

Food and Agriculture Organization of the United Nations

#### FAO and the Enhanced transparency framework

THE ROLE OF LAND REPRESENTATION IN PREPARING THE NATIONAL GHG INVENTORY FOR THE LULUCF SECTOR UNDER THE ENHANCED TRANSPARENCY FRAMEWORK OF THE PARIS AGREEMENT

> Scaling up Climate Actions in Asia Pacific *Estimating carbon stock changes in soil for climate resilient and sustainable rice production systems* 29 June 2022

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## Carbon stock changes in agricultural soils

Why soil organic carbon (SOC) is important?

SOC (major component of soils organic matter) is the largest C stock in most terrestrial ecosystems. Second largest C pool after oceans

SOM content is mainly influenced by natural factors (climate, topography, parent material, land cover) & human intervention (land use (cultivation practices, types of plants, etc.), management)

SOC is crucial to soil health, fertility, affecting soil's ability to provide essential ecosystem services, including food, production, biodiversity & contributing to the fight against climate change

Understanding & estimating SOC changes & dynamics help us to realize human impact on the above & take proper actions



#### **Decision 18/CMA.1**

Modalities, procedures & guidelines for the **transparency framework** for action and support referred to in Article 13 of the Paris Agreement (MPGs)

Provide all necessary information for preparing & submitting the BTR, including the national GHG inventory report

**Flexibility** for the implementation of art. 13 of the Paris Agreement for those developing country Parties that need it in the light of their capacities is reflected in the MPGs

The LDCs & SIDS may submit the information referred to in para. 10 (MPGs) at their discretion

FCCC/PA/CMA/2018/3/Aid.2

Decision 18/CMA.1

Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement

The Conference of the Parties serving as the meeting of the Parties to the Parts Agreement,

Recalling the Paris Agreement, adopted under the Convention, in particular Article 2, paragraph 2, and Article 13, including paragraphs 3, 14 and 15,

Also recalling decision 1/CP.21.

Becognizing that the Capacity-building Initiative for Transparency, established pursuant to decision 1/CP/21, paragraph 84, will continue to support developing country Parties, upon request, to build their institutional and technical support, both pre- and post-2020.

.4.00 recognizing that Beachily for those developing country Parties that need it in the light of their capacities is reflected in the modulities, procedures and guidelines for the Immegaring of action and support.

 Adopte, parsume to Article 13, paragraph 13, of the Paris Agreement, the modulities, procedures and guidelines for the transparency framework for action and support thereatment referred to as the modulities, procedures and guidelines) contained in the annex.

2. Request the Solvidiary Body for Scientific and Technological Advice to undertake the first review and update, as appropriate, of the modalines, procedures and guidelines to later than 2020 on the basis of experience as reporting, technical expert review and Incidentive, multilateral consideration of progress, and decider that subsequent reviews and updates will be undertaken as and when the Conference of the Parties serving as the mesting of the Parties to the Parts. Agreement determines them to be appropriate.

3. Decide that Parties shall softmar their first biennial nursparency report and national investory report, if submatted as a stand-atome report, in accordance with the modalities, procedures and guidelines, at the latest by 31 December 2024;

4. Also decider that the least developed country Parties and small island developing States may submit the information referred to in Article 13, paragraphs 7, 8, 9 and 10, of the Paris Agreement at their discretion.

5. Device Parties and, as appropriate, intergovernmental organizations to nonimate technical experts with the relevant quadrifications to the UNFCCC roster of experts in referred to in chapter VIII of the annex.

6. Reports the secretarist, in addition to the actions specified in the modulities, procedures and guidelines, to

 (a) Produce synthesis reports on Parties' biennial insuparency reports and national inventory reports;

(b) Produce in minual report on the technical expert review;

(c) Publish Pertes' biennial transprency reports and national unrentory reports, if submitted as a stand-stone report, the technical expert review reports, and the records of Parties' finalitative, multilateral consideration of progress on the UNECCC website.

 Recalls that, in accordance with Article 13, paragraphs 14 and 15, of the Paris Agreement, support shall be provided to developing country Parties for the implementation of Article 13 and for the building of transparency-related capacity of developing country Parties on a continuous basis.

#### **Decision 18/CMA.1**

For preparing the national GHG inventory Parties must use the 2006 IPCC GLs

fundamental differences with the Revised 1996 IPCC GLs in methodologies, data requirements 1<sup>st</sup> BTR (incl. national GHG inventory) at latest 31.12.2024 Countries have to start their preparations (institutional arrangements, GHGI team set up, methodological choice, data collection, etc.), ASAP



#### Land representation | introduction

Land representation is the analysis undertaken to identify & quantify human activities on land & to track their changes over time

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



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

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 | introduction



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## 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 removing & emitting GHGs

Human activities cover all impacts caused by human activities including disturbances



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

stratification by climate is important because temperature & water are the two main parameters determining accumulation of biomass & decay of organic matter

List of climate zones covering most managed lands

Boreal

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



Source: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\_Volume4/V4\_03\_Ch3\_Representation.pdf#page=38



## Land representation | stratification | ecological zone

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

#### List of GEZ

Tropical rainforest
Tropical most deciduous forest
Tropical dry forest
Tropical shrubland
Tropical desert
Tropical mountain systems
Temperate oceanic 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

Polar

Boreal mountain systems



Source: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4\_Volume4/V4\_04\_Ch4\_Forest\_Land.pdf#page=9



## 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 Orga Image: Solution of the solu

#### **Organic soils**





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



- 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



Can countries apply their own country specific land use definitions?

#### YES

- a hierarchy must be established among the country specific definitions (Forest land, Cropland, Grassland, Settlements, Wetlands, Other land)
- Country specific definitions need to cover the <u>entire</u> 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 under conversion in the new land use category (conversion within the last 20 years) ° °

Same and the



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



Source: FAO e-learning cours

Differentiation of

#### 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



d converted to a new category in the last 20

inventory for land use

rs 20 years

history of use is appropriate methodology for estimating GHG emissions/removals

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

Land Converted to Forest Land	
Land Converted to Grassland	
Land Converted to Cropland	
Land Converted to Wetlands	
Land Converted to Settlements	
Land Converted to Other Land	
	Land Converted to Forest Land Land Converted to Grassland Land Converted to Cropland Land Converted to Wetlands Land Converted to Settlements Land Converted to Other Land

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

and	Cropland converted to Forest land
	Grassland converted to Forest land
est la	Wetland converted to Forest land
For	Settlements converted to Forest land
	Other land converted to Forest land
	Forest land converted to Cropland
pu	Grassland converted to Cropland
oplai	Wetland converted to Cropland
Ö	Settlements converted to Cropland
	Other land converted to Cropland
	Forest land converted to Grassland
nu	Cropland converted to Grassland
assla	Wetland converted to Grassland
9 2 2	Settlements converted to Grassland
	Other land converted to Grassland

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## Land representation | stratification | other variables

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** 

Stratification by disturbance regime

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)

Additional level of stratification can be added according to data availability (e.g. crop/tree species)



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

- □ 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

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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

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

1 kha	1990	1991	1992				Appro	oach 1			、
Unit 1	FL	GL	GL		Tot	al area (	kha)		Net are	a chang	es (kha)
	$\frown$			Category	1990	1991	1992	Category	1990	1991	1992
Unit 2		CL )	FL 🔶	Forest land	1	1	2	Forest land	0	0	+1
				Cropland	1	1	0	Cropland	0	0	-1
	$\frown$	$\frown$	$\frown$	Grassland	1	1	1	Grassland	0	0	0
Unit 3	GL	FL )	FL 🔶	Total	3	3	3	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 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

1990						1991					1992				
	FL	CL	GL	Area at the beginning of year			FL	CL	GL	Area at the beginning of year		FL	CL	GL	Area at the beginning of year
FL	1	0	0	1	FL	-	0	0	1	1	FL	0	0	1	1
CL	0	1	0	1	CL	-	0	1	0	1	CL	1	0	0	1
GL	0	0	1	1	GL	-	1	0	0	1	GL	1	0	0	1
Area at the end of year	1	1	1	3	Area a end of	t the year	1	1	1	3	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

- 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



- 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)
- □ 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)



# Land representation | MPGs principles

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

# Land representation & SOC changes | challenges

Every country has its own challenges, gaps, constraints

#### Challenges

- Activity data availability (e.g., land uses, land-use changes, land management, landmanagement changes)
- Soil-related data (e.g. SOC content, SOC reference values, stock change factors)
- Limited familiarity with 2006 IPCC GLs
- Limited resources

#### **Possible solutions**

- Internal coordination (many times data exist, statistical services, research, expert judgment, etc.)
- Setting up proper/sustainable data collection systems, improve existing systems
- □ Networking (internally, externally)
- □ 2006 IPCC GLs provide information for tier 1
- □ Internal collaboration between experts, institutions
- □ Prioritize actions. Follow a step-by-step approach

Prioritize actions, follow a step-by-step approach. What is important is to start...

#### **TACCC NGHGI | benefits**

Having a TACCC national GHG inventory has multiple benefits, domestic & international

- Allows interested stakeholders to know what is actually happening, where we stand in the global climate action & progress made
- □ Provides information for policy making for sustainable development & mitigation actions
- Helps identifying capacity building, financial, technical needs, prioritize actions & search for support
- □ Raises country's profile internally & in the global community
- Meets international commitments
- Builds confidence & mutual understanding among countries, including with regard to common challenges, constraints
- □ Helps in increasing ambition to achieve climate goals



#### FAO and the Enhanced transparency framework

www.fao.org/climate-change/our-work/what-we-do/transparency/ etf@fao.org

#### Thank you !

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