# XLM-AGRICULTURAL LIVESTOCK TOOLKIT

## User Manual

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Ministry of Social Security, National Solidarity, and Environment and Sustainable Development
(Environment and Sustainable Development Division)
Republic of Mauritius

# XL-Mitigation Livestock Toolkit

## About this manual

**This manual, *XL-Mitigation Livestock User Reference*, forms part of a family of toolkits to compute and plot a number of other variables including GHG emissions for Agricultural Livestock sector. The user reference has been written from an application developer's perspective. A fundamental conceptual and operational knowledge of Excel is assumed.**

### Disclaimer

Data used has been obtained from reliable sources. The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development (Environment and Sustainable Development Division) assumes no responsibility for errors and omissions in the data provided. Users are, however, kindly asked to report any errors or deficiencies in this product to the Ministry. The choices of calculation made in this tool are derived from TNC Report (2016).

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# XLM-Livestock Toolkit

## Table of Contents

# XLM-Livestock Toolkit

## 1.0 Introduction

This document refers to the agricultural livestock sector.

The mitigation for this sector was assessed in the Third National Communications (TNC) Report (2016) for a Business-as-Usual (BAU) and Policy scenarios, after a screening exercise to select the most feasible options. BAU refers to the expected change in GHG emissions from the sector in the absence of the Strategic Plan 2016 – 2020 of the Ministry of Agro-Industry and Food Security (2016) involving the old technology for which the livestock manure management remains unchanged. The Policy scenarios consider both the old technology and new technology (which incorporates changes in the manure management systems used in rearing), but with an increased livestock to enhance food security.

The XLM-Livestock Toolkit performs basic calculations that take into account principally the number of animal heads considering the type of technology with regards to the manure management. The trend for livestock population until 2050 are worked out following assumptions used by TNC (2016). Users of the XLM-Livestock Toolkit can adjust the scenarios by choosing appropriate parameters/ assumptions to suit their needs for the mitigation analysis.

## 2.0 Overview of the Agricultural Livestock sector

The Agriculture sector share 4% of the total GDP; out of which livestock (including poultry) contributes 22% in this sector (Statistics Mauritius, 2015).

The livestock sector is dominated by poultry (broiler chicken and eggs) for which self-sufficiency has been reached since a number of years. For the period 2006 -2013, FAREI's resource profile study revealed that most cattle are kept in stall followed by pasture to a least extent. Grazing large areas category is non-existent in Mauritius. Goats, pigs and sheep are mostly confined in buildings. Broilers are reared on litter flooring whereas for layers, the birds are kept in cages (except for pullets, the birds are reared on litter floor for a period of 5 months). All broilers and layers are confined in buildings. For deer, two types of deer farming can be observed namely extensive (wild) and intensive (paddocks). The number of livestock by type as at December 2015 is shown below (see FACTS (2015)).

The livestock sector is vulnerable to pests and diseases. Soil erosion has become a major problem and soil fertility has been considerably reduced. Fodder is available only on high ground and has almost disappeared from the coastal region. Consequently, livestock suffers from the change in climate patterns.

**FACTS (2015): Number of Heads**

| | |
|---|---|
| Cattle#: 5,898<br>Goat#: 26,809<br>Sheep#: 2,752<br>Pigs#: 21,964 | Poultry*: 6 million<br>Deer* (on paddock system): 16,000<br>Horse$: 855 |

#Digest of Agricultural Statistics (2015) *FAREI estimate $MTC

## 3.0 GHG Emissions for the Livestock sector

Livestock, with enteric fermentation and manure management contributes to GHG emissions, of which almost half came from Rodrigues which has an important livestock population. The common manure management system/fraction (as defined in the revised IPCC guidelines 2006 pp10.62-10.63 table 10.21), observed locally, is summarized as follows:

- Cattle (pasture, solid storage, anaerobic digester, dry lot and anaerobic lagoon);
- Goats and sheep (pasture and solid storage);
- Pig (solid storage and anaerobic digester);
- Poultry (poultry with beddings and poultry without beddings); and
- Deer (paddock).

For the period 2000 to 2013, Figure 3.1 shows the trend of emissions as well as the sink for the whole AFOLU sector.

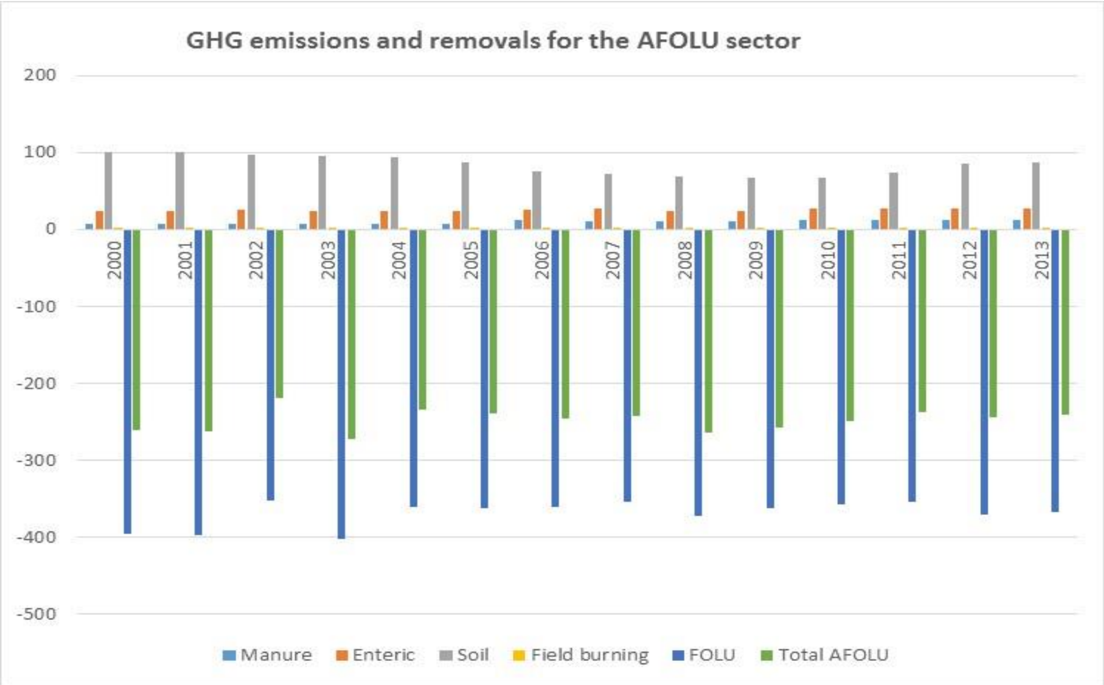


**Figure 3.1: Trend of emissions for AFOLU Sector, including livestock sector (enteric and manure) (source: TNC, 2016)**

## 4.0. Mitigation Actions proposed under TNC for the Livestock sector

### 4.1 Mitigation Scenarios and Assumptions

Relative to the BAU scenario, the Policy scenarios with new/old technologies with respect to manure management were developed in TNC (2016). The assumptions adopted by TNC for mitigations actions for the livestock sector are summarized in Table 4.1.

**Table 4.1: Mitigation scenarios for the Livestock sector (TNC 2016)**

| Mitigation scenarios | | Assumptions |
|---|---|---|
| BAU | Business-As-Usual | The assumptions involve adoption of old technology (prior to 2014) with regards to manure management with an estimated animal head numbers. |
| BAU-Enteric | Business-As-Usual (Enteric) | As BAU for Enteric Fermentation. |
| SC1 | Policy Scenario to enhance food security using old technology | This scenario assumes old technology with regards to manure management with an increased livestock to enhance food security. |
| SC2 | Policy Scenario to enhance food security using new technology | This scenario considers new technology which incorporates changes in the manure management systems used in rearing, with an increased livestock to enhance food security. The penetration of anaerobic treatment of manure is expected to increase in the future compared to solid storage or aerobic treatment of manure. |
| SC3 | Policy Scenario (Enteric) | As SC2 for Enteric Fermentation. |

The parameters used for the different scenarios appear in section 5.2.

### 4.2 TNC Targets under different scenarios

The mitigation scenarios including BAU have emissions as shown in Table 4.2.

Under the BAU scenario, the total livestock GHG emissions (combined emissions from enteric fermentation and manure management) are relatively small; either component contributing to nearly half of the total emissions (see Figure 4.1).

Under the Policy scenario that favours enhanced livestock rearing for increasing the national food security, there is a significant increase in GHG emissions to reach 50 Gg CO2e by 2050; emissions from enteric fermentation occupying a higher share in total livestock emissions.

**Table 4.2: GHG Emissions (Gg CO2e)* for the Agricultural Livestock sector**

| Scenario | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|
| BAU – Enteric fermentation | 19.6 | 19.2 | 19.1 | 19.1 | 19.2 | 19.4 | 19.5 |
| BAU – Enteric and manure management | 34.7 | 34.5 | 34.7 | 35.4 | 36.2 | 36.8 | 37.5 |
| SC1: Policy Scenario (with old technology) | 36.5 | 38.2 | 39.9 | 42.8 | 45.8 | 48.6 | 51.3 |
| SC2: Policy Scenario (with new technology) | 36.4 | 38.1 | 39.9 | 42.6 | 45.2 | 47.5 | 49.8 |
| SC3: Policy Scenario - Enteric | 21.5 | 22.5 | 23.7 | 25.4 | 27.1 | 28.7 | 30.4 |

**To convert to tonnes CO2e, multiply the numbers by 1000*

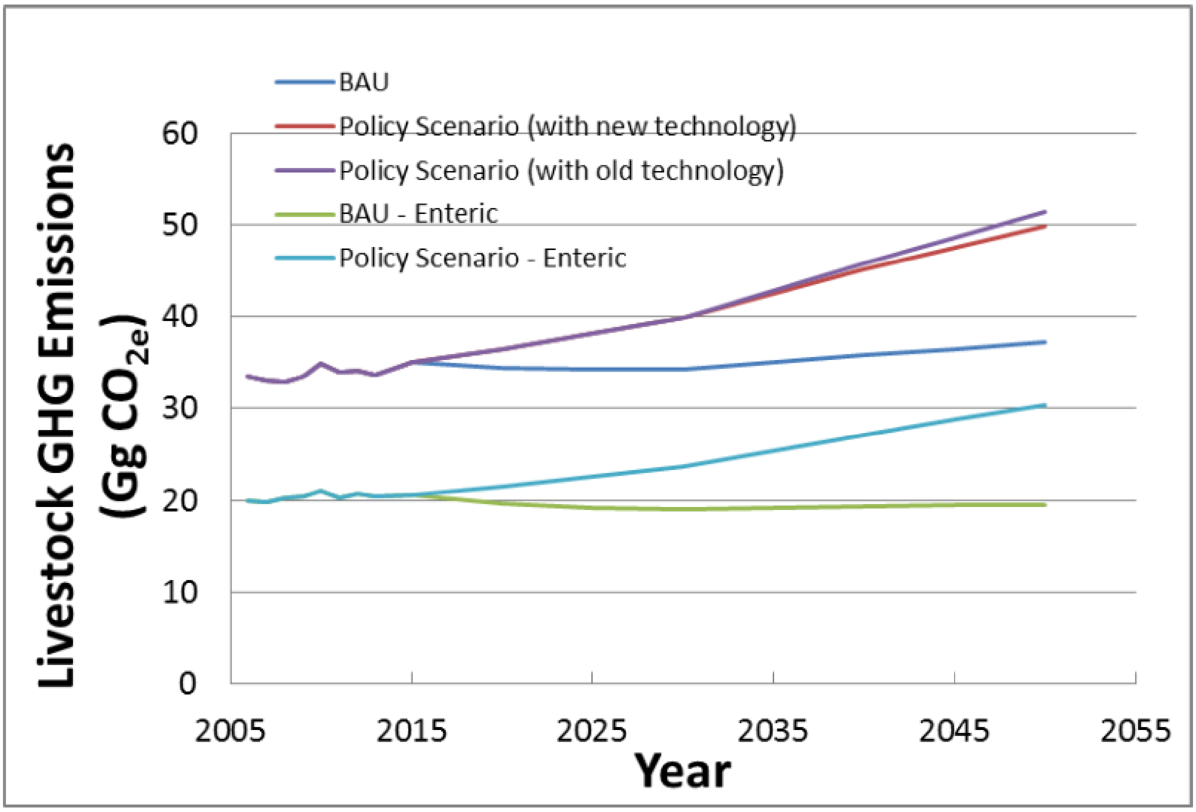


**Figure 4.1: GHG emissions scenarios for the livestock sector**
**(source: TNC, 2016)**

## 5.0 XLM–Livestock Toolkit

The structure, methodology, and components/modules of the XLM Toolkits has been described in the main User Manual.

### 5.1 Livestock Data

| Species | Data Sources | Remarks |
|---|---|---|
| Dairy cows, other cattle, Sheep, Goats and Pigs | Population data were obtained from Food and Agricultural Research and Extension Institute (FAREI) and Digest of Agricultural Statistics.<br>Imported sheep, goats and cattle figures were obtained from MMA slaughter statistics. | The imports data exclude animals slaughtered for religious purposes. |
| Deer | The deer population of 16,000 on paddock was estimated based on previous records available at FAREI. | |
| Poultry | The data for poultry was deduced from production data quoted from Food Balance sheet of the Digest of Agricultural Statistics and formulated production technical assumptions.<br>The data for duck was obtained from FAREI and Animal Production Division (APD) of the MOAFS. | |

### 5.2 Livestock Parameters

Whilst Users would not change the parameter values, they can do so, if required, in the user-defined worksheets (UD1 and UD2). For permanent alterations, Users must approach the sectoral chair for changes; in which case the default values are modified by the chair. Users should consult the XLM Toolkit sheets' data to understand the parameter details listed in this manual.

Tables 5.1 presents the major parameters used for the livestock sector.

**Table 5.1: List of Parameters for the emissions calculations for livestock sector**

*(parameters can only be changed by sectoral chair)*

| Livestock sub category | @ Typical animal mass (TAM) (kg) | # CH4 Emission factor from enteric fermentation (kgCH4/(head/ year) | # CH4 Emission factor from manure management (kgCH4/(head/ year) | # Excretion rate/mass/day (Nrate) |
|---|---|---|---|---|
| Dairy cow | 400 | 46 | 1 | 0.73 |
| Bull | 200 | 31 | 1 | 0.73 |
| Calf | 75 | 31 | 1 | 0.73 |
| Heifer | 150 | 31 | 1 | 0.73 |
| Imported bull | 500 | 31 | 1 | 0.73 |
| Sheep | 45 | 5 | 0.15 | 1.17 |
| Goat | 30 | 5 | 0.17 | 1.37 |
| Horse# | 377 | 18 | 1.64 | 0.46 |
| Mule & Asses | | 10 | 0.9 | 0.46 |
| Boar | 150 | 1 | 1 | 0.55 |
| Fattener | 90 | 1 | 1 | 1.57 |
| Piglet | 13 | 1 | 1 | 1.57 |
| sow/gilt | 125 | 1 | 1 | 0.55 |
| Broiler | 1.8 | | 0.02 | 1.1 |
| Broiler parent | 2.1 | | 0.03 | 0.82 |
| Layer/Parent | 1.8 | | 0.03 | 0.82 |
| Duck | 2.5 | | 0.03 | 0.83 |
| Deer | 60 | 20 | 0.22 | 1.17 |

@FAREI # IPCC 2006

| | |
|---|---|
| GWP CH4 | 25 |
| GWP N20 | 298 |
| Conversion Factor | 1.571428571 |

| Region (temp) | Livestock subcategory | Emission factor for direct N2O from MMS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Solid storage | Pasture range paddock | Dry lot | Anaerobic digester | Aerobic treatment | Poultry with litter | Poultry without litter |
| 22 | Dairy cow | 0.005 | | | | | | |
| | Bull | 0.005 | | | | | | |
| | Calf | 0.005 | | | | | | |
| | Heifer | 0.005 | | | | | | |
| | Boar | 0.005 | | | | | | |
| | Fattener | 0.005 | | | | | | |
| | Piglet | 0.005 | | | | | | |
| | sow/gilt | 0.005 | | | | | | |
| 24 | Dairy cow | 0.005 | | | | | | |
| | Bull | 0.005 | | | | | | |
| | Calf | 0.005 | | | | | | |
| | Heifer | 0.005 | | | | | | |
| | Boar | 0.005 | | | 0 | 0.01 | | |
| | Fattener | 0.005 | | | 0 | 0.01 | | |
| | Piglet | 0.005 | | | 0 | 0.01 | | |
| | sow/gilt | 0.005 | | | 0 | 0.01 | | |
| 25 | Dairy cow | 0.005 | | | | | | |
| | Bull | 0.005 | | | | | | |
| | Calf | 0.005 | | | | | | |
| | Heifer | 0.005 | | | | | | |
| | Imported bull | 0.005 | | 0.02 | | | | |
| | Boar | 0.005 | | 0.02 | 0 | 0.01 | | |
| | Fattener | 0.005 | | 0.02 | 0 | 0.01 | | |
| | Piglet | 0.005 | | 0.02 | 0 | 0.01 | | |
| | sow/gilt | 0.005 | | 0.02 | 0 | 0.01 | | |
| Mauritius Average | Sheep | 0.005 | | 0.02 | | | | |
| | Goat | 0.005 | | 0.02 | | | | |
| | Horse | | | | | | | |
| | Broiler | | | | | | 0.001 | 0.001 |
| | Broiler parent | | | | | | 0.01 | 0.01 |
| | Layer/Parent | | | | | | 0.01 | 0.01 |
| | Duck | | | | | | 0.01 | 0.01 |
| | Deer | | N/A | | | | | |

| breakdown since 2013 | |
|---|---|
| **PIGS** | **Heads (ratio)** |
| boars | 0.02 |
| sows/gilts | 0.18 |
| piglets | 0.25 |
| fatteners | 0.55 |

### 5.3 Livestock Assumptions

The assumptions used here are the same as TNC that is the animal heads by species (Table 5.2). These assumptions under the Policy scenario are further divided into the type of technology; new technology favouring the choice for enhancing food security.

**Table: 5.2: List of Main Assumptions for the livestock sector**

| | |
|---|---|
| 1 | Animal Heads by Species |
| 2 | Technology Options |

### 5.4 Graphic Analysis and Reporting

The complete set of figures useful to the User is listed in Table 5.3. The far right column denotes the general topic or item for which the plots can be generated for graphical analysis. The leftmost column denotes the plot number that can be identified and generated.

Graphic analysis in the 'Query' worksheet provides the following choices categorized as follows for the Livestock sector:

| Sector | Category | Plot numbers |
|---|---|---|
| **Agriculture Livestock** | All | 1-111; |
| | Population | BAU: 1-12;<br>Policy: 13-24; |
| | Emissions from Enteric Fermentation | BAU: 25-32;<br>Policy: 50-57; |
| | CH4 Emissions | BAU: 33-41;<br>Policy: 58-66; |
| | N2O Emissions | BAU 42-48;<br>Policy 67-73; |
| | Policy with New Technologies | Policy 50-66; 67-74; |
| | Policy with Old Technologies | Policy 75-84; |
| | GHG Emissions | BAU: 85-93;<br>Policy: 94-102; 103-111; |
| | Total GHG Emissions (TNC) | 32, 49, 57, 74, 84; |

## Table 5.3: List of Graphics for the Livestock sector

| Plot No. | Scenario | Plot Title | |
|---|---|---|---|
| 1 | BAU | Goat Population | BAU / Population |
| 2 | BAU | Sheep Population | |
| 3 | BAU | Horse Population | |
| 4 | BAU | Deer Population | |
| 5 | BAU | Broiler Population | |
| 6 | BAU | Layers and parent Population | |
| 7 | BAU | Duck Population | |
| 8 | BAU | Lock Sum | |
| 9 | BAU | Cattle (Diary) Population | |
| 10 | BAU | Cattle (Non Dairy) Population | |
| 11 | BAU | Cattle (Imported) Population | |
| 12 | BAU | Pigs (Population) | |
| 13 | Pol | Goat Population | Policy Scenario / Population |
| 14 | Pol | Sheep Population | |
| 15 | Pol | Horse Population | |
| 16 | Pol | Deer Population | |
| 17 | Pol | Broiler Population | |
| 18 | Pol | Layers and parent Population | |
| 19 | Pol | Duck Population | |
| 20 | Pol | Lock Sum | |
| 21 | Pol | Cattle (Diary) Population | |
| 22 | Pol | Cattle (Non Dairy) Population | |
| 23 | Pol | Cattle (Imported) Population | |
| 24 | Pol | Pigs (Population) | |
| 25 | BAU | GHG Emissions (Enteric) for Dairy Cows (Gg CO2e) | BAU - Emissions from Enteric Fermentation |
| 26 | BAU | GHG Emissions (Enteric) for Other Cattle (Gg CO2e) | |
| 27 | BAU | GHG Emissions (Enteric) for Sheep (Gg CO2e) | |
| 28 | BAU | GHG Emissions (Enteric) for Goats (Gg CO2e) | |
| 29 | BAU | GHG Emissions (Enteric) for Horses (Gg CO2e) | |
| 30 | BAU | GHG Emissions (Enteric) for Pigs (Gg CO2e) | |
| 31 | BAU | GHG Emissions (Enteric) for Deer (Gg CO2e) | |
| 32 | BAU | TOTAL GHG Emissions - Enteric (Gg CO2e) | |
| 33 | BAU | CH4 Emissions from LMM for Dairy Cows (Gg CO2e) | BAU - Direct CH4 Emissions from LMM |
| 34 | BAU | CH4 Emissions from MMS for Other Cattles (Gg CO2e) | |
| 35 | BAU | CH4 Emissions from LMM for Sheep (Gg CO2e) | |
| 36 | BAU | CH4 Emissions from LMM for Goats (Gg CO2e) | |
| 37 | BAU | CH4 Emissions from LMM for Horses (Gg CO2e) | |
| 38 | BAU | CH4 Emissions from LMM for Pigs (Gg CO2e) | |
| 39 | BAU | CH4 Emissions from LMM for Poultry (Gg CO2e) | |
| 40 | BAU | CH4 Emissions from LMM for Deers (Gg CO2e) | |
| 41 | BAU | Total CH4 Emissions under LMM (Gg CO2e) | |
| 42 | BAU | N2O Emissions from LMM for Dairy Cows (Gg CO2e) | BAU N2O Emissions from LMM |
| 43 | BAU | N2O Emissions from LMM for Other Cattles (Gg CO2e) | |
| 44 | BAU | N2O Emissions from LMM for Sheep (Gg CO2e) | |
| 45 | BAU | N2O Emissions from LMM for Goats (Gg CO2e) | |
| 46 | BAU | N2O Emissions from LMM for Pigs (Gg CO2e) | |
| 47 | BAU | N2O Emissions from LMM for Poultry (Gg CO2e) | |
| 48 | BAU | Total N2O Emissions from LMM (Gg CO2e) | |
| 49 | BAU | Total Emissions under LMM (Gg CO2e) | BAU |

| | | | |
|---|---|---|---|
| 50 | Pol | GHG Emissions (Enteric) for Dairy Cows (Gg CO2e) | **Policy Scenario - Emissions from Enteric Fermentation** |
| 51 | Pol | GHG Emissions (Enteric) for Other Cattle (Gg CO2e) | |
| 52 | Pol | GHG Emissions (Enteric) for Sheep (Gg CO2e) | |
| 53 | Pol | GHG Emissions (Enteric) for Goats (Gg CO2e) | |
| 54 | Pol | GHG Emissions (Enteric) for Horses (Gg CO2e) | |
| 55 | Pol | GHG Emissions (Enteric) for Pigs (Gg CO2e) | |
| 56 | Pol | GHG Emissions (Enteric) for Deer (Gg CO2e) | |
| 57 | Pol | TOTAL GHG Emissions - Enteric (Gg CO2e) | |
| 58 | Pol | CH4 Emissions from MMS for Dairy Cows (Gg CO2e) | **Policy scenario - Direct CH4 Emissions from MMS** |
| 59 | Pol | CH4 Emissions from MMS for Other Cattles (Gg CO2e) | |
| 60 | Pol | CH4 Emissions from MMS for Sheep (Gg CO2e) | |
| 61 | Pol | CH4 Emissions from MMS for Goats (Gg CO2e) | |
| 62 | Pol | CH4 Emissions from MMS for Horses (Gg CO2e) | |
| 63 | Pol | CH4 Emissions from MMS for Pigs (Gg CO2e) | |
| 64 | Pol | CH4 Emissions from MMS for Poultry (Gg CO2e) | |
| 65 | Pol | CH4 Emissions from MMS for Deer (Gg CO2e) | |
| 66 | Pol | TOTAL CH4 Emissions under LMM (Gg CO2e) | |
| 67 | Pol/NT | N2O Emissions from new MMS for Dairy Cows (Gg CO2e) | **Policy scenario - N2O Emissions from MMS** |
| 68 | Pol/NT | N2O Emissions from MMS for Other Cattles (Gg CO2e) | |
| 69 | Pol/NT | N2O Emissions from new MMS for Sheep (Gg CO2e) | |
| 70 | Pol/NT | N2O Emissions from new MMS for Goats (Gg CO2e) | |
| 71 | Pol/NT | N2O Emissions from new MMS for Pigs (Gg CO2e) | |
| 72 | Pol/NT | N2O Emissions from new MMS for Poultry (Gg CO2e) | |
| 73 | Pol/NT | Total N2O Emissions new MMS (Gg CO2e) | |
| 74 | Pol/NT | Total Emissions under new MMS (Gg CO2e) | **Pol** |
| 75 | Pol/OT | TOTAL GHG Emissions - Enteric (Gg CO2e) | **Policy Scenario without Technological change from livestock manure** |
| 76 | Pol/OT | Total CH4 Emissions under old MMS (Gg CO2e) | |
| 77 | Pol/OT | N2O Emissions under old MMS for Dairy Cows (Gg CO2e) | |
| 78 | Pol/OT | N2O Emissions under old MMS for Other Cattles (Gg CO2e) | |
| 79 | Pol/OT | N2O Emissions under old MMS for Sheep (Gg CO2e) | |
| 80 | Pol/OT | N2O Emissions under old MMS for Goats (Gg CO2e) | |
| 81 | Pol/OT | N2O Emissions under old MMS for Pigs (Gg CO2e) | |
| 82 | Pol/OT | N2O Emissions under old MMS for Poultry (Gg CO2e) | |
| 83 | Pol/OT | TOTAL N2O Emissions under old MMS (Gg CO2e) | |
| 84 | Pol/OT | TOTAL Emissions under old MMS (Gg CO2e) | |

| | | | |
|---|---|---|---|
| 85 | BAU | Total Emissions for Dairy Cows (Gg CO2e) | BAU |
| 86 | BAU | Total Emissions for Other Cattles (Gg CO2e) | |
| 87 | BAU | Total Emissions for all Cattles | |
| 88 | BAU | Total Emissions for Sheep (Gg CO2e) | |
| 89 | BAU | Total Emissions for Goats (Gg CO2e) | |
| 90 | BAU | Total Emissions for Horses (Gg CO2e) | |
| 91 | BAU | Total Emissions for Pigs (Gg CO2e) | |
| 92 | BAU | Total Emissions for Poultry (Gg CO2e) | |
| 93 | BAU | Total Emissions for Deer (Gg CO2e) | |
| 94 | Pol/NT | Total Emissions for Dairy Cows (Gg CO2e) | Pol/NT |
| 95 | Pol/NT | Total Emissions for Other Cattles (Gg CO2e) | |
| 96 | Pol/NT | Total Emissions for all Cattles | |
| 97 | Pol/NT | Total Emissions for Sheep (Gg CO2e) | |
| 98 | Pol/NT | Total Emissions for Goats (Gg CO2e) | |
| 99 | Pol/NT | Total Emissions for Horses (Gg CO2e) | |
| 100 | Pol/NT | Total Emissions for Pigs (Gg CO2e) | |
| 101 | Pol/NT | Total Emissions for Poultry (Gg CO2e) | |
| 102 | Pol/NT | Total Emissions for Deer (Gg CO2e) | |
| 103 | Pol/OT | Total Emissions for Dairy Cows (Gg CO2e) | Pol/OT |
| 104 | Pol/OT | Total Emissions for Other Cattles (Gg CO2e) | |
| 105 | Pol/OT | Total Emissions for all Cattles | |
| 106 | Pol/OT | Total Emissions for Sheep (Gg CO2e) | |
| 107 | Pol/OT | Total Emissions for Goats (Gg CO2e) | |
| 108 | Pol/OT | Total Emissions for Horses (Gg CO2e) | |
| 109 | Pol/OT | Total Emissions for Pigs (Gg CO2e) | |
| 110 | Pol/OT | Total Emissions for Poultry (Gg CO2e) | |
| 111 | Pol/OT | Total Emissions for Deer (Gg CO2e) | |

## 6.0 References


- Digest of Agricultural Statistic (2015)
- FAREI
- IPCC guidelines 2006
- Strategic Plan 2016 – 2020 of the Ministry of Agro-Industry and Food Security (2016)
- **TNC (2016).** Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Mauritius, Port Louis
- **IPCC (2006).** Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.

## 7.0 Appendices

### A: List of Acronyms and Abbreviations

| | |
|---|---|
| **Toolkit** | |
| BAU | Business as Usual |
| Fb | Fraction of available area burned |
| GUI | Graphics User Interface |
| LMM | Livestock Manure Management |
| MB | Mass of Fuel available for burning |
| Pol | Policy Scenario Population |
| Pol/NT | Policy with New Technology |
| Pol/OT | Policy with Old Technology |
| TAM | Typical Animal Mass |
| UD1 | User-defined Scenario – Case 1 |
| UD2 | User-defined Scenario – Case 2 |
| SC*i* | Scenario *i* |
| XLMT | Excel Mitigation Toolkit |
| **Others** | |
| APD | Animal Production Division |
| FAREI | Food and Agricultural Research and Extension Institute |
| GDP | Gross Domestic Product |
| GWP | Global Warming Potential |
| IPCC | International Panel of Climate Change |
| MoAIFS | Ministry of Agro-Industry and Food Security (MOAFS in section 1.5) |
| MMA | Mauritius Meat Authority |
| MMS | Manure Management System |
| MTC | Mauritius Turf Club |
| TNC | Third National Communications |

### B: Useful Links

IPCC 2006 for livestock

General IPCC 2006 for AFOLU

TNC

Stats: digest of agricultural statistics

Others (statistics)

## C: Glossary

| | |
|---|---|
| **Enteric fermentation** | is a digestive process by which carbohydrates are broken down by microorganisms into simple molecules for absorption into the bloodstream of an animal. At the same time methane ($CH_4$) byproduct is belched by the animal and passed out as flatulence.(in a small percentage) from the large intestine. The ruminant gut structure fosters extensive enteric fermentation of their diet. . Ruminant livestock (e.g., cattle, sheep) are major sources of methane with moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). |
| **Manure management system** | refers to the storage and treatment of manure, including from manure deposited on pasture. The term 'manure' is used here collectively to include both dung and urine. |
| **Pasture/Range/Paddock** | The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed. |
| **Solid storage** | The storage of manure, typically for a period of several months, in unconfined piles or stacks. |
| **Dry lot** | A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically. |
| **Anaerobic digester** | Animal excreta with or without straw are collected and anaerobically digested in a large containment vessel or covered lagoon. Digesters are designed and operated for waste stabilization by the microbial reduction of complex organic compounds to CO2 and CH4, which is captured and flared or used as a fuel. |
| **Aerobic treatment** | The biological oxidation of manure collected as a liquid with either forced or natural aeration. |
| **Composting** | The biological oxidation of a solid waste including manure usually with bedding or another organic carbon source typically at thermophilic temperatures produced by microbial heat production. |

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use

## D: Governing Equations (IPCC, 2006)

| Terms | Description | Units | Data Sources/Remarks |
|---|---|---|---|
| **ENTERIC FERMENTATION EMISSIONS FROM A LIVESTOCK CATEGORY** $\text{Emissions } E = EF_T \times \left(\frac{N_T}{10^6}\right)$ | | | |
| **E** | Methane emissions from Enteric Fermentation | Gg CH4 $yr^{-1}$ | *Calculated value/result* |
| **$EF_T$** | Emission factor for the defined livestock population | kg $CH_4$ $head^{-1}$ $yr^{-1}$ | *Table 10.11, IPCC 2006 GL* |
| **$N_T$** | The number of head of livestock species / category T in the country | | *FAREI* |
| **T** | Species/category of livestock | | *FAREI* |
| **TOTAL EMISSIONS FROM LIVESTOCK ENTERIC FERMENTATION** $\text{TOTAL } CH_4\text{Enteric} = \sum_i E_i$ | | | |
| **Total $CH_4$ Enteric** | Total methane emissions from Enteric Fermentation | Gg $CH_4$ $yr^{-1}$ | *Calculated value/result* |
| **Ei** | The emissions for the $i^{th}$ livestock categories and subcategories | *Summation* | *Added emissions for all livestock considered* |
| **$CH_4$ EMISSIONS FROM MANURE MANAGEMENT** $CH_{4\ Manure} \sum_T \frac{(EF_T \times N_T)}{10^6}$ | | | |
| **$CH4_{Manure}$** | $CH_4$ emissions from manure management, for a defined population | Gg $CH_4$ $yr^{-1}$ | *Calculated value/result* |
| **$EF_T$** | emission factor for the defined livestock population | kg $CH_4$ $head^{-1}$ $yr^{-1}$ | *Table 10.14 to 10.16 - IPCC 2006 GL* |
| **$N_T$** | the number of head of livestock species/category T in the country | | *FAREI* |
| **T** | species/category of livestock | | *FAREI* |
| **DIRECT N2O EMISSIONS FROM MANURE MANAGEMENT** $N_2O_{D(mm)} = \left[\sum_S \left[\sum_T (N_T \times Nex_{(T)} \times MS_{(T,S)}\right] \times EF_{3(S)}\right] \times \frac{44}{28}$ | | | |
| **$N_2O_{D(mm)}$** | direct N2O emissions from Manure Management in the country, | kg N2O yr-1 | *Calculated value/result* |
| **$N_T$** | number of head of livestock species/category T in the country | | *FAREI* |
| **$Nex_{(T)}$** | annual average N excretion per head of species/category T in the country, | kg N animal-1 yr-1 | *IPCC 2006 GL Table 10.19 and expert judgment by FAREI* |
| **$MS_{(T,S)}$** | fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country | dimensionless | *FAREI* |
| **$EF_{3(S)}$** | emission factor for direct $N_2O$ emissions from manure management system S in the country, | kg $N_2O$-N/kg N in manure management system S | *IPCC 2006 HL Table 10.21* |
| **S** | manure management system | | *IPCC 2006 GL Table 10.19 and expert judgment by FAREI* |
| **T** | species/category of livestock | | *FAREI* |
| **44/28** | Conversion of (N2O-N)(mm) emissions to N2O(mm) emissions | | *IPCC 2006 GL* |