Overview of AFOLU Sector in the 2006 GL

8th June 2016 Chisinau, Republic of Moldova

Atsushi Sato

GHG emission sources/removals and processes in AFOLU sector



Overview of Agriculture Sector

Sub-categories in AFOLU



Source categories in the Agriculture sector

- Related to animal production:
 - Enteric Fermentation (new 3A1, old 4A): CH₄ emissions from ruminants and nonruminants
 - Manure Management (new 3A2, old 4B1): CH₄ emissions from manure managed under anaerobic conditions
 - Manure Management (new 3A2, old 4B2): N₂O emissions from manure when treated under different treatment systems
- Related to croplands: Agricultural Soils (new 3C4-5, old 4D): N₂O emissions from the surface of cropped soils due to anthropogenic N inputs; direct (primary) and indirect (secondary) emissions are considered
- Use of lime and urea:
 - Lime application (new 3C2, old 5(III)): CO₂ emissions from decomposition
 - Urea application (new 3C3, old missing source): CO₂ emissions from decomposition

Source categories in the Agriculture sector

- Related to cropping systems: Rice cultivation (new 3C7, old 4C): CH₄ emissions from the surface of soils kept under anaerobic conditions to cultivate rice
- Use of fire:
 - Prescribed burning of savannas (new 3C1, old 4E): non-CO₂ gas emissions due to savanna biomass burning
 - Crop residue burning (new 3C1, old 4F): non-CO₂gas emissions due to dead biomass burning

Summary table: Gases

Sector/source category	CO ₂	CH ₄	N ₂ O	СО	NOx	NMVOC	SO ₂
3A1 ENTERIC FERMENTATION		Х					
3A2 MANURE MANAGEMENT		Х	Х				
3C1 BIOMASS BURNING	X1	X	Х	X ²	X ²	X ²	X ²
3C2 LIMING	Х						
3C3 UREA APPLICATION	Х						
3C4 DIRECT N ₂ O FROM SOIL			Х				
3C5 INDIRECT N ₂ O FROM SOIL			Х				
3C6 INDIRECT N ₂ O FROM MANURE MANAGEMENT			Х				
3C7 RICE CULTIVATION		X					

¹ May be reported but not accounted for national total emission (due to avoid double counting between carbon stock change in 3B)

² Reference values.

3A1 Enteric Fermentation



- Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream.
- The amount of methane released depends on the population, age, weight and the quality and quantity of the feed consumed, etc.
- This sector covers emissions from cattle (daily, non-dairy), buffalo, goats, sheep, deer, camels, horses, mules and asses, swine, llamas, alpacas, etc.

3A2 Manure Management



- When manure is stored or treated as a liquid (e.g., in lagoons, ponds, tanks, or pits), it decomposes anaerobically and produce CH₄.
- The main factors affecting CH₄ emissions are the amount of manure produced and the portion of the manure that decomposes anaerobically.
- Direct N₂O emissions occur by nitrification and denitrification of nitrogen contained in the manure. The emission of N₂O from manure during storage and treatment depends on the nitrogen and carbon content of manure, and on the duration of the storage and type of treatment.

3C1 GHG emissions from biomass burning



- Burning of agricultural residues in the fields is a common practice in the developing countries. Biomass burning is used primarily to clear remaining straw and stubble after harvest and to prepare the field for the next cropping cycle.
- In this process, CH₄, N₂O, CO and NOx are emitted.

3C2 Liming, 3C3 Urea application



- Application of limestone, dolomite or urea into soil is often a part of fertilization in agricultural practice.
- Due to the reaction in soil, CO2 is generated and emitted to atmosphere.

3C4 Direct N₂O emissions from managed soils

Soil Organic Matter



- Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. Nitrification is the aerobic microbial oxidation of ammonium to nitrate, and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N₂).
- This sector covers N₂O emissions from human-induced N additions to soils (e.g., synthetic or organic fertilizers, deposited manure, crop residues, sewage sludge), or of mineralization of N in soil organic matter following drainage/management of organic soils, or cultivation/land-use change on mineral soils.

3C5 Indirect N₂O emissions from managed soils



- Indirect N₂O emissions take place through two pathways.
- The first pathways is the volatilization of N as NH₃ and NOx, and the deposition of these gases and their products NH₄⁺ and NO₃⁻ onto soils and the surface of lakes and other waters.
- The second pathway is the leaching and runoff from land of N mainly in the NO₃⁻ form. The nitrification and denitrification processes transform some of the NH₄⁺ and NO₃⁻ to N₂O.

3C7 Rice Cultivation



- Anaerobic decomposition of organic material in flooded rice fields produces methane.
- The annual amount of CH₄ emitted from rice cultivation depends on the area of rice fields, the number and duration of crops grown, water regimes before and during cultivation period, soil type, temperature, etc.

Overview of LULUCF Sector

Sub-categories in AFOLU



Emissions and Removals on Land



- Growth of vegetation / biomass
 - \rightarrow sequestration of carbon from atmosphere : <u>REMOVALS</u>
- Loss of vegetation / biomass
 - → release of carbon to atmosphere : <u>EMISSIONS</u>

Emissions and Removals in LULUCF



Land use and Management have impact to carbon in soil as well.



The 2006 GL and GPG-LULUCF request

- To identify land use status for all land territory
 - Six broad land use categories
 - Forest land
 - Cropland
 - Grassland
 - Wetlands
 - Settlements
 - Other land



Then, Calculate Carbon Stock Changes

- Based on five carbon-pools
 - Above ground biomass
 - Below ground biomass
 - Dead wood
 - Litter
 - Soil organic matter (mineral soil and organic soil)
 - Transition period is 20 years as a default
 - Carbon status reach stable state
 - Each land category divided into "remaining land" and "Converted land" for calculation.

The previous IPCC GL and the 2006 GL

Overview of changes in categories between the previous GLs and the 2006 IPCC Guidelines



Source: IPCC TFI presentation in SB30 Side-event

Methodological approaches unchanged

- Land Use, Land- Use Change and Forestry
 - Stock changes \Rightarrow Emissions/Removals
 - Inputs (e.g. growth) outputs (e.g. decay, harvest)
 - Total Stock at end minus Total stock at beginning
 - Managed Land Proxy
- Agriculture
 - Based on understanding of processes
- General
 - Good Practice inventories are defined as "those that contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as is practical"

"New" Guidance in the 2006GL

- Agriculture + Land Use -> AFOLU
 - 3C1 Complete and Consistent treatment of fire
 - Ag: Prescribed burning on Savannas, Ag: Residue burning, L:Biomass burning are integrated
 - No distinction between controlled fire and wild fire any more
 - 3C2 Liming (from LULUCF part to Agriculture part)
 - 3C3 Urea application
 - 3C6 Indirect N₂O emissions from manure management
 - 3B4 Wetlands (peat extraction on managed wetlands.)
 - 3B5 Settlements, DOM and Soil carbon stock estimations
 - 3D1 Harvested Wood Product

Relationship between GPGs and 2006GL

The 2006 IPCC GL			GPG2000, GPG-LULUCF					
Code Category		Category	Code		Category			
3	3 AFOLU							
34	A	Livestock		4		Agriculture		
	3A1	Enteric Fermentation		4A		Enteric Fermentation		
	3A2	Manure Management		4B		Manure Management		
3	B	Land		5		LULUCF		
	3B1	land	FL remaining FL (FF)		5 \	land	FL remaining FL (FF)	
			Land Converted to FL (LF)		JA		Land Converted to FL (LF)	
	3B2	Cropland	CL remaining CL (CC)		5B	Cropland	CL remaining CL (CC)	
			Land Converted to CL (LC)				Land Converted to CL (LC)	
	202	Grassland	GL remaining GL (GG)		50	Grassland	GL remaining GL (GG)	
	303		Land Converted to GL (LG)		30		Land Converted to GL (LG)	
3B4	2D4	Wetlands	WL remaining WL (WW)		5D	Wetlands	WL remaining WL (WW)	
	384		Land Converted to WL (LW)				Land Converted to WL (LW)	
3B	20.5	Settlement s	Settle. remaining Settle. (SS)		~ 5	Settlement s	Settle. remaining Settle. (SS)	
	385		Land Converted to S (LS)		5E		Land Converted to S (LS)	
		Other land	OL remaining OL (OO)		σ.Γ.	Other land	OL remaining OL (OO)	
	380		Land Converted to OL (LO)		55		Land Converted to OL (LO)	

Relationship between GPGs and 2006GL

The 2006 IPCC GL			GPG2000, GPG-LULUCF			
	Code	Category	Code	Category		
30		Aggregate sources and non-CO2 emissions sources on land				
	3C1	GHG emissions from biomass burning				
	3C1a	Biomass Burning in lands	5(V)	Biomass burning		
	3C1b	Biomass Burning in Croplands	4F	Agricultural Residue burning		
	3C1c	Diomaga Duming in Crasslanda	4E	Savanna Burning		
		Biomass Burning in Grassianus	5(V)	Biomass burning		
	3C1d	Biomass Burning in Other lands	5(V)	Biomass burning		
	3C2	Liming	5(IV)	CO ₂ emission from agricultural lime application		
	3C3	Urea application				
	3C4		4D1	Direct soil Emissions		
		Direct N ₂ O emissions from managed soil	5(I)	Direct N_2O emissions from N fertilization of FL and Other		
			5(II)	Non-CO ₂ emissions from drainage of soils and wetlands		
			5(III)	N_2O emissions from disturbance associated with		
				land-use conversion to cropland		
	3C5	Indirect N ₂ O emissions from managed soil	4D3	Indirect Emissions		
	3C6	Indirect N ₂ O emissions from manure				
		management				
	3C7	Rice Cultivations	4C	Rice Cultivation		
	3C8	Other	4G,5F	Other		
31	D1	Harvested Wood Products	5F	Other (Harvested Wood Products)		
31	D2	Other	4G,5F	Other ²⁶		

Thank you !!