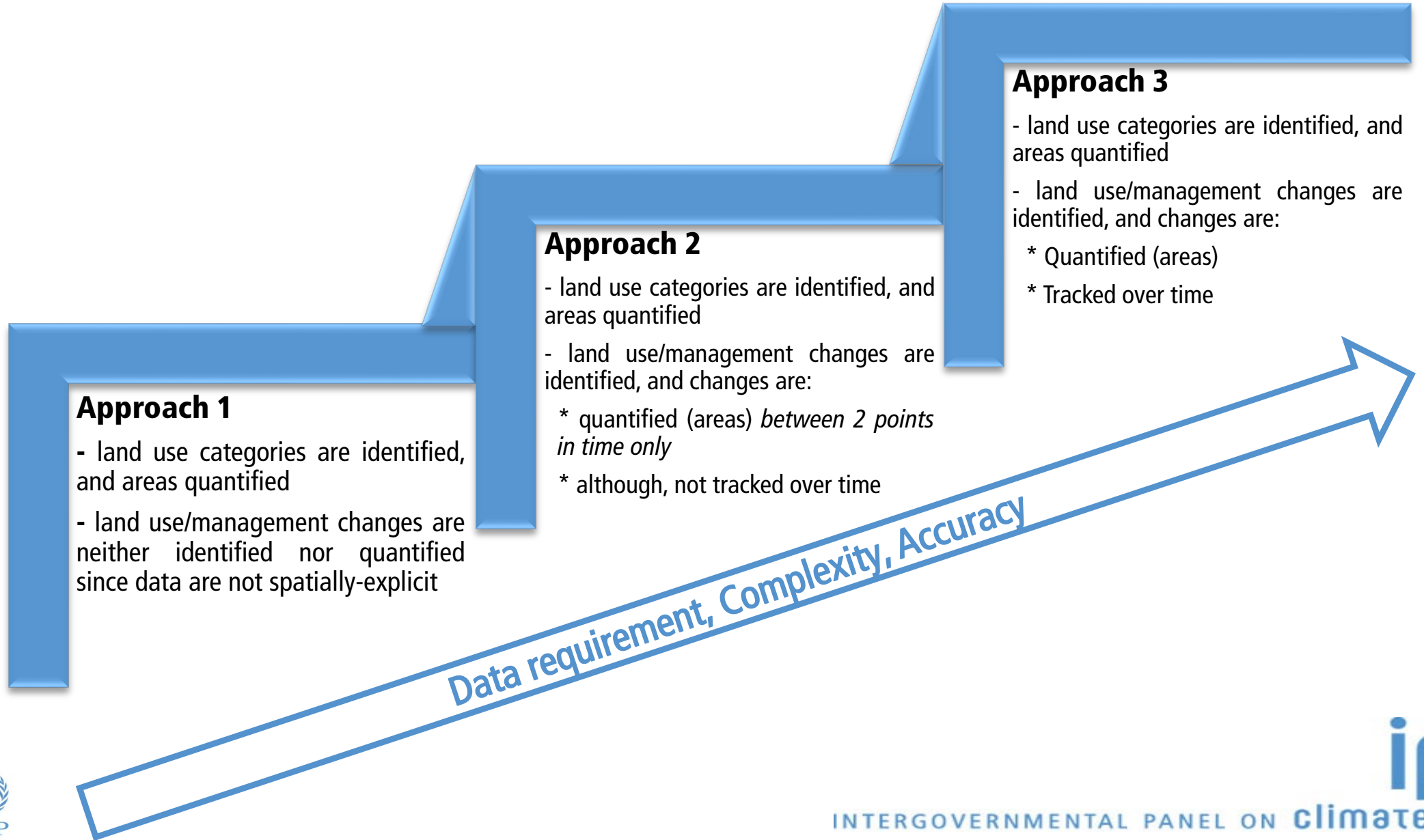
The Land Representation - IPCC Approaches

Methodological approaches to identify and track time series of units of land



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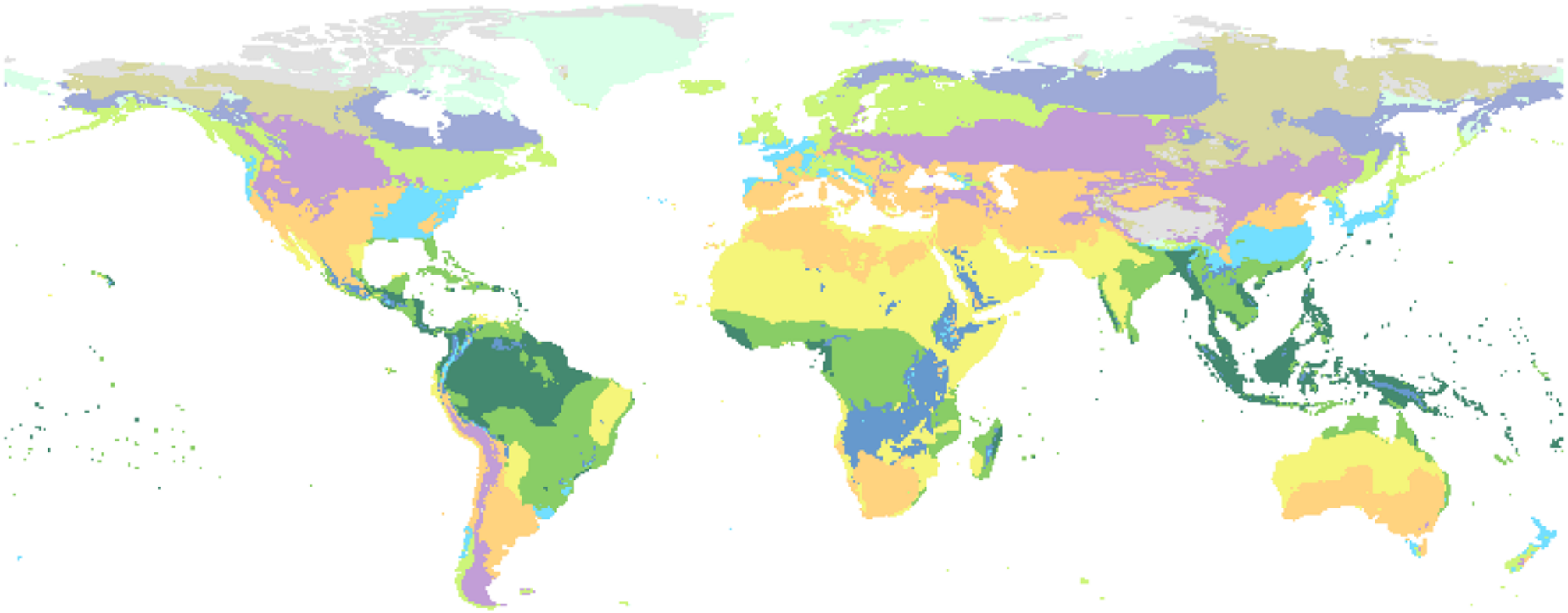
The Land Representation - Consistency

- **Consistency** of the Classification system and of the Methodology for identification and tracking of units of land across the inventory time series- **is key to ensure unbiasedness of estimates**

- **A consistent land representation is a time series of annual area estimates of units of land** *[as disaggregated according to variables of stratification]* where:
  - ✓ **The land classification methodology is consistent across the entire time series** - *no artifact land conversions caused by changes in the classification method/background-data-*
  - ✓ **The total area of the territory is reported, and it is constant across the entire time series**
  - ✓ **For Approaches 2 & 3:**
    - **In each year Y, all units of land under conversion are reported within the Land under conversion relevant categories 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 categories**

Land Representation
Bio-physical Characteristics (Climate)



Bio-physical characteristics	• Climate • Ecological zone (vegetation) • Soil
Land Use	• Managed vs unmanaged land • IPCC Land use categories (6) • Current and historical land-use
Management practices	• Current and historical management • Natural vs planted forest • Improved/unimproved grassland etc.
Disturbances	• Fires • Pest • etc.
Other specific variables	• Trees age class
Homogeneous Stratum	**• Unit of land**

IPCC Climate Zones

Tropical Montane	Tropical Dry	Cool Temperate Moist	Boreal Dry
Tropical Wet	Warm Temperate Moist	Cool Temperate Dry	Polar Moist
Tropical Moist	Warm Temperate Dry	Boreal Moist	Polar Dry

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Land Representation

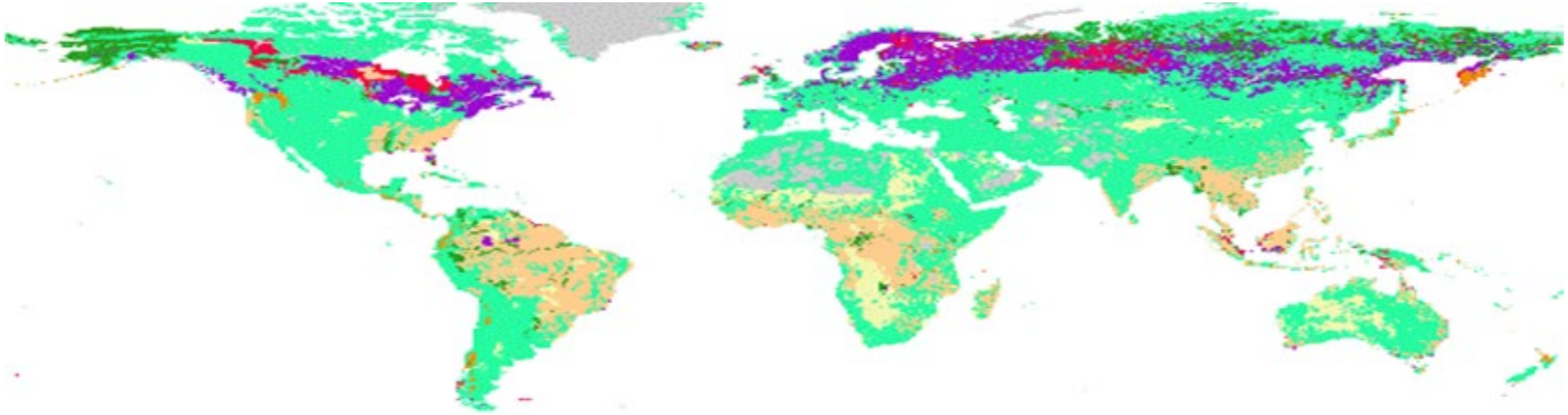
Bio-physical Characteristics (Vegetation)

FAO Global Ecological Zones (GEZ)

Tropical rainforest	Tropical moist deciduous forest	Tropical dry forest	Tropical mountain systems	Tropical shrubland	Tropical desert
	Subtropical humid forest	Subtropical dry forest	Subtropical mountain systems	Subtropical steppe	Subtropical desert
	Temperate oceanic forest	Temperate continental forest	Temperate mountain systems	Temperate steppe	Temperate desert
		Boreal coniferous forest	Boreal mountain systems	Boreal tundra woodland	Polar

Land Representation
Bio-physical Characteristics (Soil)

FAO - World Harmonized Soil Database



Organic
Sandy Soils
Wetland Soils
Volcanic Soils
Spodic Soils
High Activity Clay Soils
Low Activity Clay Soils
Other Areas

Bio-physical characteristics	• Climate • Ecological zone (vegetation) • Soil
Land Use	• Managed vs unmanaged land • IPCC Land use categories (6) • Current and historical land-use
Management practices	• Current and historical management • Natural vs planted forest • Improved/unimproved grassland etc.
Disturbances	• Fires • Pest • etc.
Other specific variables	• Trees age class
Homogeneous Stratum	**• Unit of land**

Case Study for Land Representation

3 Regions with, with 3 different approaches for Land representation

1. **Region 1 – Approach 1**
2. **Region 2 – Approach 2**
3. **Region 3 – Approach 3**
    1. **Region 1**, *3 land categories*:
        - ✓ *Managed Forest Plantation*;
        - ✓ *Grazed Managed Grassland*;
        - ✓ *Settlements (Other) Buildings*
    2. **Region 2**, *9 land categories*:
        - ✓ *Managed Forest Plantation*; *Unmanaged Primary forest*; *Unmanaged Mangroves Forest*
        - ✓ *Lotus Annual Cropland*; *Oil Palm Perennial Cropland*
        - ✓ *Managed Tidal Marshes Wetlands*; *Unmanaged Tidal Marshes Wetlands*
        - ✓ *Settlements (Other) Harbor*; *Settlements (treed) Park*
    3. **Region 3**, *3 land categories in rotation*:
        - ✓ *Maize Annual Cropland*
        - ✓ *Rice Annual Cropland*
        - ✓ *Poplar Perennial Cropland*

Case Study for Land Representation

Double click on the Table to access data

Region	Category	Subcategory	Subdivision	Soil type	Soil status	Nutrient	Climate region	Ecological zone	Species	Forest/Ecosystem/Crop/Vegetation/Wetlands type
1	Forest land	Managed	Secondary forest	Low Activity Clay mineral	none		Warm Temperate Moist	Subtropical humid forest	Other broadleaves	Natural
2	Forest land	Managed	Forest plantation	Inland Organic	Drained	Rich	Tropical Moist	Tropical moist deciduous forest	XYZ	Plantation
	Forest land	Unmanaged	Primary forest	Inland Organic	none	Rich	Tropical Moist	Tropical moist deciduous forest	Other broadleves	
	Forest land	Unmanaged	Mngroves forest	Coastal Wetlands	none		Tropical Moist	Tropical moist deciduous forest	Mangroves	
3	Cropland	Annual	Maize	Volcanic mineral	none		Warm Temperate Moist			
	Cropland	Annual	Rice	Volcanic mineral	none		Warm Temperate Moist			Rice
	Cropland	Perennial	Poplar (5-year)	Volcanic mineral	none		Warm Temperate Moist			User-defined/Poplar
	Cropland	Perennial	Poplar (10-year)	Volcanic mineral	none		Warm Temperate Moist			User-defined/Poplar
2	Cropland	Annual	Lotus (long-term)	Inland Wetland mineral	Rewetted		Tropical Moist			
	Cropland	Annual	Lotus (converted)	Inland Wetland mineral	Rewetted		Tropical Moist			
	Cropland	Perennial	Oil palm	Inland Wetland mineral	Drained		Tropical Moist			Oil palm
1	Grassland	Managed	Grazed	Low Activity Clay mineral	none		Warm Temperate Moist			Prairie
2	Wetlands	Managed	Tidal marshes	Coastal Wetlands	Rewetted		Tropical Moist			Other Wetlands/Coastal Wetlands/Tidal Marsh
	Wetlands	Unmanaged	Tidal marshes	Coastal Wetlands	none		Tropical Moist			Other Wetlands/Coastal Wetlands/Tidal Marsh
2	Settlements	Treed	Urban park	Coastal Wetlands	Drained		Tropical Moist			
	Settlements	Other	Harbor	Coastal Wetlands	Extracted		Tropical Moist			
1	Settlements	Other	Buildings	Low Activity Clay mineral	none		Warm Temperate Moist			

Activity Data for Land Representation - Approach 1

- **Approach 1** Land Representation is a list of categories/subcategories/subdivisions, with the corresponding area across a time series, as for instance:

Approach 1						1995	2000	2005	2010	2015	2020
ID	Category	Subcategory	*Subdivision*	*Climate*	*Soil*	Area (ha)					
MFL_1	Forest land	Managed Forest land	*Secondary*	*WSM*	*LAC*	900	1,000	990	980	970	960
MGL_1	Grassland	Managed Grassland	*Grazed*			2,000	1,890	1,880	1,870	1,860	1,860
OSL_1	Settlements	Settlements (Other)	*Buildings*			100	110	130	150	170	180
Total						**3,000**	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**

The land representation can be directly entered in the *Software*

Activity Data for Land Representation - Approach 2

- **Approach 2** Land Representation is a time series of Land use conversion matrices, as for instance:

Land-use conversion matrices *(all data are in hectares - ha)*

1995\2000					Category	Forest land			Cropland		Wetlands		Settlements			Total Initial		
					Subcategory	Managed Forest Land	Unmanaged Forest land		Annual Crops	Perennial Crops	Managed Wetlands	Unmanaged Wetlands	Settlements (Other)	Settlements (Treed)				
					Subdivision													
Category	Subcategory	Subdivision	Climate	Soil		Forest plantations	Primary	Mangroves	Lotus	Oil Palm	Tidal Marshes		Harbor	Urban Park		Subdivision	Subcategory	Category
Forest land	Managed Forest land	Forest plantations	TM	Organic inland		1,000										1,000	1,000	111,090
	Unmanaged Forest land	Primary				1,000	99,000									100,000	110,090	
		Mangroves		CW				9,990						100		10,090		
Cropland	Annual Crops	Lotus		IWM					10							10	10	3,010
	Perennial Crops	Oil Palm								3,000						3,000	3,000	
Wetlands	Managed Wetlands	Tidal Marshes		CW							0					0	500	500
	Unmanaged Wetlands											500				500		
Settlements	Settlements (Other)	Harbor											300			300	300	400
	Settlements (Treed)	Urban Park												100		100	100	
Total Final						2,000	99,000	9,990	10	3,000	0	500	300	200	115,000	115,000		
						2,000	108,990		10	3,000	0	500	300	200				
						110,990			3,010		500		500					
																115,000	115,000	115,000

2000\2005					Category	Forest land			Cropland		Wetlands		Settlements			Total Initial		
					Subcategory	Managed Forest Land	Unmanaged Forest land		Annual Crops	Perennial Crops	Managed Wetlands	Unmanaged Wetlands	Settlements (Other)	Settlements (Treed)				
					Subdivision													
Category	Subcategory	Subdivision	Climate	Soil		Forest plantations	Primary	Mangroves	Lotus	Oil Palm	Tidal Marshes		Harbor	Urban Park		Subdivision	Subcategory	Category
Forest land	Managed Forest land	Forest plantations	TM	Organic inland		2,000										2,000	2,000	110,990
	Unmanaged Forest land	Primary				600	98,400									99,000	108,990	
		Mangroves		CW				9,990								9,990		
Cropland	Annual Crops	Lotus		IWM					10							10	10	3,010
	Perennial Crops	Oil Palm							5	2,995						3,000	3,000	
Wetlands	Managed Wetlands	Tidal Marshes		CW							0					0	500	500
	Unmanaged Wetlands											500				500		
Settlements	Settlements (Other)	Harbor											300			300	300	500
	Settlements (Treed)	Urban Park												200		200	200	
Total Final						2,600	98,400	9,990	15	2,995	0	500	300	200	115,000	115,000		
						2,600	108,390		15	2,995	0	500	300	200				
						110,990			3,010		500		500					
																115,000	115,000	115,000

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Activity Data for Land Representation - Approach 2

- To be entered in the *Software*, data contained in the time series of land use matrices need to be converted in units of land [area homogeneous for biophysical elements, current and previous *(where relevant)* use/management, and all other variables pertinent to the relevant IPCC methodology applied)

- To do so:

Activity Data for Land Representation - Approach 2

- **First**, units of land of "land remaining under same category/subcategory subdivision" are derived from the list of category/subcategory/subdivision and the area assigned for the first year of the time series is the initial area that each category/subcategory/subdivision has in the first matrix

1995\2000					Category									Total Initial		
					Forest land			Cropland		Wetlands		Settlements				
					Subcategory											
					Managed Forest Land	Unmanaged Forest land		Annual Crops	Perennial Crops	Managed Wetlands	Unmanaged Wetlands	Settlements (Other)	Settlements (Treed)			
					Subdivision											
Category	Subcategory	Subdivision	Climate	Soil	Forest plantations	Primary	Mangroves	Lotus	Oil Palm	Tidal Marshes		Harbor	Urban Park			
Forest land	Managed Forest land	Forest plantations	TM	Organic inland	1,000									1,000	1,000	111,090
	Unmanaged Forest land	Primary			1,000	99,000								100,000	110,090	
		Mangroves		CW			9,990						100	10,090		
Cropland	Annual Crops	Lotus		IWM				10						10	10	3,010
	Perennial Crops	Oil Palm							3,000					3,000	3,000	
Wetlands	Managed Wetlands	Tidal Marshes		CW						0				0	500	500
	Unmanaged Wetlands										500			500		
Settlements	Settlements (Other)	Harbor										300		300	300	400
	Settlements (Treed)	Urban Park											100	100	100	
Total Final					2,000	99,000	9,990	10	3,000	0	500	300	200	115,000	115,000	
					2,000	108,990		10	3,000	0	500	300	200			
					110,990			3,010		500		500				

ID	Previous			Current			Area (ha)
	Category	Subcategory	Subdivision	Category	Subcategory	Subdivision	1995
MFL-MFL_1	Forest land	Managed Forest land	*Forest plantations*	Forest land	Managed Forest land	*Forest plantations*	1,000
UFL-UFL_1		Unmanaged Forest land	*Primary*		Unmanaged Forest land	*Primary*	100,000
UFL-UFL_2			*Mangroves*			*Mangroves*	10,090
ACL-ACL_1	Cropland	Annual Cropland	*Lotus*	Cropland	Annual Cropland	*Lotus*	10
PCL-PCL_1		Perennial Cropland	*Oil Palm*		Perennial Cropland	*Oil Palm*	3,000
MWL-MWL_1	Wetlands	Managed Wetlands	*Tidal Marshes*	Wetlands	Managed Wetlands	*Tidal Marshes*	0
UWL-UWL_1		Unmanaged Wetlands			Unmanaged Wetlands		500
OSL-OSL_1	Settlements	Other Settlements	*Harbor*	Settlements	Other Settlements	*Harbor*	300
TSL-TSL_1		Treed Settlements	*Urban Park*		Treed Settlements	*Urban Park*	100

Activity Data for Land Representation - Approach 2

- **Second**, the area of units of land "land remaining under same category/subcategory subdivision" changes across the time series because of:
  - subtractions of area for each area conversion to a different category/subcategory/subdivision [red]
  - additions of area of the same category/subcategory/subdivision (*and homogeneous for all relevant parameters*) that concluded the transition time [i.e. after D years have passed]

1995\2000					Category: Forest land			Cropland		Wetlands		Settlements			Total Initial		
					Subcategory: Managed Forest Land	Unmanaged Forest land		Annual Crops	Perennial Crops	Managed Wetlands	Unmanaged Wetlands	Settlements (Other)	Settlements (Treed)				
					Subdivision:												
Category	Subcategory	Subdivision	Climate	Soil	Forest plantations	Primary	Mangroves	Lotus	Oil Palm	Tidal Marshes		Harbor	Urban Park		Subdivision	Subcategory	Category
Forest land	Managed Forest land	Forest plantations	TM	Organic inland	1,000										1,000	1,000	111,090
	Unmanaged Forest land	Primary			1,000	99,000									100,000	110,090	
		Mangroves		CW			9,990						100		10,090		
Cropland	Annual Crops	Lotus		IWM				10							10	10	3,010
	Perennial Crops	Oil Palm							3,000						3,000	3,000	
Wetlands	Managed Wetlands	Tidal Marshes		CW						0					0	500	500
	Unmanaged Wetlands										500				500		
Settlements	Settlements (Other)	Harbor										300			300	300	400
	Settlements (Treed)	Urban Park											100		100	100	
Total Final					2,000	99,000	9,990	10	3,000	0	500	300	200	115,000	115,000		
					2,000	108,990		10	3,000	0	500	300	200				
					110,990			3,010		500		500					

ID	Previous			Current			Area (ha)					
	Category	Subcategory	Subdivision	Category	Subcategory	Subdivision	1995	2000	2005	2010	2015	2020
MFL-MFL_1	Forest land	Managed Forest land	*Forest plantations*	Forest land	Managed Forest land	*Forest plantations*	1,000	1,000	1,000	1,000	1,000	2,000
UFL-UFL_1		Unmanaged Forest land	*Primary*		Unmanaged Forest land	*Primary*	100,000	99,000	98,500	98,200	98,050	97,975
UFL-UFL_2			*Mangroves*			*Mangroves*	10,090	9,990	9,890	9,840	9,815	9,805
ACL-ACL_1	Cropland	Annual Cropland	*Lotus*	Cropland	Annual Cropland	*Lotus*	10	10	10	10	10	10
PCL-PCL_1		Perennial Cropland	*Oil Palm*		Perennial Cropland	*Oil Palm*	3,000	3,000	2,995	2,980	2,975	2,970
MWL-MWL_1	Wetlands	Managed Wetlands	*Tidal Marshes*	Wetlands	Managed Wetlands	*Tidal Marshes*	0	0	0	0	0	0
UWL-UWL_1		Unmanaged Wetlands			Unmanaged Wetlands		500	500	500	400	350	300
OSL-OSL_1	Settlements	Other Settlements	*Harbor*	Settlements	Other Settlements	*Harbor*	300	300	300	300	300	300
TSL-TSL_1		Treed Settlements	*Urban Park*		Treed Settlements	*Urban Park*	100	100	100	100	100	100

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Activity Data for Land Representation - Approach 2

- **Third**, each land conversion occurring in each of the matrices is reported as an independent unit of land
- **Fourth**, the area of those units of land under conversion is kept constant for D years, and thereafter merged with the corresponding unit of land (homogeneous for all relevant variables) remaining under same use/management

1995\2000					Category	Forest land			Cropland		Wetlands		Settlements			Total Initial		
					Subcategory	Managed Forest Land	Unmanaged Forest land		Annual Crops	Perennial Crops	Managed Wetlands	Unmanaged Wetlands	Settlements (Other)	Settlements (Treed)				
Category	Subcategory	Subdivision	Climate	Soil	Subdivision	Forest plantations	Primary	Mangroves	Lotus	Oil Palm	Tidal Marshes		Harbor	Urban Park		Subdivision	Subcategory	Category
Forest land	Managed Forest land	Forest plantations	TM	Organic inland		1,000										1,000	1,000	111,090
	Unmanaged Forest land	Primary				1,000	99,000									100,000	110,090	
		Mangroves		CW				9,990						100		10,090		
Cropland	Annual Crops	Lotus		IWM					10							10	10	3,010
	Perennial Crops	Oil Palm								3,000						3,000	3,000	
Wetlands	Managed Wetlands	Tidal Marshes		CW							0					0	500	500
	Unmanaged Wetlands											500				500		
Settlements	Settlements (Other)	Harbor											300			300	300	400
	Settlements (Treed)	Urban Park												100		100	100	
Total Final						2,000	99,000	9,990	10	3,000	0	500	300	200	115,000	115,000		
						2,000	108,990		10	3,000	0	500	300	200				
						110,990			3,010		500		500					

ID	Previous			Current			Area (ha)					
	Category	Subcategory	Subdivision	Category	Subcategory	Subdivision	1995	2000	2005	2010	2015	2020
UFL-MFL_2000-1	Forest land	Unmanaged Forest land	Primary	Forest land	Managed Forest land	Forest plantations	-	1,000	1,000	1,000	1,000	merged
UFL-TSL_2000-1	Forest land		Mangroves	Settlements	Treed Settlements	Urban Park	-	100	100	100	100	merged

D = Transition time to the new use/management

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Activity Data for Land Representation - Approach 3

- **Approach 3** Land Representation is a list of units of land, each encompassing an area homogeneous for biophysical elements, for current and historical use/management, and for all other variables pertinent to the relevant IPCC methodology applied)

Approach 3									
ID	1995	2000	2005	2010	2015	2020	*Climate*	*Soil*	Area (ha)
CL-CL_10	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-R	CL-AC-M	CL-PC-P	*WSM*	*Volcanic*	50
CL-CL_11	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-R	CL-PC-P	CL-PC-P			50
CL-CL_20	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-M	CL-AC-R	CL-PC-P			50
CL-CL_21	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-M	CL-PC-P	CL-PC-P			50
CL-CL_30	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-R	CL-AC-M	CL-PC-P			50
CL-CL_31	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-R	CL-PC-P	CL-PC-P			50
CL-CL_40	CL-AC-R	CL-PC-P	CL-AC-M	CL-PC-P	CL-PC-P	CL-AC-R			50
CL-CL_41	CL-AC-R	CL-PC-P	CL-AC-M	CL-PC-P	CL-PC-P	CL-PC-P			50
CL-CL_50	CL-AC-R	CL-PC-P	CL-AC-R	CL-PC-P	CL-PC-P	CL-AC-M			50
CL-CL_51	CL-AC-R	CL-PC-P	CL-AC-R	CL-PC-P	CL-PC-P	CL-PC-P			50
CL-CL_60	CL-AC-R	CL-AC-M	CL-PC-P	CL-PC-P	CL-PC-P	CL-AC-R			50
CL-CL_61	CL-AC-R	CL-AC-M	CL-PC-P	CL-PC-P	CL-PC-P	CL-AC-M			50
CL-CL_70	CL-AC-R	CL-AC-R	CL-PC-P	CL-AC-M	CL-AC-R	CL-PC-P			50
CL-CL_71	CL-AC-R	CL-AC-R	CL-PC-P	CL-AC-M	CL-PC-P	CL-PC-P			50
Total									700

Land Representation: Working Elements in the Software

I. **Land Use Manager**, to set
   - ✓ land use subdivisions, and
   - ✓ associated relevant variables on C stocks level and dynamic

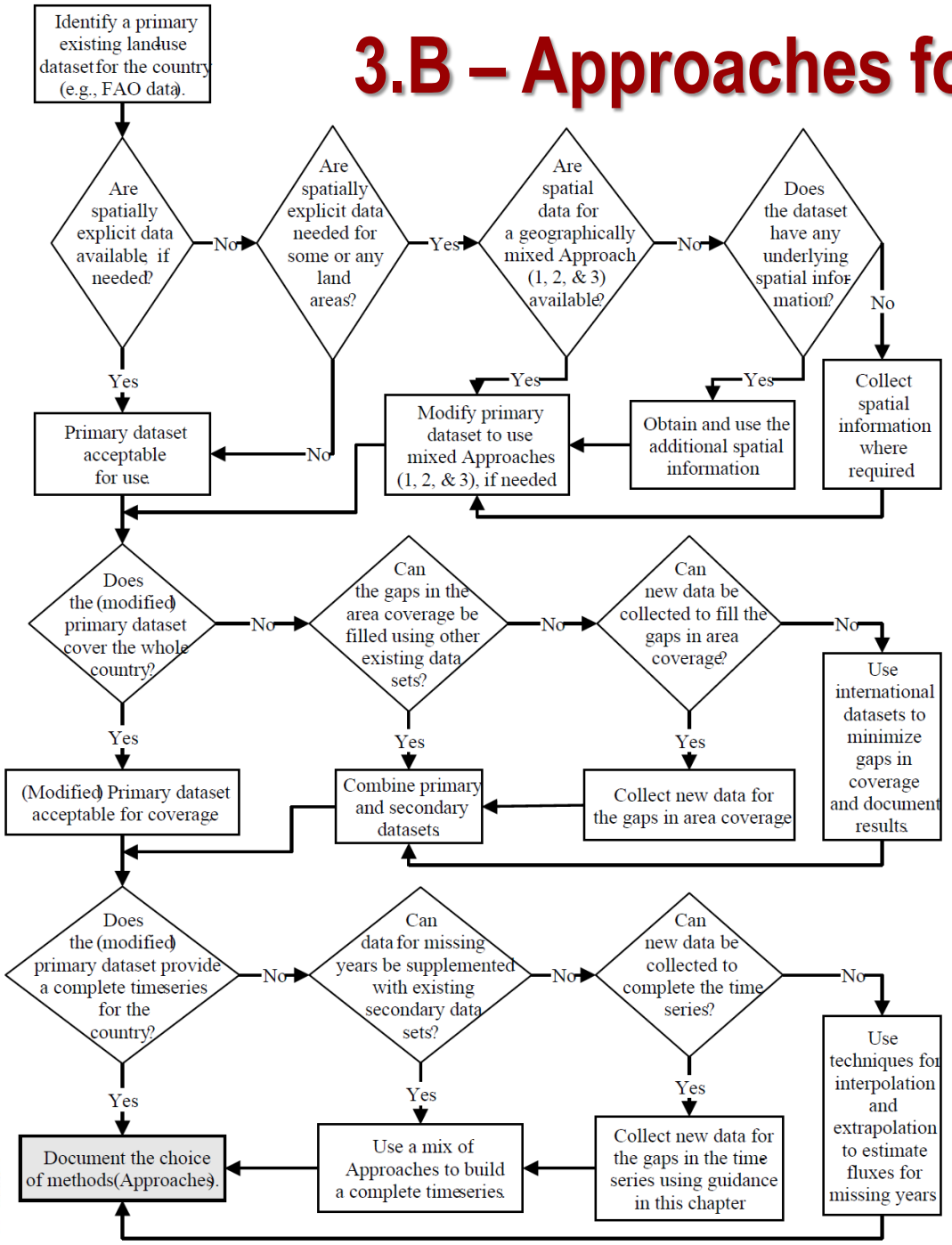
II. **Land Representation Manager**, to set
   - ✓ Regions (i.e. sub-national units)
   - ✓ Units of land (areas homogeneous for all relevant variables) and associated:
     - ➢ Time series of areas
     - ➢ C-stock change calculation methods for each unit of land

Steps to Land Representation [1-5]

1. **A**ssess availability of a time series of data on land use/cover and land use/cover change. Ideally the time series covers the period from $Y_{t_0} - D$ toY_{t_n}, where Y_{t_0} is the first year of the NGHGI time series and Y_{t_n} is the latest year of the NGHGI time series.
2. **A**ssess consistency in the methodology applied to estimate the time series of land use/cover and land use/cover change data, and make any adjustment needed to ensure it.
3. **A**ssess consistency of land categories with the default IPCC categories, which means to reconcile any user-specific categorization to the IPCC 6 land categories.
4. **A**pplies the IPCC Decision Tree at the level of Region to assess which methodological Approach is to be applied
5. **G**ap-fill the time series, if needed

Figure 3.1 Decision tree for preparation of land-use area data

3.B – Approaches for Land Representation – Fig 3.1



To be repeated for each *Region*

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3.B categories: Land Representation

Tool:

Land Use Manager

Land Representation Manager

The IPCC Inventory Software

- **All methods in the 2006 IPCC Guidelines and its Wetlands Supplement are implemented in the IPCC Inventory Software**

  Thus, needed flexibility to deal with any national circumstances, as per IPCC tiered approach, is ensured

- **Subnational disaggregation (Geographical Zone)**

  Thus, tracking of specific activities/projects, and associated emission level & trend, within a national GHG inventory is allowed

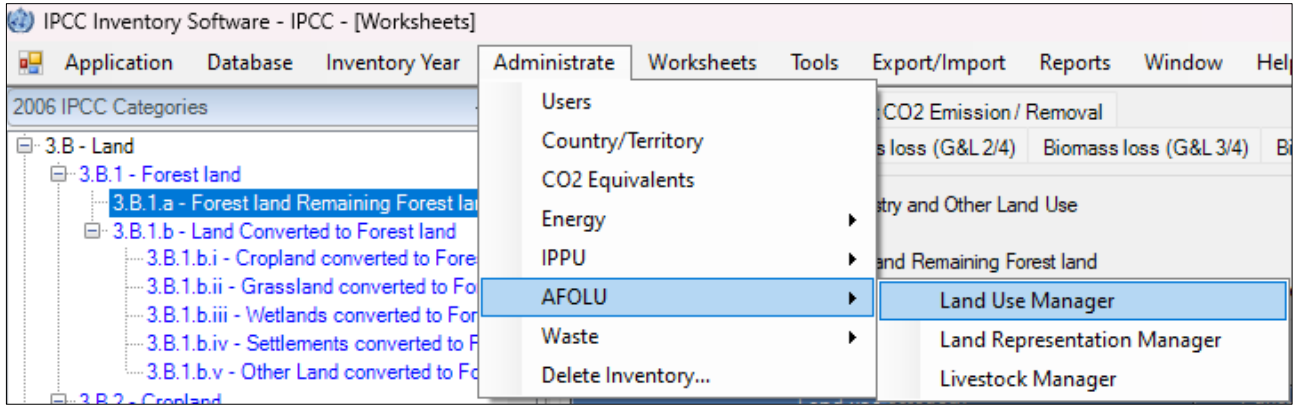
- **Interoperability with UNFCCC ETF reporting tool** allows to export a complete set of CRTs and upload it in the UNFCCC ETF reporting tool

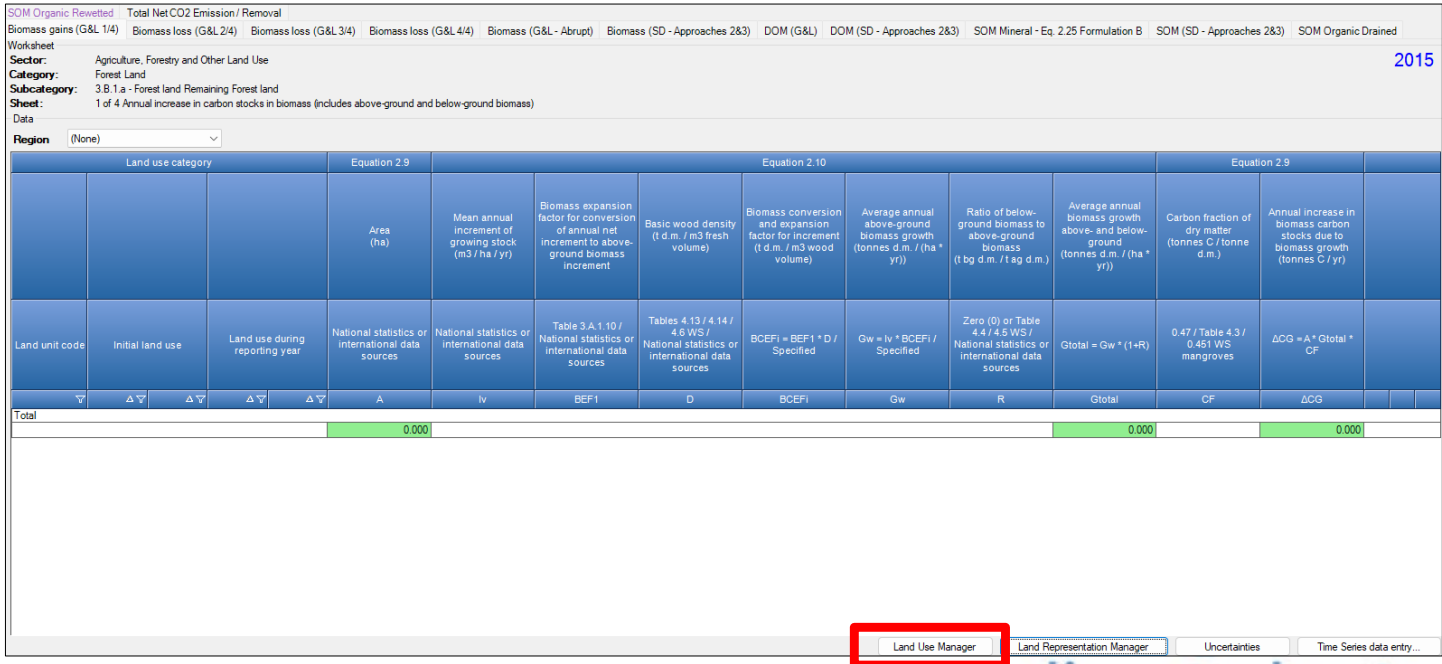
  User-specific Tier 3 estimates to be accommodated in Tier 1 methodological approach worksheets

- **AFOLU sector Guidebook – version 1 under development**

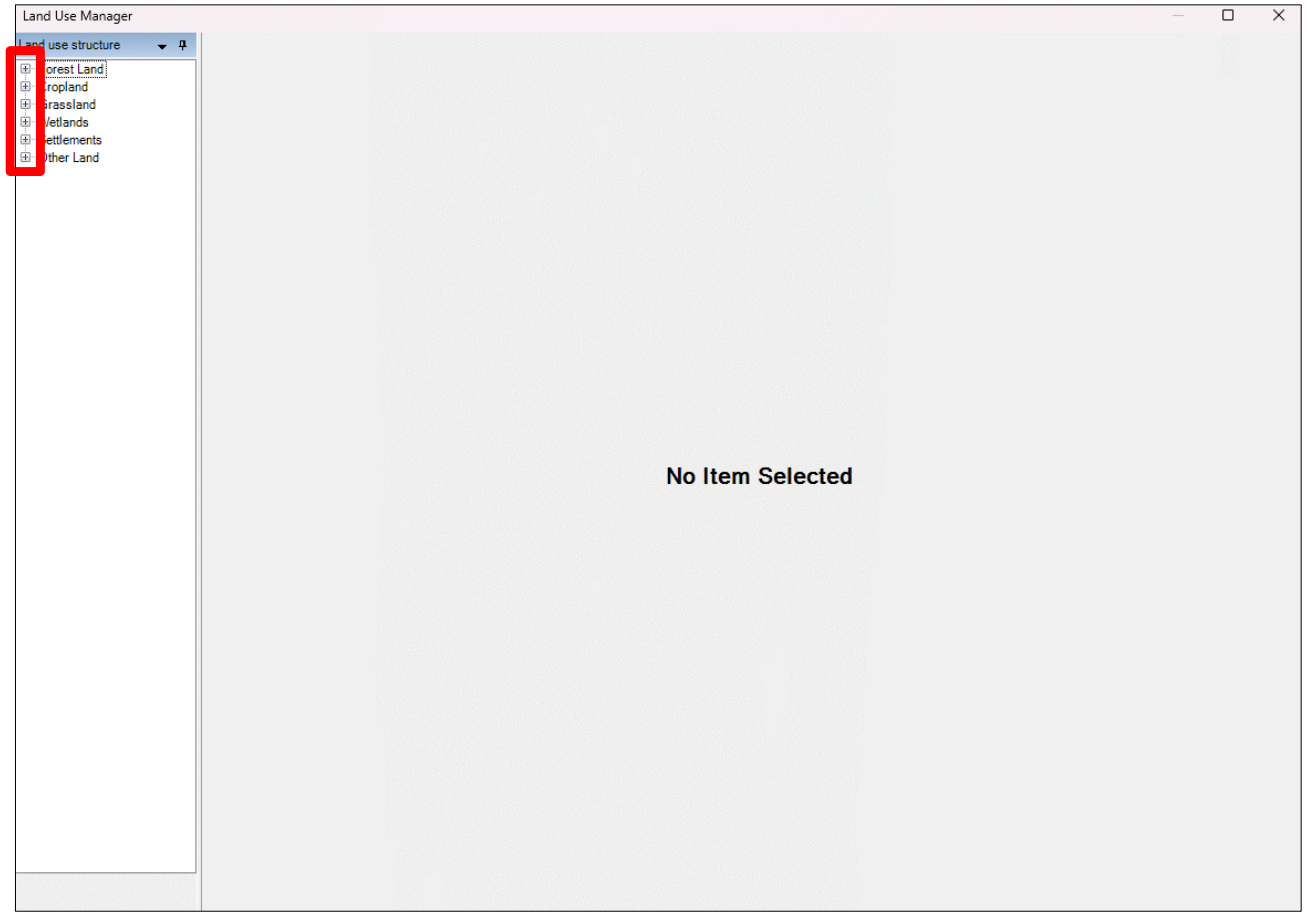
3.B – Land Representation [6]

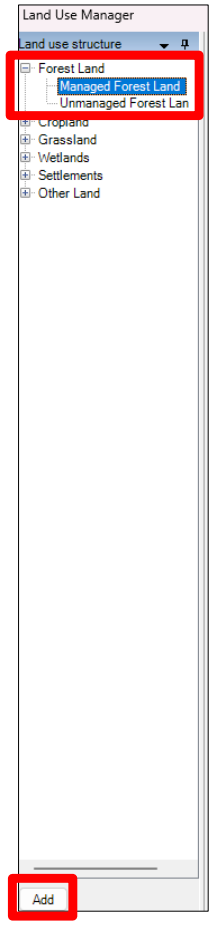
6. **Enter all subdivisions** in the land Use Manager. To do so, open it

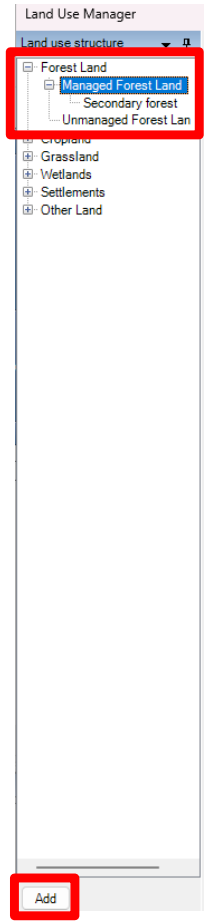




Land Use Manager - Tips





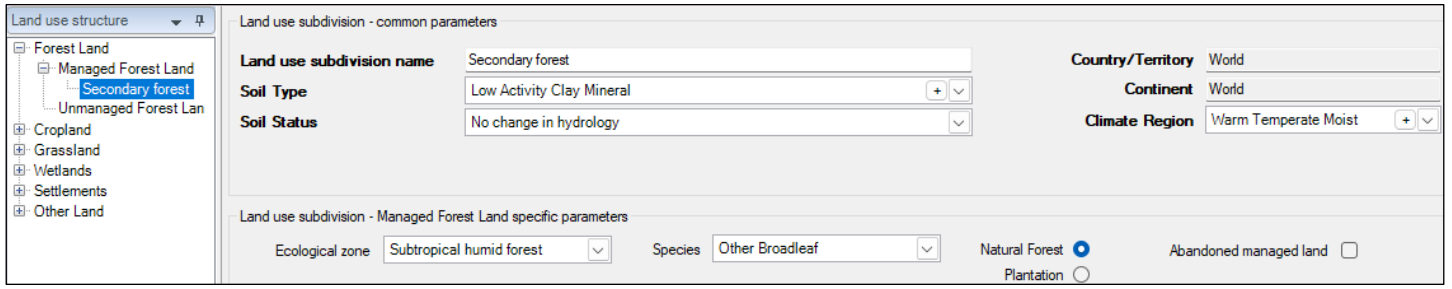


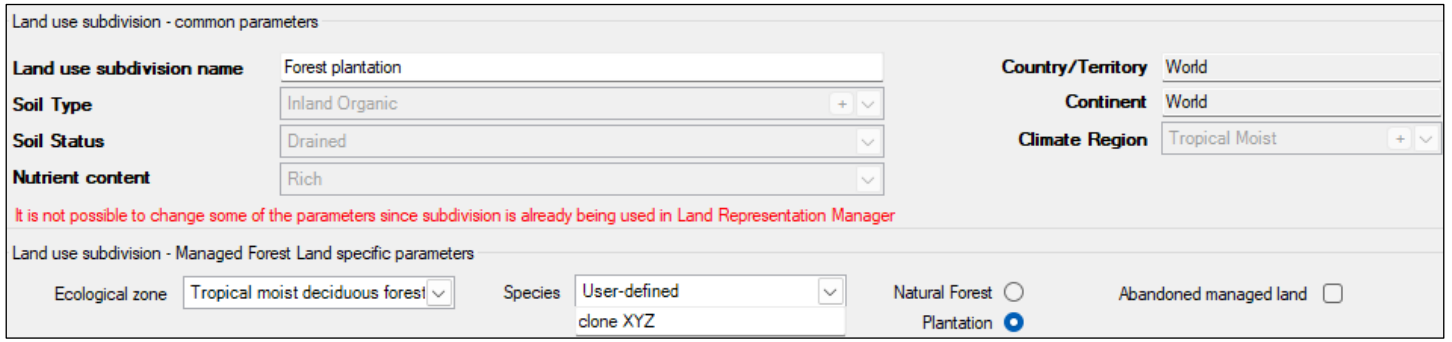
❑ On the right-hand side:

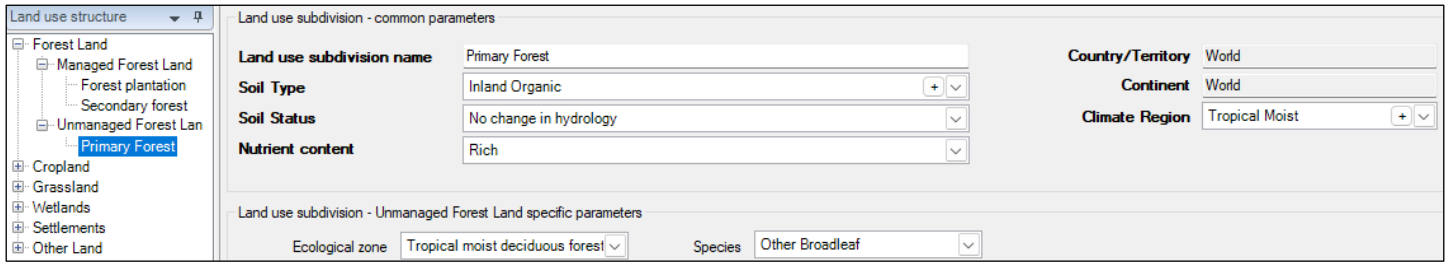
➢ The object  indicates that there is a sub-layer to select where to enter information.

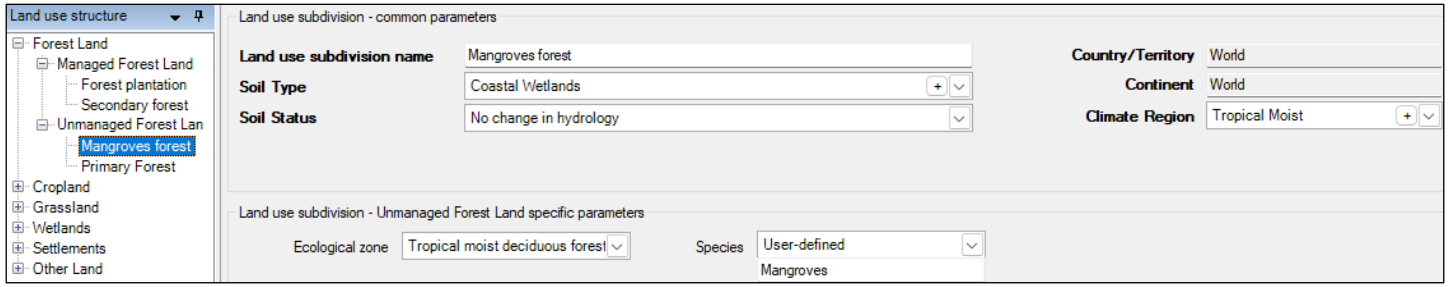
Thus, click on it to open the sub-layer and input the information

Land Use Manager (LUM) – *Subdivisions* – Forest land









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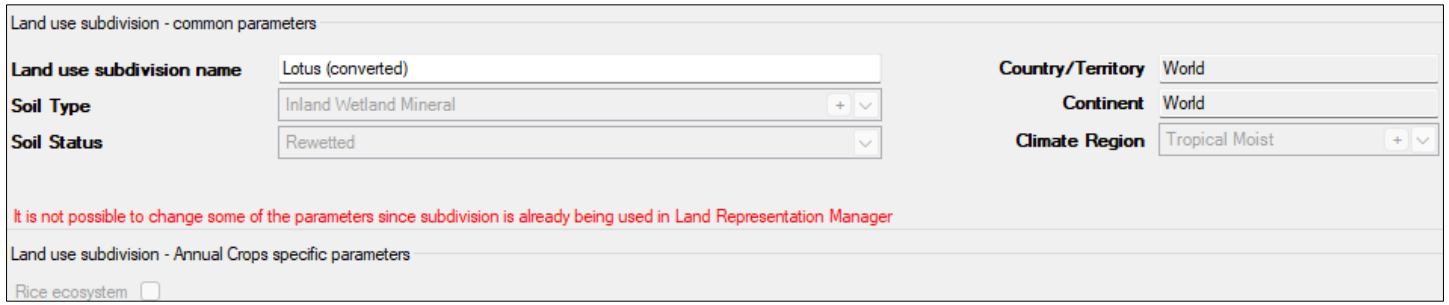
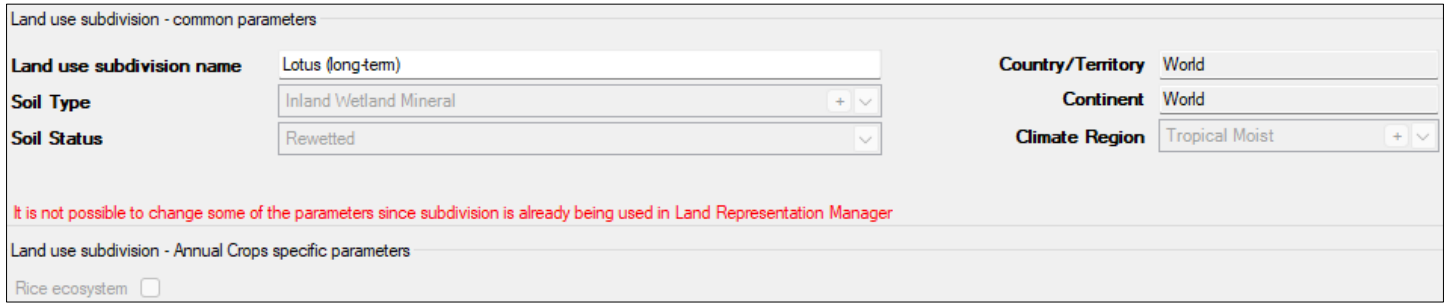
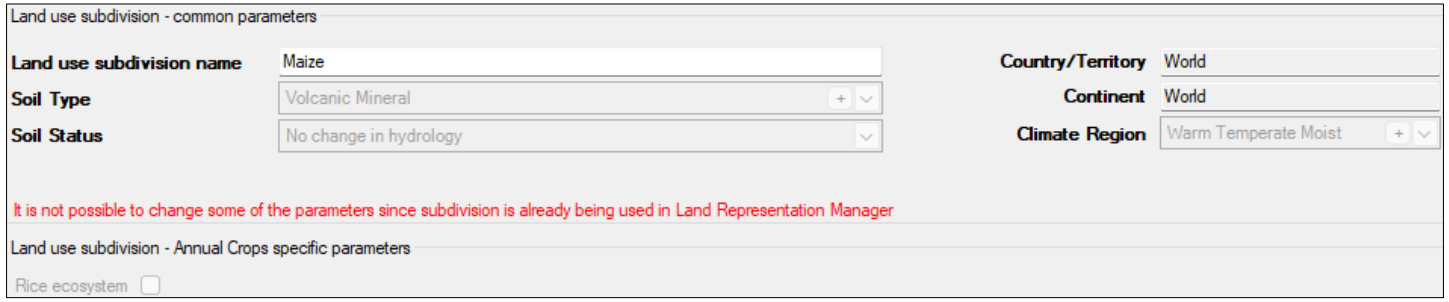
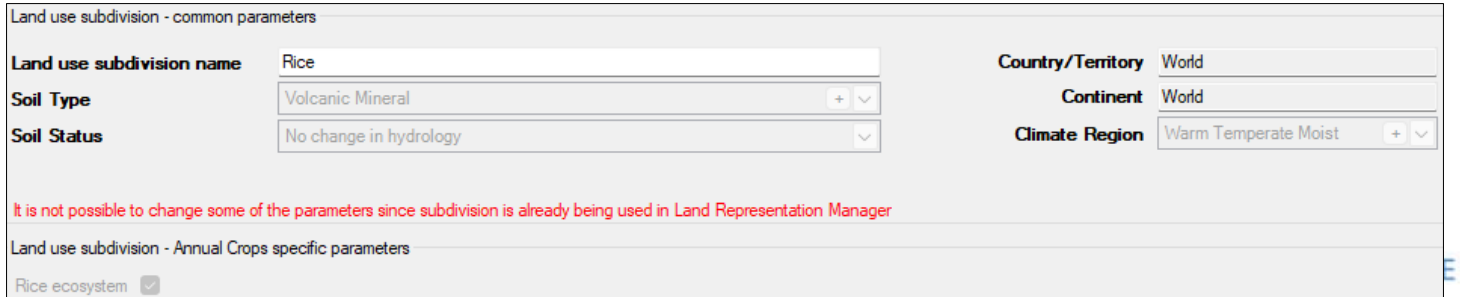
Land Use Manager (LUM) – *Subdivisions* – Annual Cropland









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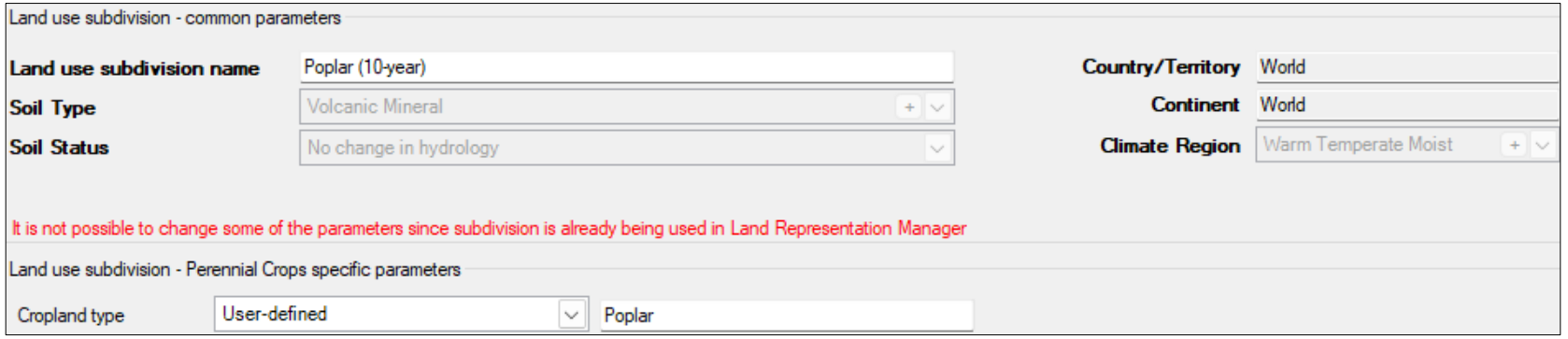
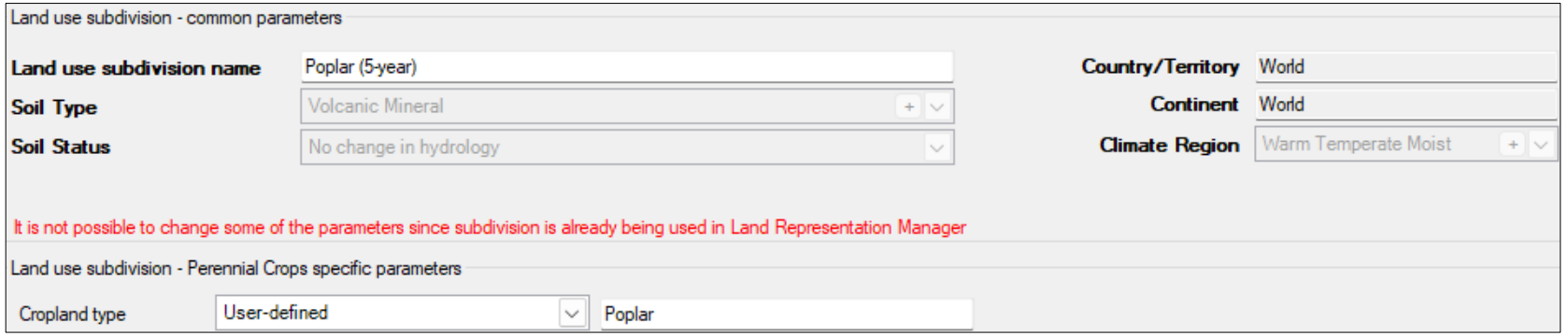
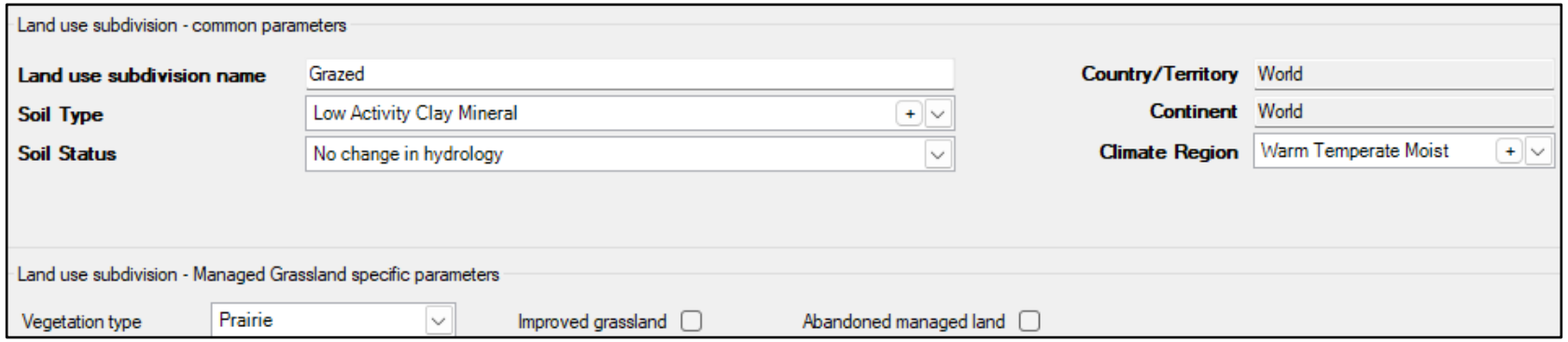
Land Use Manager (LUM) – *Subdivisions* – Perennial Cropland

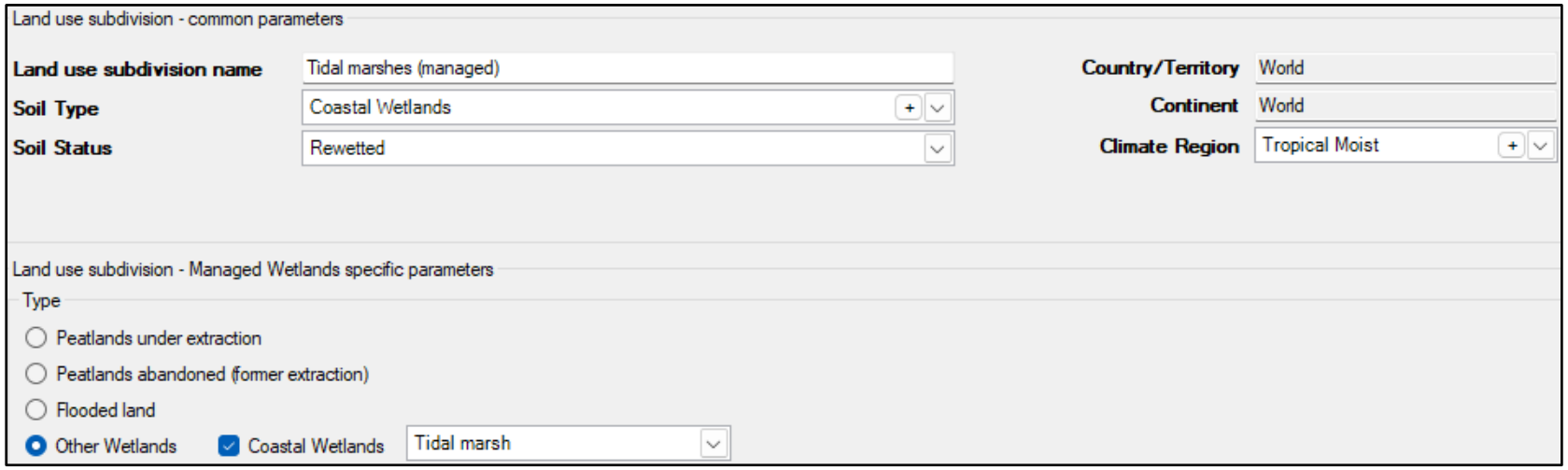




Land Use Manager (LUM) – *Subdivisions* – Managed Grassland

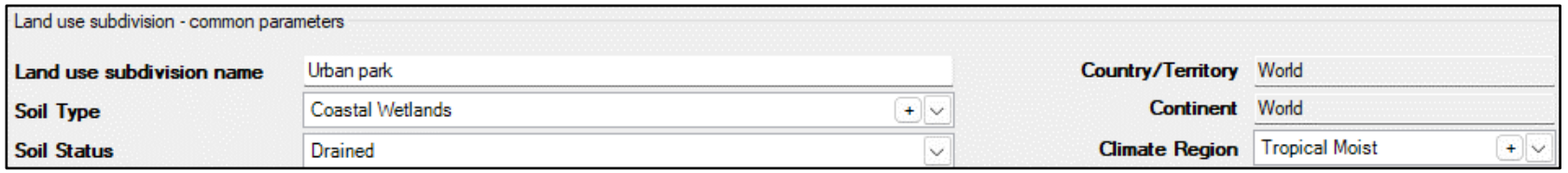


Land Use Manager (LUM) – *Subdivisions* – Managed Wetlands

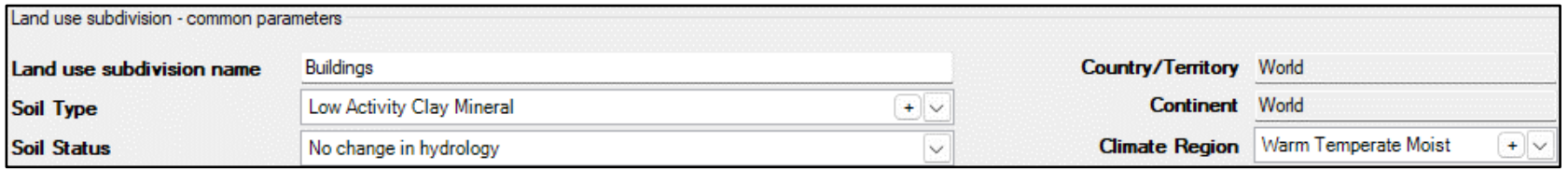


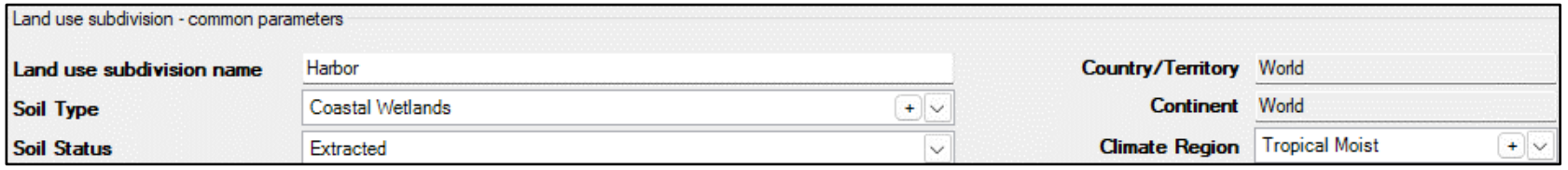
Land Use Manager (LUM) – *Subdivisions* – Unmanaged Wetlands

Land Use Manager (LUM) – *Subdivisions* – Settlements (Treed)

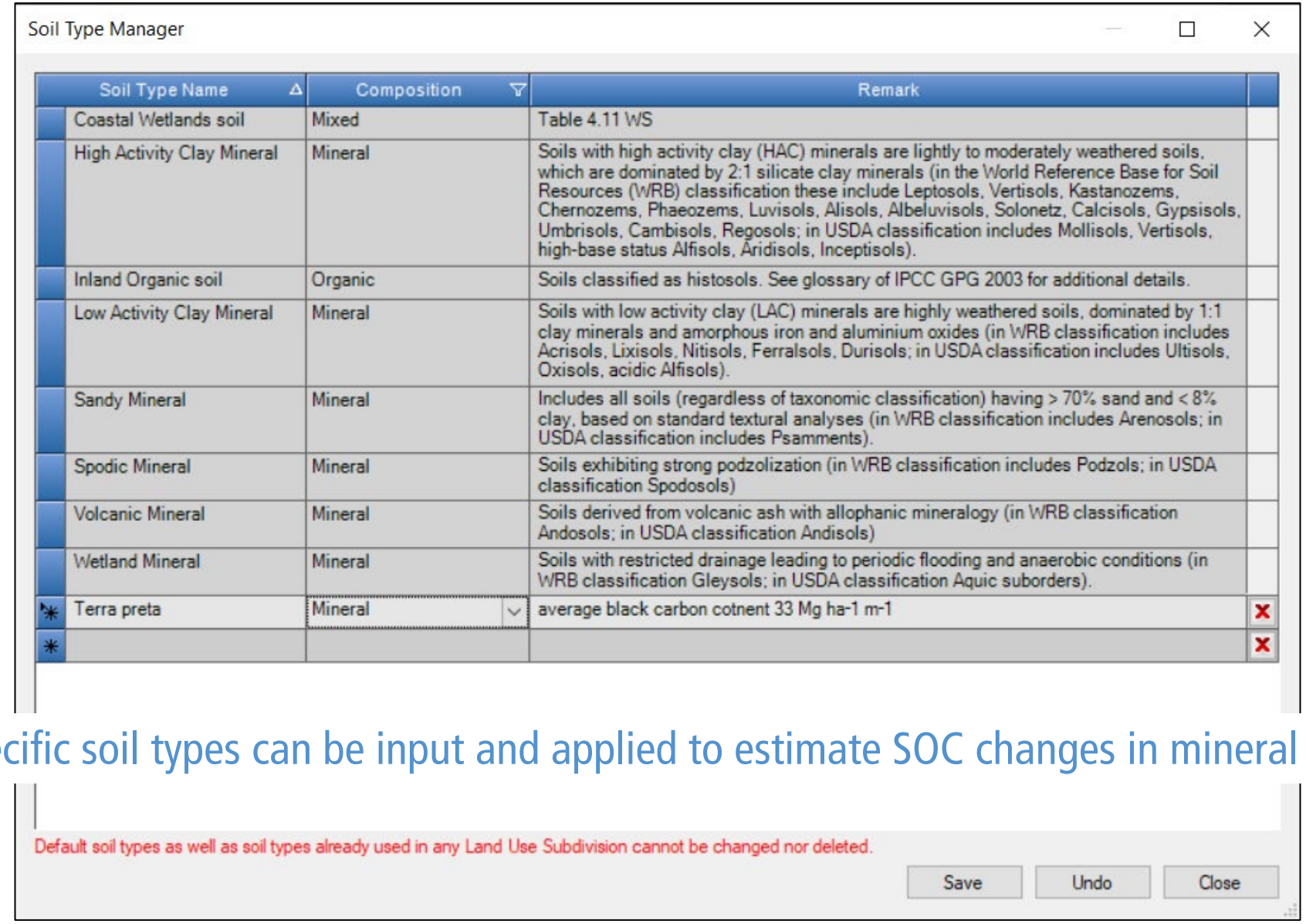


Land Use Manager (LUM) – *Subdivisions* – Settlements (Other)



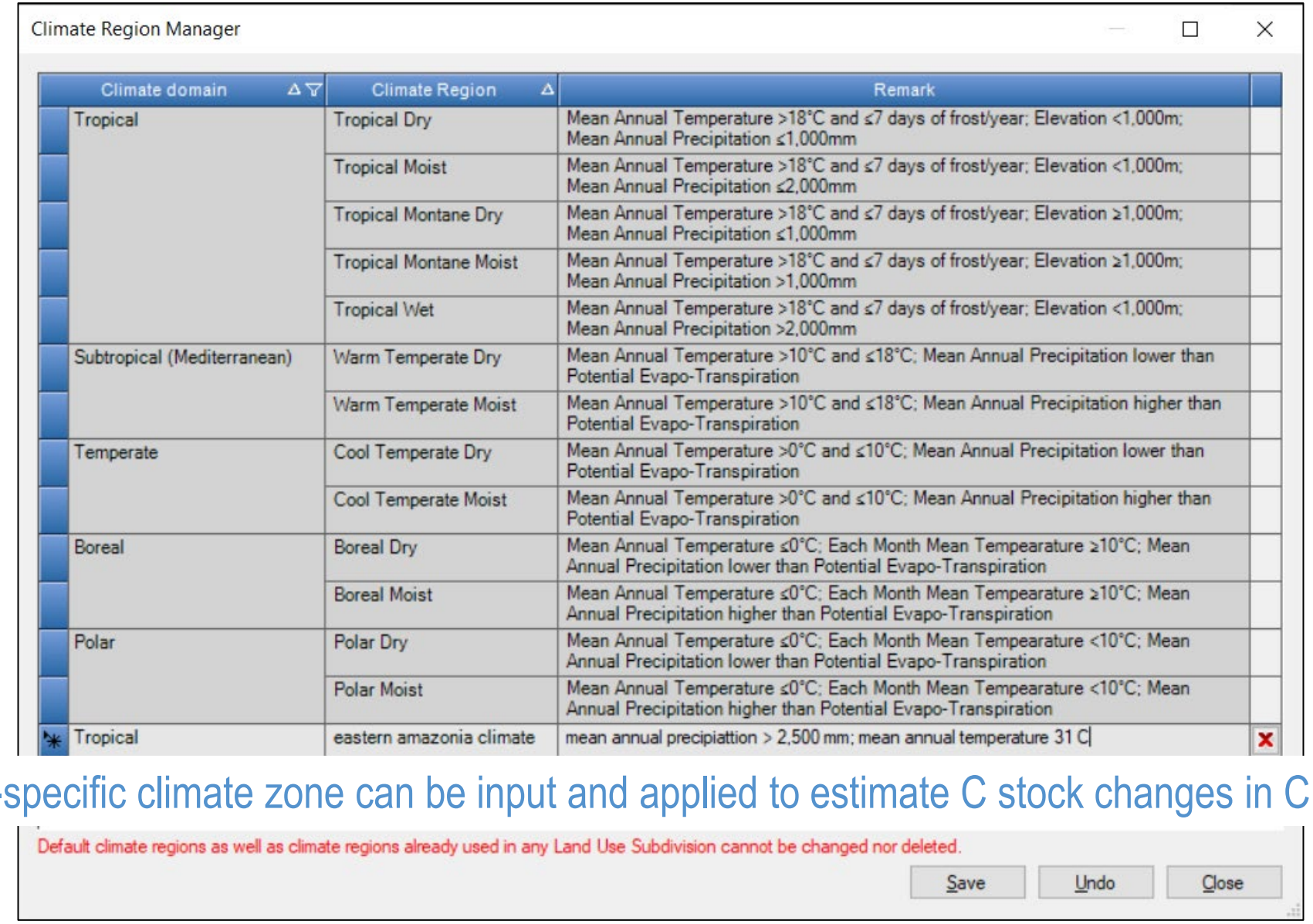


LUM – Soil Type Manager



User-specific soil types can be input and applied to estimate SOC changes in mineral soils

LUM – Climate Region Manager



Climate domain	Climate Region	Remark
Tropical	Tropical Dry	Mean Annual Temperature >18°C and ≤7 days of frost/year; Elevation <1,000m; Mean Annual Precipitation ≤1,000mm
	Tropical Moist	Mean Annual Temperature >18°C and ≤7 days of frost/year; Elevation <1,000m; Mean Annual Precipitation ≤2,000mm
	Tropical Montane Dry	Mean Annual Temperature >18°C and ≤7 days of frost/year; Elevation ≥1,000m; Mean Annual Precipitation ≤1,000mm
	Tropical Montane Moist	Mean Annual Temperature >18°C and ≤7 days of frost/year; Elevation ≥1,000m; Mean Annual Precipitation >1,000mm
	Tropical Wet	Mean Annual Temperature >18°C and ≤7 days of frost/year; Elevation <1,000m; Mean Annual Precipitation >2,000mm
Subtropical (Mediterranean)	Warm Temperate Dry	Mean Annual Temperature >10°C and ≤18°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Warm Temperate Moist	Mean Annual Temperature >10°C and ≤18°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
Temperate	Cool Temperate Dry	Mean Annual Temperature >0°C and ≤10°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Cool Temperate Moist	Mean Annual Temperature >0°C and ≤10°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
Boreal	Boreal Dry	Mean Annual Temperature ≤0°C; Each Month Mean Tempearature ≥10°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Boreal Moist	Mean Annual Temperature ≤0°C; Each Month Mean Tempearature ≥10°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
Polar	Polar Dry	Mean Annual Temperature ≤0°C; Each Month Mean Tempearature <10°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Polar Moist	Mean Annual Temperature ≤0°C; Each Month Mean Tempearature <10°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
Tropical	eastern amazonia climate	mean annual precipiattion > 2,500 mm; mean annual temperature 31 C

User-specific climate zone can be input and applied to estimate C stock changes in C pools

Land Representation Manager (LRM)

- **Allows to use any of the three IPCC approaches**:
  - ✓ Approach 1 - *no land use change identification-*
  - ✓ Approach 2 - *land use change identification-*
  - ✓ Approach 3 - *land use change identification and tracking across time-*
- **Ensures consistency of land representation**
  - ✓ Discrepancy-check in area data input
  - ✓ Tracking of unit of lands across the time series - *spatially explicit tracking under Approach 3-*
- Area data are automatically transferred to relevant worksheets where GHG emissions/removals from land-related activities are estimated
- Each unit of land gets assigned an identification code on the basis of the current and previous land use/management
- To ease the work of compilers, an additional user-defined code can be assigned to each unit of land

Land Representation Manager (LRM)

- **Data input shall be done from the first inventory year forward**
- Once input in an inventory year, the unit of land is copied by the software in all years of the time series updating its "conversion-status" according to the time passed since its conversion and the transition period set
- Approach 1 does not identify land-use conversions, therefore:
  - ✓ SOC changes are estimated comparing total SOC stock across the land representation (Region/Country) in the inventory year and 20 years before the inventory year
  - ✓ Thus, the Land Representation Manager requires for each unit of land to input the area in the inventory year as well as the area of 20 years before [Approach 1 only!]
- Any Unit of land is an area homogenous per
  - ✓ physical conditions *-climate/vegetation zone and soil type-* and
  - ✓ current and historical socio-economic functions *-land use & management type-*

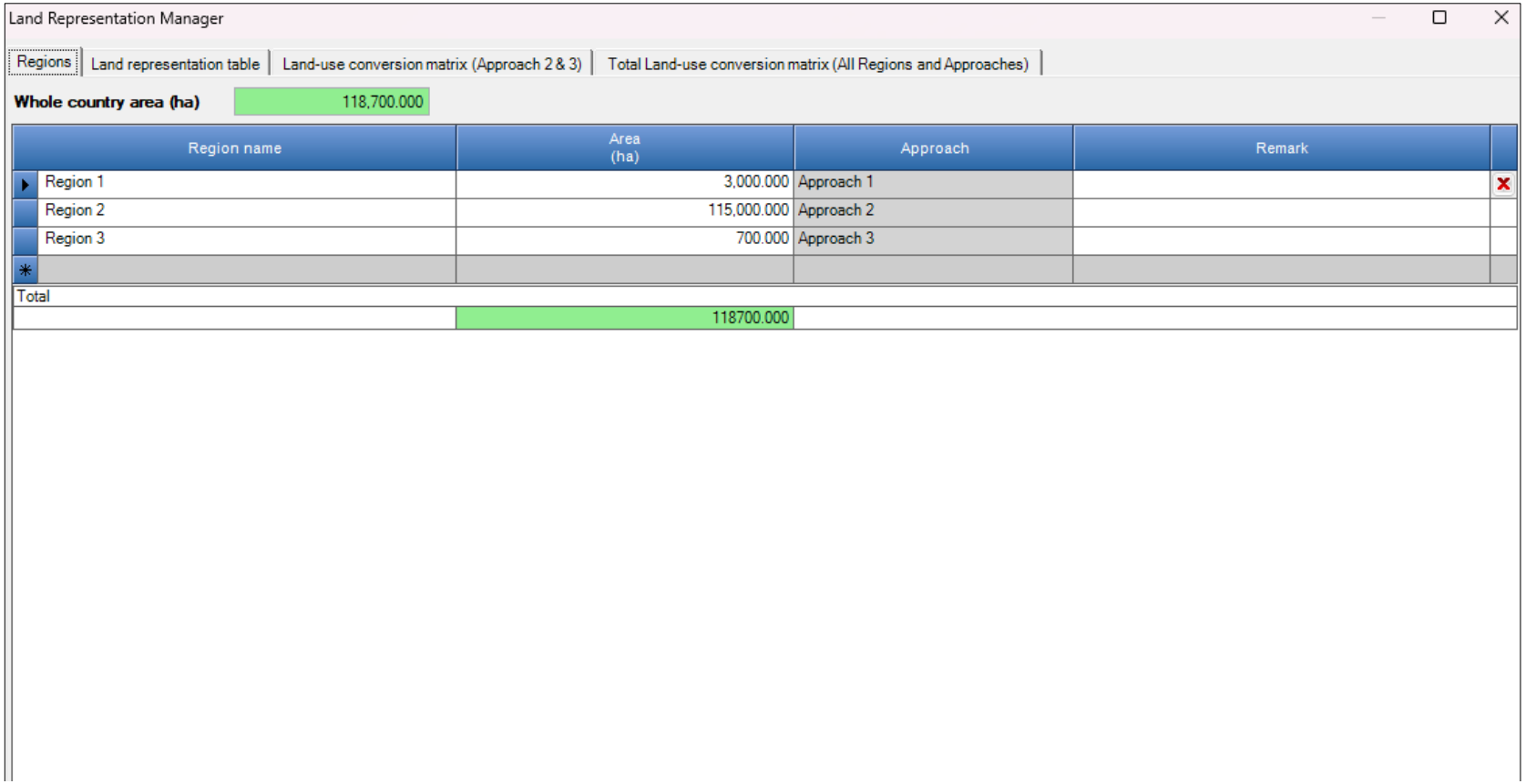
Land Representation Manager (LRM)

- For each unit of land entered, the **methodology** to apply to estimate C stock changes in each C pool, as well as to estimate CO_2 fluxes from SOM in organic soils, **is to be set**

For the case study

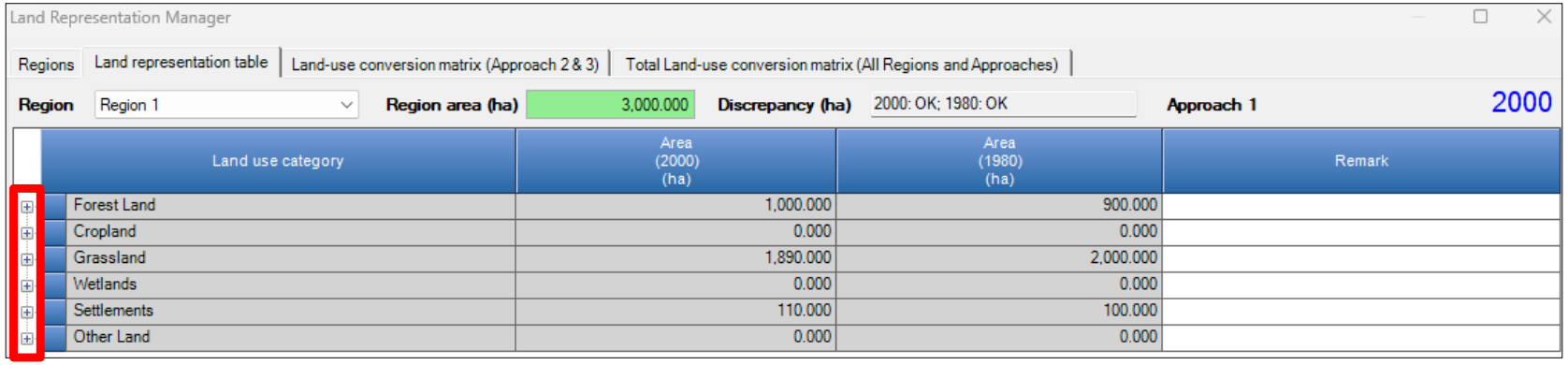
- **Region 1**: IPCC default Stock Difference methodology for Biomass and DOM C pools.
  IPCC default methodology for SOM C pool and for SOM organic soils
- **Region 2**: IPCC default methodology for all C pools and for SOM organic soils
- **Region 3**: IPCC default methodology for all C pools and for SOM organic soils

LRM – Regions Tab



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

Land Representation Manager - Tips



❑ On the right-hand side:

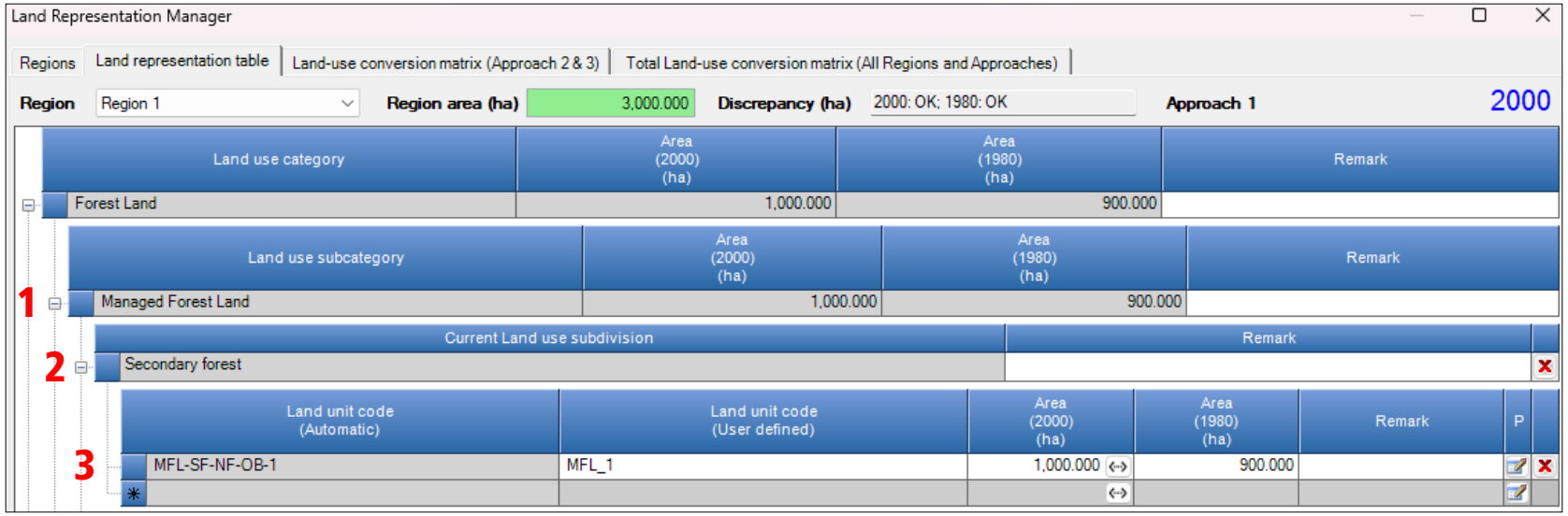
- ➢ The object ⊞ indicates that there is a sub-layer to select where to enter information.

  Thus, click on it to open the sub-layer and input the information

Land Representation Manager - Tips

Users are requested to enter information in **three sublayers**, starting from the land use category layer downward

Although information to enter differs among Approaches

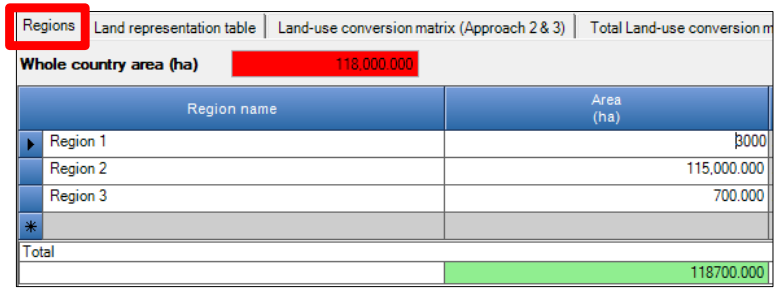


❑ On the right-hand side:

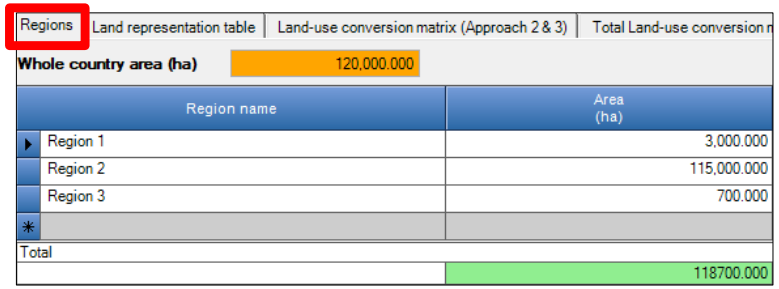
- ➢ The object ✳ indicates rows where the user can enter additional information

Land Representation Manager - Tips

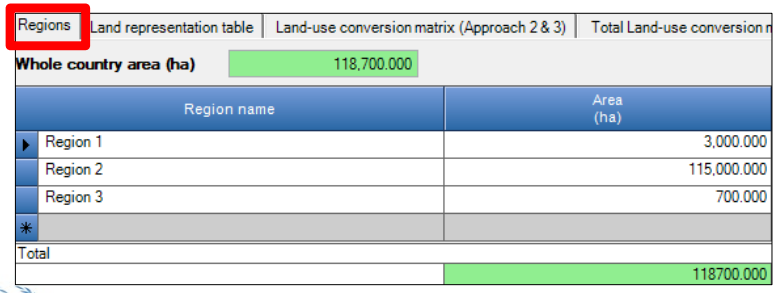
Color code for internal checks of consistency in data entered at various levels



Red: total **area** entered as **Regions** is **larger than whole country area**



Orange: total **area** entered as **Regions** is **smaller than whole country area**



Green: total **area** entered as **Regions** is **equal to whole country area**

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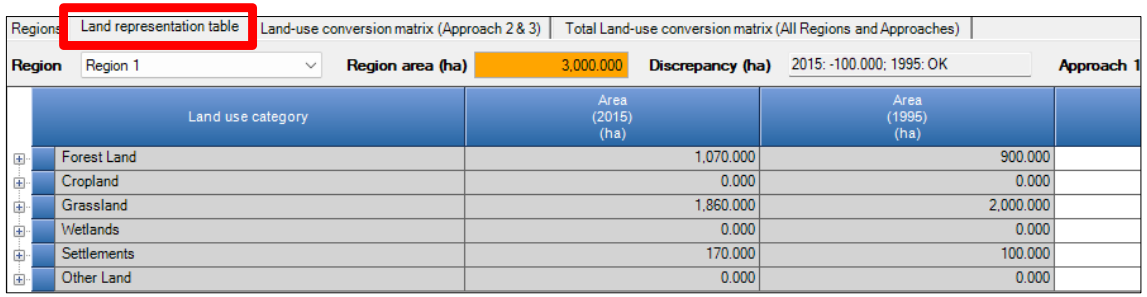
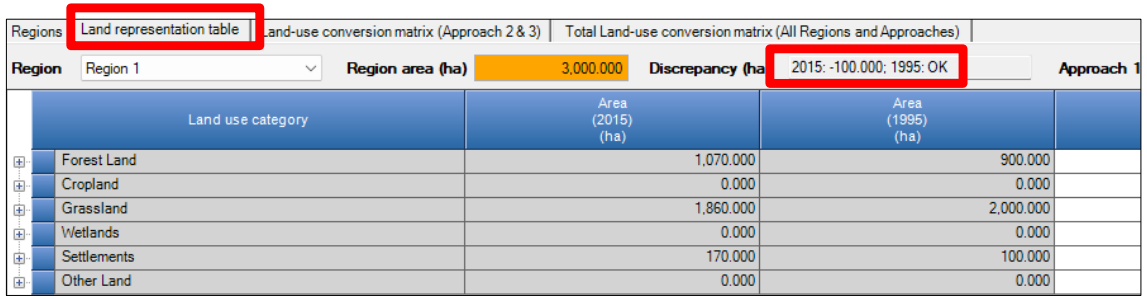
Land Representation Manager - Tips

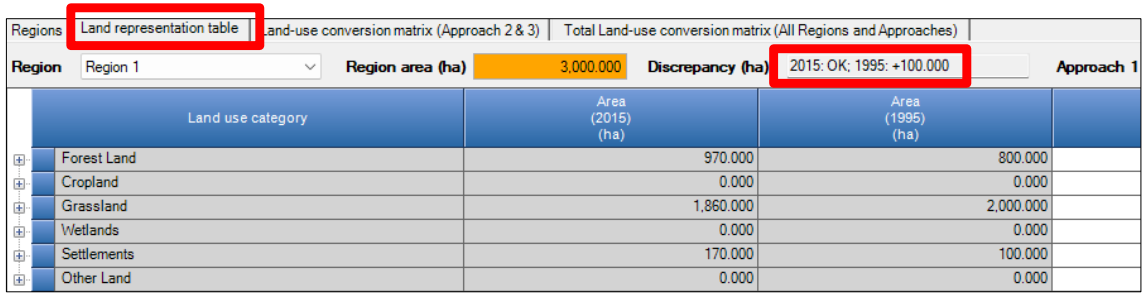
Color code for internal checks of consistency in data entered at various levels



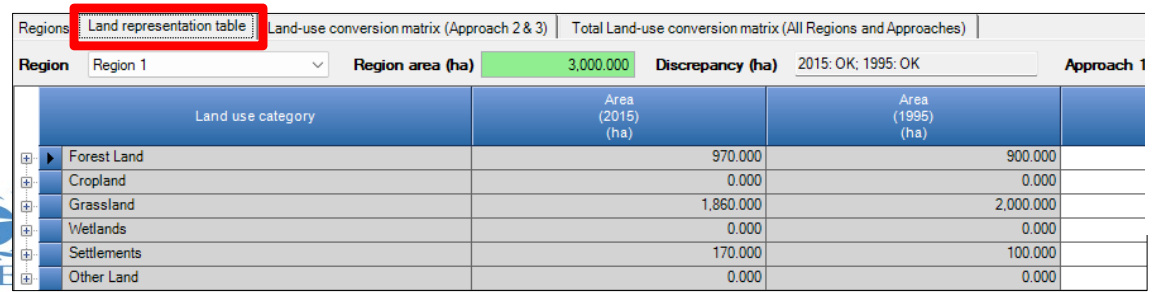
Orange: total **area** entered as **land categories differs from whole region area**



Negative value: total **area** entered as **land categories larger than whole region area**



Positive value: total **area** entered as **land categories smaller than whole region area**



Green: total **area** entered as **land categories** is **equal to whole region area**

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LRM – Land Representation Tab – Approach 1

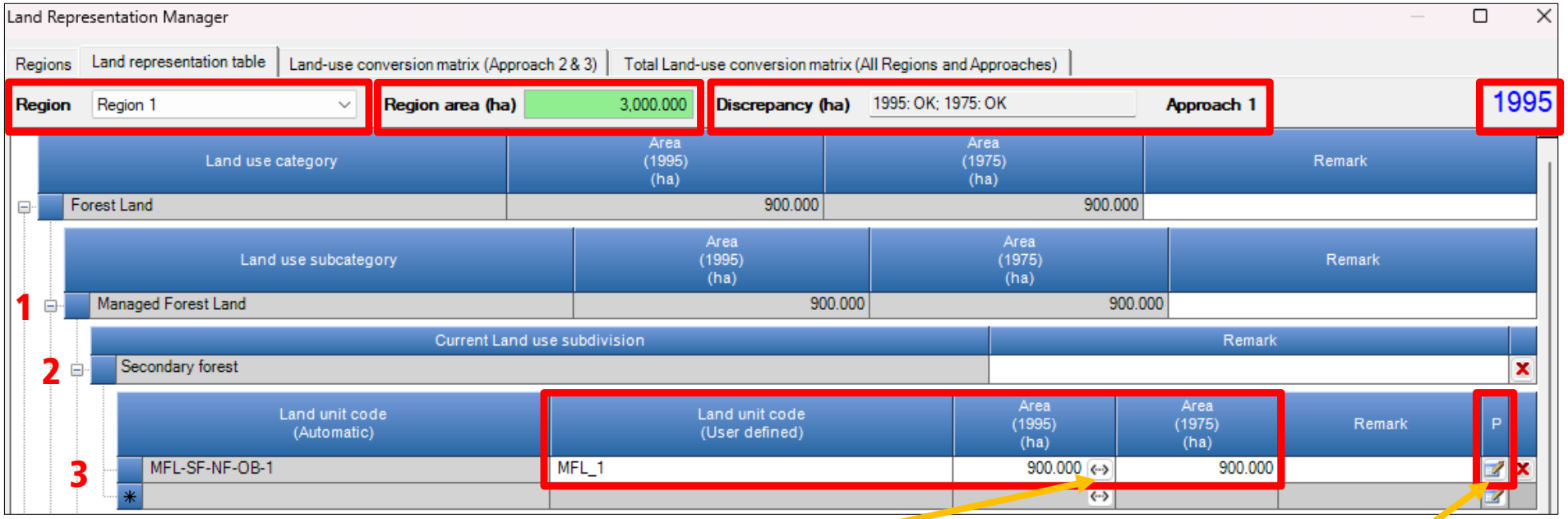
For each unit of land:

1. Enter area (ha) in the inventory year [by default the area is assigned to the current and subsequent years *see next slide*]

2. Enter area it had 20-year before [to calculate *Formulation A, Eq 2.25 - SOC*]

This step does not apply to those years which 20-years-prior year is part of the NGHGI, given the Software automatically compile it

3. Select, *for each C pool*, the methodological approach to be applied to estimate Carbon-Stock-Changes (CSCs) and CO_2 fluxes



Click on it to select the period to which the area value entered applies

Click on it to select the method to apply to each C pool to calculate CSCs and CO_2 fluxes

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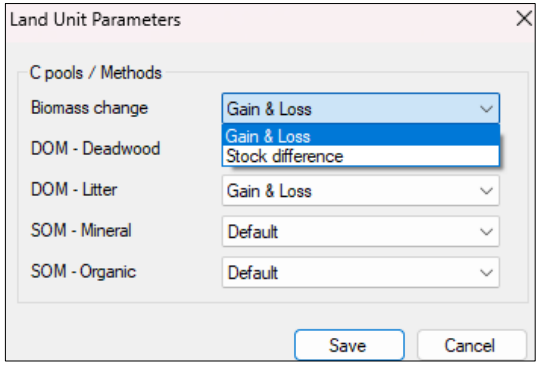
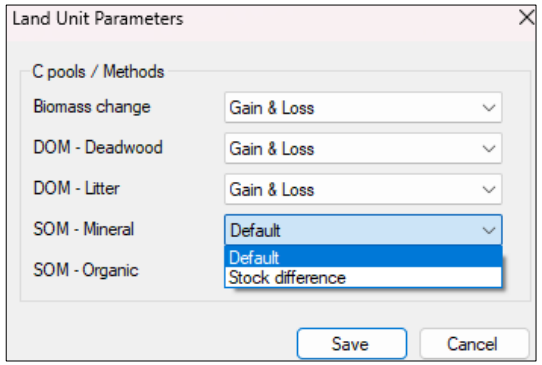
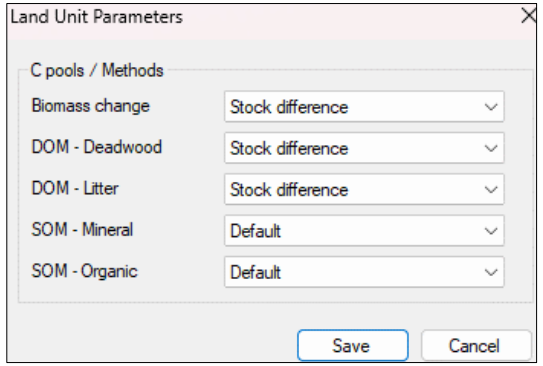
LRM – Setting method to estimate CSCs/CO_2 fluxes

Click on it to select the method to apply to each C pool to calculate CSCs and CO_2 fluxes



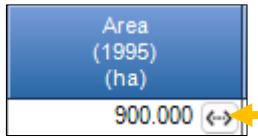


For this exercise set the method for *Biomass* & *DOM* C pools to Stock-Difference

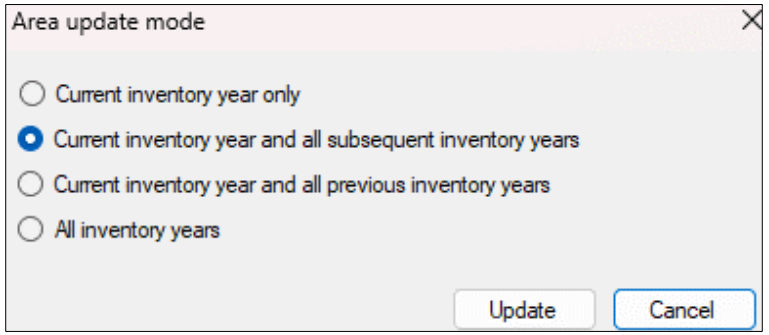


- ✓ For each C pool, users select the methodological approach to apply to estimate CSCs
- ✓ For SOM in organic soils, users select the methodological approach to apply to estimate CO_2 fluxes
- ✓ Method selected applies to the entire NGHGI time series
- ✓ By default, the *Software* applies the IPCC default methodological approach to each C pool as well as to SOM in organic soils

LRM – Setting period to which value entered for area applies



Click on it to select the period to which the area value entered applies



For each unit of land, users select the period to which the area value entered applies

A. *Current inventory year only*, this option avoids to mistakenly modify values already entered in the time series

B. *Current inventory year and all subsequent inventory years*, this is the **default option** and well fits with the requirement to enter land representation data from the first inventory year onward

C. *Current inventory year and all previous inventory years*, this is useful when setting a new unit of land that needs to be tracked back too (e.g. the area subject to a new activity)

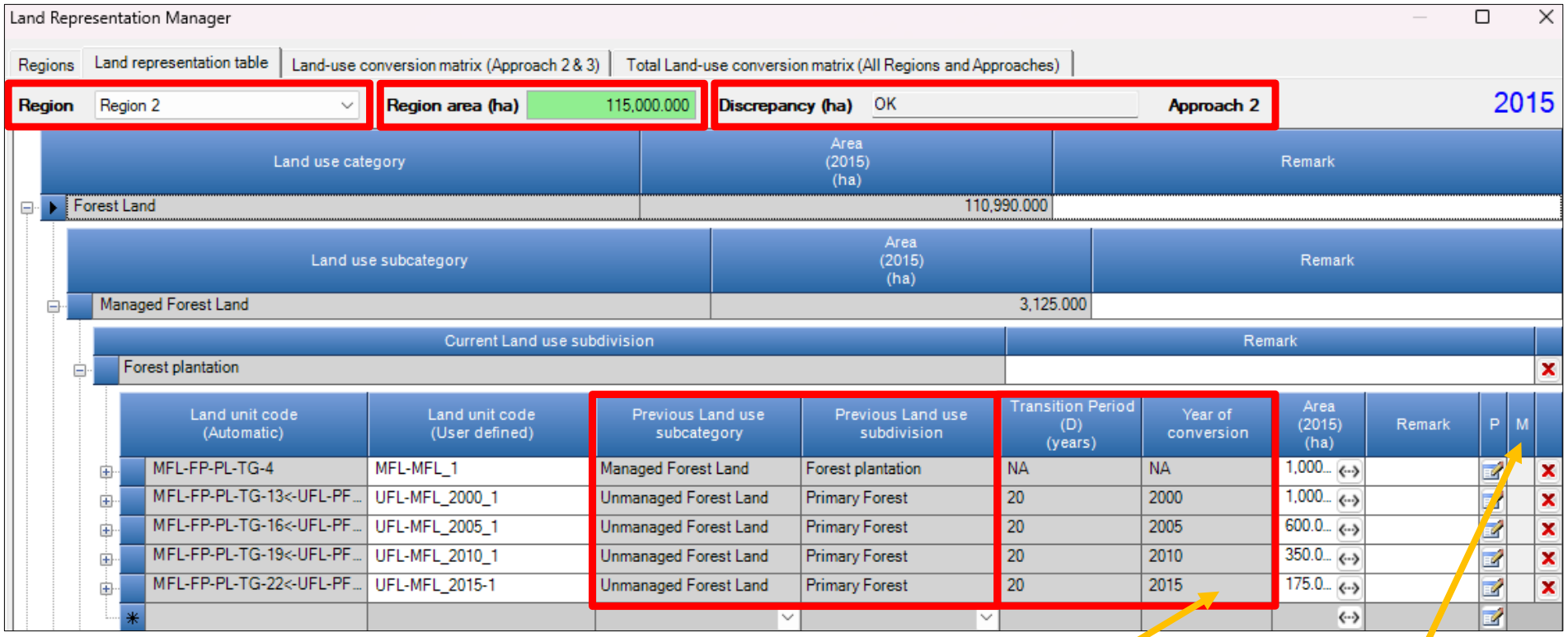
D. All inventory years, unlikely to be used, although it may expedite data enter in rare cases

LRM – Land Representation Tab – Approach 2

Additionally, for each unit of land:

1. Enter previous subcategory & subdivision

2. Enter transition period D, only if the unit of land is undergoing a conversion [*otherwise the Software compiled D as NA*]



The Year of conversion is automatically set by the *Software* as the year in which the unit of land is first entered

M –merging-, allows to merge a unit of land, which has completely transitioned to the new category, with similar units of land

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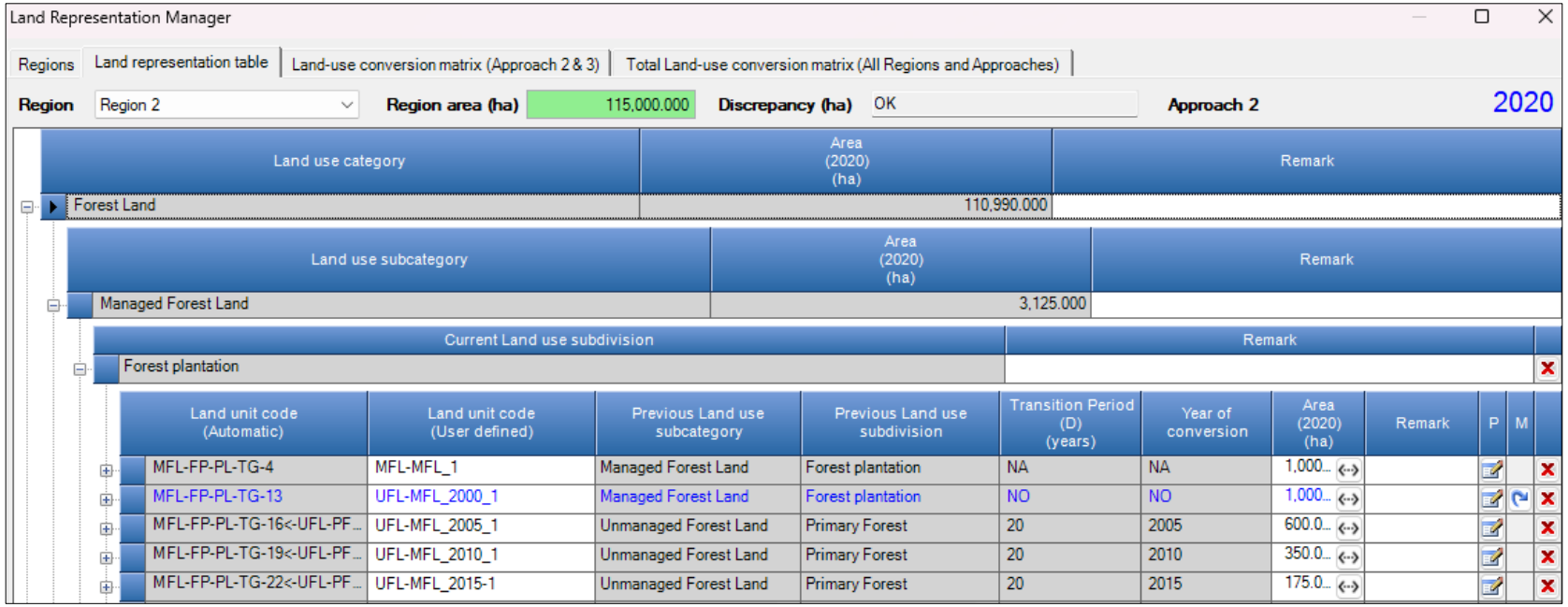
LRM – Merging a Unit of Land



Units of land that have completed the transition period are automatically transferred by the *Software* in the corresponding "*Land remaining*" category and are visualized in blue ink

Users may then merge those with equivalent units present in the relevant "*Land remaining*" category

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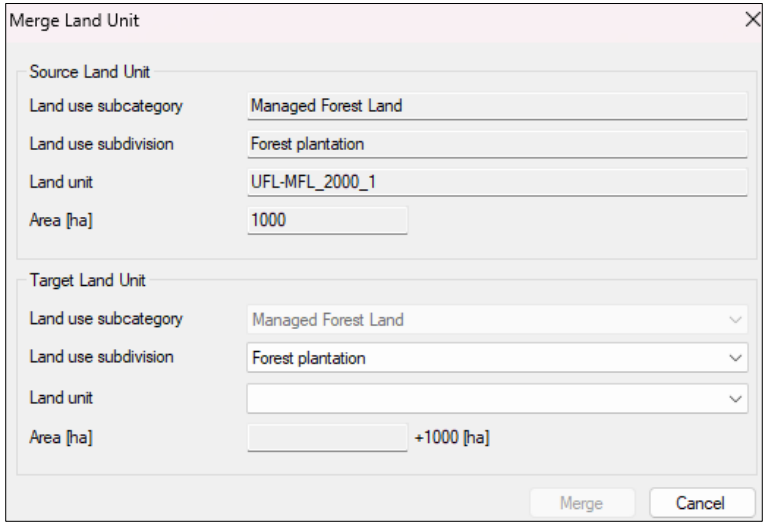
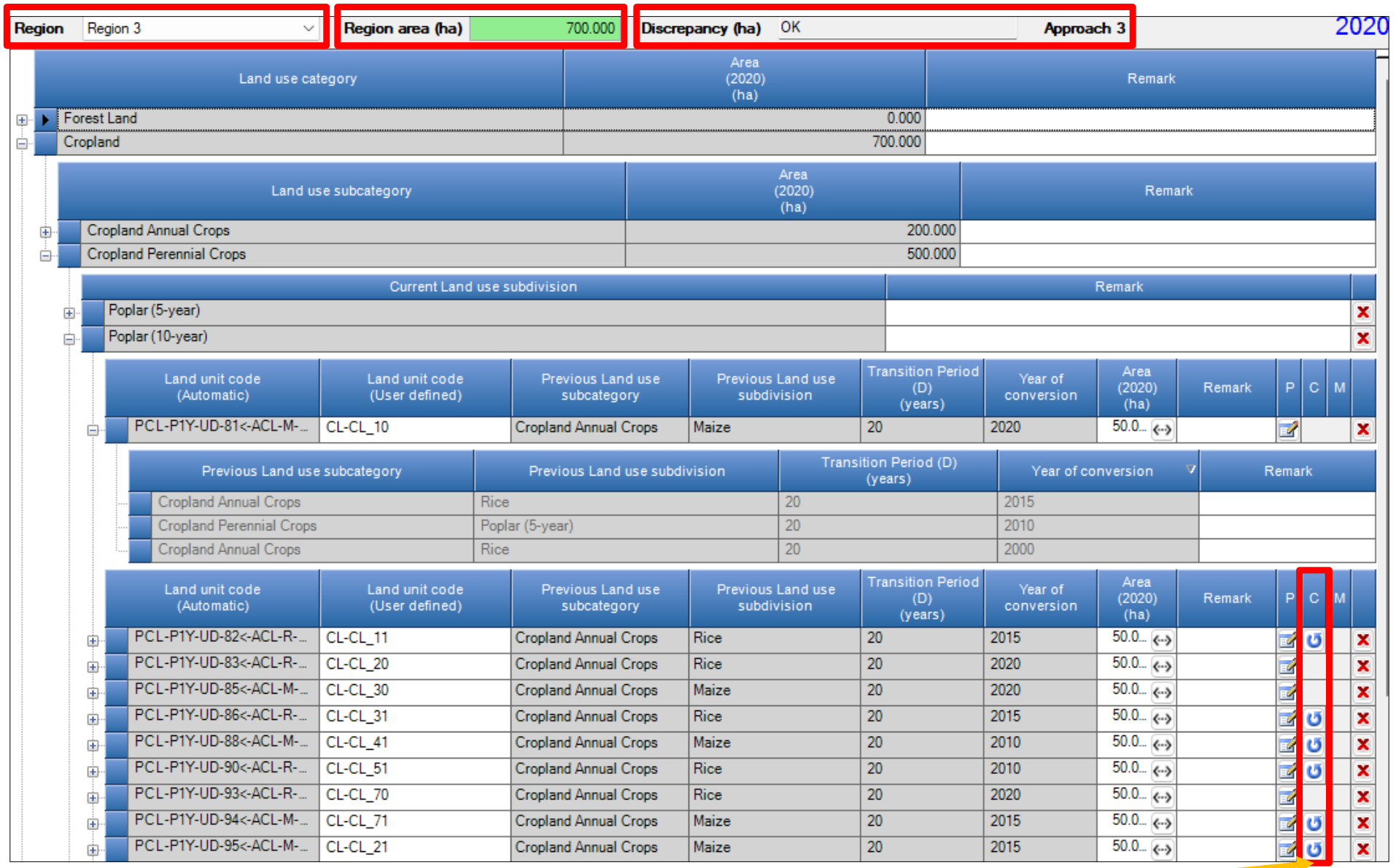
LRM – Merging a Unit of Land

Click on it to open the dialog box to merge the unit of land



Once opened the dialog box, users select the unit of land to which merging it

LRM – Land Representation Tab – Approach 3



Region	Region 3	Region area (ha)	700.000	Discrepancy (ha)	OK	Approach 3	2020

Land use category	Area (2020) (ha)	Remark
Forest Land	0.000	
Cropland	700.000	

Land use subcategory	Area (2020) (ha)	Remark
Cropland Annual Crops	200.000	
Cropland Perennial Crops	500.000	

Current Land use subdivision	Remark
Poplar (5-year)	
Poplar (10-year)	

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 (2020) (ha)	Remark	P	C	M
PCL-P1Y-UD-81<-ACL-M-...	CL-CL_10	Cropland Annual Crops	Maize	20	2020	50.0...				

Previous Land use subcategory	Previous Land use subdivision	Transition Period (D) (years)	Year of conversion	Remark
Cropland Annual Crops	Rice	20	2015	
Cropland Perennial Crops	Poplar (5-year)	20	2010	
Cropland Annual Crops	Rice	20	2000	

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 (2020) (ha)	Remark	P	C	M
PCL-P1Y-UD-82<-ACL-R-...	CL-CL_11	Cropland Annual Crops	Rice	20	2015	50.0...				
PCL-P1Y-UD-83<-ACL-R-...	CL-CL_20	Cropland Annual Crops	Rice	20	2020	50.0...				
PCL-P1Y-UD-85<-ACL-M-...	CL-CL_30	Cropland Annual Crops	Maize	20	2020	50.0...				
PCL-P1Y-UD-86<-ACL-R-...	CL-CL_31	Cropland Annual Crops	Rice	20	2015	50.0...				
PCL-P1Y-UD-88<-ACL-M-...	CL-CL_41	Cropland Annual Crops	Maize	20	2010	50.0...				
PCL-P1Y-UD-90<-ACL-R-...	CL-CL_51	Cropland Annual Crops	Rice	20	2010	50.0...				
PCL-P1Y-UD-93<-ACL-R-...	CL-CL_70	Cropland Annual Crops	Rice	20	2020	50.0...				
PCL-P1Y-UD-94<-ACL-M-...	CL-CL_71	Cropland Annual Crops	Maize	20	2015	50.0...				
PCL-P1Y-UD-95<-ACL-M-...	CL-CL_21	Cropland Annual Crops	Maize	20	2015	50.0...				

Units of land under conversion may be subject to a new conversion

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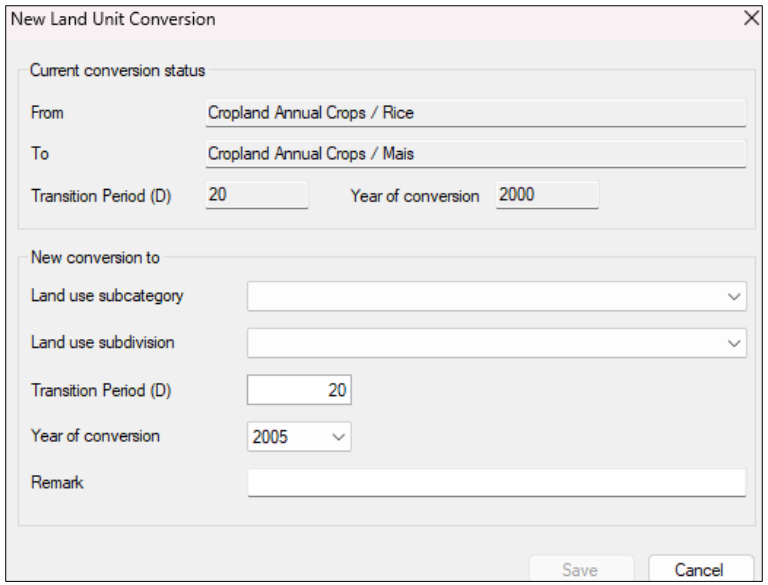
LRM – Adding a conversion to the history of a Unit of Land

Click on it to open the dialog box to add a conversion to a unit of land



Under approach 3, units of land may be subject to a new conversion before the transition period is completed. In such a case, users record the further conversion using the functionality above, where users enter:

A. **N**ew *Land use subcategory*

B. **N**ew *Land use subdivision*

C. ***T****ransition period*, (by default 20 years)

D. ***Y****ear of conversion*, (by default the current inventory year)

Regional Land conversion matrix – [Approaches 2/3]

Land Representation Manager

Regions | Land representation table | Land-use conversion matrix (Approach 2 & 3) | Total Land-use conversion matrix (All Regions and Approaches)

Region Region 2 **Region area (ha)** 115,000.000 **Approach 2** 2020

Final		Initial: Forest Land – Managed Forest Land	Forest Land – Unmanaged Forest Land	Cropland – Cropland Annual Crops	Cropland – Cropland Perennial Crops	Grassland – Managed Grassland	Grassland – Unmanaged Grassland	Wetlands – Managed Wetlands	Wetlands – Unmanaged Wetlands	Settlements – Settlements (Treed)	Settlements – Settlements (Other)	Other Land – Managed Other Land	Other Land – Unmanaged Other Land	Final Area (ha)	Net change (ha)
Forest Land	Managed Forest Land	3,210.000												3,210.000	0.000
	Unmanaged Forest Land		107,780.0...											107,780.000	0.000
Cropland	Cropland Annual Crops			40.000										40.000	0.000
	Cropland Perennial Crops				2,970.000									2,970.000	0.000
Grassland	Managed Grassland													0.000	0.000
	Unmanaged Grassland													0.000	0.000
Wetlands	Managed Wetlands							0.000		100.000				100.000	100.000
	Unmanaged Wetlands								300.000					300.000	-50.000
Settlements	Settlements (Treed)									100.000				100.000	-100.000
	Settlements (Other)								50.000		450.000			500.000	50.000
Other Land	Managed Other Land													0.000	0.000
	Unmanaged Other Land													0.000	0.000
	Initial Area (ha)	3,210.000	107,780.0...	40.000	2,970.000	0.000	0.000	0.000	350.000	200.000	450.000	0.000	0.000	115,000.000	0.000

No data Input - for verification only (not exportable yet)

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Total Land conversion matrix – [All Approaches & Regions]

Land Representation Manager

Regions | Land representation table | Land-use conversion matrix (Approach 2 & 3) | Total Land-use conversion matrix (All Regions and Approaches)

Total Area (ha) 118,700.000 2020

Final		Initial: Forest Land – Managed Forest Land	Forest Land – Unmanaged Forest Land	Cropland – Cropland Annual Crops	Cropland – Cropland Perennial Crops	Grassland – Managed Grassland	Grassland – Unmanaged Grassland	Wetlands – Managed Wetlands	Wetlands – Unmanaged Wetlands	Settlements – Settlements (Treed)	Settlements – Settlements (Other)	Other Land – Managed Other Land	Other Land – Unmanaged Other Land	Approach 1 – Final Area (ha) (2020)	Total final area (ha)	Net change (ha)
Forest Land	Managed Forest Land	3,210.000												960.000	4,170.000	960.000
	Unmanaged Forest Land		107,780....												107,780.0...	0.000
Cropland	Cropland Annual Crops			40.000	200.000										240.000	0.000
	Cropland Perennial Crops			200.000	3,270.000										3,470.000	0.000
Grassland	Managed Grassland													1,880.000	1,880.000	1,880.000
	Unmanaged Grassland														0.000	0.000
Wetlands	Managed Wetlands							0.000		100.000					100.000	100.000
	Unmanaged Wetlands								300.000						300.000	-50.000
Settlements	Settlements (Treed)									100.000					100.000	-100.000
	Settlements (Other)								50.000		450.000			160.000	660.000	210.000
Other Land	Managed Other Land														0.000	0.000
	Unmanaged Other Land														0.000	0.000
Approach 1	Initial Area (ha) (2019)															
	Total initial area (ha)	3,210.000	107,780....	240.000	3,470.000	0.000	0.000	0.000	350.000	200.000	450.000	0.000	0.000	115,700.0...	118,700.0...	3,000.000

Total Final

Total Initial

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Thank you

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