CBIT-GSP CLIMATE TRANSPARENCY

Partnership on Transparency in the Paris Agreement

Training Workshop: Preparation and Reporting of Results of National GHG Inventories under the ETF of the Paris Agreement

Kigali, Rwanda 25-27 June 2024

Topic: Understanding the 2006 IPCC Guidelines requirements on land representation for the creation of consistent time series for IPCC land use categories and land use change area information and generation of land use change matrix

Sekai Ngarize
Climate Transparency and Forestry Advisor
sngarize47@gmail.com

UN environment programme | copenhagen climate centre

gef

UN environment programme

Supported by:
Federal Ministry for Economic Affairs and Climate Action
Federal Foreign Office
on the basis of a decision by the German Bundestag

IKI INTERNATIONAL CLIMATE INITIATIVE

REMA OUR ENVIRONMENT OUR FUTURE

Presentation Outline

- IPCC Definiton: Managed land as a proxy for estimating GHG emissions \removals in the LULUCF Sector
- Land representation | introduction
- Land representation | stratification
- Land representation | methodological approach

The use of managed land as a proxy in estimating LULUCF emissions and removals (E/R)

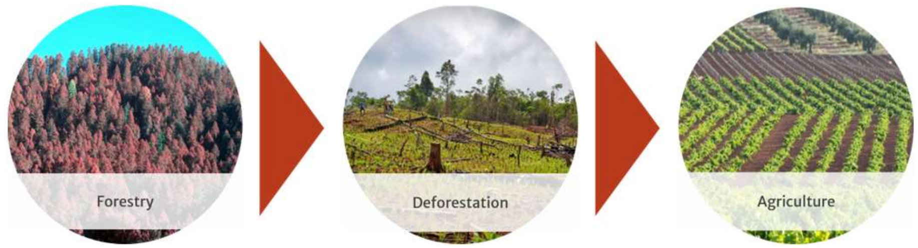
- Factors governing E/R can be both natural and anthropogenic and can be difficult to distinguish between causal factors
- Inventory methods have to be operational, practical and globally applicable while being scientifically sound
- IPCC Guidelines have taken the approach of defining anthropogenic greenhouse gas emissions by sources and removals by sinks as all those occurring on 'managed land'
- 'Managed land is land where human interventions and practices have been applied to perform production, ecological or social functions: Source - IPCC 2006 Guidelines'
- Managed land has to be nationally defined and classified transparently and consistently over time
- GHG emissions/removals need not be reported for unmanaged land

Land Representation: Introduction

- In the 2006 GL Land representation is the analysis undertaken to identify and quantify human activities on land, as well as to track their changes over time.
- This includes analysis of information, on land classification, land area data, and sampling that represents various land-use categories, this information is needed to estimate the carbon stocks, and the emission and removal of greenhouse gases associated with Forestry and Other Land Use (FOLU) or LULUCF activities.
- The land representation results in a stratification of the total area of the country into strata (units of land) homogeneous for a number of variables, that explain the current level and dynamic of C stocks within the stratum, with the purpose of making the GHG inventory compilation practicable while enhancing accuracy of GHG estimates.
- Land is characterized by bio-physical variables and various human activities. The variables for land stratification are listed below:

➢ Biophysical characteristics
➢ Land Use
➢ Management practices and disturbances
➢ Other category specific variables
➢ Stratum: Unit of Land

Land representation | introduction



Source: FAO e-learning course: The national GHG inventory for land use

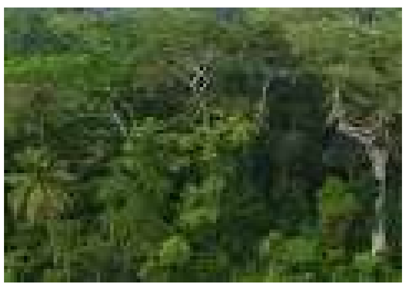
Results in a **stratification** of the total country area

Division of country into units of land (strata) homogeneous for a number of variables

Explanation of current level & dynamic of C stocks within the stratum, with the purpose of making the GHG inventory development practicable & enhance accuracy of GHG estimates

Land Representation: Why we need Land Stratification

- When estimating GHG emissions and removals, land areas are used as activity data (AD). As activity data, they represent the magnitude of a human activity that generates GHG emissions and/or removals during a given period of time.
- Stratification: is the process of subdividing a population into subsets (strata), aimed at reducing the variability of the sub-population included in each stratum.
- Example of a land representation and associated C stock changes below. This illustration below is an example of how land stratification correlates with the amount of C stocks found in a unit of land and their dynamic.



Forest Land Cropland

- As you can see the conversion of land from forest land to cropland determines a negative C dynamic of C stocks (i.e. the amount of C stocks in this unit of land decreases across time).
- This is why the stratification of land is a paramount tool to achieve accuracy of GHG estimates.

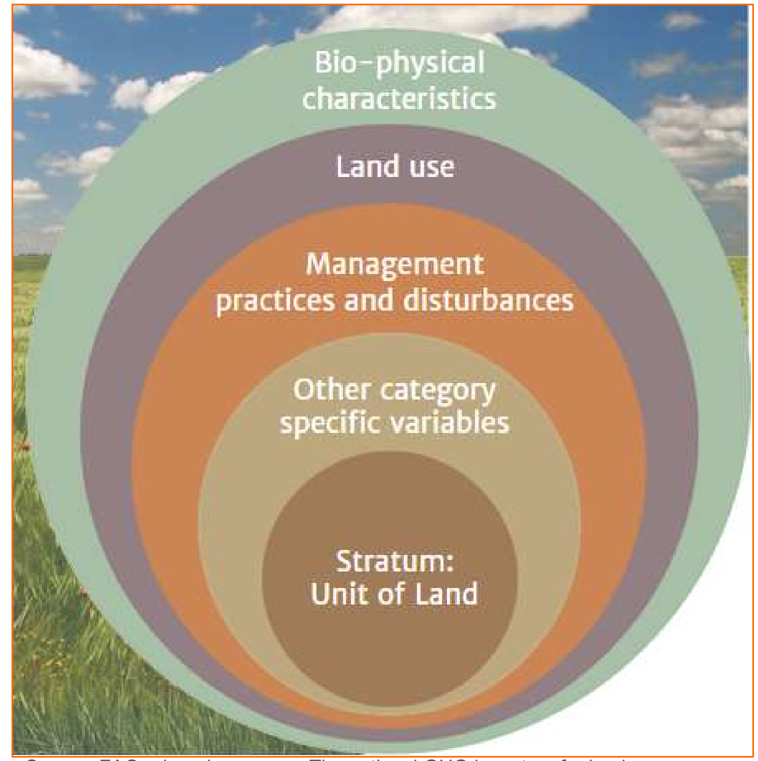
Land representation | stratification

Land is characterized by **bio-physical variables** and various **human activities**

Land use & management influence a variety of ecosystem processes (e.g. photosynthesis, decomposition, etc.) that affect GHG fluxes

These processes involve removals & emissions of GHGs

Human activities cover all impacts caused by human activities including disturbances



Source: FAO e-learning course: The national GHG inventory for land use

Land Stratification – Bio-physical characteristics (1)

- ➢ IPCC provide guidance for land stratification according to a number of variables as provided in previous slides
- ➢ IPCC Land stratification by the biophysical characteristics variables include:
- ✓ Climate
- ✓ Ecological Zone
- ✓ Soil Type
- ➢ Bio-physical characteristics impact annual C stock gains and losses as well as the C stocks carrying capacity of land

The stratification of land by climate is important because temperature and water are the two main parameters that determine the accumulation of biomass and decay of organic matter on the land.

The IPCC recommends classifying land according to climate zones that are defined by a set of rules based on:

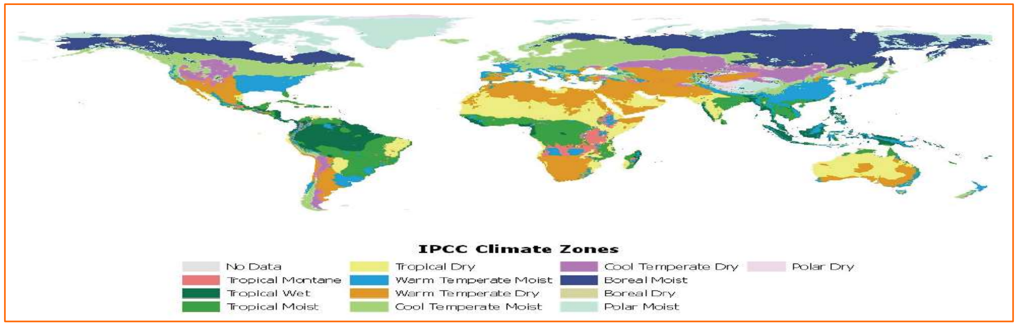
- Annual mean daily temperature
- Total annual precipitation
- Total annual potential evapo-transportation (PET)
- Elevation

The list of climate zones covering most managed lands:

- Boreal
- Cold temperate dry
- Cold temperate wet
- Warm temperate dry
- Warm temperate moist
- Tropical dry
- Tropical moist
- Tropical wet

Land representation | stratification | climate

- stratification by climate based on updated information from 2019 Refinement



Source: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_03_Ch3_Representation.pdf#page=38

Potential data sets

https://www.ipcc-nggip.iges.or.jp/public/2019rf/corrigenda1.html

https://philipaudebert.users.earthengine.app/view/ipcc-climate-zones

https://esdac.jrc.ec.europa.eu/content/support-renewable-energy-directive#tabs-0-description=1

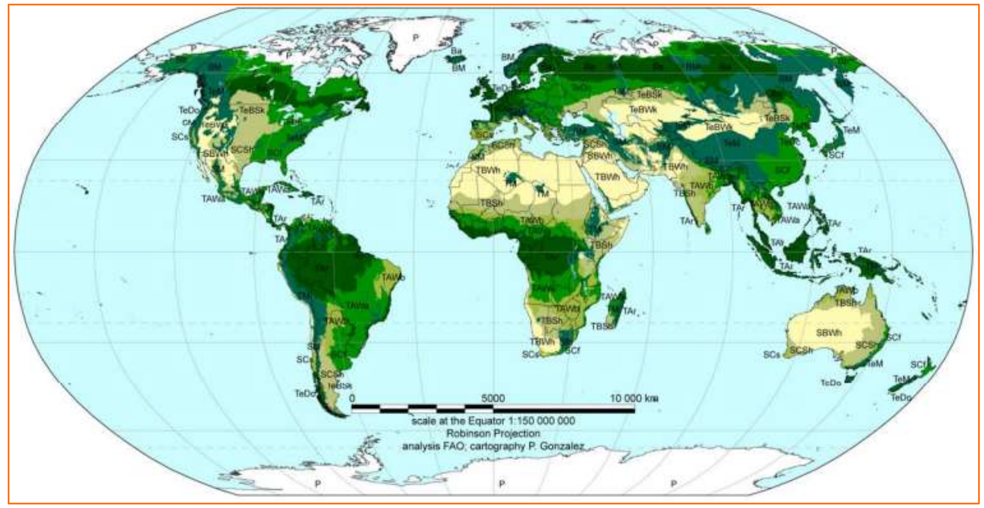
Land Stratification – Bio-physical characteristics (2)

The **stratification of land by ecological zone** (or potential vegetation zone) is important since woody biomass is the second largest terrestrial C pool. The IPCC uses the Global Ecological Zone (GEZ) classification provided by the Food and Agriculture Organization (FAO) of the United Nations. Below are ecological zones provided by FAO:

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

Land representation | stratification | ecological zone:2019 refinement

- stratification by ecological zone is important since woody biomass is the 2nd largest terrestrial C pool after soil
- IPCC uses the FAO Global Ecological Zone (GEZ) classification



Source: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf#page=9

List of GEZ

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

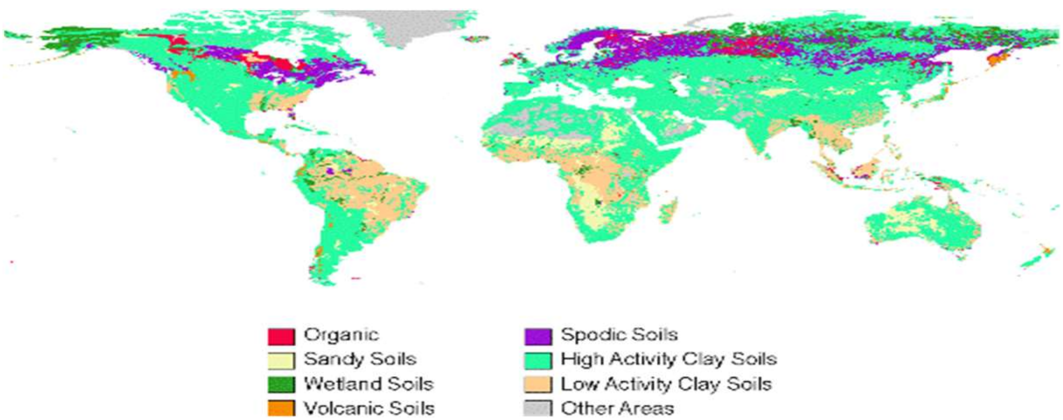
Potential data sets

https://www.fao.org/3/ap861e/ap861e00.pdf

https://data.apps.fao.org/map/catalog/srv/eng/catalog.search#/metadata/2fb209d0-fd34-4e5e-a3d8-a13c241eb61b

Land Stratification – Bio-physical characteristics (3)

The **stratification of land by soil type** is important because soil contains the largest portion of terrestrial C stocks in the Soil Organic Matter (SOM) carbon pool. Soil Organic Carbon (SOC) level and dynamic are influenced by the physical and bio-chemical characteristics of soil. The 2006 IPCC Guidelines classify country's soils in default types derived from the World Harmonized Soil Database. IPCC provides methodological guidance on two soil types namely organic and mineral soils.

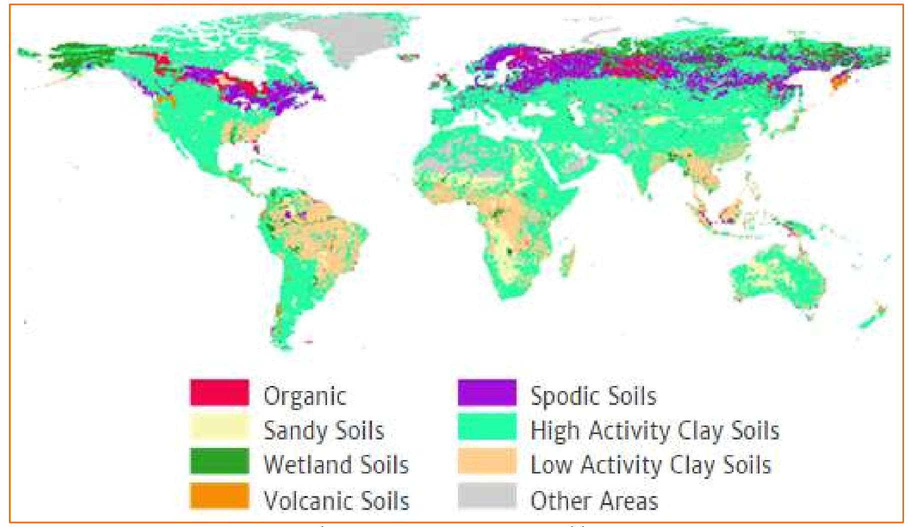


Land representation | stratification | soil type

- stratification by soil type is important because soil contains the largest portion of terrestrial C stocks in SOM carbon pool
- 2006 IPCC Guidelines classify country's soils in default types derived from the World Harmonized Soil Database

Mineral soils

Organic soils



Source: European Commission: Soil Projects, Support to Renewable Energy Directive

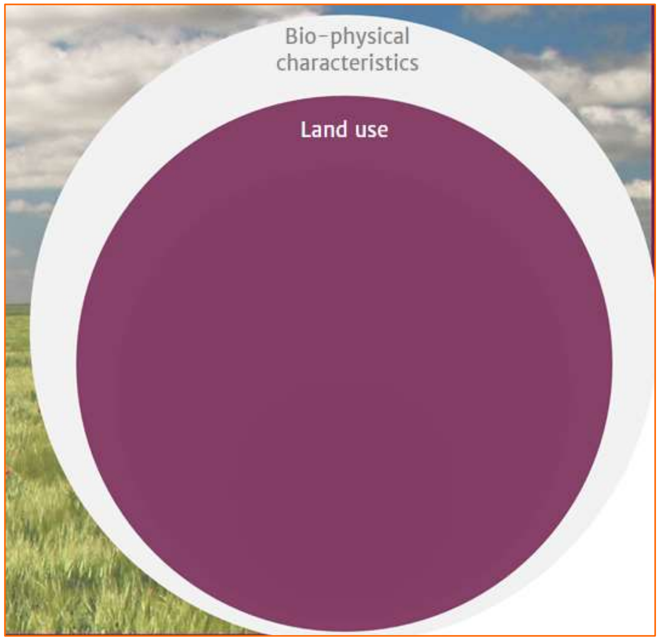
Potential data sets

https://esdac.jrc.ec.europa.eu/content/support-renewable-energy-directive#tabs-0-description=1

http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/

Land representation | stratification | land use

- ❑ Stratification by land use is one of the most laborious steps in land representation
- ❑ It requires national data
- ❑ The more detailed data available, the more detailed stratification can be applied
- ❑ 2006 IPCC Guidelines as applied through MPGs require that countries stratify their land for the following
  - ➢ Managed & unmanaged land
  - ➢ Six IPCC top-level (main) land use categories
  - ➢ History of land use
  - ➢ Land conversion categories



Source: FAO e-learning course: The national GHG inventory for land use

Land representation | stratification | land use

2006 IPCC GLs maintain the managed-land proxy

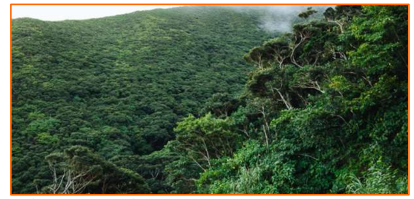
Managed land

Source: FAO e-learning course: The national GHG inventory for land use

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

current land use & changes in use over time

Unmanaged land



Source: FAO e-learning course: The national GHG inventory for land use

Area quantification & tracking over time, in order to maintain consistency in area accounting (since land-use changes occurs)

- Forest land
- Grassland
- Wetlands
- Other land

current cover

Land representation | stratification | land use

Can countries apply their own country specific land use definitions?

YES

- a hierarchy must be established among the country specific definitions. Note that the IPCC embedded hierarchy is: 1) Forest land, 2) Cropland, 3) Grassland, 4) Settlements, 5) Wetlands, 6) Other land
- Country specific definitions need to cover the entire range of land uses represented in the country's territory & avoid mixing areas with very different C stocks and C stock dynamics together in the same category
- When country-specific definitions are based on land cover classes, they need to be reconciled with IPCC land use categories
- Definitions must be applied consistently across space & time

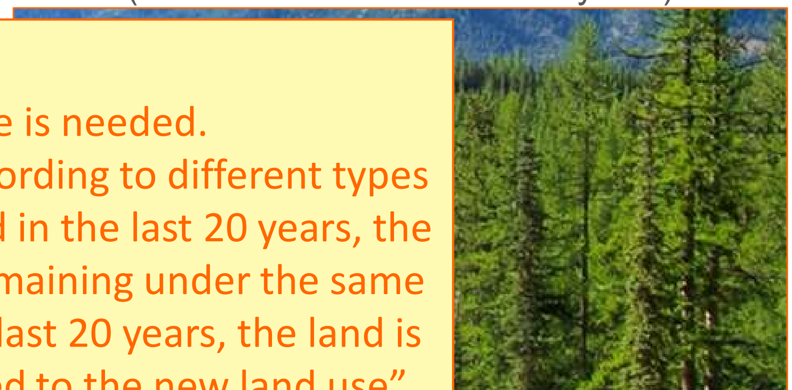
Land representation | stratification | land use

land under conversion in the new land use category
(conversion within the last 20 years)

IPCC default

land remaining in the same land use category
(no conversion in the last 20 years)

Source: FAO e-learning cour



inventory for land use

Information on historical land use is needed.
It allows the application of different CSCF according to different types of conversion. If the land use has not changed in the last 20 years, the land is reported under the category "Land remaining under the same land use." If the land use has changed in the last 20 years, the land is reported under the category "Land converted to the new land use" and in the relevant subcategory

Differentiation
history of use i
appropriate methodology for estimating GHG emissions/removals

Different C stock levels & dynamics in C stock changes occur between those two subcategories

	and converted to a new category in the last 20 ears 20 years
Forest Land Remaining Forest Land	Land Converted to Forest Land
Grassland Remaining Grassland	Land Converted to Grassland
Cropland Remaining Cropland	Land Converted to Cropland
Wetlands Remaining Wetlands	Land Converted to Wetlands
Settlements Remaining Settlements	Land Converted to Settlements
Other Land Remaining Other Land	Land Converted to Other Land

Land Stratification – Land Use

Land conversion process:

- The conversion process is tracked across a 20-year "transition period" (IPCC default). In such a period, the C stocks dynamic in the land conversion category (e.g. GL-FL) is different than the dynamic in the corresponding land remaining category (e.g. FL-FL).
- Information on historical land use allows the application of different stock change factors according to different types of conversion. If the land use has not changed in the last 20 years, the land is reported under the category "Land remaining under the same land use."
- If the land use has changed in the last 20 years, the land is reported under the category "Land converted to the new land use" and in the relevant subcategory.
- The fourth step is to differentiate land conversion categories according to the previous land use in the 30 land use change sub-categories. E.g. Forest land converted to Cropland

Land remaining in a land use category for more than 20 years	Land converted to a new category in the last 20 years
Forest Land Remaining Forest Land	Land Converted to Forest Land
Grassland Remaining Grassland	Land Converted to Grassland
Cropland Remaining Cropland	Land Converted to Cropland
Wetlands Remaining Wetlands	Land Converted to Wetlands
Settlements Remaining Settlements	Land Converted to Settlements
Other Land Remaining Other Land	Land Converted to Other Land

Land representation | stratification | land use

land under conversion in the new land use category
(conversion within the last 20 years)

Source: FAO e-learning course: The national GHG inventory for land use

Differentiation of land conversion subcategories according to the previous land-use

In total 30 land-use change sub-categories

Forest land

- Cropland converted to Forest land
- Grassland converted to Forest land
- Wetland converted to Forest land
- Settlements converted to Forest land
- Other land converted to Forest land

Cropland

- Forest land converted to Cropland
- Grassland converted to Cropland
- Wetland converted to Cropland
- Settlements converted to Cropland
- Other land converted to Cropland

Grassland

- Forest land converted to Grassland
- Cropland converted to Grassland
- Wetland converted to Grassland
- Settlements converted to Grassland
- Other land converted to Grassland

.....

.....

Land stratification – Land use versus Land cover

- Using the example of an area covered by trees that is clear cut will help to understand the methodological difference between land cover and land use.

- Applying a land cover classification, we may just estimate the loss of the biomass C stock of the tree cover. While applying a land use classification, we will estimate:

- ✓ The loss of the biomass C stock
- ✓ The gain of biomass C stock associated with the following vegetation regrowth (the type of which depends from the current land use e.g. forest regrowth in case of temporary loss of forest cover).
- ✓ The change in the DOM C stock as difference between the C stocks in the previous and in the current land use.
- ✓ The change in SOC as difference between the C stocks in the previous and in the current land use.

Land representation | stratification | management

Management systems & practices & disturbances directly affect certain C pools

Stratification by management system/practices on land is a good proxy for the expected level & dynamic of C stocks

It can be used as a further level of land stratification

Stratification by management system is required especially for the SOM pool

Management system of practices	C pools for which C stocks changes and associated emissions need to be estimated at Tier 1
Management of Natural Forest	Biomass (LB), Harvested Wood Products (HWP)
Managed Forest Plantation	Biomass (LB), Harvested Wood Products (HWP)
Improved Grassland	Soil Organic Matter (SOM)
Annual Crop Management	Soil Organic Matter (SOM)
Perennial Crop Management	Biomass (LB), Soil Organic Matter (SOM)
Drainage/Rewetting	Soil Organic Matter (SOM)
Tillage	Soil Organic Matter (SOM)
Peat Extraction	Soil Organic Matter (SOM)
Prescribed Burning	Biomass (LB), Dead Organic Matter (DOM)
Organic Fertilizaton	Soil Organic Matter (SOM)

Land representation | stratification | disturbances

Source: FAO e-learning course: The national GHG inventory for land use

C stocks are affected by disturbances, so it is important to stratify by disturbances

Fires is the most relevant & frequent disturbance, however, there are other common disturbances

Both wildfires & prescribed burning has to be taken into account in the GHG inventory when occurring

Land representation | stratification | other variables

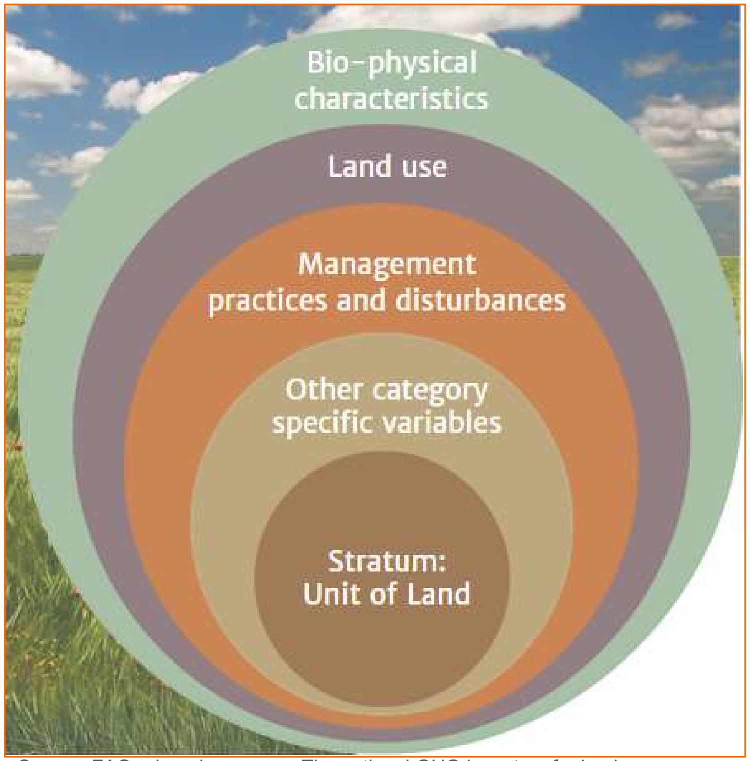
Once the stratification scheme has been determined

Must be applied across the entire national territory in a way that

- ✓ **The same stratification scheme applies to each carbon pool in the unit of land**
- ✓ **The same stratification scheme applies across the entire time series**

Other variables can be used for further stratification, e.g. crop/tree species

Additional level of stratification can be added according to data availability for C stock & stock change factors associated with the strata



Source: FAO e-learning course: The national GHG inventory for land use

Consistent land representation – Methodological Approaches

- Consistency in land representation is key to ensure that no artefact trends in GHG estimates are caused by incomplete/inconsistent time series

- The level of aggregation at which the land representation should be reported in the NGHGI is that of land use categories (the six land remaining categories and the associated thirty land-use change categories).

- Approaches for land representation are applied to classify the territory, according with the stratification scheme applied, and to quantify the area of each unit of land.

Land representation | methodological approach

IPCC provides **three** methodological approaches for land representation

Approach 1

- land use/management categories are identified & areas quantified
- land use/management changes between categories are neither identified nor quantified (spatially-explicit data are not available)
- Net area change of each land use/management category over time are quantified

Approach 2

- land use/management categories are identified and areas quantified
- land use/management changes are identified and their areas quantified
- areas of changes are not spatially-explicit tracked over time

Approach 3

- land use/management categories are identified and areas quantified
- land use/management changes are identified and their areas quantified
- areas of changes are spatially-explicit tracked over time

Land representation | methodological approach

- The choice of the approach depends on the availability of data over time and space
- Approach 1: when data do not allow land use/management conversions identification
- Approaches 2/3: when data allow land use/management conversions identification between two consecutive inventory years
- Approaches are applied to classify the territory according to the stratification scheme applied & to quantify the area of each unit of land
- A combination of approaches can be used to better adapt to data availability over time and space. Although, to ensure consistency of land representation, each unit of land identified must be reported with the same approach across the entire time series
- The most efficient tactic to build a consistent land representation is to apportion the land in macro-units of land homogeneous for climate, ecological zone and soil and to build a land representation for each of the macro-units

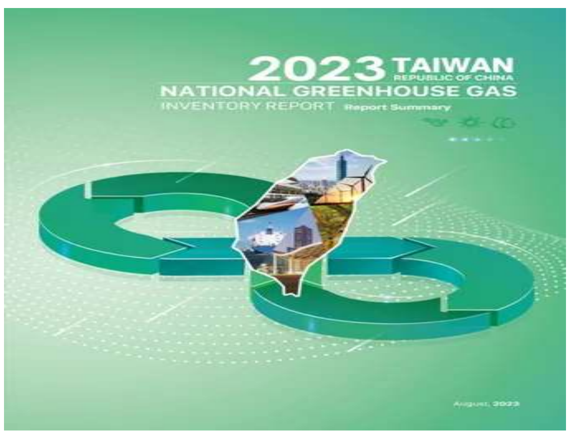
Land representation | methodological approach

- The level of aggregation at which the land representation should be reported in the NGHGI is that of land use categories (6 land remaining categories & associated 30 land-use change categories)
- This means that units of land with homogeneous history of use are aggregated under the same land use category (although the units of land within a land use category may differ for other variables, according to the stratification scheme applied)

TABLE 4.A SECTORAL BACKGROUND DATA FOR LAND USE, LAND-USE CHANGE AND FORESTRY
Forest land
(Sheet 1 of 1)

Back to Index

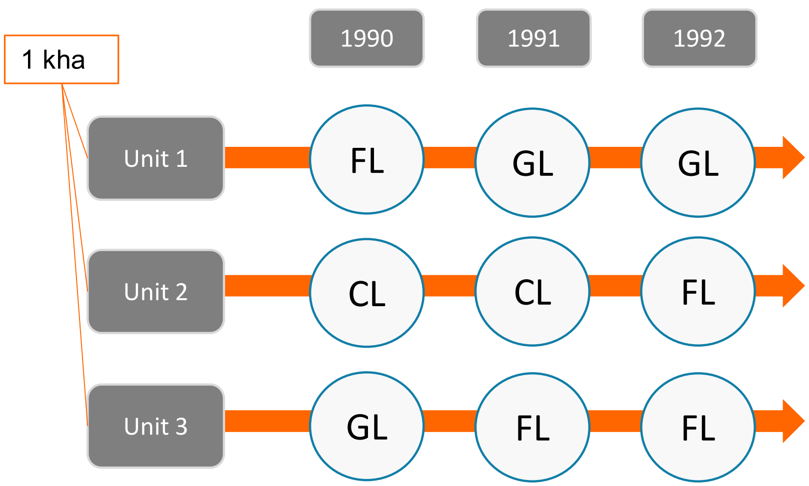
GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS					
Land-use category	Subdivision [2]	Total area [3]	Area of mineral soil	Area of organic soil	Carbon stock change in living biomass per area [4,5]			Net carbon stock change in dead wood per area	Net carbon stock change in litter per area	Net ch…
					Gains	Losses	Net change			Min… so…
		(kha)			(t C/ha)					
4.A. Total forest land										
4.A.1. Forest land remaining forest land										
4.A.2. Land converted to forest land [10]										
4.A.2.a. Cropland converted to forest land										
4.A.2.b. Grassland converted to forest land										
4.A.2.c. Wetlands converted to forest land										
4.A.2.d. Settlements converted to forest land										
4.A.2.e. Other land converted to forest land										



- Detailed information on land representation should be included in the NID (main body or annexes)
- The reader should be able to replicate the land representation results used for estimating GHG emissions/removals

Land representation | methodological approach

- The GHG inventory is composed of a number of annual estimates (time series), thus the land representation is expected to provide area information (AD) for the entire time series



Approach 1

	Total area (kha)		
Category	1990	1991	1992
Forest land	1	1	2
Cropland	1	1	0
Grassland	1	1	1
Total	**3**	**3**	**3**

	Net area changes (kha)		
Category	1990	1991	1992
Forest land	0	0	+1
Cropland	0	0	-1
Grassland	0	0	0
Total	**0**	**0**	**0**

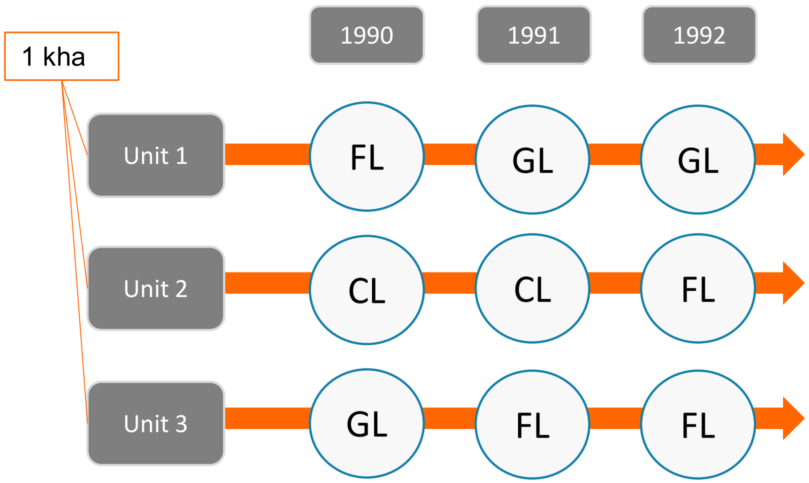
- The area of land use categories are quantified over time (just ‘land remaining in same land use category’)
- The land use changes are not identified (only net area changes are quantified), e.g. between 1990 and 1991 approach 1 does not report any conversion

Approach 1

Table 2.3.1 Example of Approach 1: Available land-use data with complete territorial coverage								
Time 1			**Time 2**			**Land-Use Change between Time 1 and Time 2**		
F	=	18	F	=	19	Forest	=	+1
G	=	84	G	=	82	Grassland	=	-2
C	=	31	C	=	29	Cropland	=	-2
W	=	0	W	=	0	Wetlands	=	0
S	=	5	S	=	8	Settlements	=	+3
O	=	2	O	=	2	Other land	=	0
Sum	=	*140*	*Sum*	=	*140*	*Sum*	=	*0*

Note: F = Forest land, G = Grassland, C = Cropland, W = Wetlands, S = Settlements, O = Other land. Numbers represent area units (Mha in this example).

Land representation | methodological approach



Approach 2

	Total area (kha)		
Category	1990	1991	1992
Forest land remaining forest land	1	0	0
Cropland remaining cropland	1	1	0
Grassland remaining grassland	1	0	0
Cropland converted to forest land	0	0	1
Grassland converted to forest land	0	1	1
Forest land converted to grassland	0	1	1
Total	**3**	**3**	**3**

- ❑ Provides gross land use conversions (i.e. losses & gains) between 2 points in time only
- ❑ Emission/removal factors can be applied to reflect different rates of change in C stocks according to the land use categories (previous and current) of the unit of land under conversion
- ❑ Area information can be organized in land use change matrix

Approach 2

TABLE 2.3.5
SIMPLIFIED LAND-USE CHANGE MATRIX FOR EXAMPLE APPROACH 2

Land-Use Change Matrix

Final \ Initial	F	G	C	W	S	O	*Final sum*
F	**15**	3	1				*19*
G	2	**80**					*82*
C			**29**				*29*
W							
S	1	1	1		**5**		*8*
O						**2**	*2*
Initial sum	*18*	*84*	*31*		*5*	*2*	*140*

Note:
F = Forest land, G = Grassland, C = Cropland, W = Wetlands,
S = Settlements, O = Other land
Numbers represent area units (Mha in this example).
There is no Wetlands in this example. Blank entry indicates no land use change.

Land representation | methodological approach

Approach 2

1990				
	FL	CL	GL	**Area at the beginning of year**
FL	1	0	0	1
CL	0	1	0	1
GL	0	0	1	1
Area at the end of year	**1**	**1**	**1**	**3**

1991				
	FL	CL	GL	**Area at the beginning of year**
FL	0	0	1	1
CL	0	1	0	1
GL	1	0	0	1
Area at the end of year	**1**	**1**	**1**	**3**

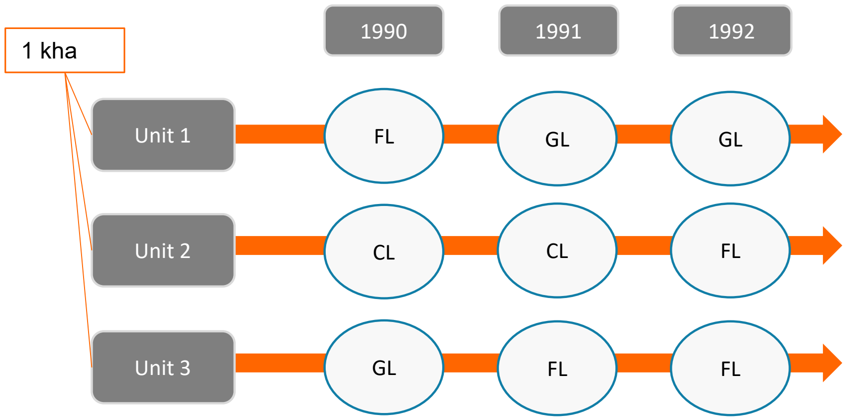
1992				
	FL	CL	GL	**Area at the beginning of year**
FL	0	0	1	1
CL	1	0	0	1
GL	1	0	0	1
Area at the end of year	**2**	**0**	**1**	**3**

- ❑ Provides gross land use conversions (i.e. losses & gains) between 2 points in time only
- ❑ Emission/removal factors can be applied to reflect different rates of change in C stocks according to the land use categories (previous and current) of the unit of land under conversion
- ❑ Area information can be organized in land use change matrix

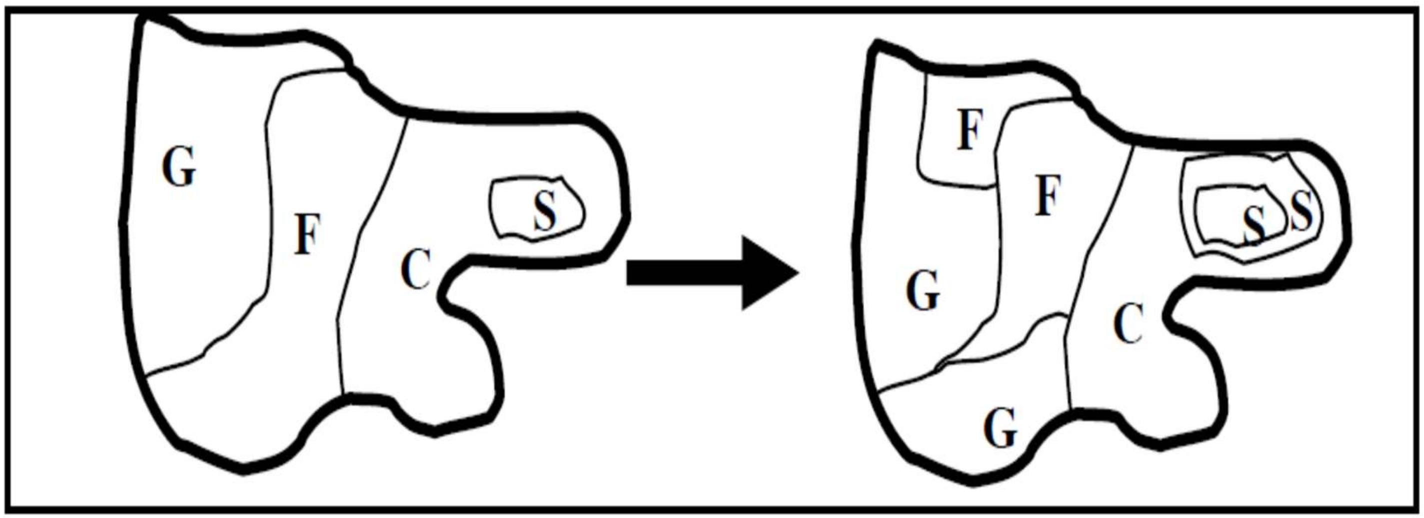
Land representation | methodological approach

- ❑ Data provide fully spatially-explicit information on the use/management of each unit of land over the entire time series. So, it is capable to track over time each land converted
- ❑ Similar to approach 2, data may be obtained through sampling or wall-to-wall mapping techniques or a combination of the two methods
- ❑ Emission/removal factors can be chosen to reflect different rates of change in carbon stocks according to the history of each tracked unit of land
- ❑ Although Approach 3 may be illustrated by means of land use and land use change matrices, Geographic Information Systems are likely needed to track across time each single unit of land

Approach 3



Approach 3: Spatially Explicit



Ex. # 1: Land Use matrix: Can you fill in the missing values?

Initial / Final	FL	CL	GL	WL	SE	OL	Final Area
FL	50	2	6	0	2	0	??
CL	5	35	8	0	2	0	50
GL	3	7	??	0	0	0	37
WL	8	0	0	20	3	0	31
SE	0	0	0	0	32	0	32
OL	0	0	0	0	0	5	5
Initial Area	66	44	??	20	??	5	215

And the answer is…

Initial / Final	FL	CL	GL	WL	SE	OL	Final Area
FL	50	2	6	0	2	0	60
CL	5	35	8	0	2	0	50
GL	3	7	27	0	0	0	37
WL	8	0	0	20	3	0	31
SE	0	0	0	0	32	0	32
OL	0	0	0	0	0	5	5
Initial Area	66	44	41	20	39	5	215

Consistent land representation – Reporting (1)

- Reporting - Annual matrices of land use and land use change
- Let's identify how matrices are complied, what information they contain and what they look like by following the example below.

Country X has been subdivided in a number of strata homogeneous by climate zone, ecological zone and soil type.

Then, for each stratum a time series of annual matrices has been prepared as shown in the below matrices. For instance, a stratum could be: Warm Temperate Moist climate zone (WTM), Temperate Mountain Systems ecological zone (TMS), and High Activity Clay soil type (HAC). As reported in the example below:

Inventory year is

2005

	Hectares	2004									Total
		Unmanaged Forest land	Manged Forest Land	Cropland	Unmanaged Grassland	Managed Grassland	Unmanaged Wetlands	Managed Wetlands	Settlements	Other Land	2005
2005	Unmanaged Forest land	6,308	0	0	0	0	0	0	0	0	6,308
	Manged Forest Land	0	322,330	352	0	0	0	0	0	0	322,682
	Cropland	0	130	324,480	0	260	0	0	0	0	324,870
	Unmanaged Grassland	0	0	0	1,965	0	0	0	0	0	1,965
	Managed Grassland	0	0	708	0	648,840	0	0	0	0	649,548
	Unmanaged Wetlands	0	0	0	0	0	6,254	0	0	0	6,254
	Managed Wetlands	0	0	0	0	0	0	5,191	0	0	5,191
	Settlements	0	0	196	0	66	0	0	25,954	0	26,216
	Other Land	0	0	0	0	0	0	0	0	6,488	6,488
	Total 2004	6,308	322,460	325,736	1,965	649,166	6,254	5,191	25,954	6,488	1,349,522

Consistent land representation – Reporting (2)

Inventory year is 2006

	Hectares	2005									Total
		Unmanaged Forest land	Manged Forest Land	Cropland	Unmanaged Grassland	Managed Grassland	Unmanaged Wetlands	Managed Wetlands	Settlements	Other Land	2006
2006	Unmanaged Forest land	6,178	0	0	0	0	0	0	0	0	6,178
	Manged Forest Land	130	322,552	195	0	0	0	0	0	0	322,877
	Cropland	0	0	323,766	0	708	0	0	0	0	324,474
	Unmanaged Grassland	0	0	0	1,900	0	0	0	0	0	1,900
	Managed Grassland	0	0	260	65	648,580	0	0	0	0	648,905
	Unmanaged Wetlands	0	0	0	0	0	6,254	0	0	0	6,254
	Managed Wetlands	0	0	0	0	0	0	5,191	0	0	5,191
	Settlements	0	130	649	0	260	0	0	26,216	0	27,255
	Other Land	0	0	0	0	0	0	0	0	6,488	6,488
Total 2005		6,308	322,682	324,870	1,965	649,548	6,254	5,191	26,216	6,488	1,349,522

➢ **How should I read matrices?**

✓ Note that a time series is composed by a number of tables corresponding to the number of years for which the land representation has to be built plus 19.

✓ For example, the time series for the GHG inventory period 2005-2017 will be composed by 30 annual matrices (i.e. from matrix 1985-1986 till matrix 2015-2016)

✓ Finally, data reported in the time series of annual matrices (1 time series for each combination of climate zone, ecological zone and soil type) are then aggregated according to GHGI category reporting (i.e., in land use and land-use change categories).

Land representation | methodological approach

- ❑ A time series is composed by a number of tables corresponding to the number of years for which the land representation is built plus 19 (when the IPCC default 20 years transition period is applied)

- ➢ For example, the time series for the GHG inventory period 1990-2020 will be composed by 50 annual matrices (i.e. from matrix 1970-1971 till matrix 2019-2020)

- ❑ Remember that when a change occurs, it must be reported cumulated for 20 years in the respective land conversion category (e.g. FL→CL). Therefore, to accurately report the starting year areas for converted land, areas converted in that year plus the areas converted in the previous 19 years are needed (e.g. in the year 2005, the area reported in the conversion category "Forest land converted to Cropland" is the area of forest land converted to cropland over the entire time period 1986-2005)

- ❑ To construct a consistent time series for the years before the starting year of the inventory, alternative data sources may be utilized (e.g., dataset on authorization of deforestation, dataset on afforestation) & proxies (e.g., use of the same conversion type(s) observed in the inventory period for the years before the starting year)

- ❑ Use of average rates of changes from the inventory period for years before starting year should be the last resort

Land representation | conclusions

The data collection & analysis system (including land classification) should respect the **guiding principles** of MPGs to ensure quality of data outputs (i.e. the land representation) & sustainability of operations

- ❑ **Transparent**: Related documentation is sufficient, data sources, definitions, methodologies & assumptions are clearly described, such that individuals other than the inventory compilers can understand how the land representation was developed & are confident it meets good practice
- ❑ **Accurate**: The GHG estimates are neither over- nor under-estimated so far as can be judged, and are free of bias
- ❑ **Complete:** All land area within the country is represented
- ❑ **Consistent**: Capable of representing categories/subcategories/ subdivisions consistently across time
- ❑ **Comparable**: Categories are suitable to be aggregated according to the IPCC default categories

The data collection & analysis system should also be **adequate** in that is capable of representing all land use categories & associated subcategories/subdivisions

Steps in a LULUCF Inventory Preparation

Thank you for your attention!

Sekai Ngarize
Climate Transparency and Forestry Advisor
sngarize47@gmail.com

Supported by:
Federal Ministry for Economic Affairs and Climate Action
Federal Foreign Office
on the basis of a decision by the German Bundestag