



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

IPCC TFI TSU

IPCC Guidelines

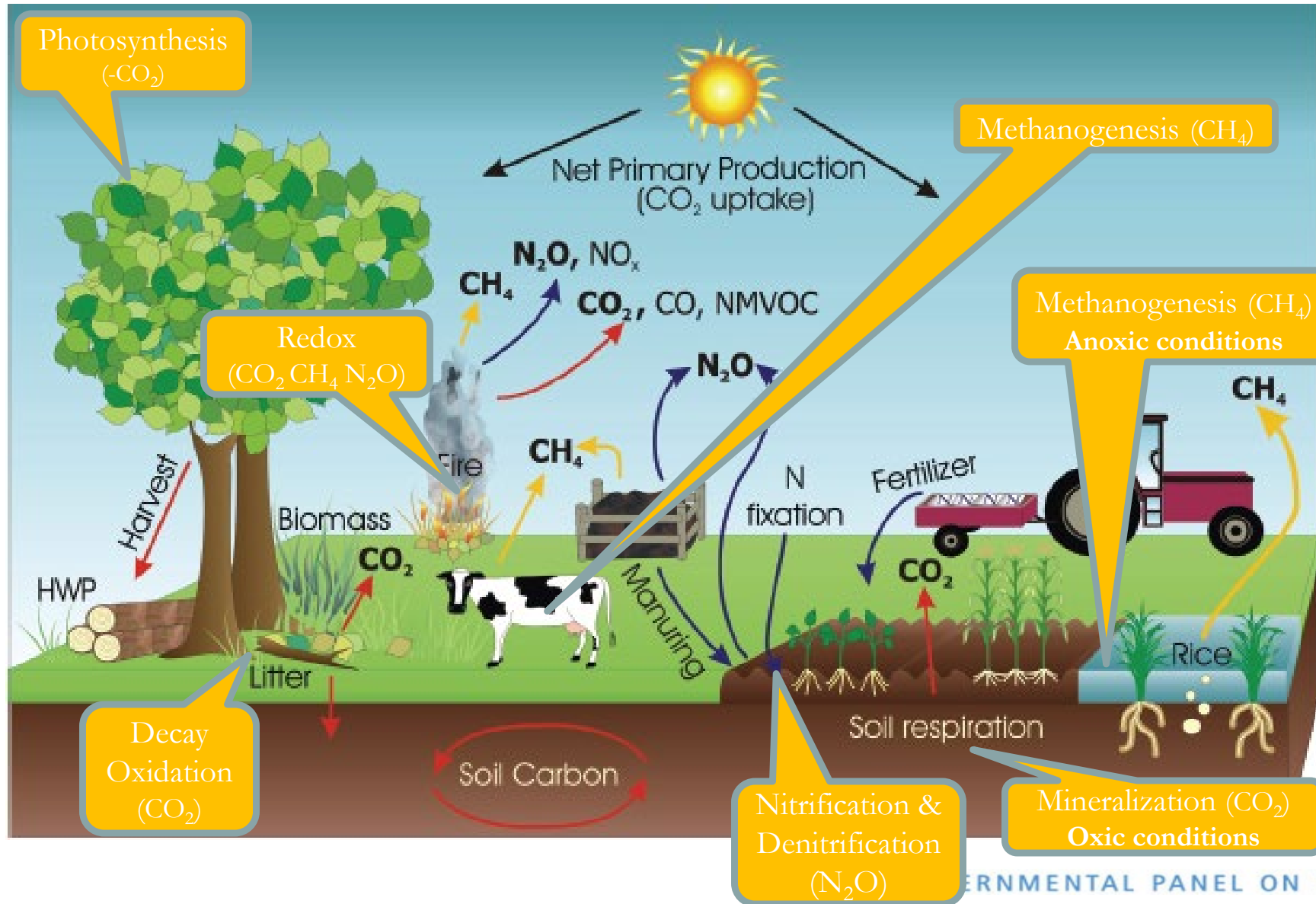
□ **Volume 4 (AFOLU), Chapter 3**

✓ **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

- $\text{CO}_2, \text{CH}_4, \text{N}_2\text{O}$
- $\text{NH}_3/\text{NH}_4^+, \text{NO}_x$
- $\text{H}_2\text{O}, \text{N}_2$

Chemicals

- ❑ Nitrogen fertilizers \Rightarrow N_2O emissions
- ❑ Carbonaceous mineral amendments \Rightarrow CO_2 emissions
- ❑ Nitrogen/Carbonaceous fertilizers (Urea) \Rightarrow N_2O + CO_2 emissions

Notations

- ❑ **Nitrogen** content of **N₂O** is indicated as **N₂O-N**, and emissions of N₂O-N are **converted** to N₂O emissions multiplying **by 44/28** (proportion of the atomic weight of the two molecules)
- ❑ **Carbon** content of **CH₄** is indicated as **CH₄-C**, and emissions of **CH₄-C** are **converted** to **CH₄** emissions multiplying **by 16/12** (proportion of the atomic weight of the two molecules)
- ❑ **Carbon** content of **CO₂** is indicated as **CO₂-C**, and emissions of **CO₂-C** are **converted** to **CO₂** emissions multiplying **by 44/12** (proportion of the atomic weight of the two molecules)
- ❑ **Emissions** have a **positive sign**, while **CO₂ 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 CO₂ 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 **CO₂ 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., CO₂ 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 CO₂ 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

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>)

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



Bio-physical characteristics	<ul style="list-style-type: none">• Climate• Ecological zone (vegetation)• Soil
Land Use	<ul style="list-style-type: none">• Managed vs unmanaged land• IPCC Land use categories (6)• Current and historical land-use
Management practices	<ul style="list-style-type: none">• Current and historical management• Natural vs planted forest• Improved/unimproved grassland etc.
Disturbances	<ul style="list-style-type: none">• Fires• Pest• etc.
Other specific variables	<ul style="list-style-type: none">• Trees age class
Homogeneous Stratum	<ul style="list-style-type: none">• Unit of land

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-pastoral 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	<ul style="list-style-type: none"> Climate Ecological zone (vegetation) Soil
Land Use	<ul style="list-style-type: none"> Managed vs unmanaged land IPCC Land use categories (6) Current and historical land-use
Management practices	<ul style="list-style-type: none"> Current and historical management Natural vs planted forest Improved/unimproved grassland etc.
Disturbances	<ul style="list-style-type: none"> Fires Pest etc.
Other specific variables	<ul style="list-style-type: none"> Trees age class
Homogeneous Stratum	<ul style="list-style-type: none"> Unit of land

The Land Representation - IPCC Approaches

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

Approach 1

- land use categories are identified, and areas quantified
- land use/management changes are neither identified nor quantified since data are not spatially-explicit

Approach 2

- land use categories are identified, and areas quantified
- land use/management changes are identified, and changes are:
 - * quantified (areas) *between 2 points in time only*
 - * although, not tracked over time

Approach 3

- land use categories are identified, and areas quantified
- land use/management changes are identified, and changes are:
 - * Quantified (areas)
 - * Tracked over time

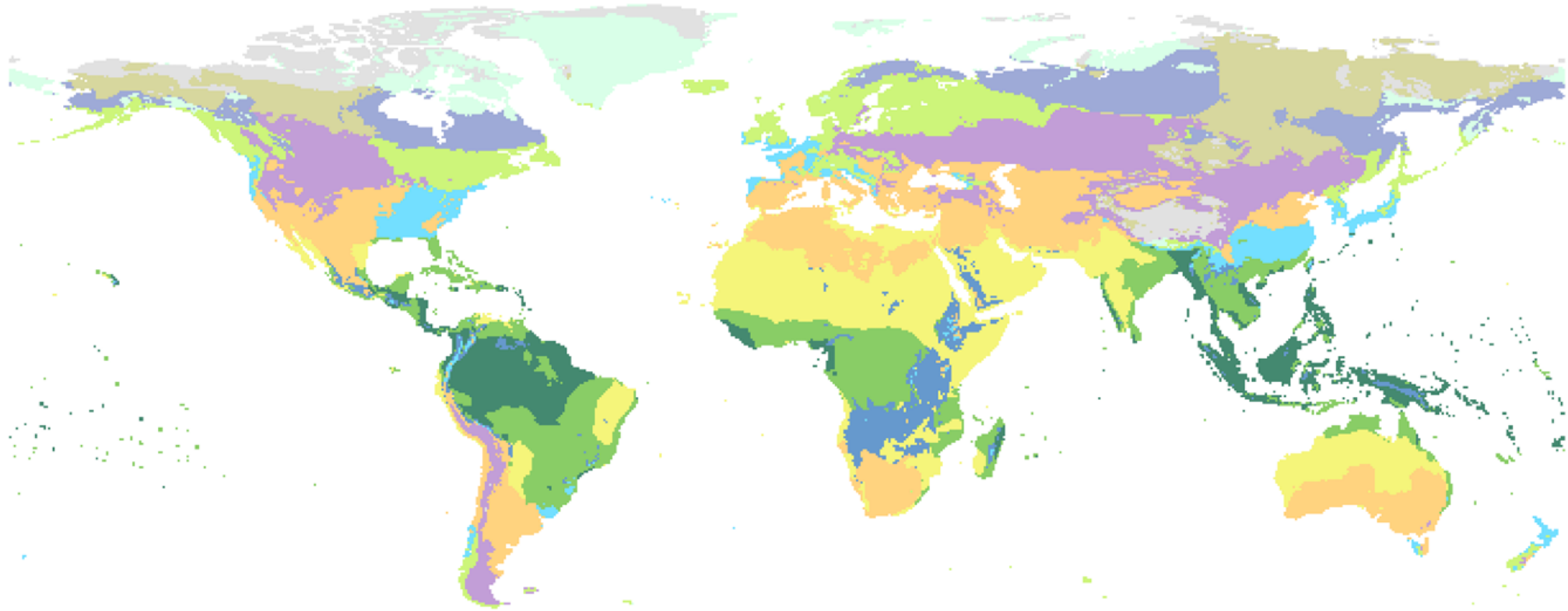
Data requirement, Complexity, Accuracy

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)



IPCC Climate Zones



	Bio-physical characteristics	<ul style="list-style-type: none"> • Climate • Ecological zone (vegetation) • Soil
	Land Use	<ul style="list-style-type: none"> • Managed vs unmanaged land • IPCC Land use categories (6) • Current and historical land-use
	Management practices	<ul style="list-style-type: none"> • Current and historical management • Natural vs planted forest • Improved/unimproved grassland etc.
	Disturbances	<ul style="list-style-type: none"> • Fires • Pest • etc.
	Other specific variables	<ul style="list-style-type: none"> • Trees age class
	Homogeneous Stratum	<ul style="list-style-type: none"> • Unit of land

Land Representation

Bio-physical Characteristics (Vegetation)

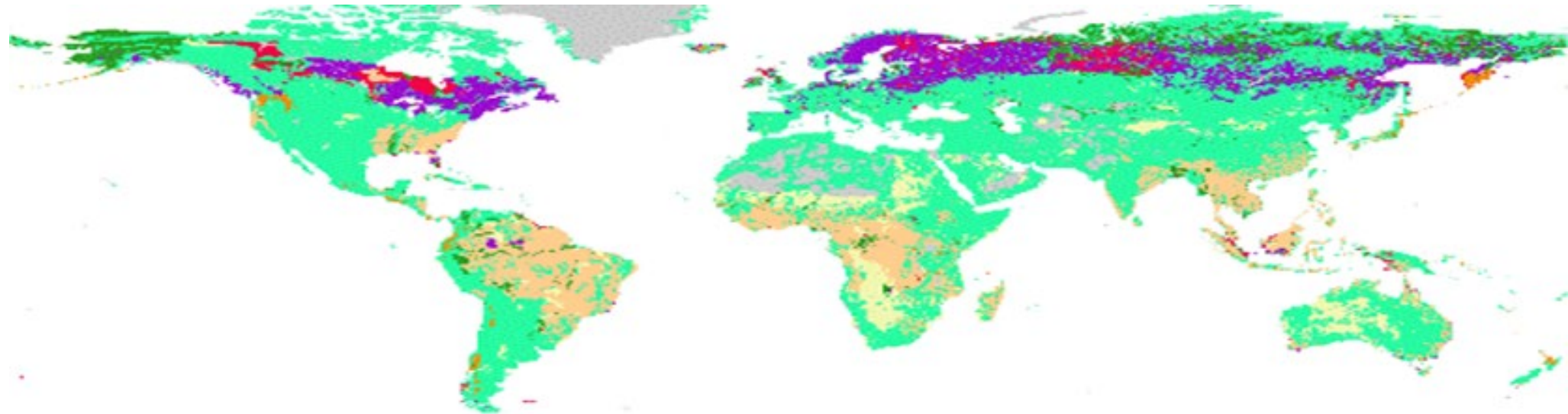
FAO Global Ecological Zones (GEZ)

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	<ul style="list-style-type: none">• Climate• Ecological zone (vegetation)• Soil• Managed vs unmanaged land• IPCC Land use categories (6)• Current and historical land-use• Current and historical management• Natural vs planted forest• Improved/unimproved grassland etc.• Fires• Pest• etc.
	Land Use	
	Management practices	
	Disturbances	
	Other specific variables	<ul style="list-style-type: none">• Trees age class
	Homogeneous Stratum	<ul style="list-style-type: none">• 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 broadleaves	
	Forest land	Unmanaged	Mngroves forest	Coastal Wetlands	none		Tropical Moist	Tropical moist deciduous forest	Mangroves	
	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									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	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					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				
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									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	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					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				
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	

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	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					9,990						100	10,090		10	
Cropland	Annual Crops	Lotus		IWM				10						3,000	3,000	3,010	
	Perennial Crops	Oil Palm							3,000					0	500		
Wetlands	Managed Wetlands	Tidal Marshes		CW						0				500	500	500	
	Unmanaged Wetlands											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	500	300	200			
					110,990			3,010		500		500					

ID	Previous			Current			Area (ha)
	Category	Subcategory	Subdivision	Category	Subcategory	Subdivision	
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								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)											
Category	Subcategory	Subdivision	Climate	Soil	Subdivision								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					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	
	Unmanaged Wetlands												500				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

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								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	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				9,990							10,090	10			
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 (Other)	Harbor								300			300					
Settlements	Settlements (Treed)	Urban Park											100	100	100	100	400
	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

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	<i>Climate</i>	<i>Soil</i>	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

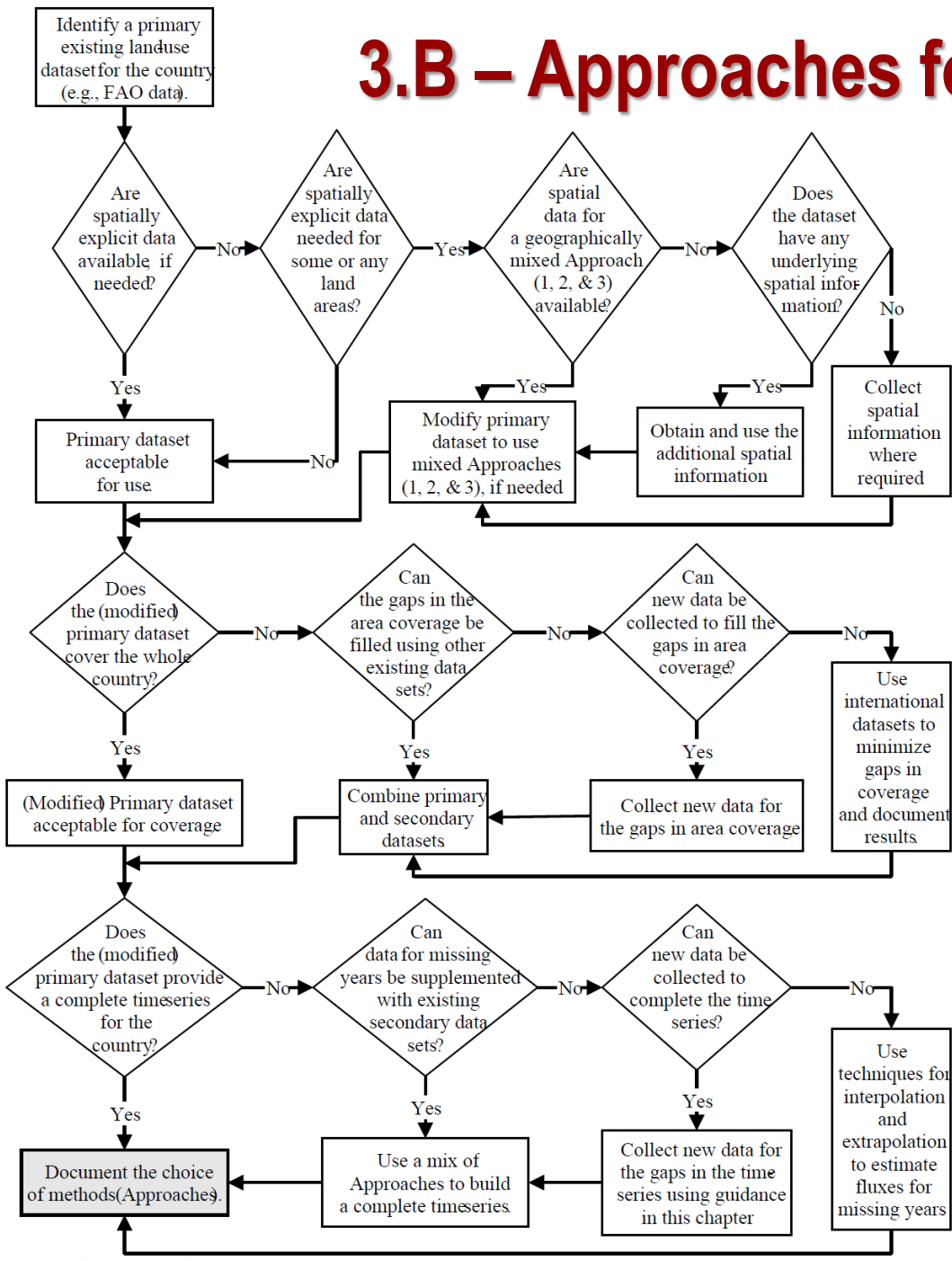
- ✓ Regions (i.e. sub-national units)
- ✓ Units of land (areas homogeneous for all relevant variables) and associated:
 - Time series of areas
 - C-stock change calculation methods for each unit of land

Steps to Land Representation [1-5]

1. **Assess availability of a time series of data on land use/cover and land use/cover change.** Ideally the time series covers the period from $Y_{t_0} - D$ to Y_{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. **Assess 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. **Assess consistency of land categories with the default IPCC categories, which means to reconcile any user-specific categorization to the IPCC 6 land categories.**
4. **Applies the IPCC Decision Tree at the level of Region to assess which methodological Approach is to be applied**
5. **Gap-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*

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

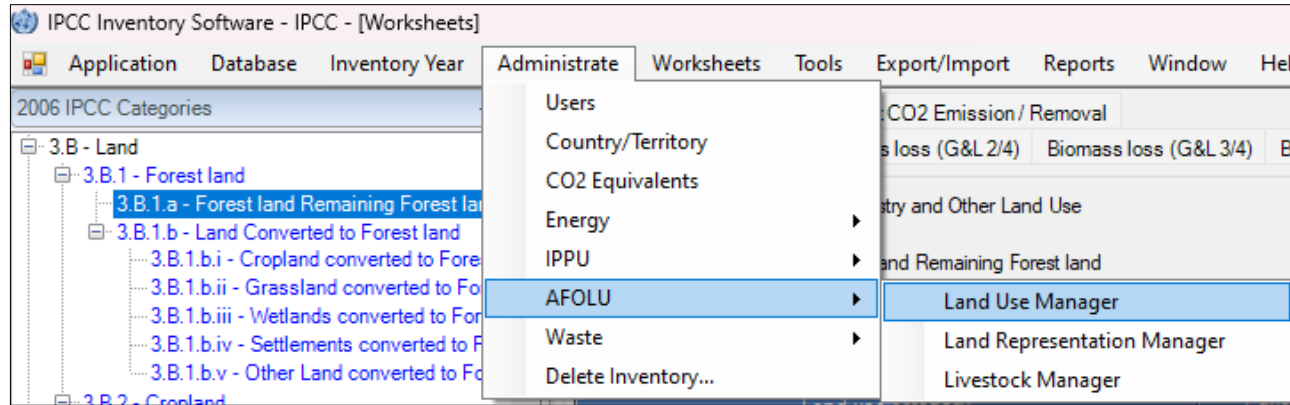
- ❑ **Interoperability with UNFCCC ETF reporting tool** allows to export a complete set of CRTs and upload it in the UNFCCC ETF reporting tool

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



SOM Organic Rewetted

Total NetCO2 Emission / Removal

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 (G&L - Abrupt)

Biomass (SD - Approaches 2&3)

DOM (G&L)

DOM (SD - Approaches 2&3)

SOM Mineral - Eq. 2.25 Formulation B

SOM (SD - Approaches 2&3)

SOM Organic Drained

Worksheet

Agriculture, Forestry and Other Land Use

Sector: Forest Land

Category: 3.B.1.a - Forest land Remaining Forest land

Subcategory: 1 of 4 Annual increase in carbon stocks in biomass (includes above-ground and below-ground biomass)

Sheet: Data

Region (None)

Land use category					Equation 2.9		Equation 2.10					Equation 2.9				
					Area (ha)	Mean annual increment of growing stock (m3 / ha / yr)	Biomass expansion factor for conversion of annual net increment to above-ground biomass increment	Basic wood density (t d.m. / m3 fresh volume)	Biomass conversion and expansion factor for increment (t d.m. / m3 wood volume)	Average annual above-ground biomass growth (tonnes d.m. / (ha * yr))	Ratio of below-ground biomass to above-ground biomass (t bg d.m. / t ag d.m.)	Average annual biomass growth above- and below-ground (tonnes d.m. / (ha * yr))	Carbon fraction of dry matter (tonnes C / tonne d.m.)	Annual increase in biomass carbon stocks due to biomass growth (tonnes C / yr)		
Land unit code	Initial land use		Land use during reporting year		National statistics or international data sources	National statistics or international data sources	Table 3.A.1.10 / National statistics or international data sources	Tables 4.13 / 4.14 / 4.6 WS / National statistics or international data sources	BCEFI = BEF1 * D / Specified	Gw = Iv * BCEFI / Specified	Zero (0) or Table 4.4 / 4.5 WS / National statistics or international data sources	Gtotal = Gw * (1+R)	0.47 / Table 4.3 / mangroves	ΔCG = A * Gtotal * CF		
▼	Δ ▼	Δ ▼	Δ ▼	Δ ▼	A	Iv	BEF1	D	BCEFI	Gw	R	Gtotal	CF	ΔCG		
Total					0.000							0.000		0.000		

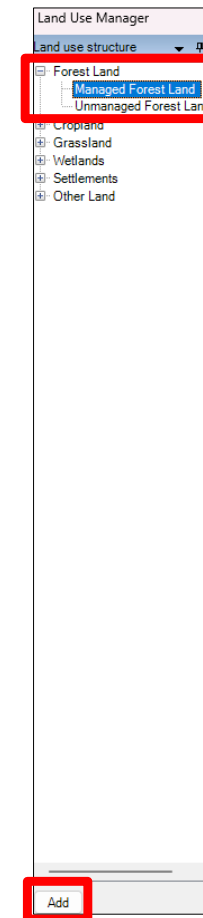
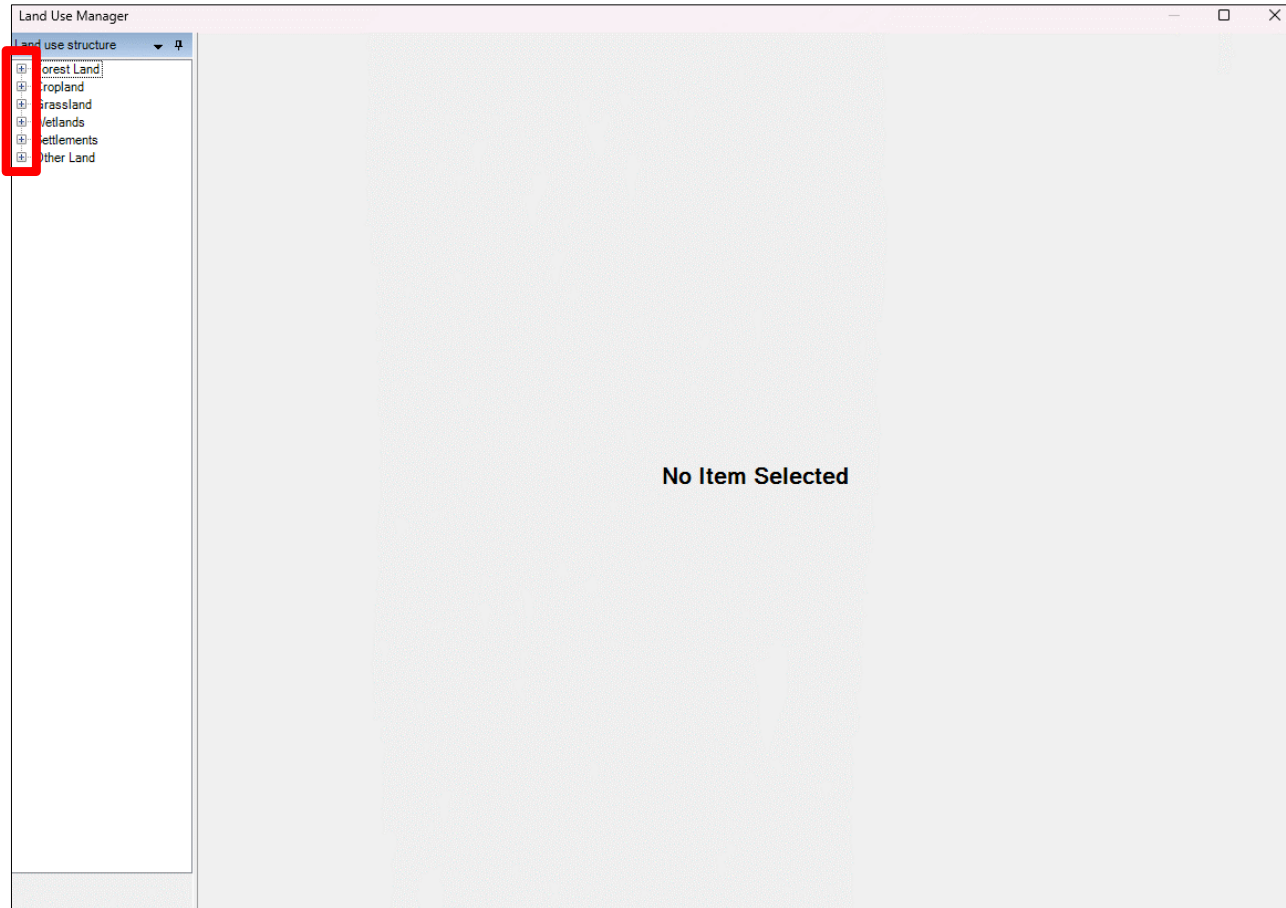
Land Use Manager

Land Representation Manager

Uncertainties

Time Series data entry

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

Land use structure <ul style="list-style-type: none">Forest Land<ul style="list-style-type: none">Managed Forest Land<ul style="list-style-type: none">Secondary forestUnmanaged Forest LanCroplandGrasslandWetlandsSettlementsOther Land	Land use subdivision - common parameters					
	Land use subdivision name	Secondary forest	Country/Territory	World		
	Soil Type	Low Activity Clay Mineral	Continent	World		
	Soil Status	No change in hydrology	Climate Region	Warm Temperate Moist		
Land use subdivision - Managed Forest Land specific parameters						
Ecological zone		Subtropical humid forest	Species	Other Broadleaf	Natural Forest <input checked="" type="radio"/>	Abandoned managed land <input type="checkbox"/>
					Plantation <input type="radio"/>	

Land use subdivision - common parameters					
Land use subdivision name	Forest plantation	Country/Territory	World		
Soil Type	Inland Organic	Continent	World		
Soil Status	Drained	Climate Region	Tropical Moist		
Nutrient content	Rich				
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager					
Land use subdivision - Managed Forest Land specific parameters					
Ecological zone	Tropical moist deciduous forest	Species	User-defined	Natural Forest <input type="radio"/>	Abandoned managed land <input type="checkbox"/>
			clone XYZ	Plantation <input checked="" type="radio"/>	

Land use structure <ul style="list-style-type: none">Forest Land<ul style="list-style-type: none">Managed Forest Land<ul style="list-style-type: none">Forest plantationSecondary forestUnmanaged Forest Lan<ul style="list-style-type: none">Primary ForestCroplandGrasslandWetlandsSettlementsOther Land	Land use subdivision - common parameters					
	Land use subdivision name	Primary Forest	Country/Territory	World		
	Soil Type	Inland Organic	Continent	World		
	Soil Status	No change in hydrology	Climate Region	Tropical Moist		
Land use subdivision - Unmanaged Forest Land specific parameters						
Ecological zone		Tropical moist deciduous forest	Species	Other Broadleaf		

Land use structure <ul style="list-style-type: none">Forest Land<ul style="list-style-type: none">Managed Forest Land<ul style="list-style-type: none">Forest plantationSecondary forestUnmanaged Forest Lan<ul style="list-style-type: none">Mangroves forestPrimary ForestCroplandGrasslandWetlandsSettlementsOther Land	Land use subdivision - common parameters					
	Land use subdivision name	Mangroves forest	Country/Territory	World		
	Soil Type	Coastal Wetlands	Continent	World		
	Soil Status	No change in hydrology	Climate Region	Tropical Moist		
Land use subdivision - Unmanaged Forest Land specific parameters						
Ecological zone		Tropical moist deciduous forest	Species	User-defined		
			Mangroves			

Land Use Manager (LUM) – Subdivisions – Annual Cropland

Land use subdivision - common parameters			
Land use subdivision name	Lotus (converted)	Country/Territory	World
Soil Type	Inland Wetland Mineral + ▾	Continent	World
Soil Status	Rewetted ▾	Climate Region	Tropical Moist + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Annual Crops specific parameters			
Rice ecosystem <input type="checkbox"/>			

Land use subdivision - common parameters			
Land use subdivision name	Lotus (long-term)	Country/Territory	World
Soil Type	Inland Wetland Mineral + ▾	Continent	World
Soil Status	Rewetted ▾	Climate Region	Tropical Moist + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Annual Crops specific parameters			
Rice ecosystem <input type="checkbox"/>			

Land use subdivision - common parameters			
Land use subdivision name	Maize	Country/Territory	World
Soil Type	Volcanic Mineral + ▾	Continent	World
Soil Status	No change in hydrology ▾	Climate Region	Warm Temperate Moist + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Annual Crops specific parameters			
Rice ecosystem <input type="checkbox"/>			

Land use subdivision - common parameters			
Land use subdivision name	Rice	Country/Territory	World
Soil Type	Volcanic Mineral + ▾	Continent	World
Soil Status	No change in hydrology ▾	Climate Region	Warm Temperate Moist + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Annual Crops specific parameters			
Rice ecosystem <input checked="" type="checkbox"/>			

Land Use Manager (LUM) – Subdivisions – Perennial Cropland

Land use subdivision - common parameters			
Land use subdivision name	<input type="text" value="Oil Palm"/>	Country/Territory	<input type="text" value="World"/>
Soil Type	<input type="text" value="Inland Wetland Mineral"/> + ▾	Continent	<input type="text" value="World"/>
Soil Status	<input type="text" value="Drained"/> ▾	Climate Region	<input type="text" value="Tropical Moist"/> + ▾
Land use subdivision - Perennial Crops specific parameters			
Cropland type	<input type="text" value="Oil Palm"/> ▾		

Land use subdivision - common parameters			
Land use subdivision name	<input type="text" value="Poplar (10-year)"/>	Country/Territory	<input type="text" value="World"/>
Soil Type	<input type="text" value="Volcanic Mineral"/> + ▾	Continent	<input type="text" value="World"/>
Soil Status	<input type="text" value="No change in hydrology"/> ▾	Climate Region	<input type="text" value="Warm Temperate Moist"/> + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Perennial Crops specific parameters			
Cropland type	<input type="text" value="User-defined"/> ▾ <input type="text" value="Poplar"/>		

Land use subdivision - common parameters			
Land use subdivision name	<input type="text" value="Poplar (5-year)"/>	Country/Territory	<input type="text" value="World"/>
Soil Type	<input type="text" value="Volcanic Mineral"/> + ▾	Continent	<input type="text" value="World"/>
Soil Status	<input type="text" value="No change in hydrology"/> ▾	Climate Region	<input type="text" value="Warm Temperate Moist"/> + ▾
It is not possible to change some of the parameters since subdivision is already being used in Land Representation Manager			
Land use subdivision - Perennial Crops specific parameters			
Cropland type	<input type="text" value="User-defined"/> ▾ <input type="text" value="Poplar"/>		

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

Land use subdivision - common parameters				
Land use subdivision name	<input type="text" value="Grazed"/>		Country/Territory	<input type="text" value="World"/>
Soil Type	<input type="text" value="Low Activity Clay Mineral"/> + ▾		Continent	<input type="text" value="World"/>
Soil Status	<input type="text" value="No change in hydrology"/> ▾		Climate Region	<input type="text" value="Warm Temperate Moist"/> + ▾
Land use subdivision - Managed Grassland specific parameters				
Vegetation type	<input type="text" value="Prairie"/> ▾	Improved grassland	<input type="checkbox"/>	
		Abandoned managed land	<input type="checkbox"/>	

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

Land use subdivision - common parameters			
Land use subdivision name	Tidal marshes (managed)	Country/Territory	World
Soil Type	Coastal Wetlands + ▾	Continent	World
Soil Status	Rewetted ▾	Climate Region	Tropical Moist + ▾
Land use subdivision - Managed Wetlands specific parameters			
Type			
<input type="radio"/> Peatlands under extraction			
<input type="radio"/> Peatlands abandoned (former extraction)			
<input type="radio"/> Flooded land			
<input checked="" type="radio"/> Other Wetlands <input checked="" type="checkbox"/> Coastal Wetlands Tidal marsh ▾			

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

Land use subdivision - common parameters			
Land use subdivision name	Tidal marshes (unmanaged)	Country/Territory	World
Soil Type	Coastal Wetlands + ▾	Continent	World
Soil Status	No change in hydrology ▾	Climate Region	Tropical Moist + ▾
Land use subdivision - Unmanaged Wetlands specific parameters			
Type			
<input checked="" type="radio"/> Other Wetlands <input checked="" type="checkbox"/> Coastal Wetlands Tidal marsh ▾			

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

Land use subdivision - common parameters			
Land use subdivision name	Urban park	Country/Territory	World
Soil Type	Coastal Wetlands + ▾	Continent	World
Soil Status	Drained ▾	Climate Region	Tropical Moist + ▾

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

Land use subdivision - common parameters			
Land use subdivision name	Buildings	Country/Territory	World
Soil Type	Low Activity Clay Mineral + ▾	Continent	World
Soil Status	No change in hydrology ▾	Climate Region	Warm Temperate Moist + ▾

Land use subdivision - common parameters			
Land use subdivision name	Harbor	Country/Territory	World
Soil Type	Coastal Wetlands + ▾	Continent	World
Soil Status	Extracted ▾	Climate Region	Tropical Moist + ▾

LUM – Soil Type Manager

Soil Type Manager			
Soil Type Name	Composition	Remark	
Coastal Wetlands soil	Mixed	Table 4.11 WS	
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).	
Inland Organic soil	Organic	Soils classified as histosols. See glossary of IPCC GPG 2003 for additional details.	
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).	
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).	
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)	
Wetland Mineral	Mineral	Soils with restricted drainage leading to periodic flooding and anaerobic conditions (in WRB classification Gleysols; in USDA classification Aquic suborders).	
* Terra preta	Mineral	average black carbon content 33 Mg ha ⁻¹ m ⁻¹	✗
*			✗

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

Default soil types as well as soil types already used in any Land Use Subdivision cannot be changed nor deleted.

Save Undo Close

LUM – Climate Region Manager

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 Temperature ≥10°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Boreal Moist	Mean Annual Temperature ≤0°C; Each Month Mean Temperature ≥10°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
Polar	Polar Dry	Mean Annual Temperature ≤0°C; Each Month Mean Temperature <10°C; Mean Annual Precipitation lower than Potential Evapo-Transpiration
	Polar Moist	Mean Annual Temperature ≤0°C; Each Month Mean Temperature <10°C; Mean Annual Precipitation higher than Potential Evapo-Transpiration
* Tropical	eastern amazonia climate	mean annual precipitation > 2,500 mm; mean annual temperature 31 C

Default climate regions as well as climate regions already used in any Land Use Subdivision cannot be changed nor deleted.

Save
Undo
Close

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 CO₂ 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

Land Representation Manager

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

Whole country area (ha) 118,700,000

Region name	Area (ha)	Approach	Remark
▶ Region 1	3,000,000	Approach 1	
Region 2	115,000,000	Approach 2	
Region 3	700,000	Approach 3	
*			
Total	118700,000		

- ✓ 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

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

Save Undo Close

Land Representation Manager - Tips

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 1 | Region area (ha): 3,000.000 | Discrepancy (ha): 2000: OK; 1980: OK | Approach 1: 2000

	Land use category	Area (2000) (ha)	Area (1980) (ha)	Remark
+	Forest Land	1,000.000	900.000	
+	Cropland	0.000	0.000	
+	Grassland	1,890.000	2,000.000	
+	Wetlands	0.000	0.000	
+	Settlements	110.000	100.000	
+	Other Land	0.000	0.000	

❑ 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

The screenshot shows the 'Land Representation Manager' window with the 'Land representation table' tab selected. The interface includes a 'Region' dropdown set to 'Region 1', a 'Region area (ha)' field with the value '3,000.000', and a 'Discrepancy (ha)' field with the value '2000: OK; 1980: OK'. The 'Approach' is set to 'Approach 1' and the 'Year' is '2000'.

The table structure is as follows:

Land use category	Area (2000) (ha)	Area (1980) (ha)	Remark
Forest Land	1,000.000	900.000	

1

Land use subcategory	Area (2000) (ha)	Area (1980) (ha)	Remark
Managed Forest Land	1,000.000	900.000	

2

Current Land use subdivision	Remark
Secondary forest	

3

Land unit code (Automatic)	Land unit code (User defined)	Area (2000) (ha)	Area (1980) (ha)	Remark	P
MFL-SF-NF-OB-1	MFL_1	1,000.000 ↔	900.000		
*		↔			

❑ 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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion m
Whole country area (ha)			
118,000,000			
Region name		Area (ha)	
Region 1		8000	
Region 2		115,000,000	
Region 3		700,000	
*			
Total		118,700,000	

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion m
Whole country area (ha)			
120,000,000			
Region name		Area (ha)	
Region 1		3,000,000	
Region 2		115,000,000	
Region 3		700,000	
*			
Total		118,700,000	

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion m
Whole country area (ha)			
118,700,000			
Region name		Area (ha)	
Region 1		3,000,000	
Region 2		115,000,000	
Region 3		700,000	
*			
Total		118,700,000	

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

Land Representation Manager - Tips

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion matrix (All Regions and Approaches)
Region	Region 1	Region area (ha)	3,000,000
		Discrepancy (ha)	2015: -100,000; 1995: OK
		Approach 1	
	Land use category	Area (2015) (ha)	Area (1995) (ha)
	Forest Land	1,070,000	900,000
	Cropland	0,000	0,000
	Grassland	1,860,000	2,000,000
	Wetlands	0,000	0,000
	Settlements	170,000	100,000
	Other Land	0,000	0,000

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion matrix (All Regions and Approaches)
Region	Region 1	Region area (ha)	3,000,000
		Discrepancy (ha)	2015: -100,000; 1995: OK
		Approach 1	
	Land use category	Area (2015) (ha)	Area (1995) (ha)
	Forest Land	1,070,000	900,000
	Cropland	0,000	0,000
	Grassland	1,860,000	2,000,000
	Wetlands	0,000	0,000
	Settlements	170,000	100,000
	Other Land	0,000	0,000

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion matrix (All Regions and Approaches)
Region	Region 1	Region area (ha)	3,000,000
		Discrepancy (ha)	2015: OK; 1995: +100,000
		Approach 1	
	Land use category	Area (2015) (ha)	Area (1995) (ha)
	Forest Land	970,000	800,000
	Cropland	0,000	0,000
	Grassland	1,860,000	2,000,000
	Wetlands	0,000	0,000
	Settlements	170,000	100,000
	Other Land	0,000	0,000

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

Regions	Land representation table	Land-use conversion matrix (Approach 2 & 3)	Total Land-use conversion matrix (All Regions and Approaches)
Region	Region 1	Region area (ha)	3,000,000
		Discrepancy (ha)	2015: OK; 1995: OK
		Approach 1	
	Land use category	Area (2015) (ha)	Area (1995) (ha)
	Forest Land	970,000	900,000
	Cropland	0,000	0,000
	Grassland	1,860,000	2,000,000
	Wetlands	0,000	0,000
	Settlements	170,000	100,000
	Other Land	0,000	0,000

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

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 CO₂ fluxes

Region	Region area (ha)	Discrepancy (ha)	1995: OK; 1975: OK	Approach 1	1995
Region 1	3,000,000				
Land use category					
Forest Land	900,000	900,000			
Land use subcategory					
Managed Forest Land	900,000	900,000			
Current Land use subdivision					
Secondary forest					
Land unit code (Automatic)					
MFL-SF-NF-OB-1					
Land unit code (User defined)					
MFL_1	900,000	900,000			
Remark					
					P

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 CO₂ fluxes

LRM – Setting method to estimate CSCs/CO₂ fluxes



Click on it to select the method to apply to each C pool to calculate CSCs and CO₂ fluxes

Land Unit Parameters

C pools / Methods

Biomass change: Gain & Loss

DOM - Deadwood: Gain & Loss

DOM - Litter: Gain & Loss

SOM - Mineral: Default

SOM - Organic: Default

Save Cancel

Land Unit Parameters

C pools / Methods

Biomass change: Gain & Loss

DOM - Deadwood: Gain & Loss

DOM - Litter: Gain & Loss

SOM - Mineral: Default

SOM - Organic: Default

Save Cancel

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

Land Unit Parameters

C pools / Methods

Biomass change: Stock difference

DOM - Deadwood: Stock difference

DOM - Litter: Stock difference

SOM - Mineral: Default

SOM - Organic: Default

Save Cancel

- ✓ 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 CO₂ 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

Area (1995) (ha)
900.000 <->

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

Area update mode

☐ Current inventory year only

☒ Current inventory year and all subsequent inventory years

☐ Current inventory year and all previous inventory years

☐ All inventory years

Update

Cancel

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,
each unit of land:

1. Enter
subcategory
subdivision

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

for

previous
&

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 | Discrepancy (ha): OK | Approach 2 | 2015

Land use category	Area (2015) (ha)	Remark							
Forest Land	110,990.000								
Land use subcategory	Area (2015) (ha)	Remark							
Managed Forest Land	3,125.000								
Current Land use subdivision	Remark								
Forest plantation									
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 (2015) (ha)	Remark	P	M
MFL-FP-PL-TG-4	MFL-MFL_1	Managed Forest Land	Forest plantation	NA	NA	1,000.0			
MFL-FP-PL-TG-13<-UFL-PF...	UFL-MFL_2000_1	Unmanaged Forest Land	Primary Forest	20	2000	1,000.0			
MFL-FP-PL-TG-16<-UFL-PF...	UFL-MFL_2005_1	Unmanaged Forest Land	Primary Forest	20	2005	600.0			
MFL-FP-PL-TG-19<-UFL-PF...	UFL-MFL_2010_1	Unmanaged Forest Land	Primary Forest	20	2010	350.0			
MFL-FP-PL-TG-22<-UFL-PF...	UFL-MFL_2015-1	Unmanaged Forest Land	Primary Forest	20	2015	175.0			
*									

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

LRM – Merging a Unit of Land

Land Representation Manager

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

RegionRegion 2Region area (ha)115,000.000Discrepancy (ha)OKApproach 22020

Land use category		Area (2020) (ha)	Remark						
Forest Land		110,990.000							
Land use subcategory		Area (2020) (ha)	Remark						
Managed Forest Land		3,125.000							
Current Land use subdivision		Remark							
Forest plantation									
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	M
MFL-FP-PL-TG-4	MFL-MFL_1	Managed Forest Land	Forest plantation	NA	NA	1,000.0			
MFL-FP-PL-TG-13	UFL-MFL_2000_1	Managed Forest Land	Forest plantation	NO	NO	1,000.0			
MFL-FP-PL-TG-16<UFL-PF...	UFL-MFL_2005_1	Unmanaged Forest Land	Primary Forest	20	2005	600.0			
MFL-FP-PL-TG-19<UFL-PF...	UFL-MFL_2010_1	Unmanaged Forest Land	Primary Forest	20	2010	350.0			
MFL-FP-PL-TG-22<UFL-PF...	UFL-MFL_2015-1	Unmanaged Forest Land	Primary Forest	20	2015	175.0			

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

LRM – Merging a Unit of Land



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

Merge Land Unit

Source Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Forest plantation

Land unit: UFL-MFL_2000_1

Area [ha]: 1000

Target Land Unit

Land use subcategory: Managed Forest Land

Land use subdivision: Forest plantation

Land unit:

Area [ha]: +1000 [ha]

Merge Cancel

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
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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

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

New Land Unit Conversion

Current conversion status

From: Cropland Annual Crops / Rice

To: Cropland Annual Crops / Mais

Transition Period (D): 20 Year of conversion: 2000

New conversion to

Land use subcategory: [dropdown]

Land use subdivision: [dropdown]

Transition Period (D): 20

Year of conversion: 2005 [dropdown]

Remark: [text area]

Save Cancel

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. New Land use subcategory
- B. New Land use subdivision
- C. Transition period, (by default 20 years)
- D. Year 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						
Initial		Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land				
Final		Managed Forest Land	Unmanaged Forest Land	Cropland Annual Crops	Cropland Perennial Crops	Managed Grassland	Unmanaged Grassland	Managed Wetlands	Unmanaged Wetlands	Settlements (Treed)	Settlements (Other)	Managed Other Land	Unmanaged Other Land	Final Area (ha)	Net change (ha)	
Forest Land	Managed Forest Land	3,210.000												3,210.000	0.000	
	Unmanaged Forest Land		107,780.000											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	107,780.000	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)

Total Land conversion matrix – [All Approaches & Regions]

Land Representation Manager

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

Total Area (ha)118,700.0002020

Initial		Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		Approach 1		
Final		Managed Forest Land	Unmanaged Forest Land	Cropland Annual Crops	Cropland Perennial Crops	Managed Grassland	Unmanaged Grassland	Managed Wetlands	Unmanaged Wetlands	Settlements (Treed)	Settlements (Other)	Managed Other Land	Unmanaged Other Land	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		107,780.000												107,780.000	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	107,780.000	240.000	3,470.000	0.000	0.000	0.000	350.000	200.000	450.000	0.000	0.000	115,700.000	118,700.000	3,000.000

Total Final

Total Initial



Thank you

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

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INTERGOVERNMENTAL PANEL ON climate change

