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

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Settlements

Buildings/constructions/infrastructure in urban, rural and infrastructure across the country, associates to „*Settlements*".

It has 3 groups (urban/rural, buildings and infrastructure) and includes: fenced and constructed areas, sealed lands (e.g. car parks, roundabouts, platforms), urban/rural lawns, playgrounds in green areas, beach lawn and other areas with lawn, dwellings, industrial and administration buildings (e.g. banks, churches, railway stations, restaurants), warehouses, huts, ruins, greenhouses, graveyards, dirt roads, trails, rail roads and roads (street, sidewalk, square), bridges and dams.

Settlements – activity data

- Tier 1 - No activity data are needed.
  - The Tier 1 methodology assumes no change in biomass carbon stocks in *Settlements Remaining Settlements*.
- Tier 2 collect area of crown cover for each class within a perennial type (Equation 8.2), or number of individual plants in each class within a perennial type (Equation 8.3).

$$\Delta CB = \Delta CTrees + \Delta CShrubs + \Delta CHerbs$$

- Crown cover is defined as the percent of ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage.

Settlements Emissions factors

- The Tier 1 assumption of no change in carbon stocks in all pools might be applied in subcategory SL remaining SL.
- In the case of conversions from forest land it should considered that the emissions from biomass and dead organic matter (DW, LT) occur in the year of conversion.

Settlements Emissions Factors

- To estimate carbon stock change in Land (i.e Forest Land) converted to Settlements, instant oxidation of carbon stock in living biomass and litter & dead wood and 20 years transition for soil pools might be considred.
- For conversions of non-forest lands to settlements, the CO2 emissions from biomass and dead organic matter were considered negligible, with the exception of conversion from grassland where default value of the C stock in biomass was used (Tier 1), assuming an initial biomass C stock of 1.6 t dm/ha, respectively 0.8t C/ha, according Table 3.4.2 of IPCC GPG (2003), the default value for the warm temperate dry eco-region.

Convertions: Forest land converted to Settlements - biomass

For biomass, we follow the same methodology that is detailed in the general section of the sector. With respect to carbon stock change, Equation 2.16 of the IPCC 2006 GL is applied:

$$\Delta C_{Conversion} = A * (B_{After} - B_{Before}) * CF$$

where

- $\Delta C_{Conversion}$ = carbon stock change due to conversion, tC
- A = area of conversion in the inventory year, ha
- B_{After} = area-specific biomass after the conversion, tC ha-1
- B_{Before} = area-specific biomass before the conversion, tC ha-1
- CF = carbon fraction, tC tbiomass-1.

For converting FL to Wetland, Settlements and Other land, it is assumed that the biomass carbon stock after the conversion is equal to zero, so all carbon in the biomass of the deforested land is completely emitted as CO2. In case the converted land is used as cropland or grassland, it is assumed that BAfter equals to 0.

Convertions: Forest land converted to Settlements - DOM

- Emissions from deadwood and litter are estimated by multiplying the area of annual deforestations by area-specific values.
- In these calculations, just like with biomass, it should be assumed that, in the year of the deforestation, all deadwood and litter are completely removed from the area, i.e. carbon in these pools are emitted in the year of the deforestation
- It is additionally assumed that after deforestation neither deadwood nor litter are produced any more after the conversion, thus, no removals are accounted for in these pools.

Convertions: Cropland converted to Settlements- biomass

- Carbon stock changes in biomass in this category are the sum of those from converting Cropland with annual crops to Settlement and those from converting Cropland with perennials to Settlement.
- For annual crops, the methodology of estimating carbon stock changes is the same as reported cropland section

Convertions: Cropland converted to Settlements- biomass

The annual decrease in carbon stocks from biomass loss of perennials might be estimated using Equation 2.16 of the IPCC 2006 GL:

$$\Delta CL = Aperennials * BBefore * CF$$

where

- BBefore = biomass of the regenerated orchard or vineyard at the age of 30 years, t biomass, and is equal to GTOTAL (tC ha-1 yr-1) * 30 (years). (Since all biomass is considered loss, the "fraction of biomass lost in disturbance" term, or fd, in the equation is taken to be equal to 1.)

Convertions: Cropland converted to Settlements - biomass

- Bbefore for annual croplands, the default 10 t biomass/ha, might be taken from text to Table 5.9 of the IPCC 2006 GL.
- For Croplands, Bbefore might be estimated from the proportion of Cropland area of cold dry and warm dry climate types (PCD = 0.41, PwD = 0.59)
- Respective specific default Cropland biomass (total above- and below-ground biomass, Table 6.4 of the IPCC 2006 GL: BCD = 6.5 t biomass ha-1 and BwD = 6.1 t biomass ha-1, respectively);
- In accordance with the Tier 1 assumption, Bafter in the equation is 0, and the carbon fraction is the default value of 0.47 tC t biomass-1. ΔCL was assumed to be equal to 0.

Conversions: Grassland converted to Settlements - biomass

The annual decrease in carbon stocks from biomass loss of grasslands might be estimated using Equations 2.15 and 2.16 of the IPCC 2006 GL:

$$\Delta CL = Aperennials * BBefore * CF$$

where

$$\Delta C = \Delta CG + \Delta CCONVERSION - \Delta CL$$

and

$$\Delta C_{CONVERSION} = AConversion * (Bafter - Bbefore) * CF$$

where:

- ΔC = biomass carbon stock change due to land use conversion, tC year-1
- ΔCG = annual increase in carbon stocks in biomass due to growth on the 'converted to' land, tonnes C yr-1
- ΔCL = annual decrease in biomass carbon stocks due to losses, tonnes C yr-1
- ΔCCONVERSION = initial change in carbon stocks in biomass on the 'converted to' land, tonnes C yr-1
- AConversion = annual area of the land conversion, ha
- Bafter = carbon stocks of biomass after the conversion, tonnes C ha-1
- Bbefore = carbon stocks in biomass before the conversion, tonnes C ha-1
- CF = carbon fraction, tC (t biomass)-1.

Conversions: Wetland converted to Settlements - biomass

- For $A_{Conversion}$, data from the annual land use change matrix should be used
- For converting Grassland to Settlement, the methodology of estimating carbon stock changes is the same as reported in section Grassland to Cropland, the only exception being that ΔCG (and ΔCL) were assumed to be equal to 0.

Convertions: Wetlland converted to Settlements - biomass

- Wetlands converted to Settlements are typically inland marshes (rarely peat bogs) the biomass of which is typically grass and water bodies with no biomass.
- Therefore, the emissions from biomass might be estimated using the methodology that is applied to the Grassland converted to Settlement, which, for water bodies, may somewhat overestimate the amount of biomass lost.

Convertions: Wetland converted to Settlements – organic soils

For these conversions, Equation 2.26 should be used to estimate the annual carbon loss:

Lorganic from water-bodies = Aentire category * Pwater-bodies * EFwater-bodies

and

Lorganic from marshes-bogs = Aentire category * P marshes-bogs * EFmarshes-bogs

where

- Lorganic = annual carbon loss from organic soils of water bodies and marshes-bogs, respectively, from converting Wetland to Settlements, tCyr-1
- Aentire category = area of the entire category of Wetland converted to Settlements, ha
- Pwater-bodies = proportion of the area of water bodies relative to Aentire category, %
- Pmarshes-bogs = proportion of the area of marshes-bogs, relative to Aentire category, %
- EFwater-bodies = emission factor for water bodies, tCha-1yr-1
- EFwater-bodies = emission factor for marshes and bogs, tCha-1yr-1

The emission factors the default IPCC (2006) values of 0.25 (cold temperate) and 2.5 (warm temperate) tCha-1yr-1 (Table 6.3) and 10.0 tCha-1yr-1 (Table 5.6) might be used, respectively.

Convertions: Land converted to Settlements - soil

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).

Convertions: Land converted to Settlements - soil

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 * 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.

Convertions: Land converted to Settlements - soil

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

- 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:

$$N2O = N2O–N * 44/28$$

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:

Thank you!

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