3rd Day – 17 April 2016:
The FAO Emissions database: GHG estimates for the Agriculture and Land Use sectors – Part II

This presentation is composed of two parts. Part II presents a suite of exercises with the FAO emissions database for key sources of GHG emissions in the AFOLU of Uganda, namely: the computation of emissions from a) forest; b_1) from enteric fermentation; b_2) manure left on pastures; b_3) manure management systems, and b_4) manure applied to soils; c) from cultivation of organic soils.
Data gaps, benefits and data implications of moving towards higher tiers and uncertainties are also discussed during the exercises.

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The FAO emissions database: GHG estimates for the agriculture and land use sectors Part II

15 –17 April 2016, Kampala, Uganda

ENVIRONMENT – TEAM
FAO STATISTICS DIVISION

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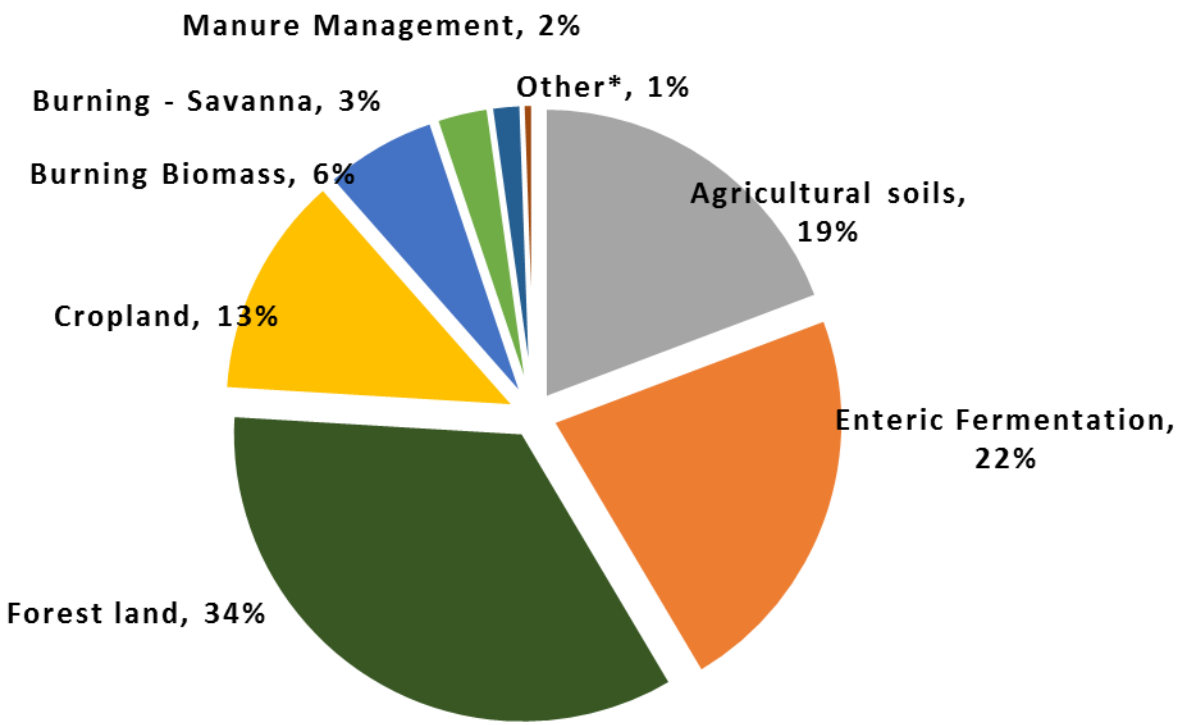
Key sources of emissions (AFOLU) from FAOSTAT database

FAOSTAT (year 2012) Approx. 49,000 Gg CO_2eq



* Other (< 1% of AFOLU emissions) (Burning Crop residues; Direct CO2 emissions from organic soils on grassland; Burning of Crop Residues)

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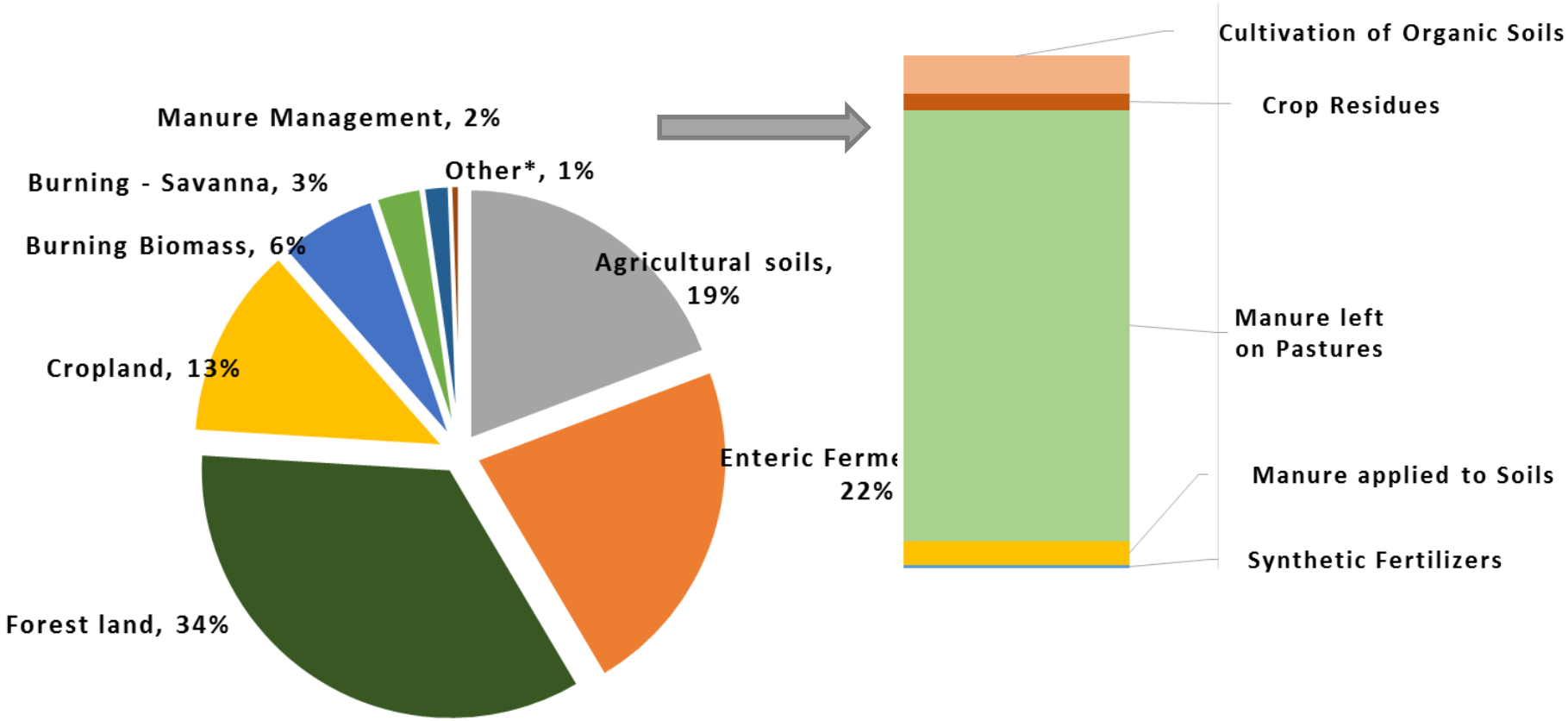

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Outline

Practical exercises: activity data & calculations

1) Exercises with the **FAOSTAT Land use** database: Emissions from Forest Land;

2) Exercises with the **FAOSTAT Agriculture** database: Emissions from Livestock domains (Enteric Fermentation; Manure Left on Pastures and Applied to Soils and MMS);

3) Emissions from organic soils (**FAOSTAT Land Use** & **Agriculture);**

4) Key messages;

Emissions from Land Use: gasses and available elements

CO_2

1. **Forest Land**: Forest and Net Forest Conversion (Area; Implied EFs; Net emissions/removals (CO_2 and CO_{2eq});
2. Carbon losses due to **drainage of organic soils** (under cropland and grassland)(Area, implied EFs; Net stock change (C); Net emissions/removals (CO_2 and CO_2eq);

CH_4, Nitrous oxide gases

Burning of tropical and humid forest; Other forest: Emissions and implied EFs; Dry matter of burning biomass; Burned area;

CO_2 , CH_4, Nitrous oxide gases

Combustion of organic soils: Emissions and implied EFs; Dry matter of burning biomass; Burned area;

Emissions land use:
Data & Metadata & Conceptual notes

HOME | BROWSE DATA | **DOWNLOAD DATA** | COMPARE DATA | SEARCH DATA | ANALYSIS | METHODS & STANDARDS | Search

Download

FAOSTAT Domains

- Food Security
- Production
- Trade
- Food Balance
- Prices
- Inputs
- Population
- Investment
- Macro-Statistics
- Agri-Environmental Indicators
- Emissions - Agriculture
- Emissions - Land Use
  - Land Use Total
  - Forest Land
  - Cropland
  - Grassland
  - Burning - Biomass
- Forestry

Metadata / Emissions - Land Use

FAOSTAT data is organized in domains. Please find below the list of available domains for this group: select one of the boxes to access the data.

Land Use Total | Forest Land | Cropland | Grassland | Burning - Biomass

INDEX

- Land Use Total
- Forest Land
- Cropland
- Grassland
- Burning - Biomass

FOREST LAND: 34% emissions from AFOLU sector in 2012

The FAOSTAT Emissions Land Use database provides country-level estimates of greenhouse gas (GHG) emissions based on FAOSTAT activity data using Tier 1 computations, following 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories. Technical details of specific activity data used and relevant computational steps employed, including the mapping between IPCC and FAOSTAT land use categories, are given in the Methodology and Quality Information section of the metadata for each of the sectors in the domain.

Changes in carbon stocks and ecosystem function linked to anthropogenic activities such as land-use change and land management determine emissions and removals of GHG that are typically reported by countries under the IPCC Land Use, Land-Use Change and Forestry (LULUCF) categories. In general, activities that increase terrestrial carbon stocks over time lead to removal of carbon dioxide (CO2) from the atmosphere, while activities that decrease total carbon stocks lead to CO2 and non-CO2 emissions.

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Integrating FRA forest data to the database

http://faostat3.fao.org/download/R/RL/E

HOME | BROWSE DATA | **DOWNLOAD DATA** | COMPARE DATA | SEARCH DATA | ANALYSIS | METHODS & STANDARDS | Search

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BULK DOWNLOADS

FAOSTAT Domains

- Food Security
- Production
- Trade
- Food Balance
- Prices
- Inputs
  - Fertilizers
  - Fertilizers archive
  - Fertilizers - Trade Value
  - Pesticides (use)
  - Pesticides (trade)
  - Land
  - Employment Indicators
- Population
- Investment
- Macro-Statistics
- Agri-Environmental Indicators

Filters / Inputs / Land

Countries | Regions | Special Groups

United States of America
United States Virgin Islands
Uruguay
USSR
Uzbekistan

SELECT ALL | CLEAR ALL

Elements

Area
Carbon stock in living biomass

SELECT ALL | CLEAR ALL

Items

Primary forest
Other naturally regenerated forest
Planted forest
Other land
Inland water

SELECT ALL | CLEAR ALL

Years

2013
2012
2011
2010
2009

SELECT ALL | CLEAR ALL

Summary

COUNTRIES Uganda

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Integrating FRA forest data to the database

http://faostat3.fao.org/download/R/RL/E

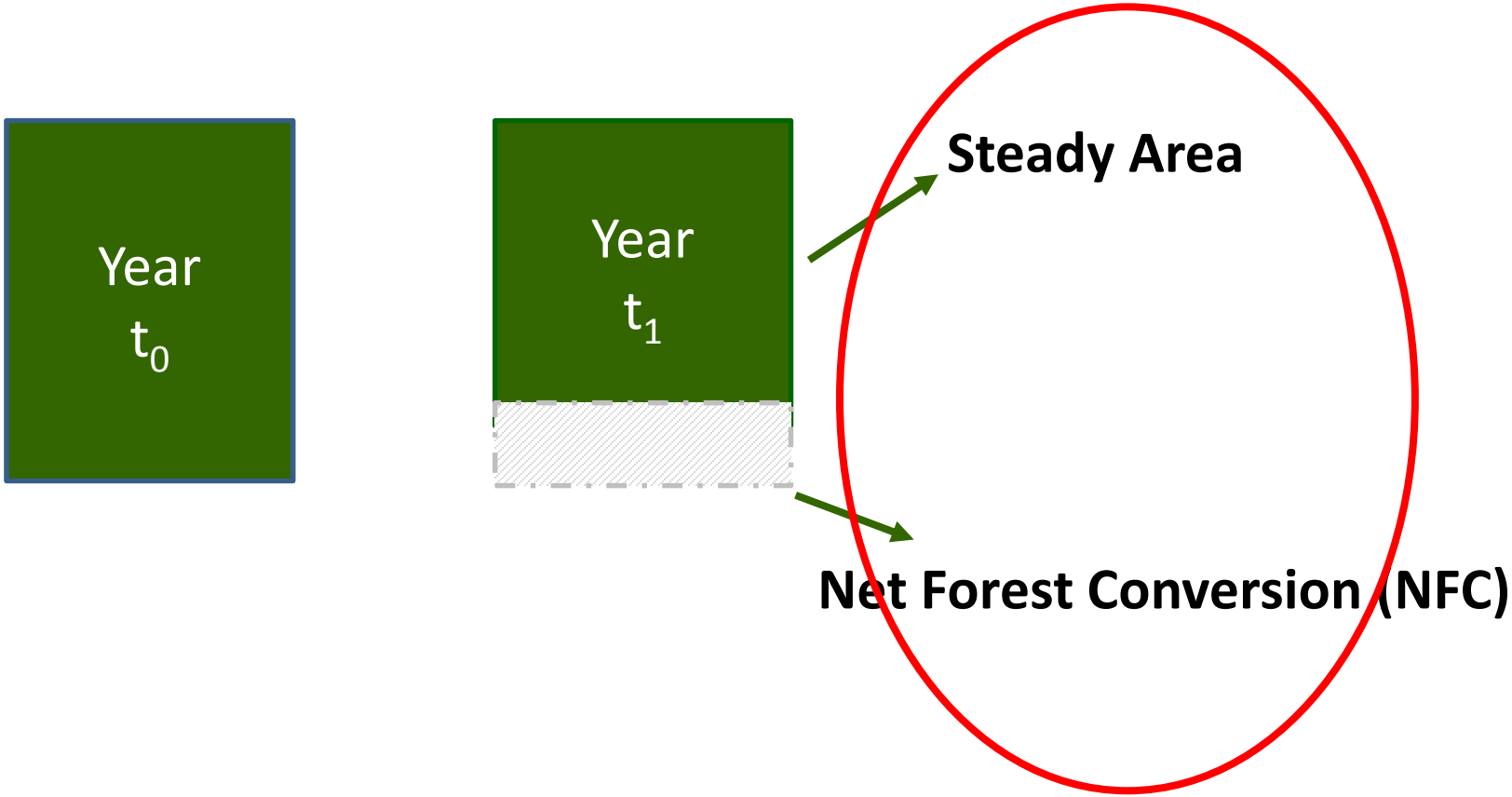
HOME BROWSE DATA **DOWNLOAD DATA** COMPARE DATA SEARCH DATA ANALYSIS METHODS & STANDARDS Search

Dow **DOWNLOAD DATA** COMPARE DATA SEARCH DATA ANALYSIS METHODS & STANDARDS Search

FAOS

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Land	Uganda	Area	Forest	2010	1000 Ha	2753.00	Q	Official data reported on FAO Questionnaires from countries
Land	Uganda	Area	Forest	2011	1000 Ha	2617.80	Fm	Manual Estimation
Land	Uganda	Area	Primary forest	2010	1000 Ha	0.00	Q	Official data reported on FAO Questionnaires from countries
Land	Uganda	Area	Primary forest	2011	1000 Ha	0.00	Fm	Manual Estimation
Land	Uganda	Area	Planted forest	2010	1000 Ha	55.00	Q	Official data reported on FAO Questionnaires from countries
Land	Uganda	Area	Planted forest	2011	1000 Ha	56.00	Fm	Manual Estimation
Land	Uganda	Area	Other naturally regenerated forest	2010	1000 Ha	2698.00	Q	Official data reported on FAO Questionnaires from countries
Land	Uganda	Area	Other naturally regenerated forest	2011	1000 Ha	2561.80	Fm	Manual Estimation
Land	Uganda	Carbon stock in living biomass	Forest	2010	million tonnes	100.50	Q	Official data reported on FAO Questionnaires from countries
Land	Uganda	Carbon stock in living biomass	Forest	2011	million tonnes	95.70	Fm	Manual Estimation

FRA Forest Components



FOREST = Primary (P) + Secondary (S) + Plantation (PLA)

Uncertainty in FRA 2015

FRA assessments: methodology evolved; uncertainties vary by country; 2015 uses a Tiered approach for *status and trends* (Keenan et al., 2015 – Country reports)

TIER for STATUS	
Tier 3	Recent national forest inventories (NFI) (≤ 10 years) or remote sensing with ground truthing or programs for repeated compatible NFI
Tier 2	Full cover mapping / remote sensing or old NFI (> 10 years)
Tier 1	Other type of assessment

TIER for REPORTED TRENDS	
Tier 3	Estimated based on repeated compatible tiers 3 (for status)
Tier 2	Estimated based on repeated compatible tier 2 or combination tier 3, 2, and 1 (for status)
Tier 1	Other type of assessment

E.g. Uganda FRA report

Category	TIER for STATUS	TIER for REPORTED TREND
FOREST	Tier 2	Tier 2
OTHER WOODED LAND	Tier 2	Tier 2
FOREST EXPANSION	Tier 1	Tier 1
DEFORESTATION	N/A	N/A
REFORESTATION	Tier 1	Tier 1

Emissions/Removals of Carbon (methods 1)

Currently 5 carbon pools have to be reported under the UNFCCC:

Above-ground Biomass
Below-ground Biomass
} Biomass

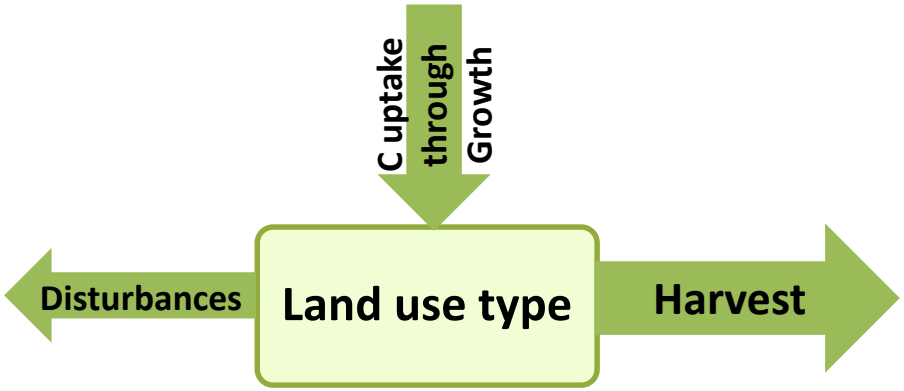
Dead Wood
Litter
} Dead Organic Matter (DOM)

Soil Organic Matter (SOM)
} mineral soils
organic soils

A sixth pool can be voluntarily reported: Harvested Wood Product (HWP)

Emissions/Removals of Carbon (methods 2)

1) **gain & losses** : the process-based approach, which estimates the net balance of carbon additions and subtraction to and from a carbon stock;



2) **stock change**: estimate the difference in carbon stocks measured at two points in time.

Implemented in FAOSTAT using FRA data

GHG emission estimates for the AFOLU sector

- Multiply the amount or level of a human activity by an emission factor, which represents the emissions per unit of the activity.

Emission Estimate = **Activity Data** X **Emission Factor**

Emission Estimates

"Key Categories" of AFOLU sector

,

Official Statistics

FAOSTAT
+ geo-spatial

Guidelines

2006
IPCC Guidelines

Default values

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Forest Land – calculation

Formula:

$$E/R = A * CSC * -44/12$$

A = Area under forest management or the forest area net change, in ha – Linearly interpolated to compile a complete time series (FRA data every 5 years): made of **SFA** (Steady Forest Area); **NAD** (Net Area converted to forest)**; NFC** (Net forest conversion – forest area lost to other land uses – proxy for deforestation);

CSC = Carbon Stock Change in the living biomass pool (**above and below ground**) – the method requires biomass carbon stock inventories at two points in time – Linearly interpolated to compile a complete time series (FRA data every 5 years);

Regional average carbon density when values are missing;

Forest Land – calculating emissions: Data for Uganda 2011

Source: FAO emissions database

YEAR	AREA		C Stock	C Density
	Thousand ha		Million tons	kt / ha
2010	**2753** of which		100.5	0.036506
	PRIMARY FOREST	0		
	OTHER NATURALLY REGENERATED	2698		
	PLANTATION	55		
2011	**2617.8** of which		95.7	0.036557
	PRIMARY FOREST	0		
	OTHER NATURALLY REGENERATED	2561.8		
	PLANTATION	56		
From C to CO_2 dimension-less factor -44/12				

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Forest Land – calculation: Detailed approach for Uganda 2011

AREA CHANGE

a) **NFC Area (thd ha) =** Min.(i, 0) $_{t2}$ - Min.(ii, 0)$_{t1}$ =

i. **Area change for Primary and Secondary Forest (PS) =**

(0 + 2,561.8) – (0 + 2,698) = -136.2;

ii. **Area Change for plantation (PLA) =** (56 – 55) = 1

= -136.2 thousand ha of forest converted to other land uses

b) Forest area (thd ha) = Net area gain (**NAD**) $_{t2,t1}$ + Steady forest area (**SFA**) $_{t2,t1}$ =

iii. **Net area gain =** Max. (i, 0) $_{t2}$ + Max. (ii, 0) $_{t1}$ = (0 + 1) = 1

iv. **Steady area =** Min. Area PS(2010, 2011) + Min. Area PLA (2010, 2011) = 2,561.8 + 55 = 2,616.8

Forest Land – calculation: Detailed approach for Uganda 2011

NET CARBON STOCK CHANGE

a) **Net Forest Conversion (NFC) (Gg) =** C Dens. (ktC/ha) in 2010 * NFC Area (1,000 ha) * 1,000 = 0.036506 * (-136.2) * 1,000 = -4,972.7

b) Forest (Gg) = Net area gain component (i) + Steady area component (ii) =

i. = C Dens. (ktC/ha) in 2011 * Net area gain (1,000 ha) * 1,000 = 0.036557 * 1 * 1,000 = 36.55741

ii. = (C Dens. in 2011 – C Dens. in 2010)(ktC/ha) * Steady area (1,000 ha) * 1000 = (0.036557 – 0.036506) * 2,616.8 * 1,000 = 135.5094

= 36.55741 + 135.5094 = 172.0668

Carbon Density = C Dens. ; kt = Gg

Forest Land – calculation: Detailed approach for Uganda 2011

NET EMISSIONS / REMOVALS (Gg of CO_2)

a) **NFC (Gg of CO_2) =** Net Carbon Stock Change for NFC * -44/12 =

-4,927.07 * -3.666667 = 18,230.91

b) **Forest (Gg of CO2) =** Net Carbon Stock Change for Forest * -44/12 =

172.0668 * -3.666667 = -630.91

= 18,230.91 – 630.912 = 17,600

Carbon Density = C Dens. ; kt = Gg

Forest Land – calculation: Detailed approach for Uganda 2011

NET EMISSIONS / REMOVALS (Gg of CO_2)

a) **NFC (Gg of CO_2) =** Net Carbon Stock Change for NFC * -44/12 =

-4,927.07 * -3.666667 = 18,230.91

b) **Forest (Gg of CO2) =** Net Carbon Stock Change for Forest * -44/12 =

172.0668 * -3.666667 = -630.91

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Forest Land	Uganda	Net emissions/removal (CO2eq) (Forest land)	Forest	2011	Gigagrams	-630.91	Fc	Calculated data
Forest Land	Uganda	Net emissions/removal (CO2eq) (Forest land)	Net Forest conversion	2011	Gigagrams	18230.91	Fc	Calculated data

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Forest Land	Uganda	Net emissions/removal (CO2eq) (Forest land)	Forest land	2011	Gigagrams	17600.00	A	Aggregate, may include official, semi-official, estimated or calculated data

Forest Land – calculation: simplified approach for Uganda 2011

NET EMISSIONS / REMOVALS (Gg of CO_2)

1) **Carbon Stock Change (2011,2010) (million tons) =** 95.7 – 100.5 = -4.8

2) **Net emissions/removals (Gg of CO_2) =** (CSC * 1000) * (-44/12) =

= 17,600

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Forest Land	Uganda	Net emissions/removal (CO2eq) (Forest land)	Forest land	2011	Gigagrams	17600.00	A	Aggregate, may include official, semi-official, estimated or calculated data

Background material / Notes (1)

FAO FRA Definition of Forest (adopted by member countries in FRA country assessments reports):

"Forest is the land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 metres in situ. Areas under reforestation that have not yet reached but are expected to reach a canopy cover of 10 percent and a tree height of 5 metres are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, which are expected to regenerate. Includes: areas with bamboo and palms provided that height and canopy cover criteria are met; forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest; windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 ha and width of more than 20 metres; plantations primarily used for forestry or protective purposes, such as: rubber-wood plantations and cork, oak stands. Excludes: tree stands in agricultural production systems, for example in fruit plantations and agroforestry systems. The term also excludes trees in urban parks and gardens"

Background material / Notes (2)

The FRA definition of Forest includes:

Primary forest: Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.

Other naturally regenerated forest: Naturally regenerated forest where there are clearly visible indications of human activities.

Planted forest: Forest predominantly composed of trees established through planting and/ or deliberate seeding.

In the detailed approach, Primary and Other naturally regenerated forest (referred as Secondary forest) are kept together considering the transitions typically occur from primary to secondary forest.

Background material / Notes (3)

Emissions estimates from forest are based on analysis of the variations of carbon stock between two periods (emissions/removals of carbon). Quantities of carbon need to be converted to CO_2.

The fraction of carbon in carbon dioxide is the ratio of their weights (atomic weight for C and molecular weight for CO2) Molecular weight for CO_2 = 12 (for C) + 2 * 16 for the two molecules of Oxygen = 44

Thus 1 tons of C equals 44/12 (~ 3.67) tons of CO_2

Emissions Agriculture – Livestock-related domains

Enteric fermentation — CH_4

Manure management systems — CH_4 and N_2O

Manure applied to soils
Manure left on pastures — N_2O

More than 41% of AFOLU emissions in 2012 in Uganda

Animal manure: a sustainable agricultural practice (increasing micro- and macro-nutrients AND soil organic matter content;

If not adequately managed, threating to the environment (more relevant for liquid forms/slurry in confined/intensive systems);

Emissions from livestock: number of animals

- **FAOSTAT/production/Livestock/Live Animals;**

- **FAOSTAT/Production/Livestock/Livestock Primary:**

  - **Cattle dairy** from “Milk, whole fresh cow” and “Producing animals/Milk animals”; **Non-dairy cattle** by difference with Live animals/Cattle;
  - **Chicken layers** from “Eggs, hen, in shell” and “Producing animals/Laying”; **Chicken broilers** by difference with Live animals/chicken;

- **FAOSTAT** livestock data include the “pigs” item. **Market** and **breeding swine** are calculated as 90% and 10% of the pigs item respectively (IPCC 2006, Vol. 4, Ch. 10, Table 10.19).

Emissions Agriculture: Enteric Fermentation

CH_4 emissions produced in digestive systems of ruminants and to a lesser extent of non-ruminants

Emissions = A * EF

A = Activity data **number of heads of livestock** for each animal category;

EF = Tier 1 2006 IPCC emission factors (Kg CH_4 $head^{-1}$ $year^{-1}$)

Enteric Fermentation is calculated for the following animal categories: Asses; Buffaloes; camels; Cattle, dairy; Cattle, non-dairy (Other cattle in IPCC guidelines); Goats; Horses; Lllamas; Mules; Sheep; Swine, breeding; Swine, market.

Enteric fermentation (Uganda 2010)

HOME | BROWSE DATA | DOWNLOAD DATA | COMPARE DATA | SEARCH DATA | ANALYSIS | METHODS & STANDARDS | Search

- Prices
- Inputs
- Population
- Investment
- Macro-Statistics
- Agri-Environmental Indicators
- Emissions - Agriculture
  - Agriculture Total
  - Enteric Fermentation
  - Manure Management
  - Rice Cultivation
  - Synthetic Fertilizers
  - Manure applied to Soils
  - Manure left on Pasture
  - Crop Residues
  - Cultivation of Organic Soils
  - Burning - Savanna
  - Burning - Crop Residues
  - Energy Use
- Emissions - Land Use
- Forestry

United States of America
United States Virgin Islands

SELECT ALL | CLEAR ALL

Items | Items Aggregated

All Animals + (Total)
All Animals > (List)
Camels and Llamas + (Total)
Camels and Llamas > (List)
Cattle + (Total)

SELECT ALL | CLEAR ALL

Emissions (CO2eq)

SELECT ALL | CLEAR ALL

Years | Year Projections

2012
2011
2010
2009
2008

SELECT ALL | CLEAR ALL

Summary

COUNTRIES	Uganda
ELEMENTS	Emissions (CO2eq)
ITEMS	All Animals + (Total)
YEARS	2010

DISPLAY OUTPUT AS TABLE PIVOT | PREVIEW | CSV | EXCEL

Output Preview (first 50 rows only) | Show Options

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Enteric Fermentation	Uganda	Emissions (CO2eq) (Enteric)	All Animals	2010	Gigagrams	10583.38	A	Aggregate, may include official, semi official, estimated or calculated data

Uganda: enteric fermentation 10,583 Gg of CO_2eq (i.e. nearly half emissions from agriculture sector and more than one fifth all emissions) in 2010

Enteric fermentation (Uganda 2010)

Comparable figures were reported in the second national communication (for the year 2000) CH_4 emissions from enteric fermentation.

Gg of CH_4 from enteric fermentation in Uganda for the year 2000	
2nd national communication to the UNFCCC	FAO Emissions database
230 Gg	245.97

2nd national communication: Emissions from enteric fermentation in 2000 accounted for 4,830 Gg of CO_2eq and approx. **one third** of the entire agricultural sector AND **12%** of the entire emissions 38,078 Gg from all sectors in 2000.

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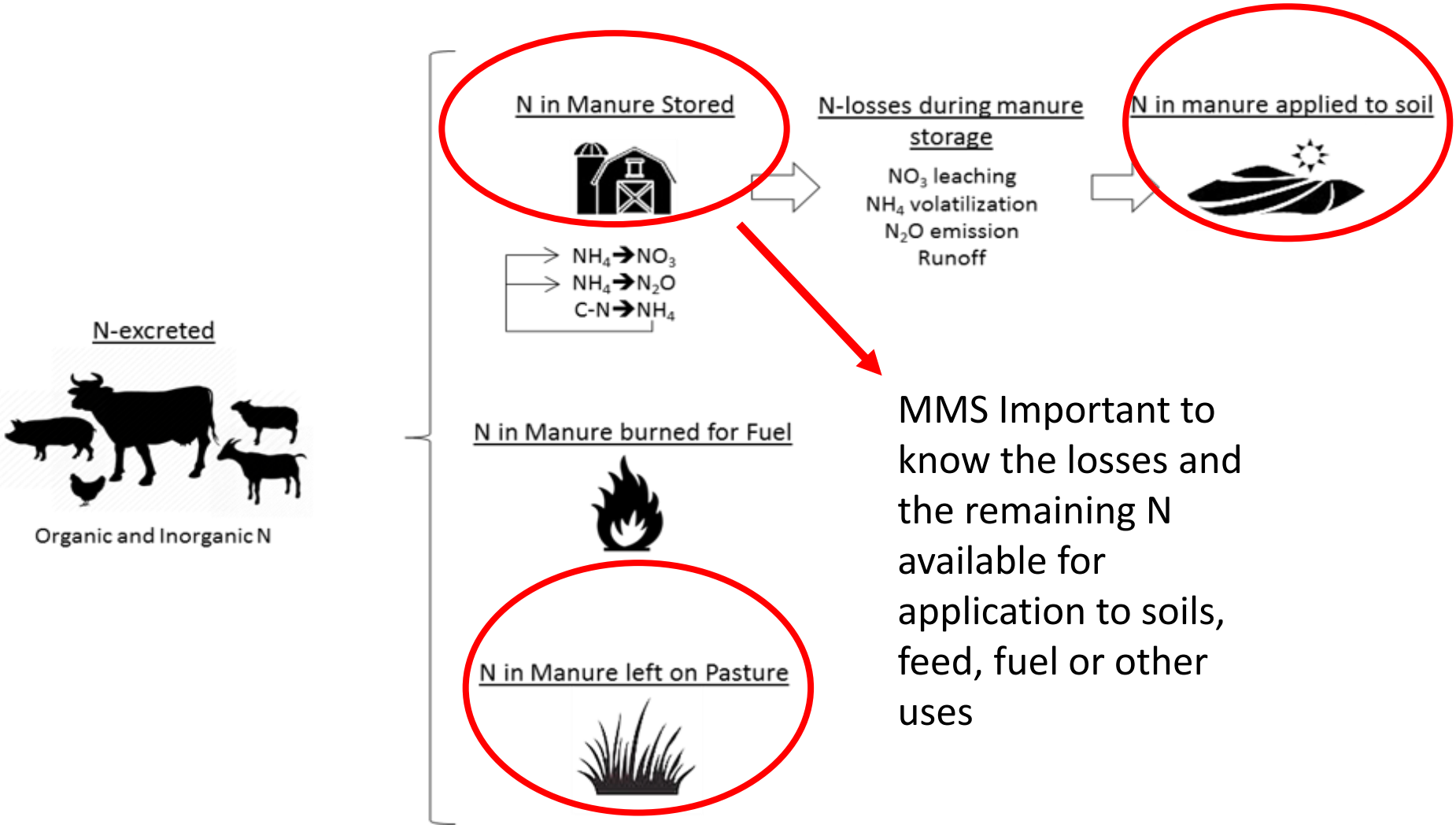
Emissions Agriculture – Livestock manure



MMS Important to know the losses and the remaining N available for application to soils, feed, fuel or other uses

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Emissions Agriculture – Livestock manure

N is excreted in two forms: **inorganic** (NH_4, NO_3, NO_2) and **organic** N (i.e. undigested feed, urea).

The amount and the nutrient content of the manure excreted depend on the animal species, age, diet, managing systems, and sex of the animals as well as the breeding and climate conditions. Additionally, when stored, different N-losses occur, through gaseous losses (NH_4 and N_2O), N-leaching (NO_3) and run-off (both organic and inorganic N-forms). Therefore the final N content of the treated manure available for use depends on the storage method and facilities chosen, as well as on the length of the storage time.

Manure left on pastures

Emissions from estimated amount of N deposited on range, pasture and paddock by grazing animals (Tier 1)

N_2O — Direct → Nitrification and de-nitrification microbial processes in sites of application

N_2O — indirect → N volatilization, re-deposition and leaching from managed soils

Main parameters

- Excretion rates by livestock category and region;
- Share of total annual **N excretion** for each livestock species/category that is deposited on **pasture, range and paddock**. The calculation includes the nitrogen contained in the urine for the corresponding fraction of N under the MMS burned for fuel.

Manure left on pastures in the database

- Soil
- Water
- Emissions by Sector
- Emission intensity
- Emissions - Agriculture
  - Agriculture Total
  - Enteric Fermentation
  - Manure Management
  - Rice Cultivation
  - Synthetic Fertilizers
  - Manure applied to Soils
  - Manure left on Pasture
  - Crop Residues
  - Cultivation of Organic Soils
  - Burning - Savanna
  - Burning - Crop Residues
  - Energy Use
  - GHG EDGAR
- Emissions - Land Use
  - Land Use Total

Items | Items Aggregated

All Animals + (Total)
All Animals > (List)
Camels and Llamas + (Total)
Camels and Llamas > (List)
Cattle + (Total)
Cattle > (List)

SELECT ALL | CLEAR ALL

Years | Year Projections

2013
2012
2011
2010
2009
2008

SELECT ALL | CLEAR ALL

Summary

COUNTRIES	Uganda
ELEMENTS	Emissions (CO2eq)
ITEMS	All Animals + (Total)
YEARS	2013

DISPLAY OUTPUT AS TABLE PIVOT

PREVIEW | CSV | EXCEL

Output Preview (first 50 rows only)

Show Options

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Manure left on Pasture	Uganda	Emissions (CO2eq) (Manure on pasture)	All Animals	2013	Gigagrams	8231.44	A	Aggregate, may include official, semi-official, estimated or calculated data

Uganda: 8,231 Gg CO_2eq in 2013

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Emission agriculture: Manure management systems (MMSs)

MMSs: Lagoon, Slurry, Solid storage, Drylot, *Daily spread*, Digester, Pit below 1 month; Pit above 1 month; Other

CH_4 produced by anaerobic decomposition of stored and treated manure;

Daily spread: from animal confinement facility to soil applications. Minimum emissions during storage accounted for this MMS.

Activity data represent the fraction of total amount of nitrogen (N) in manure treated in each MMS that volatizes or is lost through leaching (IPCC 2006 Tier 1 default).

Emission agriculture: Manure management systems (MMSs)

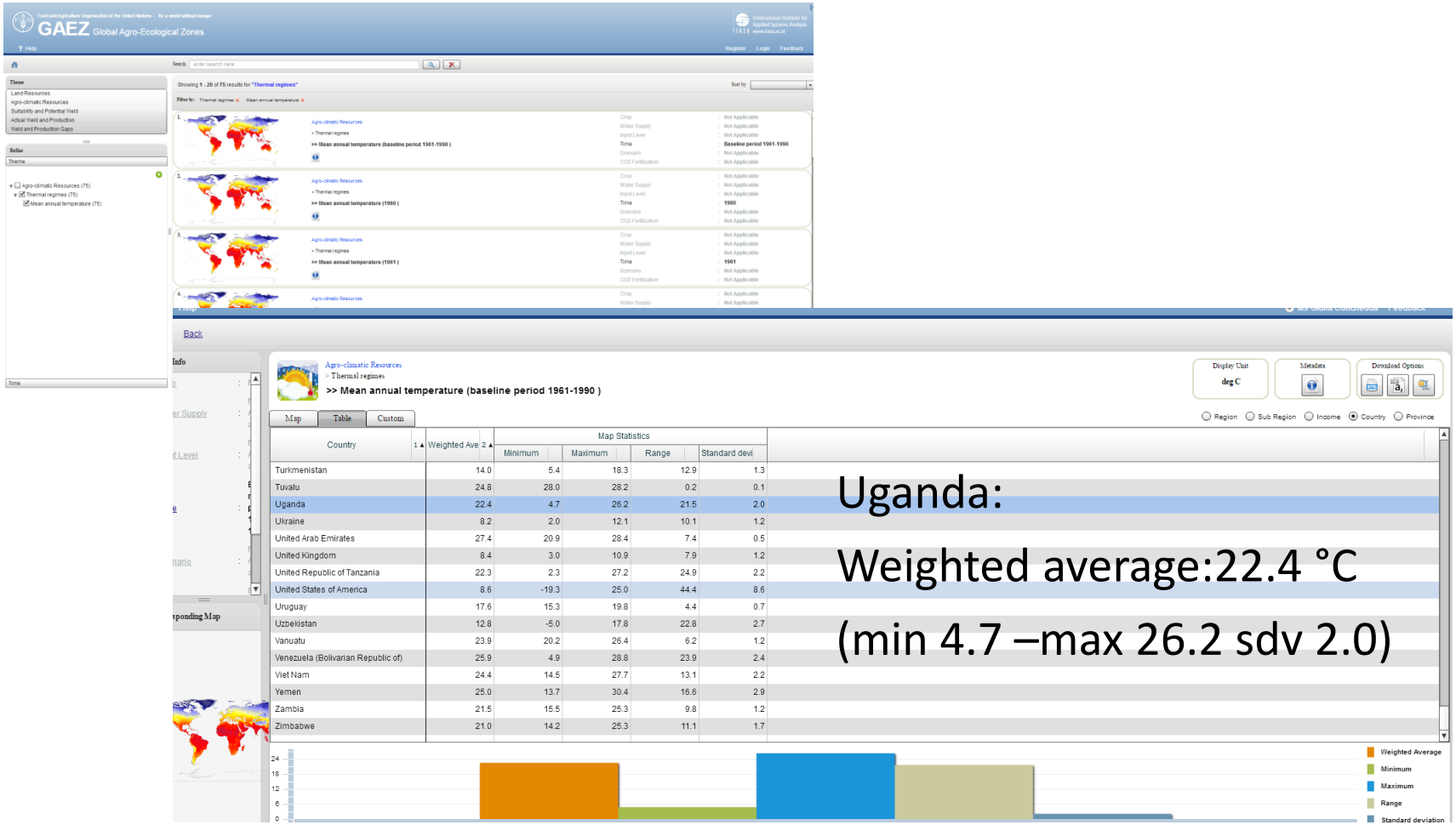
Methane conversion factor (MCF):

The amount of methane that can be produced under MMSs varies by share of manure handled in each system and temperature: varies theoretically between 0 – 100%.

Examples: a) manure managed ad dry material in cold climate has very low methane conversion factor (1%); b) manure managed in liquid form in warm climate conditions has conversion factor ranging from 65 to 80%.

This is a simplified method that only requires livestock population data by animal species/category and climate region or temperature, in combination with IPCC default emission factors, to estimate emissions. Because some emissions from manure management systems are highly temperature dependent, it is good practice to estimate the average annual temperature associated with the locations where manure is managed.

Manure management systems (MMS) and temperature



Country	Weighted Ave	Map Statistics			
		Minimum	Maximum	Range	Standard devi
Turkmenistan	14.0	5.4	18.3	12.9	1.3
Tuvalu	24.8	28.0	28.2	0.2	0.1
Uganda	22.4	4.7	26.2	21.5	2.0
Ukraine	8.2	2.0	12.1	10.1	1.2
United Arab Emirates	27.4	20.9	28.4	7.4	0.5
United Kingdom	8.4	3.0	10.9	7.9	1.2
United Republic of Tanzania	22.3	2.3	27.2	24.9	2.2
United States of America	8.6	-19.3	25.0	44.4	8.6
Uruguay	17.6	15.3	19.8	4.4	0.7
Uzbekistan	12.8	-5.0	17.8	22.8	2.7
Vanuatu	23.9	20.2	26.4	6.2	1.2
Venezuela (Bolivarian Republic of)	25.9	4.9	28.8	23.9	2.4
Viet Nam	24.4	14.5	27.7	13.1	2.2
Yemen	25.0	13.7	30.4	16.6	2.9
Zambia	21.5	15.5	25.3	9.8	1.2
Zimbabwe	21.0	14.2	25.3	11.1	1.7

Uganda:

Weighted average:22.4 °C

(min 4.7 –max 26.2 sdv 2.0)

GAEZ Data Portal: http://gaez.fao.org/Main.html#

Register and login

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Manure management systems (MMS) and temperature

The temperature data should be based on national meteorological statistics where available. Good practice is that countries should estimate the percentage of animal populations in different temperature zones and compute a weighted average emission factor*.

Where this is not possible, the annual average temperature for the entire country could be utilized; however, this may not give an accurate estimate of emissions that are highly sensitive to temperature variations (e.g., liquid/slurry systems).

*Spatial distribution of livestock can be used to this scope at higher Tiers.

Manure management systems (MMS) in the database

- Emissions by Sector
- Emission intensity
- Emissions - Agriculture
  - Agriculture Total
  - Enteric Fermentation
  - Manure Management
  - Rice Cultivation
  - Synthetic Fertilizers
  - Manure applied to Soils
  - Manure left on Pasture
  - Crop Residues
  - Cultivation of Organic Soils
  - Burning - Savanna
  - Burning - Crop Residues
  - Energy Use
  - GHG EDGAR
- Emissions - Land Use
  - Land Use Total

All Animals + (Total)
All Animals > (List)
Camels and Llamas + (Total)
Camels and Llamas > (List)
Cattle + (Total)
Cattle > (List)

SELECT ALL | CLEAR ALL

2013
2012
2011
2010
2009
2008

SELECT ALL | CLEAR ALL

Summary

COUNTRIES	Uganda
ELEMENTS	Emissions (CO2eq)
ITEMS	All Animals + (Total)
YEARS	2013

DISPLAY OUTPUT AS TABLE PIVOT

PREVIEW | CSV | EXCEL

Output Preview (first 50 rows only)

Show Options

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Manure Management	Uganda	Emissions (CO2eq) (Manure management)	All Animals	2013	Gigagrams	851.36	A	Aggregate, may include official, semi-official, estimated or calculated data

Uganda: 851 Gg CO_2eq in 2013

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Manure applied to soils

Nitrous oxide gas emissions from N additions in the treated manure applied to managed soils (Tier 1)

N_2O — Direct → Nitrification and de-nitrification microbial processes in sites of application

N_2O — indirect → N volatilization, re-deposition and leaching from managed soils

Assumption: All treated manure, net of losses (by MMS) and with additions from bedding (where applicable and by MMS) is applied to managed soils (IPCC 2006);

Analysis at **higher tiers** may disaggregate EFs based on type of soils (drainage, texture, pH); type of crop;

Manure applied to soils in the database

HOME | BROWSE DATA | DOWNLOAD DATA | COMPARE DATA | SEARCH DATA | ANALYSIS | METHODS & STANDARDS | Search

- Agri-Environmental Indicators
- Emissions - Agriculture
  - Agriculture Total
  - Enteric Fermentation
  - Manure Management
  - Rice Cultivation
  - Synthetic Fertilizers
  - Manure applied to Soils
  - Manure left on Pasture
  - Crop Residues
  - Cultivation of Organic Soils
  - Burning - Savanna
  - Burning - Crop Residues
  - Energy Use
- Emissions - Land Use
- Forestry
- ASTI R&D Indicators

Items | Items Aggregated

All Animals + (Total)
All Animals > (List)
Camels and Llamas + (Total)
Camels and Llamas > (List)
Cattle + (Total)

SELECT ALL | CLEAR ALL

Years | Year Projections

2012
2011
2010
2009
2008

SELECT ALL | CLEAR ALL

Summary

COUNTRIES	Uganda
ELEMENTS	Emissions (CO2eq)
ITEMS	All Animals + (Total)
YEARS	2010

DISPLAY OUTPUT AS TABLE PIVOT

PREVIEW | CSV | EXCEL

Output Preview (first 50 rows only)

Show Options

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
Manure applied to Soils	Uganda	Emissions (CO2eq) (Manure applied)	All Animals	2010	Gigagrams	417.72	A	Aggregate, may include official, semi-official, estimated or calculated data

Uganda: 417.7 Gg CO_2eq in 2010

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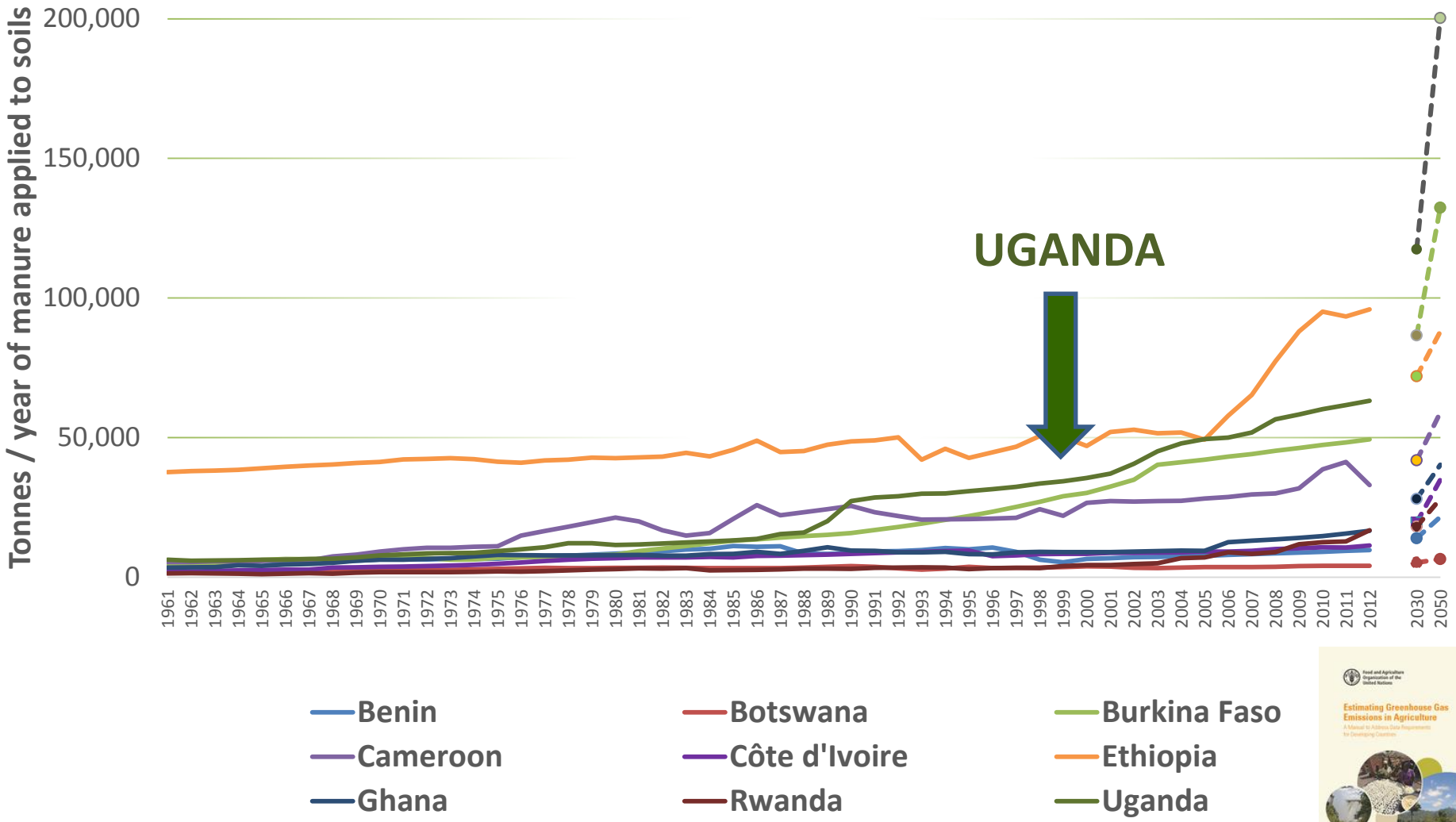
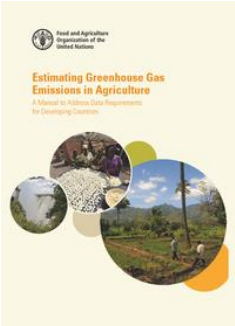
FAOSTAT 1961 – 2012 Manure applied to soils





Background material / Notes (1)

United Nations
Framework Convention on
Climate Change

Global Warming Potentials: is an index that attempts to integrate the overall climate impacts of a specific action (e.g., emissions of CH_4, NO_x or aerosols). It relates the impact of emissions of a gas to that of emission of an equivalent mass of CO_2. The duration of the perturbation is included by integrating radiative forcing over a time horizon (e.g., standard horizons for IPCC have been 20, 100, and 500 years). The time horizon thus includes the cumulative climate change and the decay of the perturbation.

In the FAO emission database: GWP-CH_4 = 21 and GWP-N_2O = 310 for for 100-year time horizon based on IPCC guidelines (IPCC, 1996: Technical summary, Tab 4, pg. 22).

Towards higher tiers

- Emissions from enteric fermentation and manure domains: **unbiased Tier 1 method**;

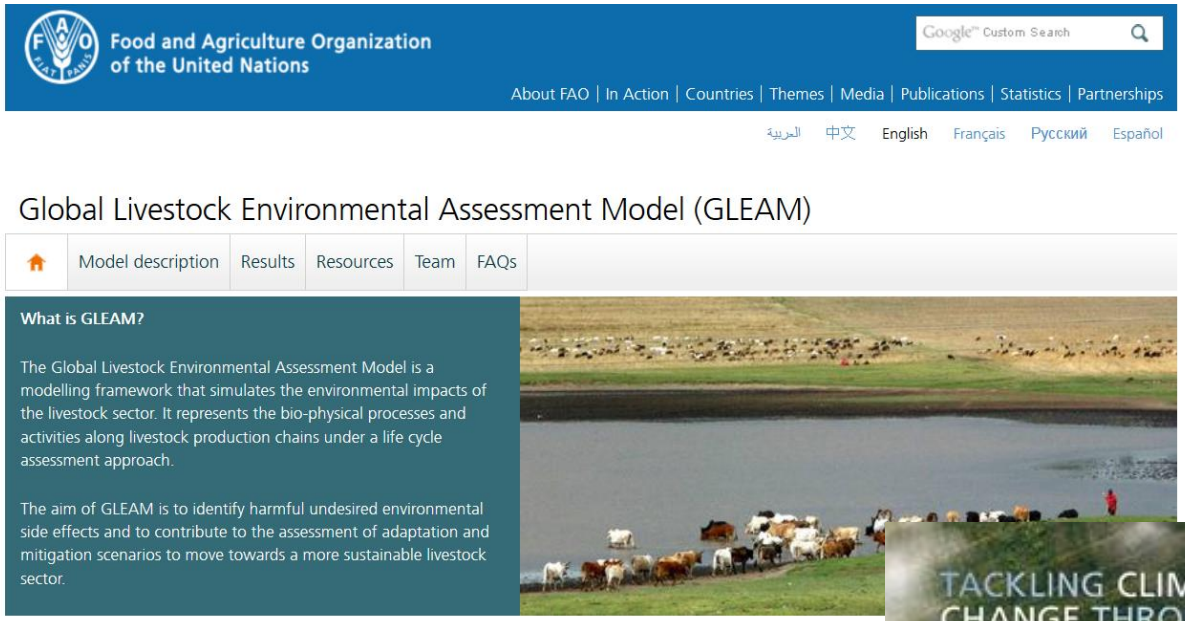
- **Time series** in the database but yearly values only due to population dynamics;

- Emission factors and parameters default regional values AND do not vary yearly;

- **Country specific parameters** needed particularly when enteric fermentation and manure are important sources of emissions;

- **Livestock sector very dynamic**: intensification (breeds, geographic concentration; herd composition; species shifting)

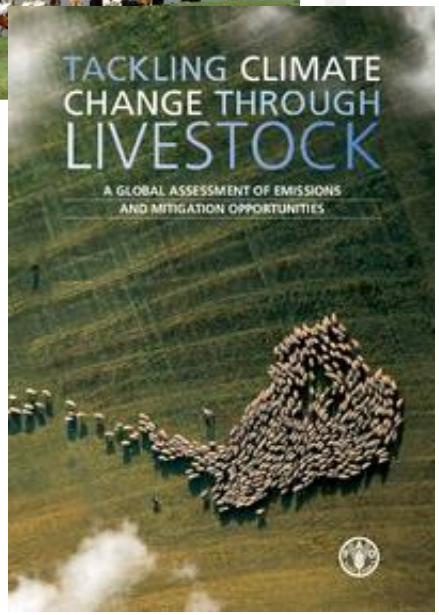
Global Livestock Environment Assessment Model (GLEAM)



GLEAM model in brief

GLEAM is a modelling framework that simulates the interaction of activities and processes involved in livestock production and the environment. The model is developed to assess livestock's impacts, adaptation and mitigation options at (sub)national, regional and global scale.

GLEAM differentiates key stages along livestock supply chains such as feed production, processing and transport; herd dynamics, animal feeding and manure management; and animal products processing and transport. The model captures the specific impacts of each stage, offering a comprehensive and disaggregated picture of livestock production negative side effects and a valuable information for intervention.



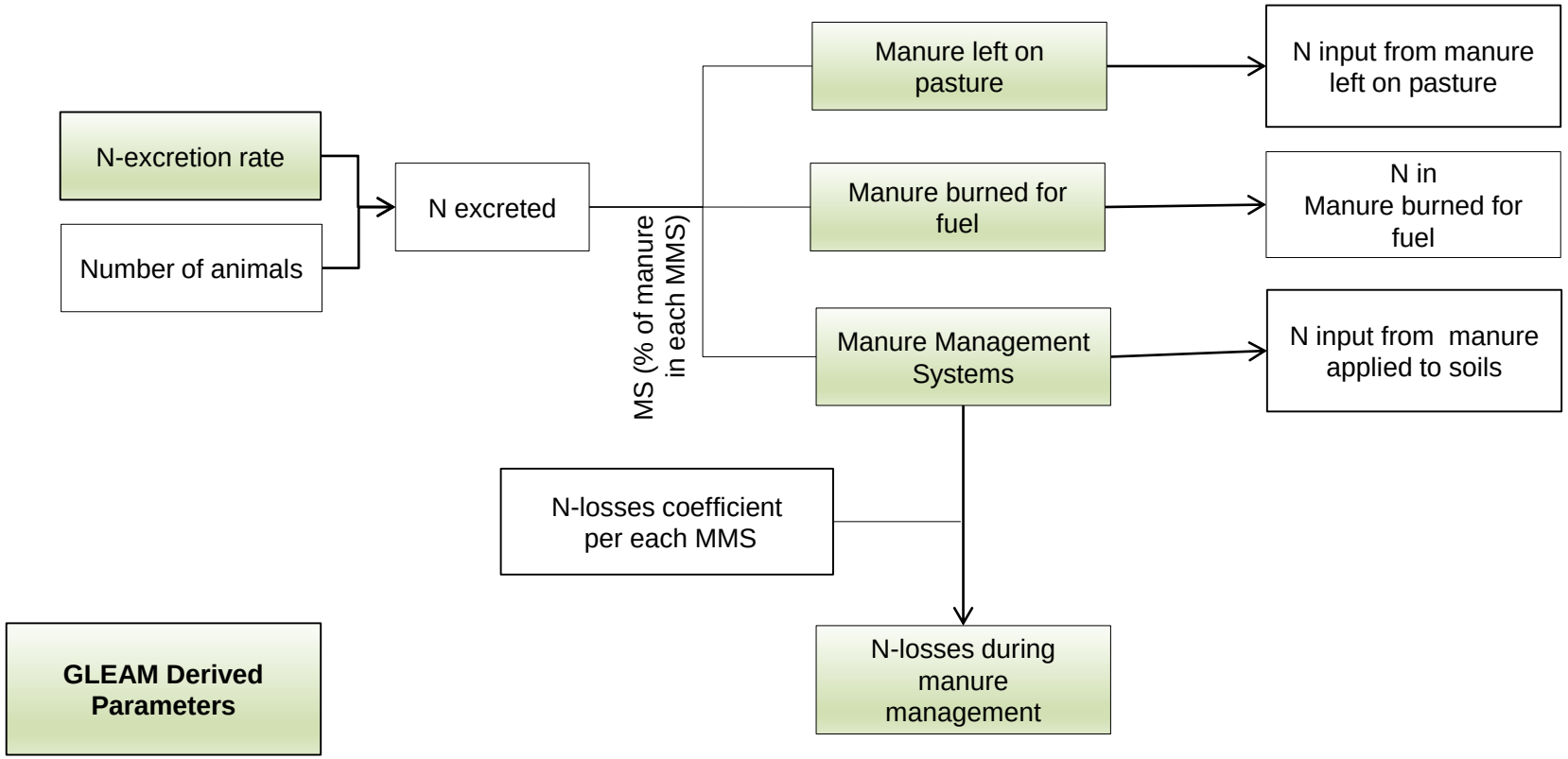
FAO Animal Production and Health division

http://www.fao.org/gleam/en/

Global Livestock Environment Assessment Model (**GLEAM**): a Tier 2/Tier 3

- Modeling **spatial framework** that simulates the environmental impacts of the livestock sector;
- Develop to **assess livestock's impacts**;
- Support **mitigation and adaptation options** at various scales;
- Assess specific impacts of **key stages** along the livestock supply chains:
  - feed production, processing and transport ;
  - herd dynamics, animal feeding and manure management;
  - animal products processing and transports

Simplified TIER 2 coefficients based on the GLEAM livestock model (v1 and v2)



Country weighted average extracted as a result of country specific herd composition by species/category, production system, feed basket and intake per cohort (sex, age and function); production system;

Synthesis Results: Aggregated Coefficients

N excretion coefficients at Tier 1 and Tier 2

		CATTLE DAIRY / NO-DAIRY	GOATS	SHEEP	PIGS MARKET / BREEDERS	CHICKEN BROILERS/LAYERS
		kg N per animal per year				
	TIER 1	60.23 / 39.78	15.00	11.96	16.05 / 5.62	0.36 / 0.54
TIER 2 *	BENIN	32.0	4.3	3.1	12.0	0.5
	BOTSWANA	26.7	3.6	3.6	8.9	0.6
	BURKINA FASO	35.1	2.6	3.3	7.6	0.5
	CAMEROON	30.6	2.6	3.5	8.9	0.5
	CÔTE D'IVOIRE	33.6	2.5	2.8	12.8	0.6
	ETHIOPIA	31.1	2.6	2.8	7.6	0.5
	GHANA	32.6	2.4	2.7	10.3	0.5
	RWANDA	28.4	2.3	2.2	6.4	0.5
	UGANDA	37.2	2.4	2.9	6.3	0.5

*Based on 2005 representation with GLEAM 1

Possible Applications

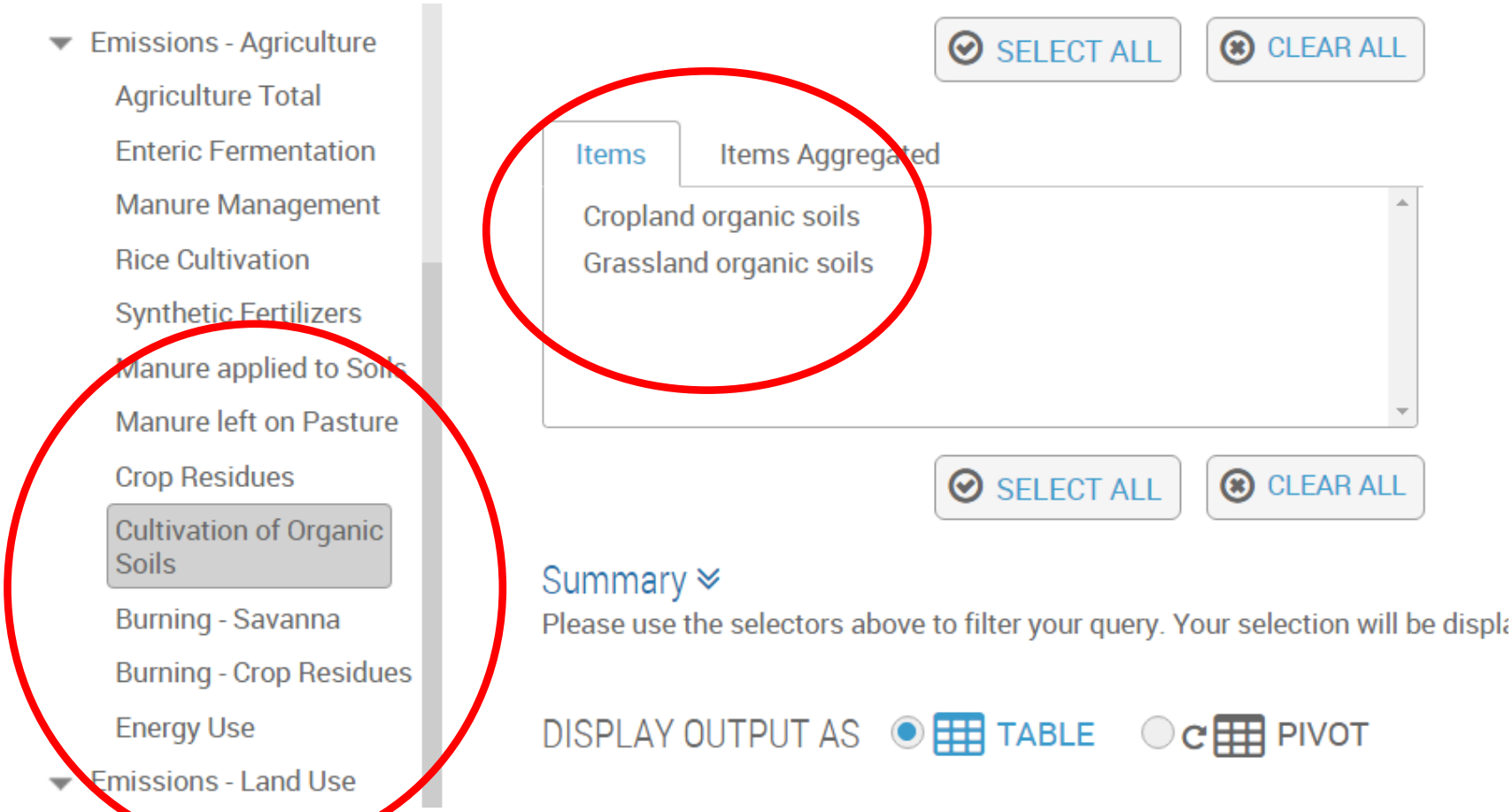
- ✓ **Improved quality control** to assess robustness of simpler Tier 1 approach and setting of robust baselines;

- ✓ **Guide** the development of more complex (Tier 2) coefficients better adapted to national conditions;

- ✓ 2005; 2010 parameters allow for **partial capturing of dynamics** beyond simple changes in livestock numbers;

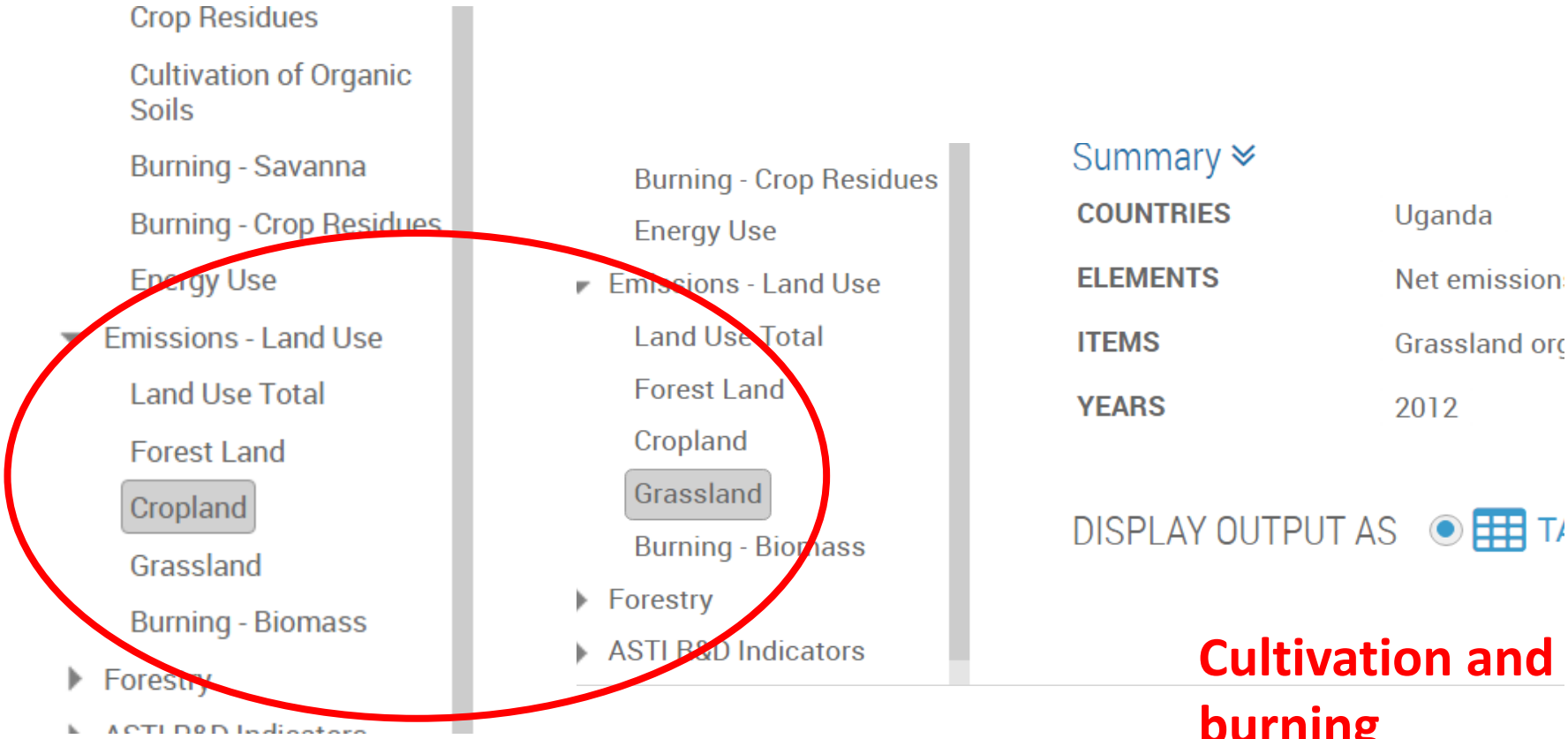
FAO is currently preparing a Report (extracted parameters in Annex). Possibly publish the two sets (2005 and 2010) of tier 2 simplified parameters under FAOSTAT (Agri-Environment Indicators).

Emissions from organic soils in FAOSTAT database



N_2O component of emissions
CO_2 component of emissions

Emissions from organic soils in FAOSTAT database



Cultivation and burning together 14.5% of AFOLU emissions in 2012

N_2O component of emissions
CO_2 component of emissions

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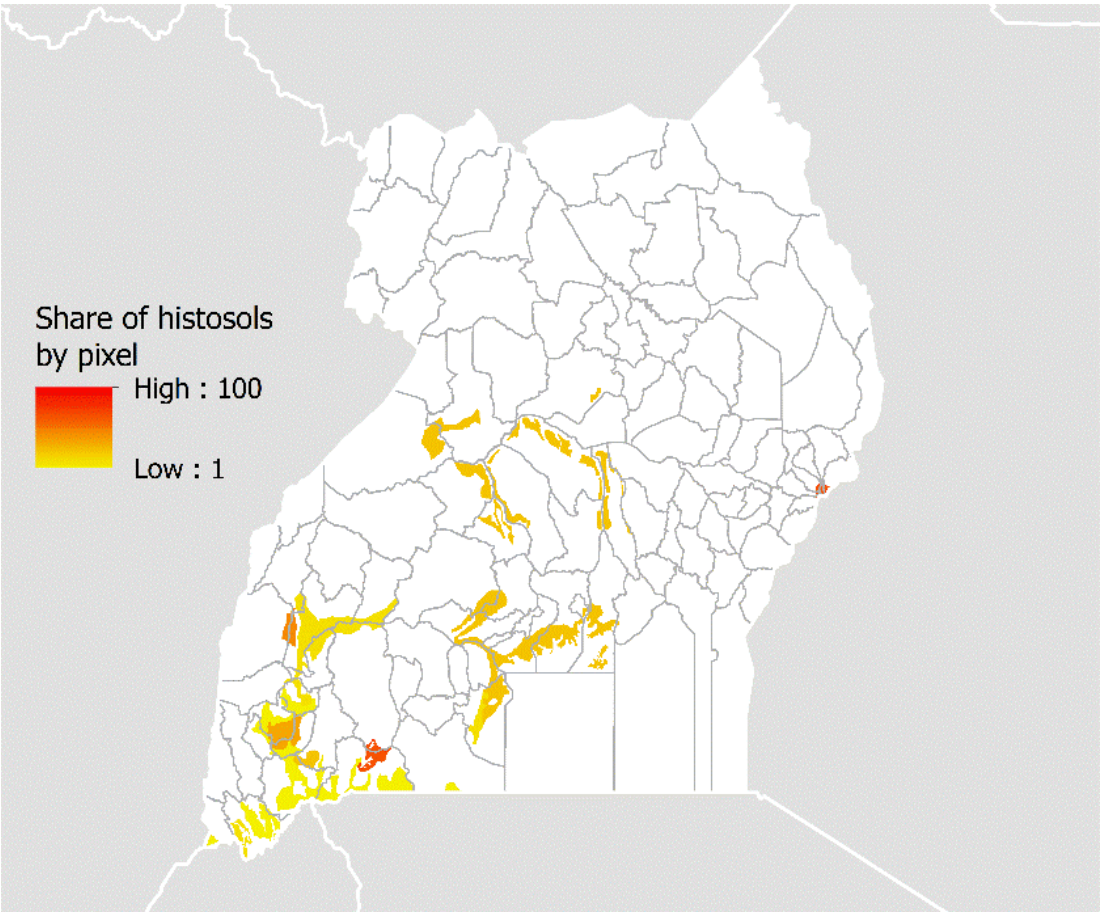
Geospatial analysis + EFs from 2006 guidelines

Harmonized World Soil Database (HWSD v1.2): queried to extract all pixels with any share of histosols, either as dominant or secondary soil type

http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/

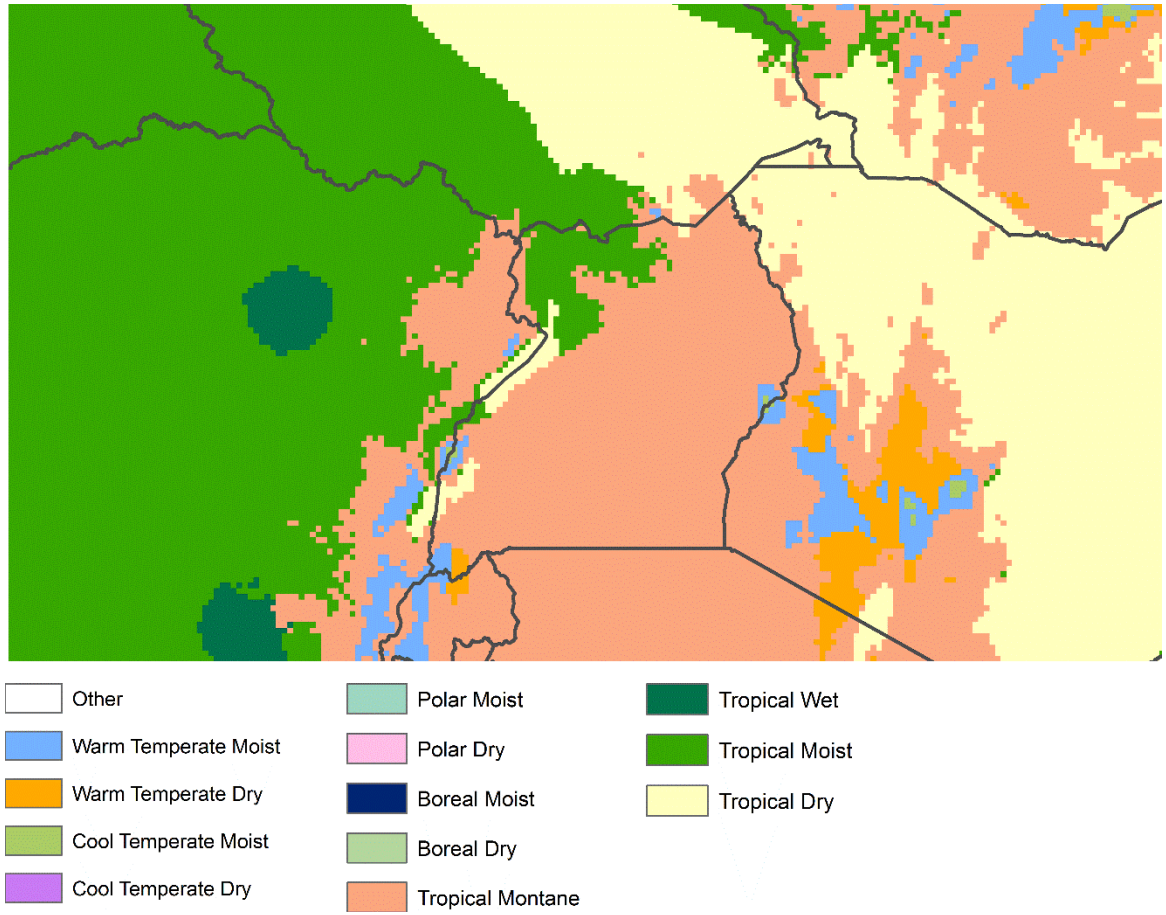


Spatial layer available in FAO GeoNetwork

Geospatial analysis + EFs from 2006 guidelines

Specific EFs factors vary by climatic zone: the JRC map of climatic zones

http://esdac.jrc.ec.europa.eu/content/support-renewable-energy-directive#tabs-0-description=1



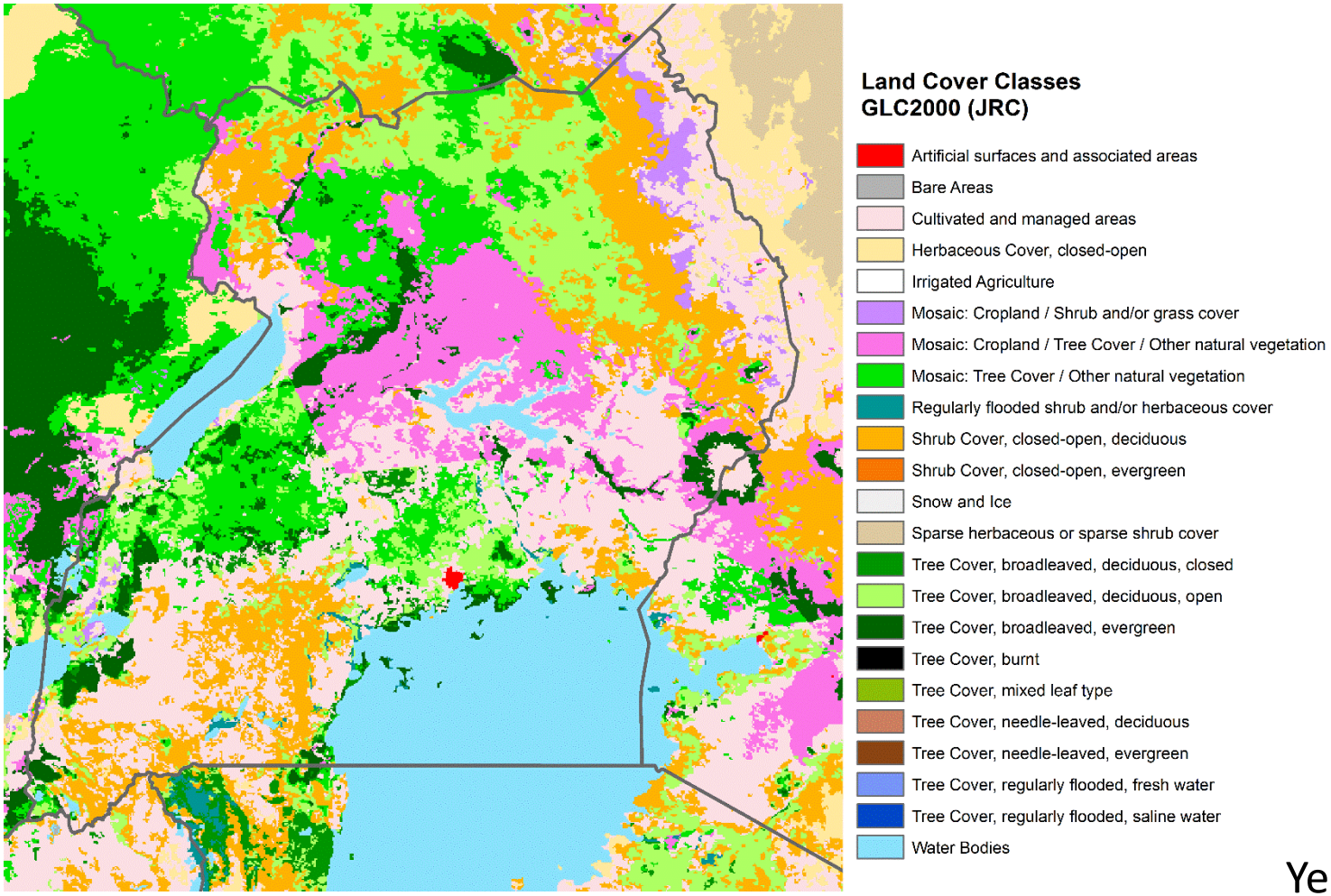
The map of climatic zones was created following the IPCC 2006 guidelines

Geospatial as source/complement for activity data

Cultivation on organic soils: Global Land Cover 2000 database (GLC2k)

http://forobs.jrc.ec.europa.eu/products/glc2000/products.php

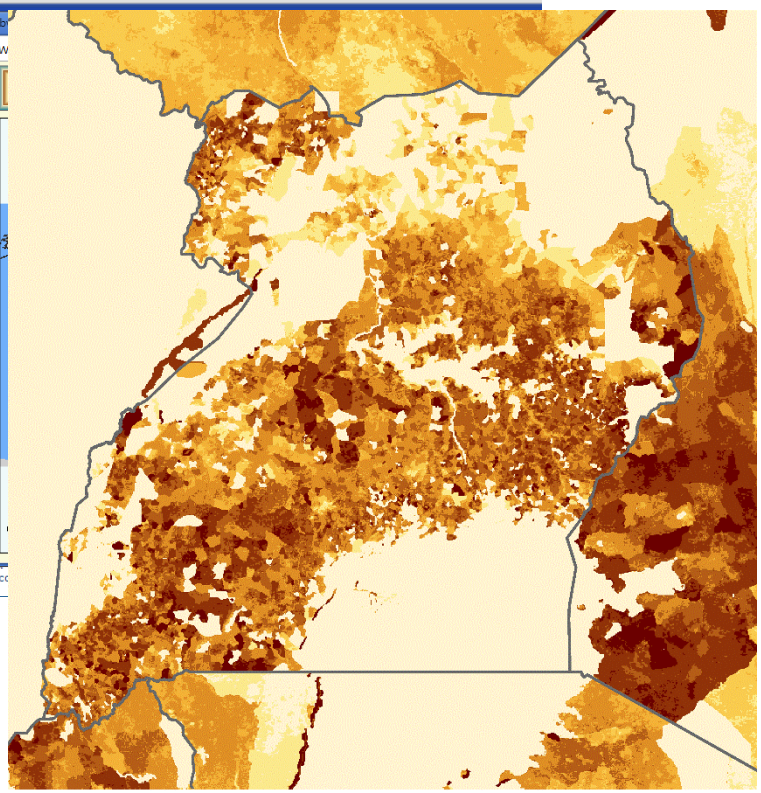
and literature information to derive crop percentage for mosaic classes



Year 2000

Geospatial as source/complement for activity data

Emissions due to livestock grazing on grassland cover in organic soils: densities of livestock (Gridded Livestock of the World) - queried for livestock presence in organic soils



Cattle density (head/sqkm)

< 1	5 - 10	20 - 50	100 - 250
1 - 5	10 - 20	50 - 100	> 250

Spatial layers of the GLW available in FAO GeoNetwork

http://www.fao.org/geonetwork/srv/en/main.home?uuid=f8e9b460-88fd-11da-a88f-000d939bc5d8

Year 2000 (GLW 1 2005)

Drained organic soils and associated emissions in Uganda

Emission estimates at pixel level and aggregated by country

Surface with Organic soils	Cultivated organic soils	Grassland and grazed organic soils
203,000 ha	92,351 ha (~45%)	3,729 ha (~1.8%)
Emissions N_2O (in CO_2eq):	691	29
Emissions CO_2:	6,404	68
Total emissions in CO_2eq	7,192	

Useful to complement relevant information in national communications

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A few considerations on uncertainties and completeness

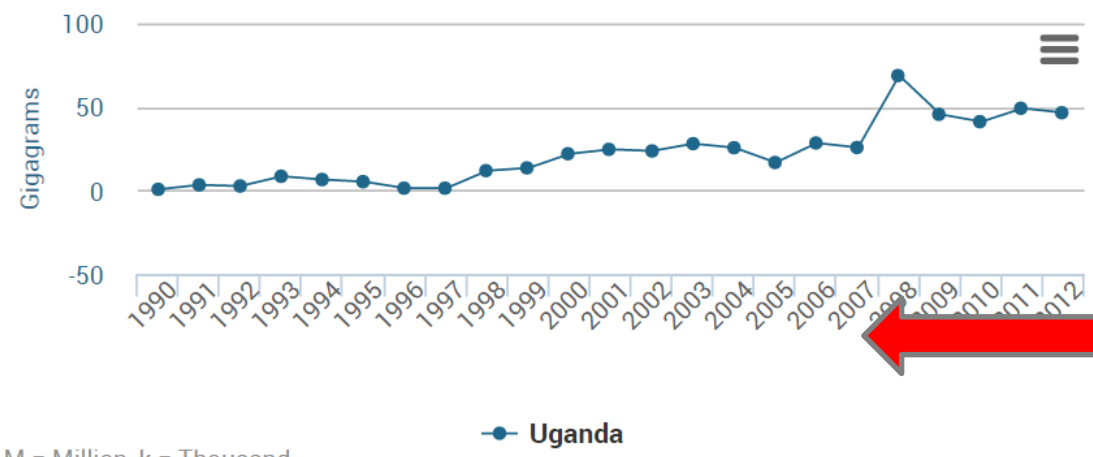
Uncertainties on activities data and emissions factors compound

- **Data propagation formula**: FAOSTAT activity data - important check for flags;
- **EFs**: more information on the guidelines (2006 / 1996);
- **Geospatial data**: user accuracy (e.g. for relevant land cover classes in GLC2000);

A few considerations on uncertainties and completeness

ITEM	AREA	FROM YEAR	TO YEAR	AGGREGATION
Synthetic Nitrogen fert	Uganda	1990	2012	Average

The designations employed and the presentation of material in the maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.
South Sudan declared its independence on July 9, 2011. Due to data availability, the assessment presented in the map for Sudan and South Sudan reflects the situation up to 2011 for the former Sudan.



Average annual growth rate by continent 1990 - 2012

Africa	2.354%
Americas	1.75%
Asia	3.424%
Europe	-1.24%
Oceania	3.914%

Growth rate calculated based by the least squares method

Currently limited contribution but increasing

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A few considerations on uncertainties and completeness

- Activity data derived from the Fertilizers domain under Inputs/Land;

- Limited availability - no answer to the questionnaire;

YEARS 2010

DISPLAY OUTPUT AS TABLE PIVOT PREVIEW CSV EXCEL

Output Preview (first 50 rows only) Show Options

Domain	Country	Element	Item	Year	Unit	Value	Flag	Flag Description
No data available for the current selection								

- Apparent consumption defined when Import (+) & Export Fluxes (0) from UN COMTRADE database http://comtrade.un.org/. In this cases, the apparent consumption assumed to coincide with actual consumption (SNA accounting).
- Trends and sectorial studies would greatly benefit;

Key messages

- Identify data gaps and underlying issues for country work: Cost Benefits of moving from **Tier 1 to Higher Tiers**, given significant lack of activity data and large uncertainties;
- Support member countries for **statistical processes** and mechanisms (NCs, BURs, NAMAs and REDD+) involved in reporting their GHG emissions (Help analysis of trends, regional comparison; QC);
- Identify **mitigation strategies** that are consistent with food security, resilience and rural development goals;
- Stimulating synergies (WB; FRA; UNREDD; CDREDD; UNDP; Global Strategy RS) and national statistical processes;

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THANK YOU

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Email: Environment-Statistics@fao.org