3B1 Forest land, 3B2 Cropland, 3B3 Grassland, 3B4 Wetlands, 3B5 Settlements, 3B6 Other land

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Acronyms

- AGB: Above Ground Biomass
- BGB: Below Ground Biomass
- DOM: Dead Organic Matter
- R: Root to shoot ratio
- BEF: Biomass Expansion Factor
- BCEF: Biomass Conversion and Expansion Factor
- CS: Country Specific

Estimation methods for land use

- The general equations are in chapter.2 of AFOLU in the 2006GL
- Each section from chapter 4 (forest land) ~ chapter.9 (other land) provides sector specific information such as category specific parameter and guidance.
- Biomass stock changes are important for forest land, perennial woody biomass in non-forest land and ,those relevant land use changes
- DOM stock changes are only relevant to forest relating categories.
- Soil stock changes (Mineral Soil) are important for cropland, grassland, (forest land) and any of land use changes

3B1a Forest Land Remaining Forest land

Pools and activities		Tier.1	Tier.2
Biomass-Gain		AGB: Default Gw BGB: can be zero, or using R	AGB: biomass growth from CS-Iv, BEF, D BGB: CS-R
Biomass -Loss	Harvesting	FAO data	CS-Data
	Fuel wood	FAO data	CS-Data
	Fire etc	All biomass assumed to emit in the year of event	Forest category, amount of mass should be taken into account
DOM		Assumed to be zero	Calculated from biomass left to decay on ground
Soil		Does not change due to management Not necessary to stratify in detailed level	EF: Using carbon factors and SOC values for estimation AD: Should stratify in detailed level

- Section 4.5 Tables provides a lot of default parameters (mainly for Tier.1)

3B1b Land converted to Forest land

Pools and activities		Tier.1	Tier.2
Loss of carbon in previous land use	Biomass	Not necessary to estimate	Averaged biomass existed in each sub-categories within previous land use lost
	DOM	Not necessary to estimate, because DOM does not exist in non-forest land very much	
Annual increase of biomass		Same as FL-FL.	Same as FL-FL.
Biomass loss occurred		Not necessary to estimate	Consider estimation when disturbance occurred
DOM		Implement estimation with default parameters	Implement estimation with CS parameters
Soil		Implement estimation with default parameters	Implement estimation with CS parameters

3B2a Cropland remaining Cropland

- Major sources/sinks
  - Carbon stock changes in perennial woody biomass
    - Estimation is done by generic stock-difference or gain-loss
    - Sometimes the shape of tree in cropland are kept steady state and so has maturity cycle in the 2006GL
  - Carbon stock changes in mineral soil
    - The 2006GL provides category specific carbon factors
  - Non-CO_2 gas emissions due to agriculture practices are covered in section 3C

3B2a Cropland remaining Cropland

- Default parameters for perennial woody crop

TABLE 5.1
DEFAULT COEFFICIENTS FOR ABOVE-GROUND WOODY BIOMASS AND HARVEST CYCLES IN CROPPING SYSTEMS CONTAINING PERENNIAL SPECIES

Climate region	Above-ground biomass carbon stock at harvest (tonnes C ha^{-1})	Harvest /Maturity cycle (yr)	Biomass accumulation rate (G) (tonnes C ha^{-1} yr^{-1})	Biomass carbon loss (L) (tonnes C ha^{-1} yr^{-1})	Error range[1]
Temperate (all moisture regimes)	63	30	2.1	63	± 75%
Tropical, dry	9	5	1.8	9	± 75%
Tropical, moist	21	8	2.6	21	± 75%
Tropical, wet	50	5	10.0	50	± 75%

Note: Values are derived from the literature survey and synthesis published by Schroeder (1994).
[1] Represents a nominal estimate of error, equivalent to two times standard deviation, as a percentage of the mean.

- For Tier.2 and more, appropriate sub-categorization is recommended. (Moldova has already implemented)

3B2a Cropland remaining Cropland

- Carbon factors for soil (a part of)

TABLE 5.5
RELATIVE STOCK CHANGE FACTORS (F_{LU}, F_{MG}, AND F_I) (OVER 20 YEARS) FOR DIFFERENT MANAGEMENT ACTIVITIES ON CROPLAND

Factor value type	Level	Temper-ature regime	Moist-ure regime[1]	IPCC defaults	Error[2,3]	Description
Land use (F_{LU})	Long-term culti-vated	Tem-perate/ Boreal	Dry	0.80	± 9%	Represents area that has been continuously managed for >20 yrs, to predominantly annual crops. Input and tillage factors are also applied to estimate carbon stock changes. Land-use factor was estimated relative to use of full tillage and nominal ("medium") carbon input levels.
			Moist	0.69	± 12%	
		Tropical	Dry	0.58	± 61%	
			Moist/ Wet	0.48	± 46%	
		Tropical montane[4]	n/a	0.64	± 50%	
Land use (F_{LU})	Paddy rice	All	Dry and Moist/ Wet	1.10	± 50%	Long-term (> 20 year) annual cropping of wetlands (paddy rice). Can include double-cropping with non-flooded crops. For paddy rice, tillage and input factors are not used.
Land use (F_{LU})	Peren-nial/ Tree Crop	All	Dry and Moist/ Wet	1.00	± 50%	Long-term perennial tree crops such as fruit and nut trees, coffee and cacao.
Land use (F_{LU})	Set aside (< 20 yrs)	Tempe-rate/ Boreal and Tropical	Dry	0.93	± 11%	Represents temporary set aside of annually cropland (e.g., conservation reserves) or other idle cropland that has been revegetated with perennial grasses.
			Moist/ Wet	0.82	± 17%	
		Tropical montane[4]	n/a	0.88	± 50%	

3B2b Land converted to Cropland

- Loss of biomass existed in previous land use
  - Conversion from Forest land and Grassland > Use the average biomass stock
  - Conversion from other land uses > usually 0
- Loss of DOM existed in previous land use
  - Only relevant for conversion from Forest land
- Accumulation of biomass carbon
  - Both perennial woody biomass and annual crop have removals for the first year. After that, removals of perennial woody biomass is estimated by reaching mature state.

TABLE 5.9
DEFAULT BIOMASS CARBON STOCKS PRESENT ON LAND CONVERTED TO CROPLAND IN THE YEAR FOLLOWING CONVERSION

Crop type by climate region	Carbon stock in biomass after one year (ΔC_G) (tonnes C ha^{-1})	Error range[#]
Annual cropland	5.0	± 75%
Perennial cropland		
Temperate (all moisture regimes)	2.1	± 75%
Tropical, dry	1.8	± 75%
Tropical, moist	2.6	± 75%
Tropical, wet	10.0	± 75%

[#]Represents a nominal estimate of error, equivalent to two times standard deviation, as a percentage of the mean.

3B2b Land converted to Cropland

- Stock changes in soil
  - In Tier.1 or 2, comparing SOC of previous land use (below is the suggestion of the way applying carbon factors under Tier.1) and SOC under current agriculture practice

TABLE 5.10
SOIL STOCK CHANGE FACTORS (F_{LU}, F_{MG}, F_I) FOR LAND-USE CONVERSIONS TO CROPLAND

Factor value type	Level	Climate regime	IPCC default	Error #	Definition
Land use	Native forest or grassland (non-degraded)	All	1	NA	Represents native or long-term, non-degraded and sustainably managed forest and grasslands.
		Tropical	1	NA	
Land use	Shifting cultivation – Shortened fallow	Tropical	0.64	± 50%	Permanent shifting cultivation, where tropical forest or woodland is cleared for planting of annual crops for a short time (e.g., 3-5 yr) period and then abandoned to regrowth.
	Shifting cultivation – Mature fallow	Tropical	0.8	± 50%	
Land-use, Management, & Input	Managed forest	(default value is 1)			
Land-use, Management, & Input	Managed grassland	(See default values in Table 6.2)			
Land-use, Management, & Input	Cropland	(See default values in Table 5.5)			

Represents a nominal estimate of error, equivalent to two times standard deviation, as a percentage of the mean. NA denotes 'Not Applicable', where factor values constitute defined reference values.

3B3a Grassland remaining Grassland

- Major sources/sinks
  - Impact of natural disturbances and fire on managed grassland
    - Non-CO2 gas emissions are more important (covered in 3C)
    - CO2 gas (C loss) is considered by offset due to quick recovery of grass growth
  - Carbon stock changes in mineral soil
    - The 2006GL provides category specific carbon factors
  - Biomass may have some impact
    - BGB has more carbon than AGB

3B3a Grassland remaining Grassland

- Biomass
  - Tier.1: Assumed as zero
  - Tier.2: When biomass C stocks available for different grassland categories and also available area change information among them, estimation can be done.
  - CF is 0.5 for grassland
- Soil carbon
  - The 2006GL provides methodologies Tier.1 and more. Estimation is possible only when area change information among grassland is available.

3B3a Grassland remaining Grassland

- Default Carbon Factors for soil in each grassland category

TABLE 6.2
RELATIVE STOCK CHANGE FACTORS FOR GRASSLAND MANAGEMENT

Factor	Level	Climate regime	IPCC default	Error [1,2]	Definition
Land use (F_{LU})	All	All	1.0	NA	All permanent grassland is assigned a land-use factor of 1.
Management (F_{MG})	Nominally managed (non –degraded)	All	1.0	NA	Represents non-degraded and sustainably managed grassland, but without significant management improvements.
Management (F_{MG})	Moderately degraded grassland	Temperate /Boreal	0.95	±13%	Represents overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs.
		Tropical	0.97	±11%	
		Tropical Montane[3]	0.96	±40%	
Management (F_{MG})	Severely degraded	All	0.7	±40%	Implies major long-term loss of productivity and vegetation cover, due to severe mechanical damage to the vegetation and/or severe soil erosion.
Management (F_{MG})	Improved grassland	Temperate /Boreal	1.14	±11%	Represents grassland which is sustainably managed with moderate grazing pressure and that receive at least one improvement (e.g., fertilization, species improvement, irrigation).
		Tropical	1.17	±9%	
		Tropical Montane[3]	1.16	±40%	
Input (applied only to improved grassland) (F_I)	Medium	All	1.0	NA	Applies to improved grassland where no additional management inputs have been used.
Input (applied only to improved grassland) (F_I)	High	All	1.11	±7%	Applies to improved grassland where one or more additional management inputs/improvements have been used (beyond that is required to be classified as improved grassland).

3B2b Land converted to Grassland

- Loss of biomass existed in previous land use
  - Conversion from Forest land > Use the average biomass stock
  - Conversion from other land uses > usually 0
- Loss of DOM existed in previous land use
  - Only relevant for conversion from Forest land
- Accumulation of biomass carbon
  - Able to estimate carbon accumulation by the average biomass amount (including both AGB and BGB) in each grassland categories.
- Stock changes in soil
  - In Tier.1 or 2, comparing SOC of previous land use and SOC under current grassland.

3B4 Wetlands

- Wetlands has two sub-categories: Peatlands and Flooded land

- Wetlands remaining Wetlands (Flooded land remaining Flooded land)
  - At this moment in the 2006GL, no guidance is provided about flooded land remaining flooded land (some guidance in Appendix)

- Land converted to Wetlands (Land converted to Flooded land)
  - Only biomass loss due to creation of new flooded land is covered. As the biomass stock after conversion is considered as zero, biomass in the previous land use is estimated as loss in the year of conversion. (CF=0.5)

3B5a Settlements remaining Settlements

- Biomass
  - Tier.1: Assumed as zero
  - Tier.2: Estimation using default parameters. Three components, Trees, Shrubs and Herbs are mentioned but only tree default values available.
  - Two methods suggested for estimating net removals in trees
    - Crown cover area method (crown cover area by woody vegetation is AD)
    - Individual plant growth method (number of individual plant is AD)
  - Default growing period under settlements is set as 20 years.

- DOM and Soil carbon
  - Tier 1 is zero assumption. There are Tier.2 explanation but specific factors are not available.

3B5b Land converted to Settlements

- Loss of biomass existed in previous land use
  - Conversion from Forest land, Grassland, Cropland > Use the average biomass stock
  - Conversion from other land uses > usually 0
- Loss of DOM existed in previous land use
  - Only relevant for conversion from Forest land
- Accumulation of biomass carbon
  - Tier.1:0
  - Tier.2: Able to estimate carbon accumulation by the share of new settlements (ex. 50% green-space with tree, 50% non-green space) and its relevant biomass removals factors.
- Stock changes in soil
  - In Tier.1 or 2, comparing SOC of previous land use and SOC under current grassland.

3B5b Land converted to Settlements

- Specific suggestions of carbon factors for land converted to settlements
  - (i) for the proportion of the settlement area that is paved over, assume product of FLU, FMG and FI is 0.8 times the corresponding product for the previous land use (i.e., 20% of the soil carbon relative to the previous land use will be lost as a result of disturbance, removal or relocation);
  - (ii) for the proportion of the settlement area that is turfgrass, use the appropriate values for improved grassland from Table 6.2, Chapter 6;
  - (iii) for the proportion of the settlement area that is cultivated soil (e.g., used for horticulture) use the no-till FMG values from Table 5.5 (Chapter 5) with FI equal to 1;
  - (iv) for the proportion of the settlement area that is wooded assume all stock change factors equal 1.

3B6 Other land

- Other land is basically considered as lands without any carbon stock.
- Other land remaining other land
  - Considered as no carbon stock changes occurred in any of carbon pools.
  - If it is known carbon stocks exist in a certain subcategory under other land, it is recommended to reallocate such land under “non-other land” land use category

- Land converted to Other land
  - Often considered as all carbon existed in the previous land use are lost and the new carbon stock is considered as zero.