Climate MRV for Africa – Phase 2
Development of National GHG Inventory
Grassland

NIRAS Lead partner GreenStream TÜVRheinlan Precisely Right. camco clean energy

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Grassland-calculation steps

- **Step 1:** Estimate the annual carbon uptake in above-ground biomass, using the area abandoned (during the previous 20 years) and annual biomass growth.
- **Step 2:** Estimate the total carbon uptake from area abandoned (during 20–100 years) and annual growth rate.
- **Step 3:** Estimate the total carbon uptake from abandoned land (Step 1 + Step 2).

Issues in Estimating CO_2 Uptake from Abandonment of Managed Lands

Lack of compatibility between vegetation types given in the Revised 1996 IPCC Guidelines and national classification for abandoned land

Lack of methods to identify managed land abandoned and regenerating:

- according to different vegetation types
- for the past 20 years and 20–100 years

Absence of annual data for aboveground biomass growth for abandoned land:

- according to different vegetation types
- for the past 20 years and 20–100 years.

Sources of Activity Data

Activity data	Tier 1	Tier 2	Tier 3
Area under different land use/management systems and soil type during year t (inventory year)	FAO data base (faostat.fao.org)	National land use survey data	National land use maps overlay on soil survey maps Ministries responsible for agriculture, forests and natural resources
Area under different land use/management systems and soil type 20 years prior to year t (inventory year)	FAO data base (faostat.fao.org)	Historical, national land use survey data	National land use maps overlai on soil survey maps Ministries responsible for agriculture, forests and natural resoures
Area under manager organic soils	Global datasets	National database on organic soils	National database

Biomass

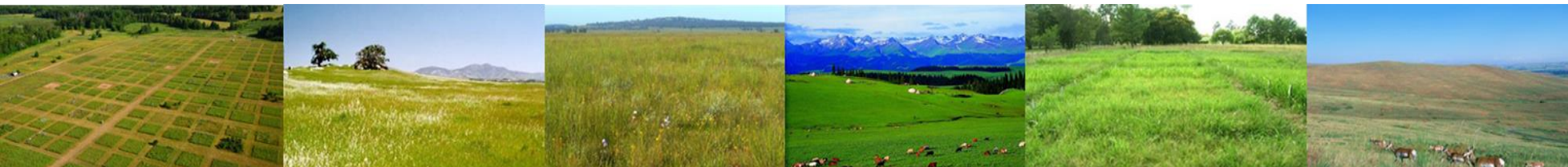
- Grasslands are generally distinguished form „forest as ecosystems having a tree canopy cover of less than a certain threshold, which varies from region to region
- Applying Tier 1 → no change in Grassland remaining Grassland. In Grassland where there is no change is either type or intensity of management biomass will be in approximate steady-state

Biomass (above- and belowground)

- Grasslands are meadows and pastures which are grazed or harvested annually and where tree cover is non-existent or very low.
- Due to its relatively small area and dynamics, the biomass of grassland remaining grassland is assumed as non-key category.
- In this case, the Tier 1 method of the IPCC 2006 GL which assumes no change in biomass is applicable.
- Note that, due to the increase of set-aside grassland, a rather slow increase in woody biomass might have been

Dead organic matter

- As the dead organic matter pool and its carbon stock changes is assumed relatively small, the Tier 1 method might be applied which assumes that the dead wood and litter stocks are at equilibrium, and the carbon stock changes for these pools not need to be estimated.



Dead organic metter

- Applying Tier 1 method → dead wood and litter stock are at equilibrium. No need to estimate the carbon changes for these pools.
- Countries experiencing significant changes in grassland types or disturbances or management regimes in thair grasslands are encouraged to developed domestic data to quantify this impact and report it under Tier 2&3

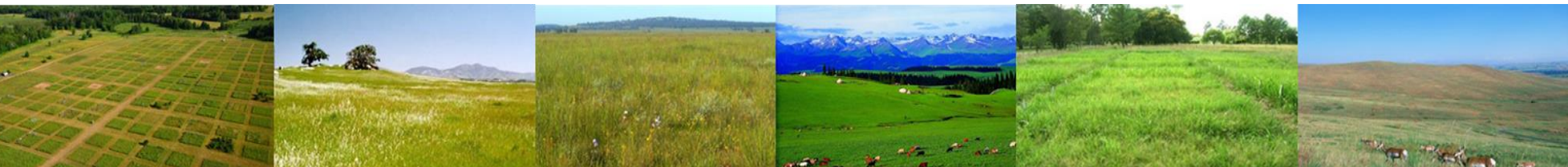
Mineral soils

For the entire land use sector, soil carbon stock changes should be estimated using the below formula:

$$\Delta C = \Sigma_i \Delta C_i$$

where

- ΔC = total carbon stock changes in mineral soils for all land converted to a specific land-use and land use change category, tC; and
- i = a "from"-"to" land-use change category (e.g., non-set-aside Cropland to Grassland).



Mineral soils

The estimation for each land-use and land use change category, follows the Tier 1 approach in which ΔCi is estimated using the first formula in Equation 2.25 of the IPCC 2006 GL:

$$\Delta Ci = (SOC0 - SOC0\text{-}T)i / D$$

where

- ΔCi = annual area-specific soil organic carbon stock change in a conversion sub-category, tCha-1;
- SOC0 = area-specific SOC soil organic carbon stock in the specific "to" land-use category in the inventory year, tC ha-1;
- SOC0-T = area-specific SOC soil organic carbon stock in the "from" land-use category T years prior to the inventory year, tC ha-1;
- T = number of years over a single inventory time period, yr, T = 1 yr; and
- D = default time period for transition between equilibrium SOC values, yr (the default value of 20 years is applied).

Mineral soils

For estimating SOC (for both the inventory year and the year T year before), the second formula in Equation 2.25 of the IPCC 2006 GL should be used:

$$\mathbf{SOC = Ai * SOCREF * FLU * FMG * FI}$$

where

- Ai = land area in the land-use change category in the inventory year, ha
- SOCREF = area-specific reference soil organic carbon, tCha-1
- FLU, FMG and FI are land use specific land-use, management and input stock change factors for which default values are used.

Mineral soils

For estimating SOC (for both the inventory year and the year T year before), the second formula in Equation 2.25 of the IPCC 2006 GL should be used:

$$SOC = Ai * SOC_{REF} * FLU * FMG * FI$$

where

- A_i = land area in the land-use change category in the inventory year, ha
- SOC_{REF} = area-specific reference soil organic carbon, tCha-1
- F_{LU}, F_{MG} and F_I are land use specific land-use, management and input stock change factors for which default values are used.

The land area values (Ai) were taken from the land use change matrix and include areas in the inventory year, which includes all area in the year in a 'remaining' category, and include areas for conversion category i for the period of default length of 20 years

N_2O emissions from mineral soils as a result of loss of soil carbon through change in land use or management

According to the IPCC 2006 Guidelines, N mineralizes when there is loss of soil organic C stocks in mineral soils through land-use change or management practices, and that results in N2O emissions. For each land use and land use change sub-category and for each year when carbon is lost from mineral soils, these emissions were estimated using the following Equations of the IPCC 2006 GL:

Equation on page 11.10:

$$N2O = N2O\text{–}N * 44/28$$

where

- N2O = N2O emissions, kg N2O =yr-1
- N2O–N = annual direct N2O–N emissions produced from managed soils, kg N2O–N yr-1;

Equation 11.1:

$$N2O\text{-}N = FSOM * EF1$$

where

- FSOM = annual amount of N in mineral soils that is mineralized, in association with loss of soil C from soil organic matter as a result of changes to land use or management, kg N yr-1
- EF1 = emission factor for N2O emissions from N inputs, kg N2O–N (kg N input)-1 (the value 0.01 was taken from Table 11.1 of the IPCC 2006 GL); and Equation 11.8:

N_2O emissions from mineral soils as a result of loss of soil carbon through change in land use or management

Equation 11.8:

$$FSOM = \Delta C_{Mineral} / R * 1000$$

where

- ΔCMineral = average annual loss of soil carbon for each land-use type (LU), tonnes C
- R = C:N ratio of the soil organic matter. A default value of 15 is used for situations involving land-use change from Forest Land or Grassland to Cropland, in the absence of more specific data for the area, and a default value of 10 is used for situations involving management changes on Cropland Remaining Cropland (page 11.16 of the IPCC 2006 GL).

Non-CO2 emissions from wildfires

In estimating these emissions, the Tier 1 method and Equation 2.27 were used as follows:

$$\mathbf{Lfire = A * MB * Cf * Gef * 10^{-3}}$$

Where:

- Lfire = amount of greenhouse gas emissions from fire, tonnes of each GHG
- A = Area burnt, ha
- MB = mass of fuel available for combustion, tonnes ha-1
- Cf = combustion factor, dimensionless
- Gef = greenhouse-gas specific emission factor g (kg.d.m.)-1.

Data on the areas affected by wildfires might be derived from the available statistics

Convertions: Cropland converted to Grassland

- Carbon stock changes in biomass in this category are the sum of those from converting Cropland with annual crops to Grassland and those from converting Cropland with perennials to Grassland
- For annual crops, the methodology of estimating carbon stock changes is the same as reported in grassland category, and symbols applied there might be used here, too.
- For $A_{Conversion}$, data from the annual land use

Thank you!

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