Use of the IPCC Inventory Software to Establish the National GHG inventory in the Agriculture, Forestry and Other Land Use (AFOLU) sector

Livestock categories

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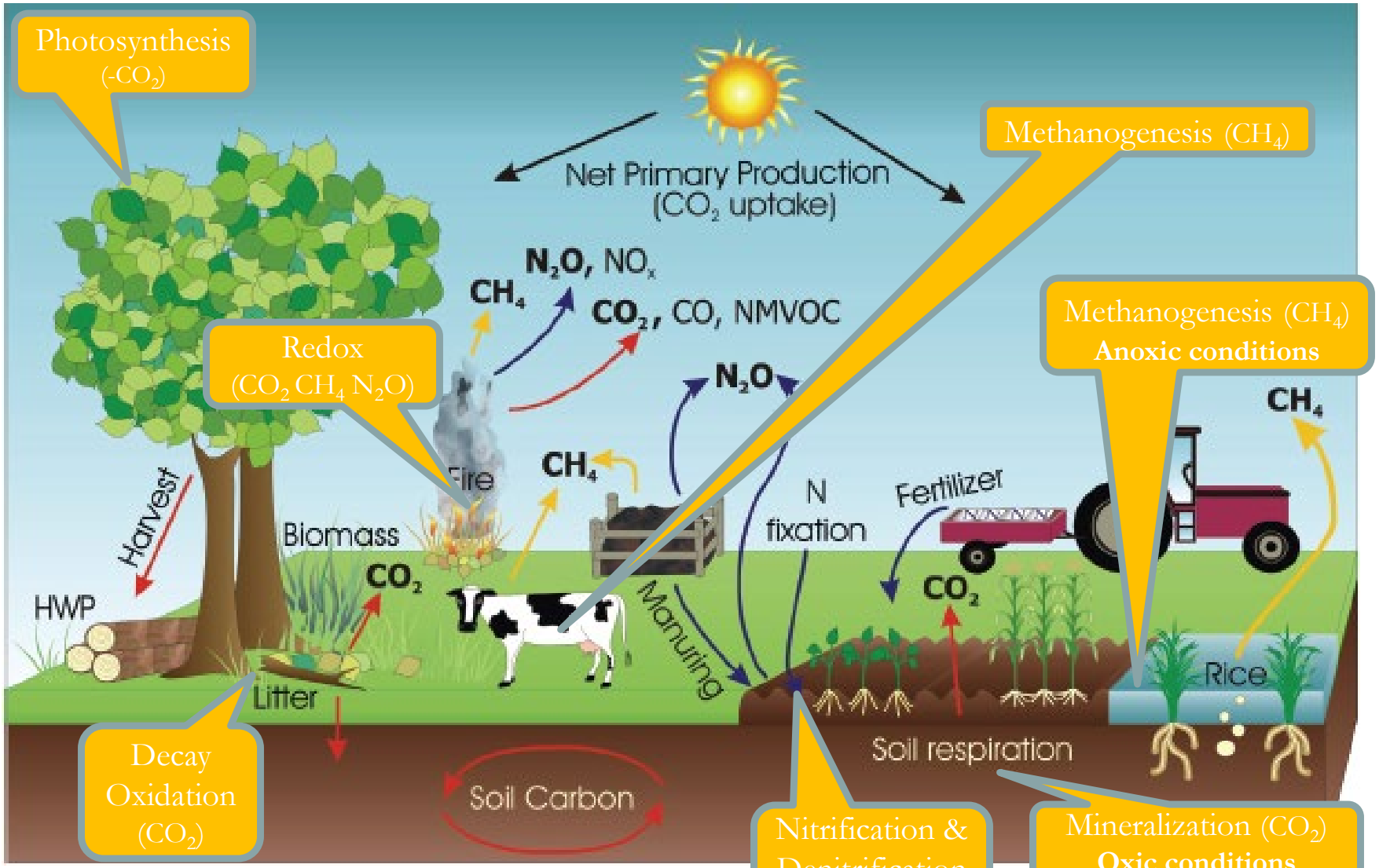
IPCC Guidelines

- Volume 4 (AFOLU), Chapters 10 and 11*
  - ✓ 2006 IPCC Guidelines
  - ✓ 2019 Refinement

* Limited to EF_4 and EF_5 for indirect N_2O emissions from manure management (category 3.C.6)

Processes covered by IPCC Guidance on AFOLU



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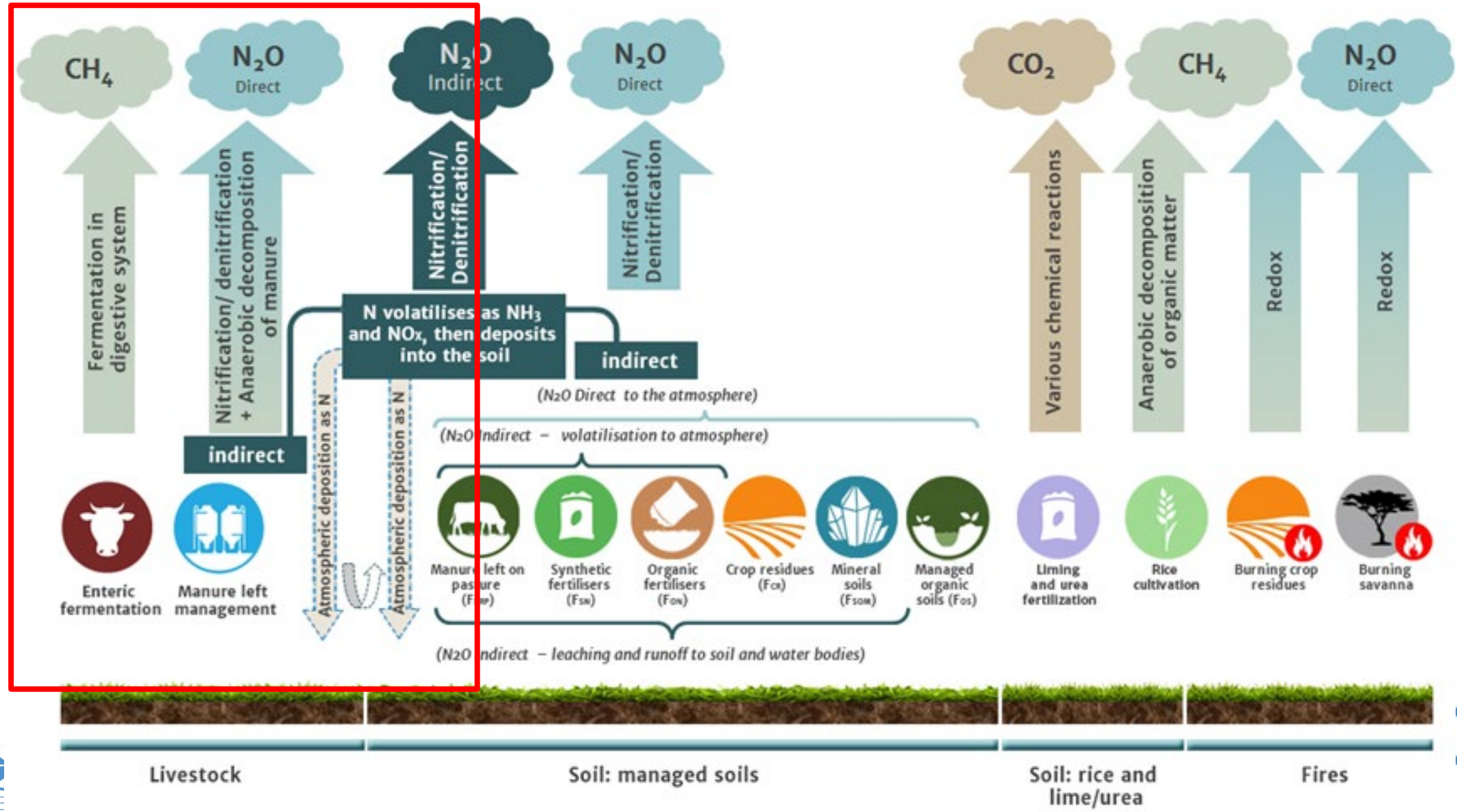
GHG emissions in Agriculture



Organic Matter

- **Organic matter is heterogeneous very complex compound. Generally, as weight, is**
  - 45–55% Carbon
  - 35–45% Oxygen
  - 3–5% Hydrogen
  - 1–4% Nitrogen
- **Organic matter is the component of**
  - Biomass, living organic matter, which can have
    - Either an annual cycle [Growth → Harvest&Consumption or Decay to dead organic matter]
    - Or a multiyear cycle [Growth in plant perennial tissues (wood)] and thus stores Carbon across years
  - Dead organic matter, dead wood, litter, soil organic matter, harvested wood products which stores Carbon across years

Organic Matter

- **Organic matter redox/decay processes timescale**
  - *hours*
  - *within a year*
  - *years/centuries*
  - *centuries/millennia*

- **Organic matter redox/decay results in**
  - CO_2, CH_4, N_2O
  - NH_3/NH_4^+, NO_X
  - H_2O, N_2

Chemicals

- ❑ Synthetic Nitrogen fertilizers => N_2O emissions
- ❑ Mineral Carbonaceous amendments => CO_2 emissions
- ❑ Nitrogen/Carbonaceous fertilizers (Urea) => $N_2O + CO_2$ emissions

Notations

- **Nitrogen** content of **N_2O is** indicated as **N_2O-N**, and emissions of N_2O-N are **converted** to N_2O emissions multiplying **by 44/28** (proportion of the atomic weight of the two molecules)
- **Carbon** content of **CH_4 is** indicated as **CH_4-C**, and emissions of **CH_4-C** are **converted** to **CH_4** emissions multiplying **by 16/12** (proportion of the atomic weight of the two molecules)
- **Carbon** content of **CO_2 is** indicated as **CO_2-C**, and emissions of **CO_2-C** are **converted** to **CO_2** emissions multiplying **by 44/12** (proportion of the atomic weight of the two molecules)
- Emissions have a positive sign, while CO_2 removals have a negative sign. *This is because the "point of view" of an NGHGI is the atmosphere, so a positive sign means an addition of GHG to the atmosphere, while a negative sign means a subtraction of CO_2 from the atmosphere*
- Carbon stock gains have a positive sign, while Carbon stock losses have a negative sign. *This is because the "point of view" is the C pool to which the C stock pertains, so a positive sign means an addition of Carbon to the C pool, while a negative sign means a subtraction of C stock from the C pool*
- Thus, **converting** a net **C stock** change **to CO_2** net **emission/removal** requires to multiplying the net C stock **by -44/12**, *given that the sign is to be changed*

Stratification of Activity Data

- **Stratification of activity data promotes accuracy and precision since**:
  - ✓ Subdivisions are more homogenous than the whole population, *and thus associated EF are more accurate and precise*
  - ✓ Propagation of random error, as it occurs summing up subdivisions' estimates, tends to cancel those out -*Systematic Errors instead DO NOT cancel out across propagation*-

Systematic Errors instead DO NOT cancel out across propagation, thus, GOOD PRACTICE is to always REMOVING any identified SYSTEMATIC ERROR -*a biased estimate is NOT acceptable in an NGHGI*-; while minimizing RANDOM ERRORS -*these indeed cannot be zeroed!*-.

Random errors do bias neither the level of emissions/removals estimated nor the estimated change across time (mitigation); while Systematic errors do.

Livestock

3.A – Livestock

Category	Activity	GHGs
3.A.1	Enteric Fermentation	CH_4
3.A.2	Manure Management	CH_4 – N_2O

Volume 4, Chapter 10

Livestock

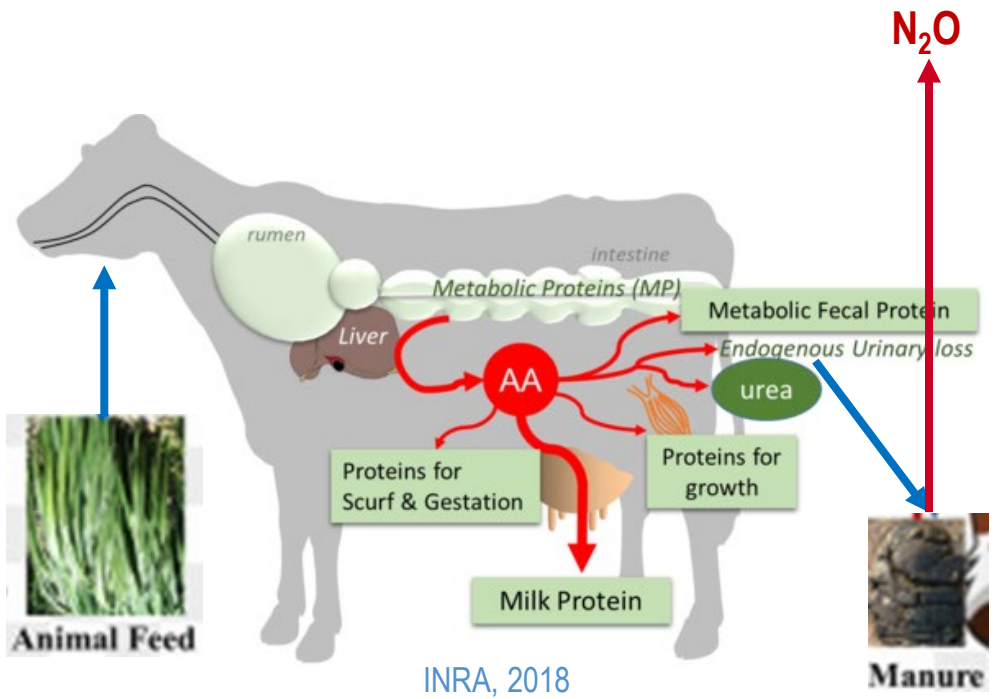
- **Annual Biomass as feed**
  - Enteric Fermentation – CH_4 [3.A.1]
  - Metabolism – CO_2
  - Manure
    - Uncollected (Urine & Dung left on pasture) – CO_2, N_2O direct/indirect [3.C.4/3.C.5]
    - Collected (Manure Management) – CO_2, CH_4 & direct N_2O [3.A.2], indirect N_2O [3.C.6]

      → & Applied to soil – N_2O direct/indirect [3.C.4/3.C.5]

Annual biomass within the year uptakes CO_2 as it grows and releases, because redox biological or physio-chemical processes, and transfers it to other C pools as mortality

3.A – Livestock

Given a livestock population, Diet ***(quantity and quality of feed) -estimated as average daily feed intake (and its quality)-*** **is the main determinant of Enteric Fermentation & Manure production**



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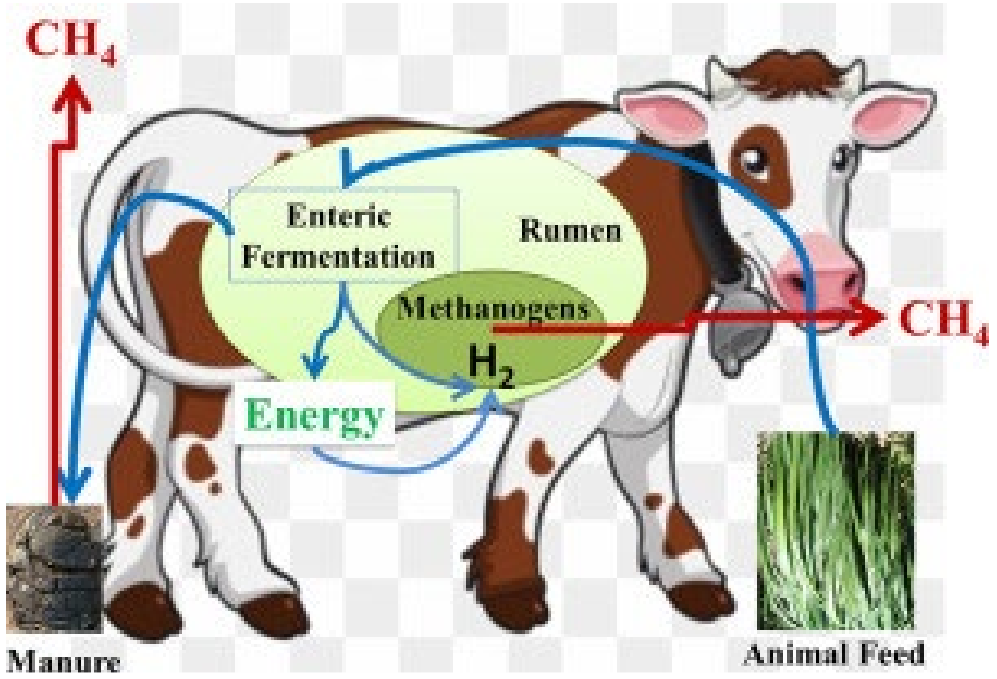

https://doi.org/10.1016/j.scitotenv.2019.136135

Ruminants (e.g. cattle, sheep) -> non-Ruminants (e.g. pigs, horses)

CH_4 emissions are driven by the energy content of feed, its digestibility, and its use

N_2O emissions are driven by the protein content of feed and its use

3.A – Livestock – Activity Data

- **IPCC default methodology:**
  - Population *(number of heads)*, Stratification: Basic Characterisation
  - Manure Management Systems (MMS) –for *Manure Management* only
  - Typical Animal Mass (kg) –for N_2O emissions from *Manure Management* only

- **Tier 2 IPCC methodology**
  - Population *(number of heads)*, Stratification: Enhanced Characterisation
  - Body Weight/Typical Animal Mass (kg)
  - Average Daily Feed Intake (either MJ or kg DMI per day)
  - Manure Management Systems (MMS) –for *Manure Management* only

3.A – Livestock – Feed Intake

- **Feed intake** is measured:
  - ✓ either as **Gross Energy (GE) -** *Mega Joules (MJ) per day*
  - ✓ or as **Dry Matter -** *kilograms (kg) per day*

    Dry Matter Intake (DMI) is the amount of feed consumed (kg) after it has been corrected for the water content.

- To estimate **average daily feed intake for each subcategory/subdivision**, *good practice* is to collect data on:
  - ✓ **Animal's typical diet** (digestibility/energy content/protein content)
  - ✓ **Performance** (growth/production/work)

3.A – Livestock – Gross Energy

- **Average Daily Feed Intake** (kg d.m./day) can be **derived through** the daily **Gross Energy** (MJ/day) **needed** by the animal **for maintenance and for activities** such:
  - ✓ Net Energy for maintenance (*NEm*)
  - ✓ Net Energy for activity (*NEa*)
    - ✓ Net Energy for pregnancy(*NEp*)
    - ✓ Net Energy for lactation (*NEl*)
    - ✓ Net Energy for growth (*NEg*)
      - ✓ Net energy for wool (*NEwool*)
      - ✓ Net Energy for work (*NEwork*)

- **From** the Gross Energy (**GE**), the Dry Matter Intake (**DMI**) (kg d.m./day) **is** then **calculated by dividing GE by the Energy Density of Feed (MJ/kg).**

Tier 2 AD – Average Daily Feed Intake – Livestock 3.A – CH_4 ,N_2O

Parameter			Equation	IPCC Default
Tier 2 Approach / Average Daily Feed Intake	Detailed	Net Energy for Maintenance [NEm]	10.3 & 10.2 *for* Cf_{i_cold}	Table 10.4 *for* Cf_i – Tables 10.10 & 10A.1-9 *for* animal weight
		Net Energy for Activity [NEa]	10.4 (Cattle/Buffalo) – 10.5 (Sheep)	Tables 10.5 *for* Ca – Table 10A.1-3 *for* feeding situation – Table 10.10 & 10A.9 *for* animal weight
		Net Energy for Growth [NEg]	10.4 (Cattle/Buffalo) – 10.5 (Sheep)	Tables 10A.1-6 *for* animal weight & gain – Table 10.6 *for* constants
		Net Energy for Lactation [NEl]	10.8 (Cattle/Buffalo) – 10.9-10 (Sheep)	Tables 10A.1-3 *for* milk production – Fat content
		Net Energy for Work - Net energy for Wool	10.11 - 10.12	Tables 10A.1-3 *for* work
		Net Energy for Pregnancy [NEp]	10.13	Tables 10.7 *for* Cpregnancy – Tables 10A.1-3 *for* pregnancy
		Ratio of Net Energy available for: - Maintenance (REM) - Gain (REG)	10.14 10.15	Table 10.2 *for* Digestibility
		Daily Gross Energy Intake (GE)	10.16	Table 10.2 *for* Digestibility
	simplified	Daily Dry Matter Intake (DMI)	10.17 10.18a 10.18b	Table 10.8 *for* dietary net energy concentration Tables 10A.1-3 *for* animal weight Table 10.2 *for* Digestibility

3.A – Livestock – GHG Emissions Equations and EFs

- **3.A.1 Enteric Fermentation:**
  - Tier 1: IPCC Default method [Eq 10.19] & EF [Tab 10.10]
  - Tier 2: IPCC Default method [Eq 10.19] with livestock-specific EF [Eq 10.21]

- **3.A.2 Manure Management – CH_4:**
  - Tier 1: IPCC Default method [Eq 10.22] & EF [Table 10.14/15/16]
  - Tier 2: IPCC Default method [Eq 10.22] with livestock-specific Parameter [Eq 10:24 – Tab 10.17] & EF [Eq 10.22]

- **3.A.2 Manure Management – N_2O:**
  - Tier 1: IPCC Default method [Eq 10.25] & Parameter [Eq 10:30 – Tab 10.19] & EF [Table 10.21]
  - Tier 2: IPCC Default method [Eq 10.25] with livestock-specific Parameter [Eq 10:31 – Tab 10.20 or Eq 10.33*(Cattle)*] with either livestock-specific or IPCC default EF [Table 10.21]

GHG emissions from Livestock: Working Elements in the Software

I. **Livestock Manager**
   - ✓ Stratification of livestock population
   - ✓ Stratification of manure *(MMS)*

II. **Livestock population**
   - ✓ Annual Average Population
   - ✓ Typical Animal Mass
   - ✓ Parameters

III. **Average Daily Feed Intake** *(Tier 2)*
   - ✓ Gross Energy Intake *vs* Dry Matter Intake

IV. **Volatile Solid Excretion Rate** *(Tier 2)*

CH_4 emissions from Manure Management

V. **N Excretion Rate**

Direct (& Indirect) N_2O emissions from Manure Management

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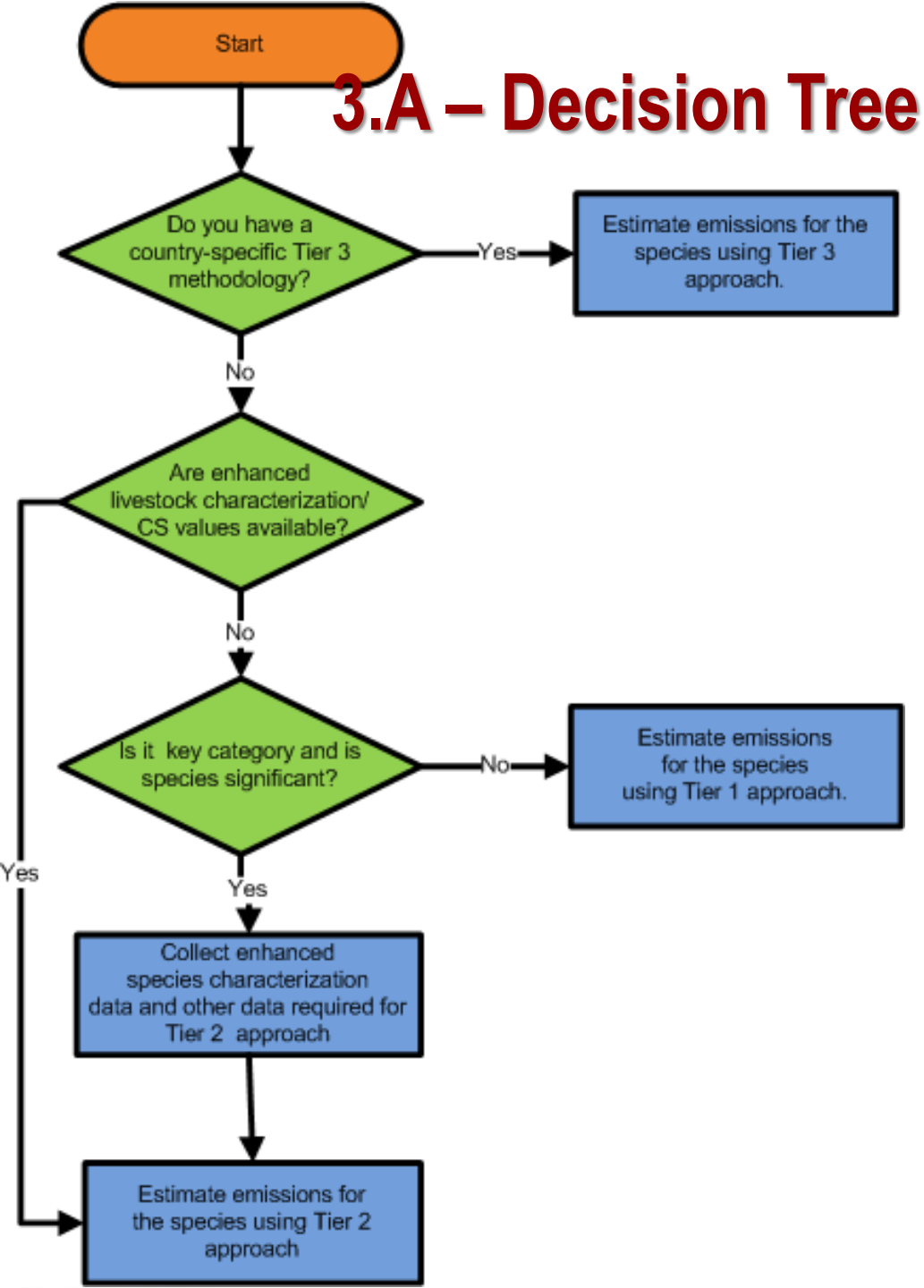
3.A – AD Steps to GHG estimates [1-3]

1. Assess whether a domestic population exist

2. Assess whether the Population is to be disaggregated in different subunits *-"Regions" in the Software-* according to a variable of interest as:
   - ✓geographical distribution,
   - ✓husbandry system
   - ✓administrative units (if any)

3. Applies the IPCC Decision Tree at the level of each subunit (different tiers may be applied to different subunits of the same population) to assess:
   A. which methodological Tier is to be applied and thus
   B. the relevant Livestock Characterisation to be applied

3.A – Decision Tree for Methodological Tier – Fig 10.2



To be repeated for
each Livestock species and GHG in each *Region*

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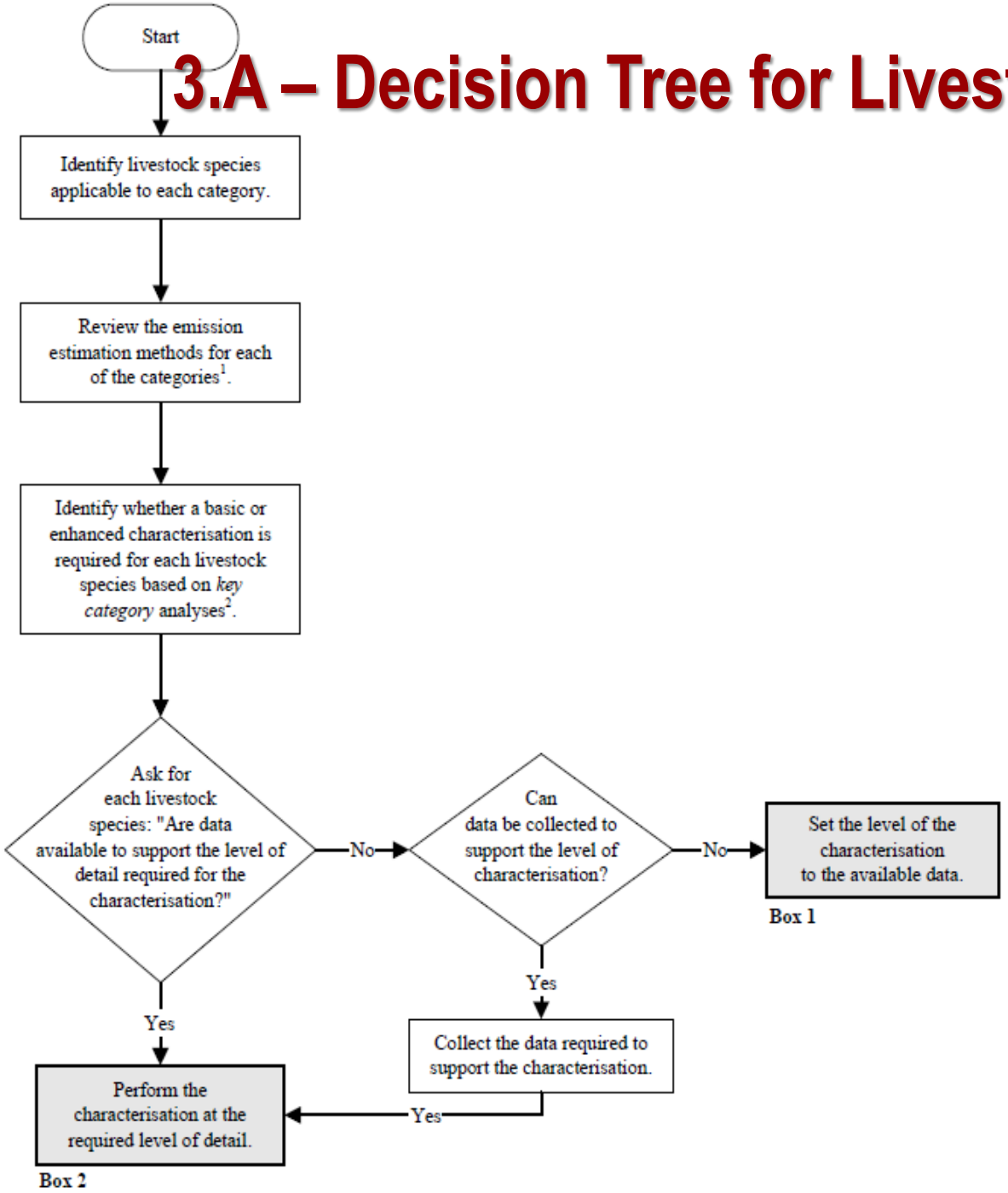
3.A – Decision Tree for Livestock Characterisation – Fig 10.1



To be repeated for
each Livestock species in each *Region*

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3.A – AD Steps to GHG estimates [4]

4. Define categories and subcategories of the *Livestock Characterisation*

The livestock population subcategories/subdivisions are defined to create relatively homogenous sub-groupings of animals. The Enhanced characterisation seeks to define animal growth stage, productivity, diet quality and management circumstances to support a more accurate estimate of the average daily feed intake.

3.A – IPCC categories *2006 IPCC Guidelines* vs *2019 Refinement*

TABLE 10.1
REPRESENTATIVE LIVESTOCK CATEGORIES[1,2]

Main categories	Subcategories
Mature Dairy Cow or Mature Dairy Buffalo	• High-producing cows that have calved at least once and are used principally for milk production • Low-producing cows that have calved at least once and are used principally for milk production
Other Mature Cattle or Mature Non-dairy Buffalo	Females: • Cows used to produce offspring for meat • Cows used for more than one production purpose: milk, meat, draft Males: • Bulls used principally for breeding purposes • Bullocks used principally for draft power
Growing Cattle or Growing Buffalo	• Calves pre-weaning • Replacement dairy heifers • Growing / fattening cattle or buffalo post-weaning • Feedlot-fed cattle on diets containing > 90 % concentrates
Mature Ewes	• Breeding ewes for production of offspring and wool production • Milking ewes where commercial milk production is the primary purpose
Other Mature Sheep (>1 year)	• No further sub-categorisation recommended
Growing Lambs	• Intact males • Castrates • Females

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3.A – IPCC categories *2006 IPCC Guidelines* vs *2019 Refinement*

TABLE 10.1 (UPDATED) Representative livestock categories[1,2]		
Main categories	**Production categories Tier 1a**	**Subcategories**
Mature Dairy Cow or Mature Dairy Buffalo	High Productivity Systems	High-producing cows that have calved at least once and are used principally for milk production
	Low Productivity Systems	Low-producing cows that have calved at least once and are used principally for milk production
Other Mature Cattle or Mature Non-dairy Buffalo	High Productivity Systems	Females:
		• Cows used to produce offspring for meat
		• Cows used for more than one production purpose: milk, meat, draft
		Males:
		• Bulls used principally for breeding purposes
	Low Productivity Systems	Females:
		• Cows that may be used for more than one production purpose: milk, meat, draft
		Males:
		• Bulloks used principally for draft power
Growing Cattle or Growing Buffalo	High Productivity Systems	• Calves pre-weaning
		• Replacement dairy heifers
		• Growing / fattening cattle or buffalo post-weaning
		• Feedlot-fed cattle on diets containing > 85% concentrates
	Low Productivity Systems	• Calves pre-weaning
		• Growing / fattening cattle or buffalo post-weaning

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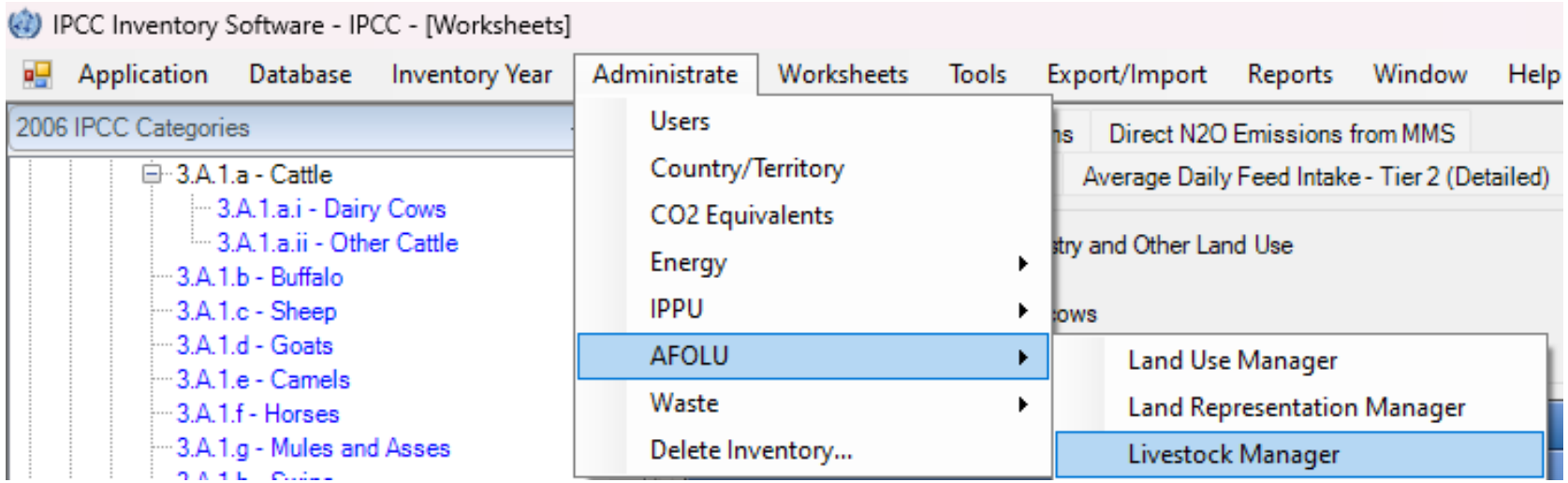
3.A – AD Steps to GHG estimates [4]

4. Enter the *Livestock Characterisation*

- Note that the Software allows one single Livestock characterisation and thus where subunits requires different Characterisation of the population, all categories, subcategories, subdivisions are compiled altogether in the relevant TAB of the Software
- ***Livestock Characterisation*, is entered in the *Livestock manager***



Case Study for Livestock - Cattle

- **3 Regions with**
  - 3 different climate zones
    A. Annual Average Temperature 26°C
    B. Annual Average Temperature 20°C
    C. Annual Average Temperature 14°C
  - 2 different Livestock Characterisations
    I. Basic *(Tier 1)* – Dairy cows, Other cattle,
    II. Enhanced *(Tier 2)* – Mature Dairy Cows, Growing Cattle, Other Mature Cattle
  - 4 different Manure Management Systems
    1. Pasture/Range/Paddock *(Region A only)*
    2. Pasture/Paddock (6 months) + Solid Storage & Spread *(All Regions)*
    3. Liquid Slurry *(6 months)* + Spread *(Region B only)*
    4. Anaerobic Digester *(Region B only)*

Case Study for Livestock – Cattle - Data

Double click on the Table to access data

Region	Average Annual Temperature	Characterisation	species	category	subcategory	subdivision	Population heads 2015	Population heads 2020	TAM kg	Method	Ca	Tw	Cfi	Cfi (in_cold)	produ kg/ 2015
A	26	Basic	Cattle	Dairy cows			2,510	6,226	496.8	Tier 1					
				Other cattle			5,029	16,904	177.4	Tier 1					
B	20	Enhanced	Cattle	Dairy Cows	Mature Dairy Cows	High-producing cows for milk production, calved at least once (stall)	2,509,667	1,556,463	621.0	Detailed Tier 2	0.00		0.386	No	11.5
				Other Cattle	Growing Cattle	Calves pre-weaning	300,000	463,597	157.0	Tier 1					
						Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	749,111	726,873	405.0	Simplified Tier 2					
						Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	186,060	260,935	404.0	Simplified Tier 2					
						Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	72,461	22,574	557.0	Simplified Tier 2					
						Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	708,329	526,175	557.0	Simplified Tier 2					
						Growing/Fattening cattle post-weaning	2,127,959	1,253,974	236.3	Simplified Tier 2					
						Replacement dairy heifers	443,855	509,720	540.0	Detailed Tier 2	0.00		0.322	No	0.0
					Other Mature Cattle	Bulls used principally for breeding purposes	128,958	101,006	700.0	Simplified Tier 2					
						Cows used to produce offspring for meat	312,649	361,142	557.0	Simplified Tier 2					
C	14	Enhanced	Cattle	Dairy Cows	Mature Dairy Cow	High-producing cows for milk production, calved at least once (mix)	132,088	81,919	602.7	Detailed Tier 2	0.17	3	0.386	Yes	11.5
				Other Cattle	Growing Cattle	Replacement dairy heifers	23,361	26,827	540.0	Detailed Tier 2	0.17	3	0.322	Yes	0.0

The IPCC Inventory Software

- **All methods in the 2006 IPCC Guidelines and its Wetlands Supplement are implemented in the IPCC Inventory Software**

  Thus, needed flexibility to deal with any national circumstances, as per IPCC tiered approach, is ensured

- **Subnational disaggregation (Geographical Zone)**

  Thus, tracking of specific activities/projects, and associated emission level & trend, within a national GHG inventory is allowed

- **Interoperability with UNFCCC ETF reporting tool** allows to export a complete set of CRTs and upload it in the UNFCCC ETF reporting tool

  User-specific Tier 3 estimates to be accommodated in Tier 1 methodological approach worksheets

- **AFOLU sector Guidebook – version 1 under development**

Case Study for Livestock - Cattle

- **Estimate**
  - CH_4 emissions form Enteric Fermentation (3.A.1)
  - CH_4 and N_2O emissions form Manure Management (3.A.2)
  - Indirect N_2O emissions from Manure Management (3.C.6)

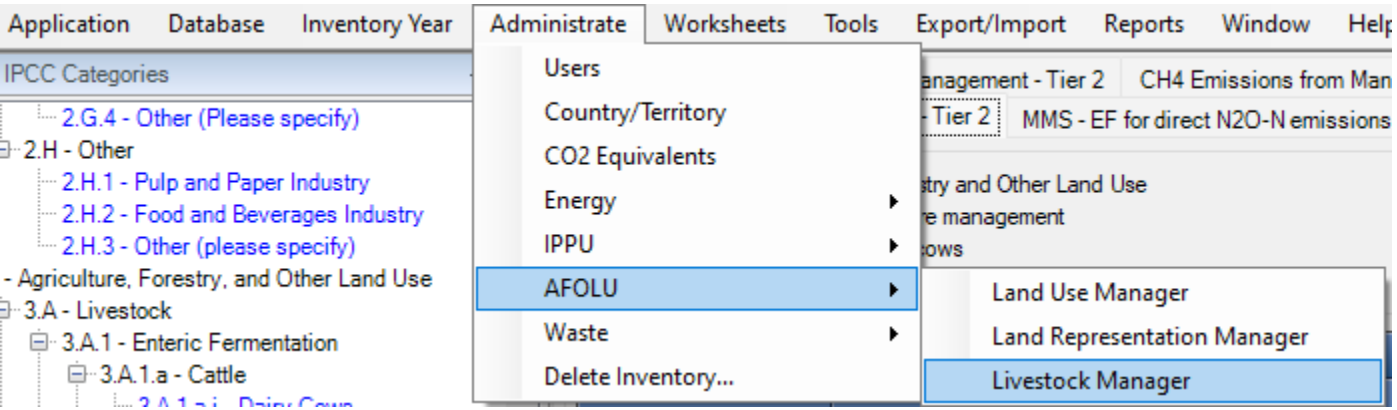
3.A.1 – Enteric Fermentation CH_4 emissions

3.A.2 – Manure Management CH_4 & direct N_2O emissions

Tool:

Livestock Manager

Open the Livestock Manager



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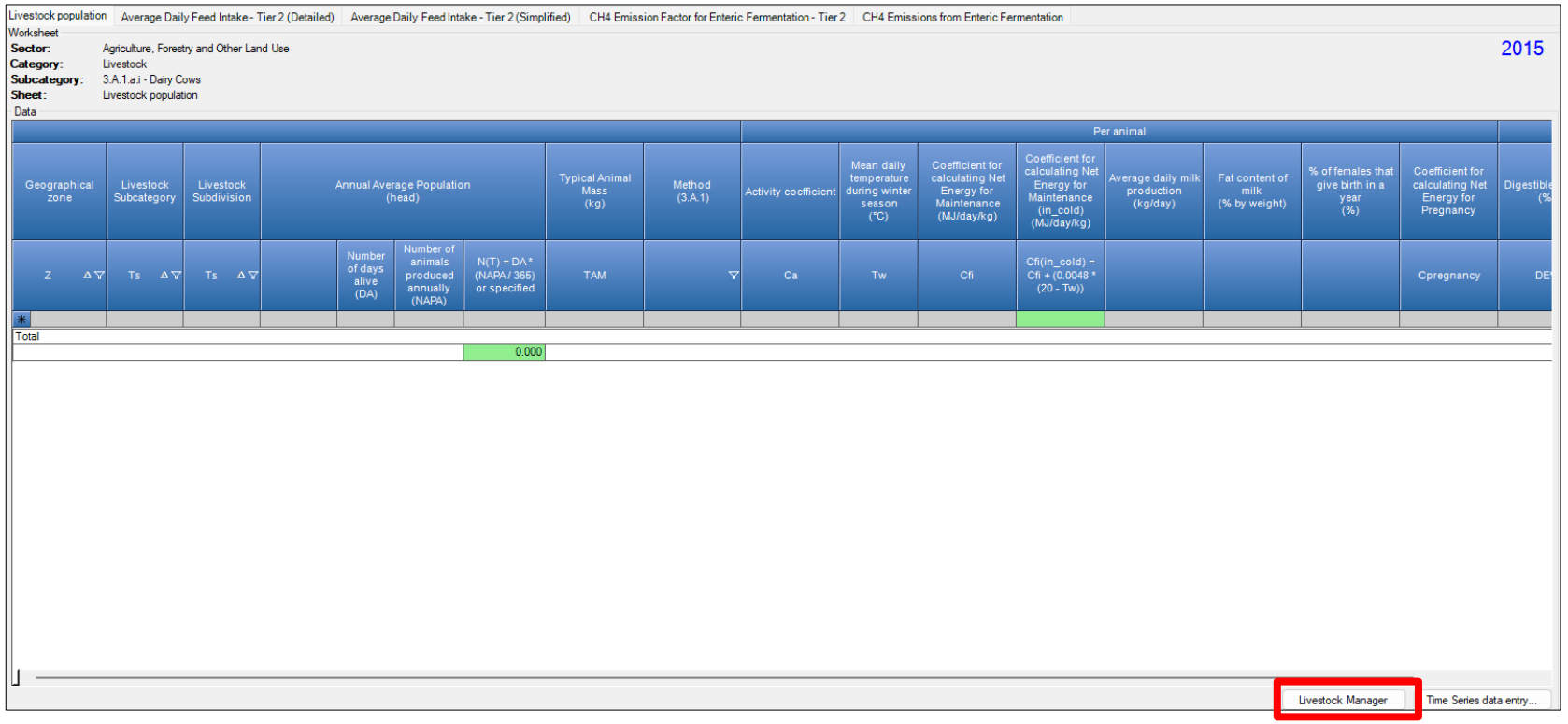
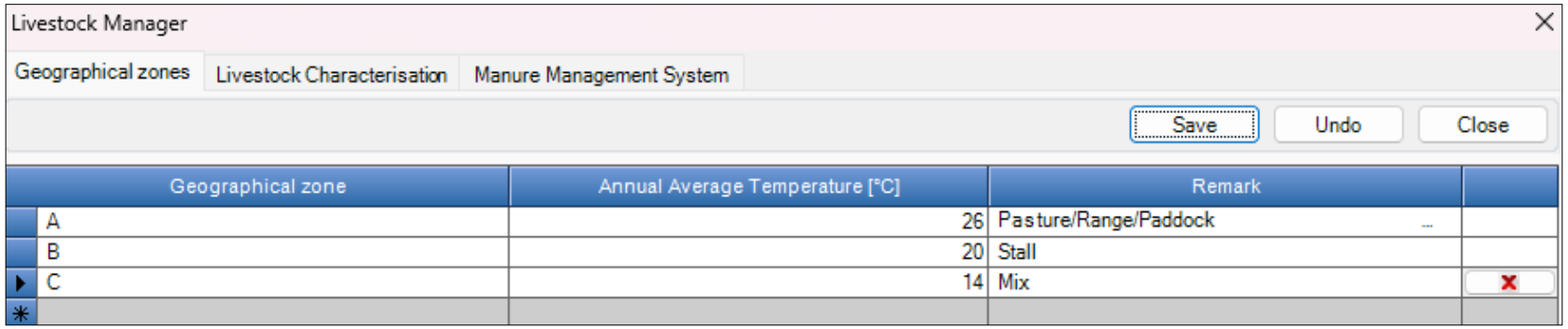


Livestock Manager Data Enter: I. Geographical zones

❑ Geographical zones

- ✓ Defined by the “Annual Average Temperature”
- ✓ A single Geographical zone or several Geographical zones



Livestock Manager Data Enter: II. Livestock Characterisation

❑ Livestock Characterisation

Single characterisation for the inventory for both categories: 3.A.1 (*Enteric Fermentation*) & 3.A.2 (*Manure Management*)

It can be *Basic* or *Enhanced* or *Country-specific* or *Any combination*

Region	Average Annual Temperature	Characterisation	species	category	subcategory	subdivision
A	26	Basic	Cattle	Dairy cows		
				Other cattle		
B	20	Enhanced	Cattle	Dairy Cows	Mature Dairy Cows	High-producing cows for milk production, calved at least once (stall)
				Other Cattle	Growing Cattle	Calves pre-weaning
						Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)
						Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)
						Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)
						Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)
						Growing/Fattening cattle post-weaning
						Replacement dairy heifers
					Other Mature Cattle	Bulls used principally for breeding purposes
						Cows used to produce offspring for meat
C	14	Enhanced	Cattle	Dairy Cows	Mature Dairy Cow	High-producing cows for milk production, calved at least once (mix)
				Other Cattle	Growing Cattle	Replacement dairy heifers

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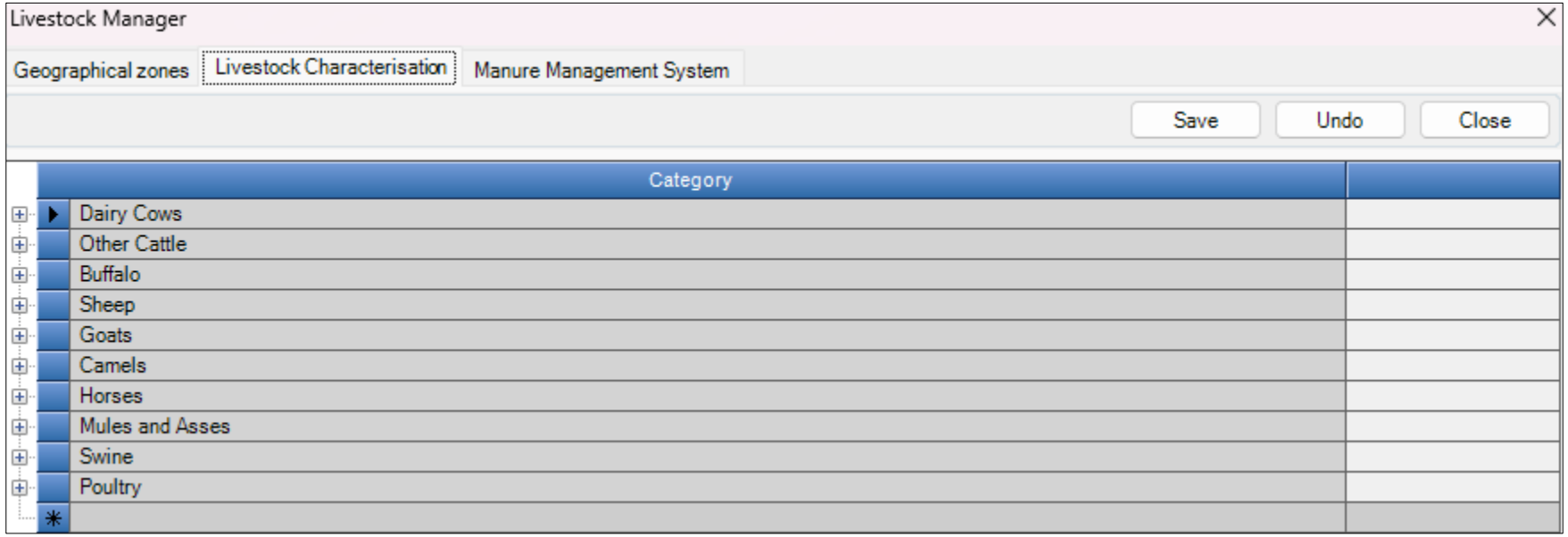
Livestock Manager - Tips

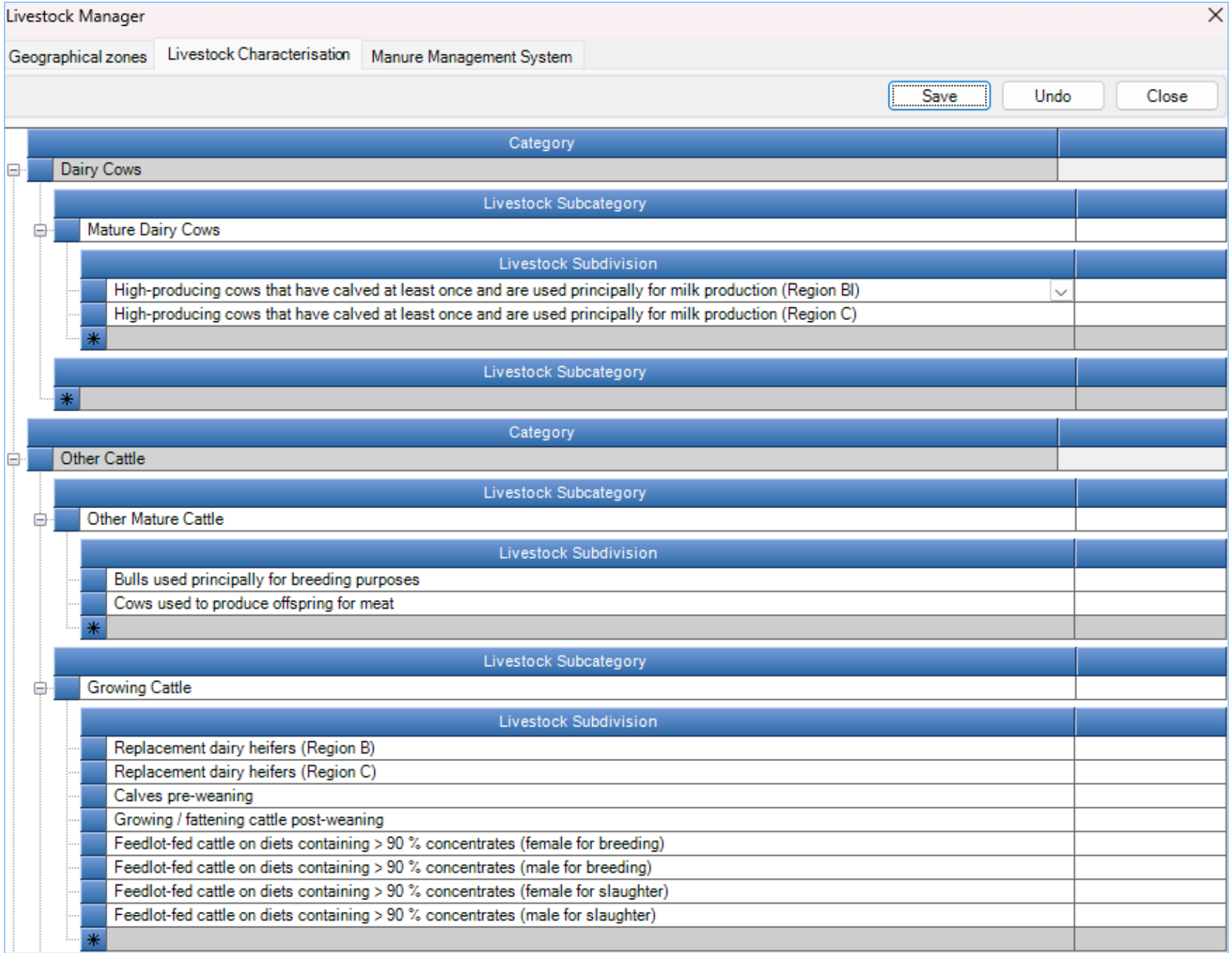


❑ On the right hand side:

- The object ⊞ indicates that there is a sub-layer to be compiled.
  Thus, click on it to open the sub-layer and input the information

- The object ✳ indicates rows where the user can enter additional information

Livestock Manager Data Enter: II. Livestock Characterisation



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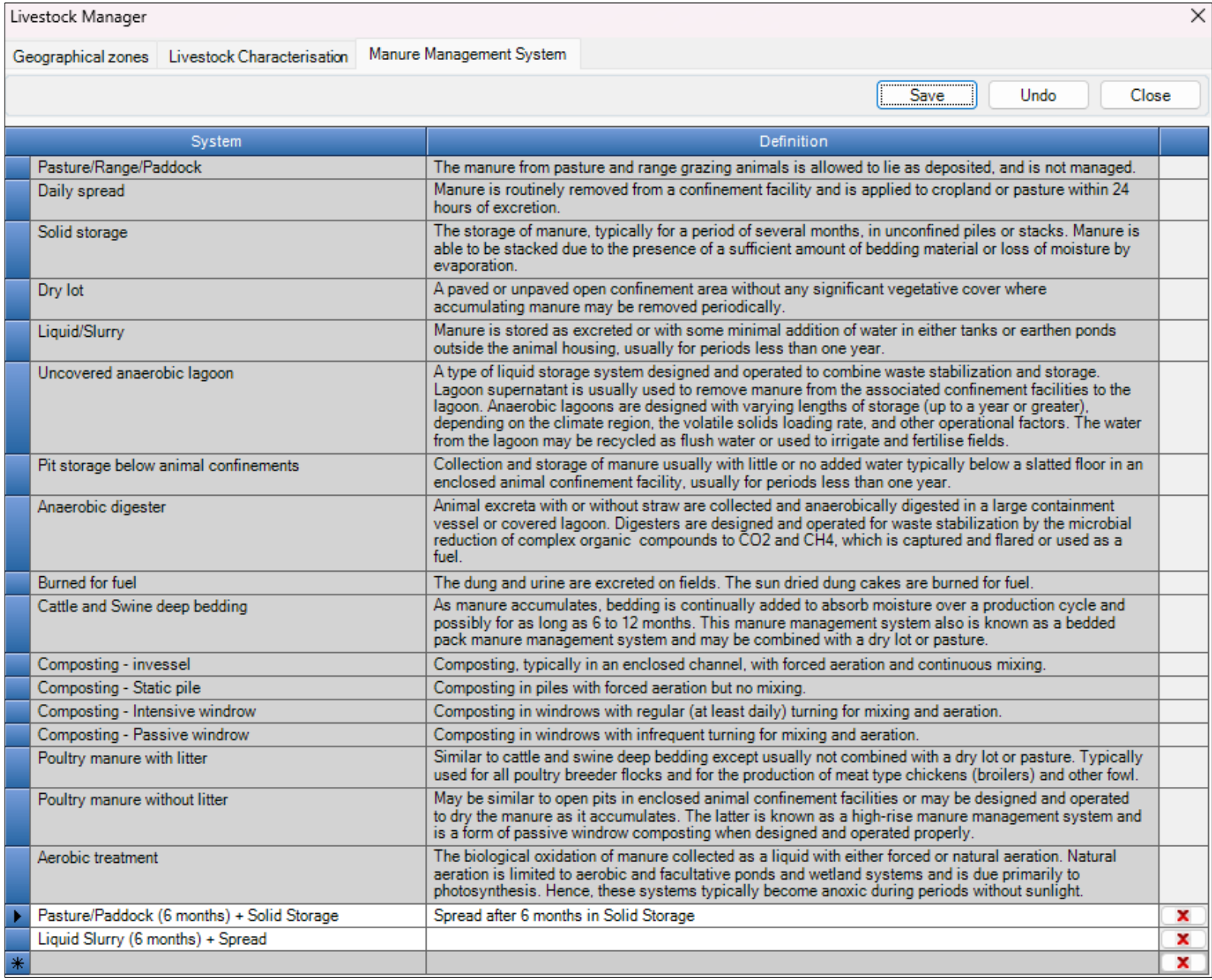
Livestock Manager Data Enter: III. Manure Management Systems

- **Manure Management Systems:** A single set for the entire Inventory



System	Definition
Pasture/Range/Paddock	The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed.
Daily spread	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.
Solid storage	The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.
Dry lot	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.
Liquid/Slurry	Manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year.
Uncovered anaerobic lagoon	A type of liquid storage system designed and operated to combine waste stabilization and storage. Lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors. The water from the lagoon may be recycled as flush water or used to irrigate and fertilise fields.
Pit storage below animal confinements	Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year.
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.
Burned for fuel	The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel.
Cattle and Swine deep bedding	As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture.
Composting - invessel	Composting, typically in an enclosed channel, with forced aeration and continuous mixing.
Composting - Static pile	Composting in piles with forced aeration but no mixing.
Composting - Intensive windrow	Composting in windrows with regular (at least daily) turning for mixing and aeration.
Composting - Passive windrow	Composting in windrows with infrequent turning for mixing and aeration.
Poultry manure with litter	Similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture. Typically used for all poultry breeder flocks and for the production of meat type chickens (broilers) and other fowl.
Poultry manure without litter	May be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly.
Aerobic treatment	The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight.
Pasture/Paddock (6 months) + Solid Storage	Spread after 6 months in Solid Storage
Liquid Slurry (6 months) + Spread	

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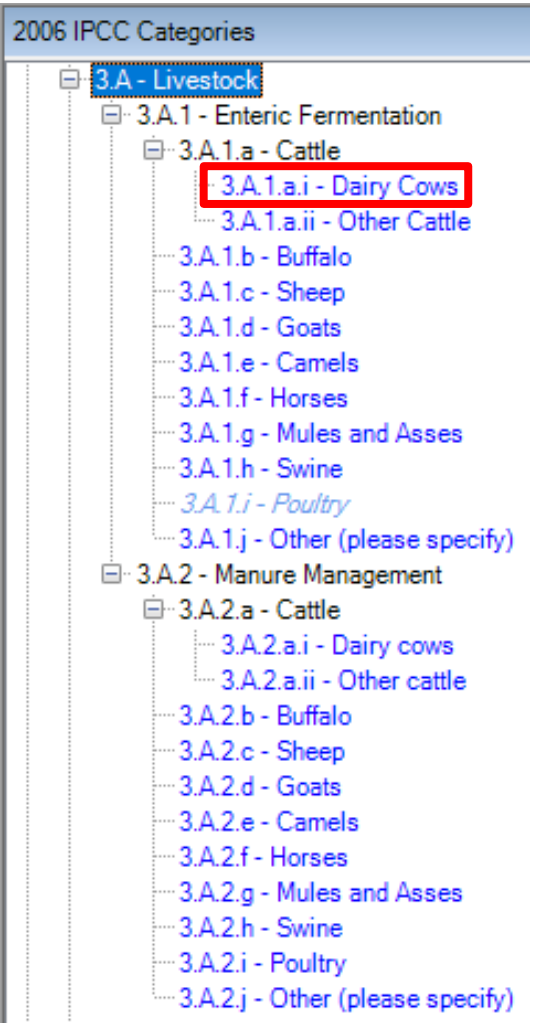
Open the Calculation Worksheets



- Clicking on **blue categories** opens the relevant calculation worksheets where to enter AD, parameters and EFs for the category selected

- **Data** to characterize the Livestock population **can be entered either for 3.A.1** ***(Enteric Fermentation)*** **or 3.A.2** ***(Manure Management)***, the ***Software*** **automatically copies the data in the other category**

3.A.1 – Enteric Fermentation CH_4 emissions

3.A.2 – Manure Management CH_4 & direct N_2O emissions

Worksheet:

Livestock Population

Enter *Annual Average Population*
Livestock Population Worksheet

5. Enter Annual Average Population, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- **Population data can be collected**
  - Either through census/survey at farm
  - Or from economic statistic -sell/buy- *(e.g. slaughtered animals)*. Economic statistics are affected by the period within the year the individual is part of the population *e.g. broiler chickens are typically grown in flocks for 60 days, so 6 flocks can be grown within a year; accordingly slaughter statistics in a year would count 6 times the actual annual average population.*
- **Population may have seasonality**
  - Age classes have therefore a different population size in different phases of the year; accordingly the annual average population is to be calculated *e.g. Sheep are seasonal breeders in temperate regions, meaning that they experience distinct periods of sexual activity or inactivity annually. Specifically, sheep are short day breeders, breeding at times of the year when the day length is shorter and night time longer. Consequently, lamb population has a peak in Spring (where most are slaughtered for meat consumption) and a minimum in Winter (given those are slaughtered at age of 6-8 months).*
  - A population may migrate from a country to another country, and thus its annual population is averaged by the number of months X of the year (12) in which the population is present in the country [i.e. X/12]

Thus, the annual average population of the relevant subdivision of population is to be calculated on the basis of its average lifetime

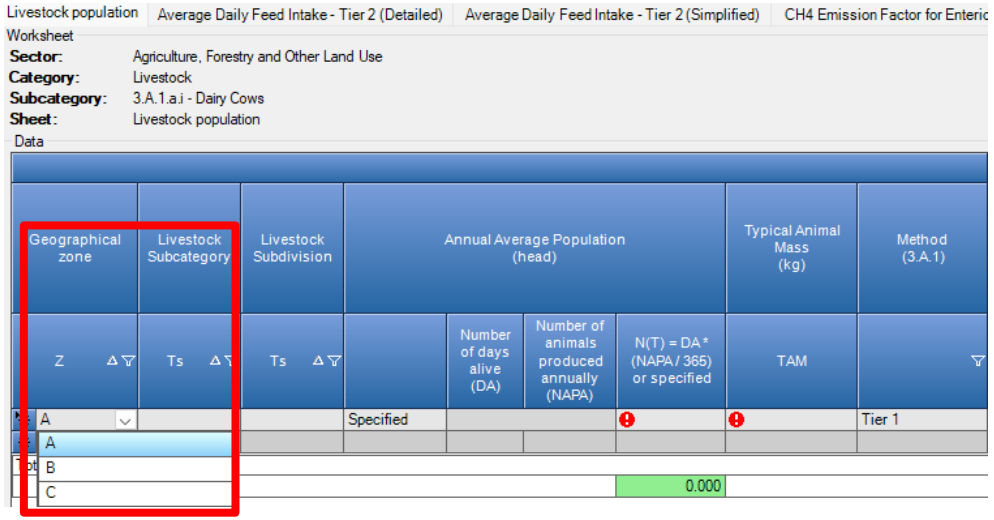
3.A.1 *(Enteric Fermentation)* or 3.A.2 *(Manure Management)* – AD – Livestock Population

5. **Enter Annual Average Population**, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

subdivision	Population heads 2015	Population heads 2020	TAM kg	Method
Dairy cows	2,510	6,226	496.8	Tier 1
Other cattle	5,029	16,904	177.4	Tier 1
High-producing cows for milk production, calved at least once (stall)	2,509,667	1,556,463	621.0	Detailed Tier 2
Calves pre-weaning	300,000	463,597	157.0	Tier 1
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	749,111	726,873	405.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	186,060	260,935	404.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	72,461	22,574	557.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	708,329	526,175	557.0	Simplified Tier 2
Growing/Fattening cattle post-weaning	2,127,959	1,253,974	236.3	Simplified Tier 2
Replacement dairy heifers	443,855	509,720	540.0	Detailed Tier 2
Bulls used principally for breeding purposes	128,958	101,006	700.0	Simplified Tier 2
Cows used to produce offspring for meat	312,649	361,142	557.0	Simplified Tier 2
High-producing cows for milk production, calved at least once (mix)	132,088	81,919	602.7	Detailed Tier 2
Replacement dairy heifers	23,361	26,827	540.0	Detailed Tier 2

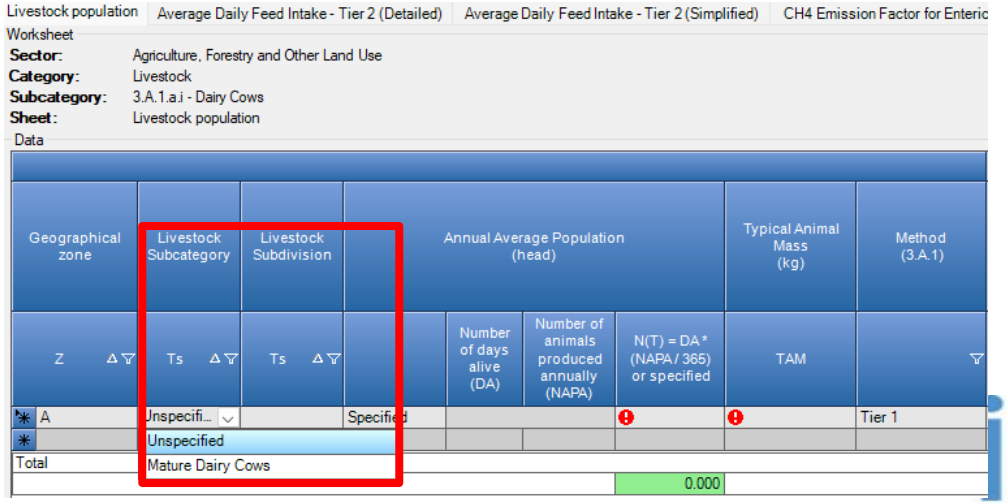
Enter *Annual Average Population*
Livestock Population Worksheet

I. Select Region



II. Select relevant Livestock population:

Subcategory



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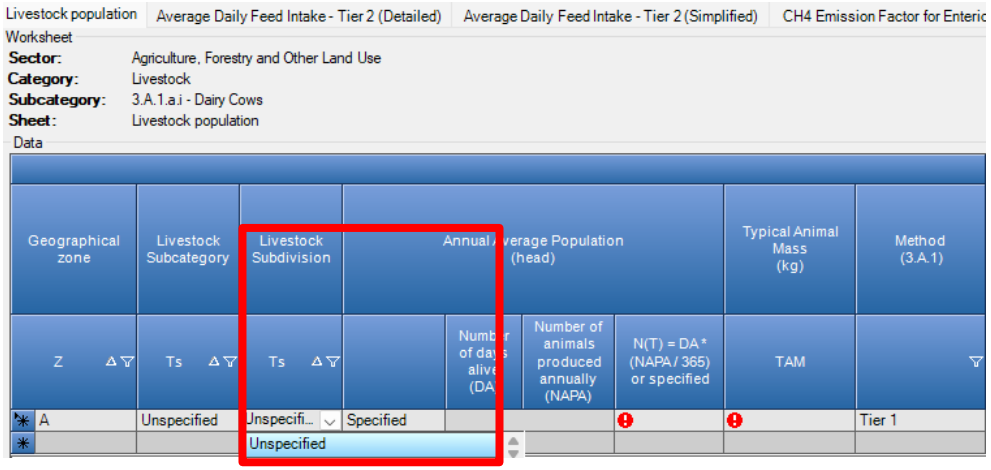
Enter *Annual Average Population*
Livestock Population Worksheet

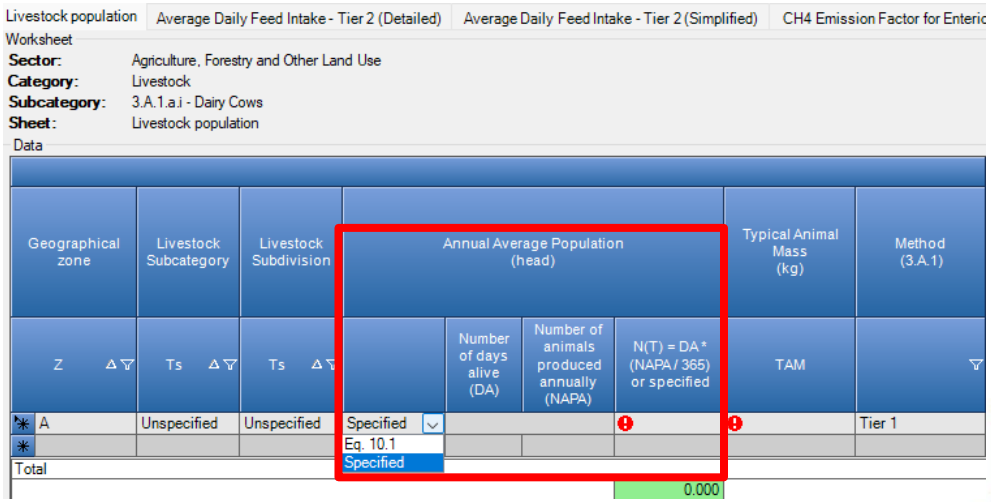
III. Select relevant Livestock population:

Subdivision



IV. Enter Annual Average Population data (heads)

- ✓ Either Calculated (Eq 10.1)
- ✓ Or Specified (i.e. directly Entered)



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Enter *Typical Animal Mass/Body Weight* *Livestock Population* Worksheet

6. **Enter Typical Animal Mass/Body Weight,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ Live-weight data should be collected for each animal category/subcategory/subdivision. It is unrealistic to perform a complete census of live-weights, so live-weight data should be obtained from representative sample studies or statistical databases if these already exist.
- ❑ Live-weight data of mature animal categories/subcategories/subdivision should refer to yearly average weight.

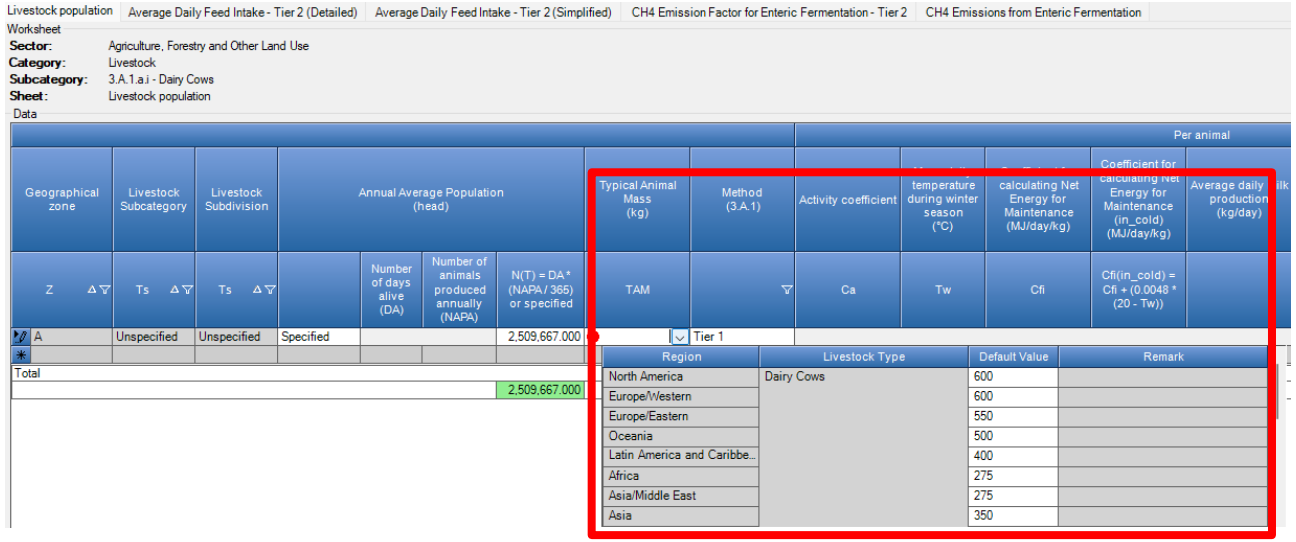
3.A.1 *(Enteric Fermentation)* or 3.A.2 *(Manure Management)* – AD – Livestock Population

6. **Enter Typical Animal Mass/Body Weight,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

subdivision	Population heads 2015	Population heads 2020	TAM kg	Method
Dairy cows	2,510	6,226	496.8	Tier 1
Other cattle	5,029	16,904	177.4	Tier 1
High-producing cows for milk production, calved at least once (stall)	2,509,667	1,556,463	621.0	Detailed Tier 2
Calves pre-weaning	300,000	463,597	157.0	Tier 1
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	749,111	726,873	405.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	186,060	260,935	404.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	72,461	22,574	557.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	708,329	526,175	557.0	Simplified Tier 2
Growing/Fattening cattle post-weaning	2,127,959	1,253,974	236.3	Simplified Tier 2
Replacement dairy heifers	443,855	509,720	540.0	Detailed Tier 2
Bulls used principally for breeding purposes	128,958	101,006	700.0	Simplified Tier 2
Cows used to produce offspring for meat	312,649	361,142	557.0	Simplified Tier 2
High-producing cows for milk production, calved at least once (mix)	132,088	81,919	602.7	Detailed Tier 2
Replacement dairy heifers	23,361	26,827	540.0	Detailed Tier 2

Enter Typical Animal Mass/Body Weight *Livestock Population* Worksheet

I. **Select** relevant **IPPC default EF** value **or Enter** a **user-specific** value:



Livestock population | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | CH4 Emission Factor for Enteric Fermentation - Tier 2 | CH4 Emissions from Enteric Fermentation

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.1.a.i - Dairy Cows
Sheet: Livestock population

Data

									Per animal				
Geographical zone	Livestock Subcategory	Livestock Subdivision	Annual Average Population (head)				Typical Animal Mass (kg)	Method (3.A.1)	Activity coefficient	temperature during winter season (°C)	calculating Net Energy for Maintenance (MJ/day/kg)	Coefficient for calculating Net Energy for Maintenance (in_cold) (MJ/day/kg)	Average daily production (kg/day)
Z	Ts	Ts		Number of days alive (DA)	Number of animals produced annually (NAPA)	N(T) = DA * (NAPA / 365) or specified	TAM		Ca	Tw	Cfi	Cfi(in_cold) = Cfi + (0.0048 * (20 - Tw))	
A	Unspecified	Unspecified	Specified			2,509,667.000		Tier 1					
Total						2,509,667.000							

Region	Livestock Type	Default Value	Remark
North America	Dairy Cows	600	
Europe/Western		600	
Europe/Eastern		550	
Oceania		500	
Latin America and Caribbe..		400	
Africa		275	
Asia/Middle East		275	
Asia		350	

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Select the methodological Tier to apply
Livestock Population Worksheet

7. **Select for each category, i.e. 3.A.1 and 3.A.2, the methodological Tier to apply,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ According to the decision tree in Figure 10.2, select the methodological Tier to be applied to estimate either 3.A.1 or 3.A.2

  (Note the methodological Tier selection does not transfer from a category to the other).

- ❑ Three options are available, which selection determines whether the *Software* requires to calculate the Average Daily Feed Intake *(i.e. the daily Energy need of the population),* and which approach is to be applied to calculate it, or it does not require the Average Daily Feed Intake:

  I. IPCC Default, Average Daily Feed Intake calculations is not needed

  II. IPCC Tier 2 Simplified, the Average Daily Feed Intake is calculated directly from the Daily Dry Matter Feed Intake and the Energy Content of Feed

  III. IPCC Tier 2 Detailed, the Average Daily Feed Intake is calculated from the Average Daily Gross Energy need

3.A.1 *(Enteric Fermentation)* or 3.A.2 *(Manure Management)* – AD – Livestock Population

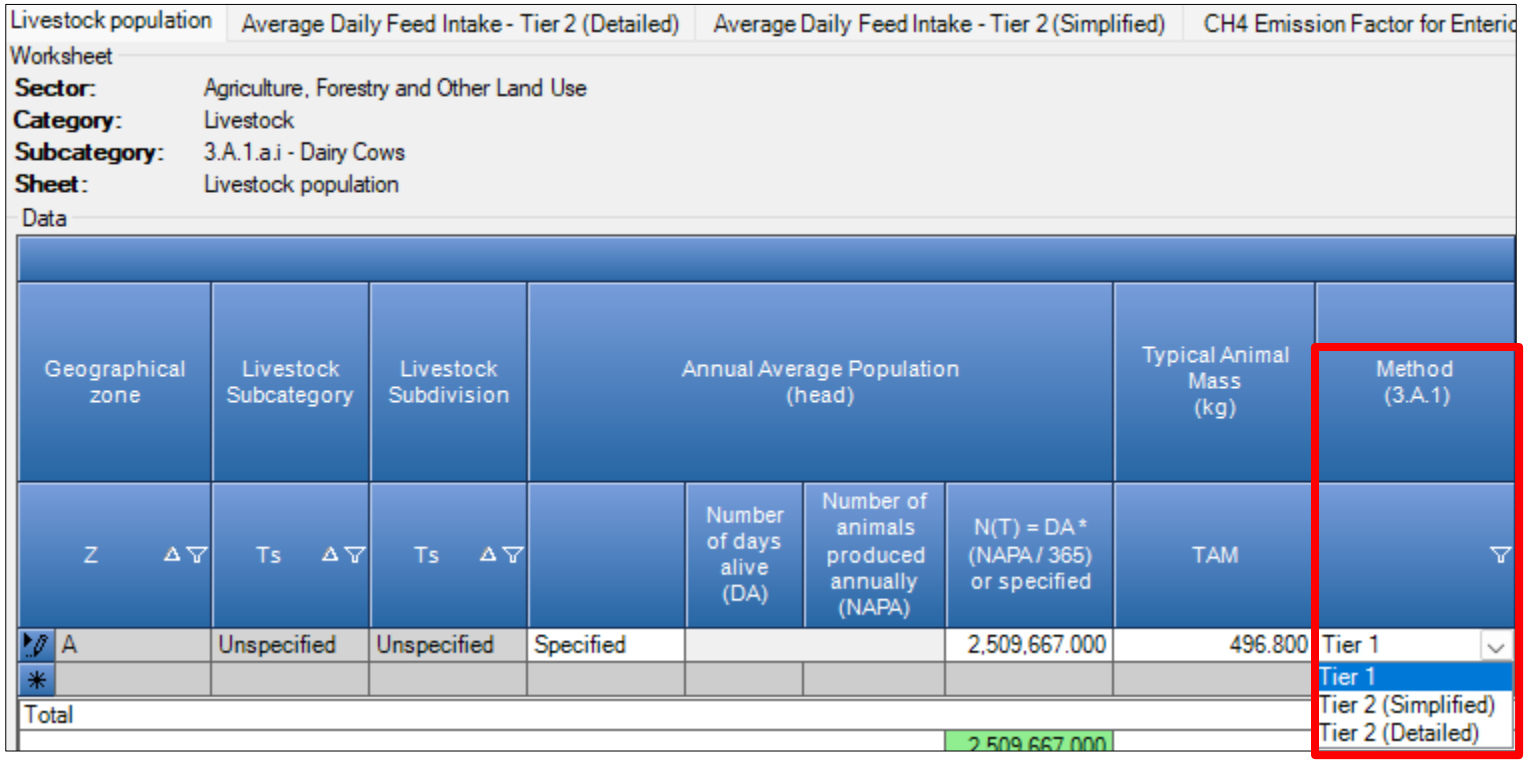
7. **Select for each category, i.e. 3.A.1 and 3.A.2, the methodological Tier to apply,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

subdivision	Population heads		TAM	Method
	2015	2020	kg	
Dairy cows	2,510	6,226	496.8	Tier 1
Other cattle	5,029	16,904	177.4	Tier 1
High-producing cows for milk production, calved at least once (stall)	2,509,667	1,556,463	621.0	Detailed Tier 2
Calves pre-weaning	300,000	463,597	157.0	Tier 1
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	749,111	726,873	405.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	186,060	260,935	404.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	72,461	22,574	557.0	Simplified Tier 2
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	708,329	526,175	557.0	Simplified Tier 2
Growing/Fattening cattle post-weaning	2,127,959	1,253,974	236.3	Simplified Tier 2
Replacement dairy heifers	443,855	509,720	540.0	Detailed Tier 2
Bulls used principally for breeding purposes	128,958	101,006	700.0	Simplified Tier 2
Cows used to produce offspring for meat	312,649	361,142	557.0	Simplified Tier 2
High-producing cows for milk production, calved at least once (mix)	132,088	81,919	602.7	Detailed Tier 2
Replacement dairy heifers	23,361	26,827	540.0	Detailed Tier 2

Note *the methodological Tier selection does not transfer from a category to the other; thus, it shall be made for both categories i.e. 3.A.1 and 3.A.2*

Select the methodological Tier to apply
Livestock Population Worksheet

7. **Select the methodological Tier to apply,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



(Note the methodological Tier selection does not transfer from a category to the other).

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Add values for Parameters (Tier 2)
Livestock population Worksheet

8. **Additional parameters to enter in the *Livestock population* Worksheet,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

❑ Additional Parameters shall be entered when a Tier 2 method is selected. In particular:

- IPCC Tier 2 (Simplified) requires only *Digestible Energy (DE%)* is entered
- In addition, IPCC Tier 2 (Detailed) requires some of the following parameters to be entered depending on the livestock species and the livestock population: *Average weigh Gain per day*, *Coefficient for calculating Net Energy for Growth*, *Mature Weight*, *Average number of hours worked per day*, *Activity coefficient*, *Mean daily temperature during winter session*, *Coefficient for calculating Net Energy for Maintenance*, *Average daily milk production*, *Fat content of milk*, *% of females that give birth in a year*, *Coefficient for calculating Net energy for Pregnancy*, *Live bodyweight at weaning*, *Live bodyweight at 1-year old or at slaughter if slaughtered prior to 1 year of age*, *Weight Gain*, *Weight gain of the lamb between birth and weaning*, *Constants a and b for calculating Net Energy for Growth*, *Energy required to produce 1 kg of milk*, *Average annual wool production per head*, *Energy value of each kg of wool produced*.

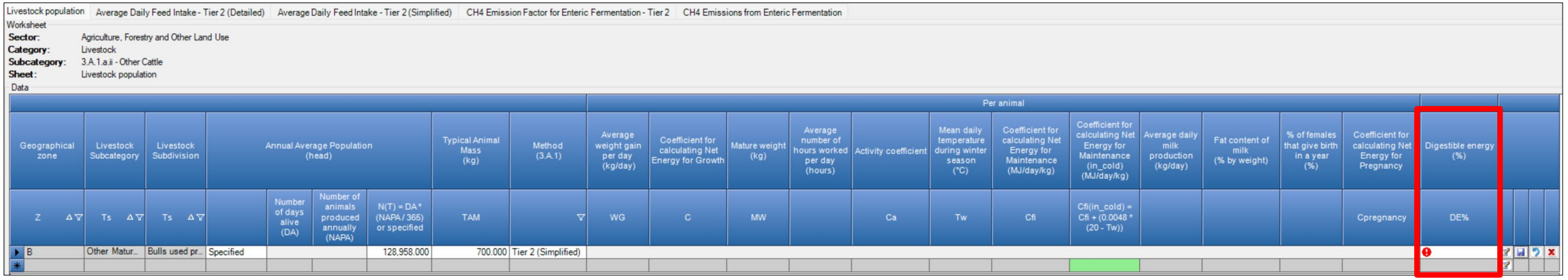
(Note all parameters' values entered for 3.A.1 are automatically transferred by the Software to 3.A.2 and vice versa).

3.A.1 *(Enteric Fermentation)* or 3.A.2 *(Manure Management)* – AD – GE/DMI

subdivision	Ca	Tw	Cfi	(in_cold)	Milk production kg/day 2015	Milk production kg/day 2020	Milk Fat content % 2015	Milk Fat content % 2020	Females giving birth % 2015	Females giving birth % 2020	_Pregnan	WG kg/day	C	MW kg	Work hours	DE % 2015	DE % 2020
Dairy cows																	
Other cattle																	
High-producing cows for milk production, calved at least once (stall)	0.00		0.386	No	11.5	23.7	3.59	3.88	97.33	91.48	0.1					75.0	78.0
Calves pre-weaning																	
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)																77.0	80.0
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)																77.0	80.0
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)																77.0	80.0
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)																77.0	80.0
Growing/Fattening cattle post-weaning																70.3	73.4
Replacement dairy heifers	0.00		0.322	No	0.0	0.0	0.00	0.00	0.00	0.00	0.0	0.48	0.8	621	0.0	70.3	73.4
Bulls used principally for breeding purposes																70.3	73.4
Cows used to produce offspring for meat																70.3	73.4
High-producing cows for milk production, calved at least once (mix)	0.17	3	0.386	Yes	11.5	23.7	3.59	3.88	97.33	91.48	0.1	0	0	0	0.0	65.5	68.8
Replacement dairy heifers	0.17	3	0.322	Yes	0.0	0.0	0.00	0.00	0.00	0.00	0.0	0.40	0.8	602.7	0.0	65.5	68.8

Parameters - *Livestock Population* Worksheet

8. Select IPCC default or enter the *Digestible Energy (DE%)* value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | CH4 Emission Factor for Enteric Fermentation - Tier 2 | CH4 Emissions from Enteric Fermentation

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.1.a.ii - Other Cattle
Sheet: Livestock population

Data

									Per animal														
Geographical zone	Livestock Subcategory	Livestock Subdivision	Annual Average Population (head)				Typical Animal Mass (kg)	Method (3.A.1)	Average weight gain per day (kg/day)	Coefficient for calculating Net Energy for Growth	Mature weight (kg)	Average number of hours worked per day (hours)	Activity coefficient	Mean daily temperature during winter season (°C)	Coefficient for calculating Net Energy for Maintenance (MJ/day/kg)	Coefficient for calculating Net Energy for Maintenance (in_cold) (MJ/day/kg)	Average daily milk production (kg/day)	Fat content of milk (% by weight)	% of females that give birth in a year (%)	Coefficient for calculating Net Energy for Pregnancy	Digestible energy (%)		
Z	Ts	Ts		Number of days alive (DA)	Number of animals produced annually (NAPA)	N(T) = DA * (NAPA / 365) or specified	TAM		WG	C	MW		Ca	Tw	Cfi	Cfi(in_cold) = Cfi + (0.0048 * (20 - Tw))				Cpregnancy	DE%		
B	Other Matur...	Bulls used pr...	Specified			128,958.000	700.000	Tier 2 (Simplified)															

(Note the methodological Tier selection does not transfer from a category to the other).

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Parameters - *Livestock Population* Worksheet

8. Additional parameters to enter in the *Livestock population* Worksheet, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

Livestock population | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | CH4 Emission Factor for Enteric Fermentation - Tier 2 | CH4 Emissions from Enteric Fermentation

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.1.a.ii - Other Cattle
Sheet: Livestock population

Data

	Geographical zone	Livestock Subcategory	Livestock Subdivision	Annual Average Population (head)			Typical Animal Mass (kg)	Method (3.A.1)	Per animal													Digestible energy (%)
	Z	Ts	Ts		Number of days alive (DA)	Number of animals produced annually (NAPA)	N(T) = DA * (NAPA / 365) or specified	TAM		WG	C	MW		Ca	Tw	Cfi	Cfi(in_cold) = Cfi + (0.0048 * (20 - Tw))				Cpregnancy	DE%
	A	Unspecified	Unspecified	Specified			5,029.000	177.400	Tier 1													
	B	Growing Catt...	Calves pre-w...	Specified			300,000.000	157.000	Tier 1													
			Feedlot-fed c...	Specified			749,111.000	405.000	Tier 2 (Simplified)													77.000
			Feedlot-fed c...	Specified			186,060.000	404.000	Tier 2 (Simplified)													77.000
			Feedlot-fed c...	Specified			72,461.000	557.000	Tier 2 (Simplified)													77.000
			Feedlot-fed c...	Specified			708,329.000	557.000	Tier 2 (Simplified)													77.000
			Growing / fat...	Specified			2,127,959.000	236.300	Tier 2 (Simplified)													70.300
			Replacemen...	Specified			443,855.000	540.000	Tier 2 (Detailed)	0.480	0.8	621.000	0.000	0		0.322		0.000	0.000	0.000	0.000	70.300
▶		Other Matur...	Bulls used pr...	Specified			128,958.000	700.000	Tier 2 (Simplified)													70.300
			Cows used t...	Specified			312,649.000	557.000	Tier 2 (Simplified)													70.300
	C	Growing Catt...	Replacemen...	Specified			23,361.000	540.000	Tier 2 (Detailed)	0.400	0.8	602.700	0.000	0.17	3.000	0.322	0.404	0.000	0.000	0.000	0.000	65.500

(Note the methodological Tier selection does not transfer from a category to the other).

Apply to Tier 2 estimates only

3.A.1 – Enteric Fermentation CH_4 emissions
3.A.2 – Manure Management CH_4 & direct N_2O emissions

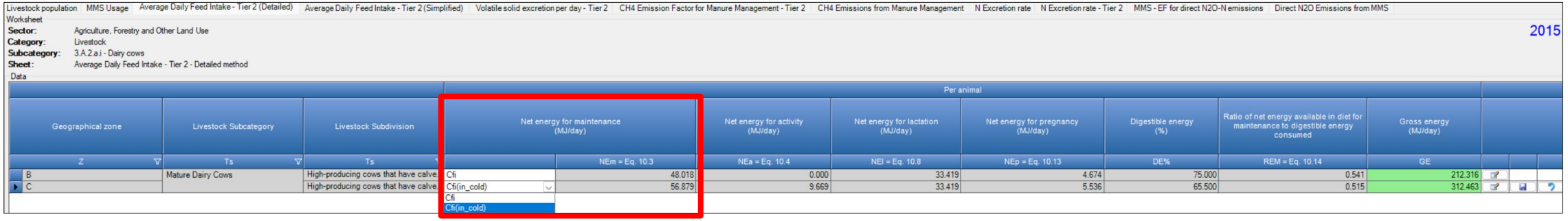
Worksheet:

Average Daily Feed Intake – Tier 2 (Detailed)

Average Daily Feed Intake – Tier 2 (Simplified)

Parameters – *Average Daily Feed Intake (Detailed)* Worksheet

12. **Select the *Coefficient for Net energy for maintenance*** [either **Cfi** or **Cfi(in_cold)**], at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

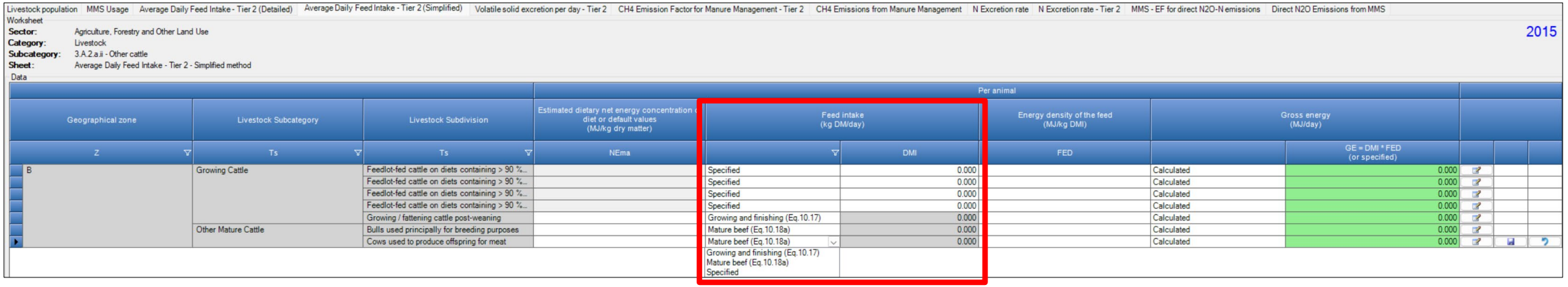


3.A.1 *(Enteric Fermentation)* or 3.A.2 *(Manure Management)* – AD – GE/DMI

subdivision	FED MJ/kgDMI	NEma MJ/kgDM	DMI kgDM/day
Dairy cows			
Other cattle			
High-producing cows for milk production, calved at least once (stall)			
Calves pre-weaning			
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	18.45	NA	8.51
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	18.45	NA	9.28
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	18.45	NA	10.69
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	18.45	NA	11.64
Growing/Fattening cattle post-weaning	18.45	NA	4.85
Replacement dairy heifers			
Bulls used principally for breeding purposes	18.45	NA	17.10
Cows used to produce offspring for meat	18.45	NA	10.58
High-producing cows for milk production, calved at least once (mix)			
Replacement dairy heifers			

Parameters – *Average Daily Feed Intake (Simplified)* Worksheet

9. Enter the *Feed Intake (kg DMI/day)*, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Average Daily Feed Intake - Tier 2 - Simplified method

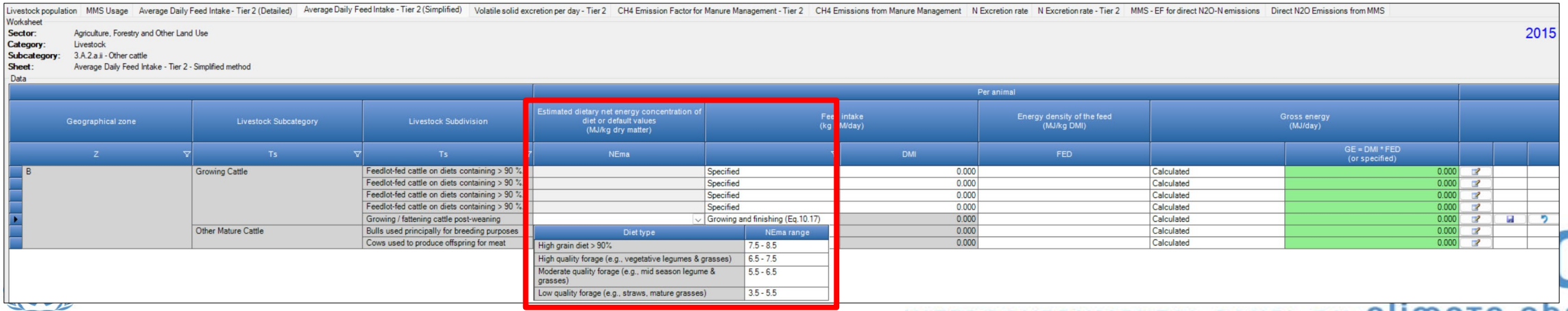
2015

Data

Geographical zone	Livestock Subcategory	Livestock Subdivision	Per animal: Estimated dietary net energy concentration of diet or default values (MJ/kg dry matter)	Per animal: Feed intake (kg DM/day)		Per animal: Energy density of the feed (MJ/kg DMI)	Per animal: Gross energy (MJ/day)	
Z	Ts	Ts	NEma		DMI	FED		GE = DMI * FED (or specified)
B	Growing Cattle	Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Growing / fattening cattle post-weaning		Growing and finishing (Eq.10.17)	0.000		Calculated	0.000
	Other Mature Cattle	Bulls used principally for breeding purposes		Mature beef (Eq.10.18a)	0.000		Calculated	0.000
		Cows used to produce offspring for meat		Mature beef (Eq.10.18a)	0.000		Calculated	0.000
				Growing and finishing (Eq.10.17) Mature beef (Eq.10.18a) Specified				

Feed Intake can be either entered or calculated by applying IPCC equations 10.17 (growing cattle) or 10.18a (Mature Cattle) or 10.18b (Dairy Cows)

10. If calculated, the ***Dietary net energy concentration (NEma)*** **is to be entered**



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Average Daily Feed Intake - Tier 2 - Simplified method

2015

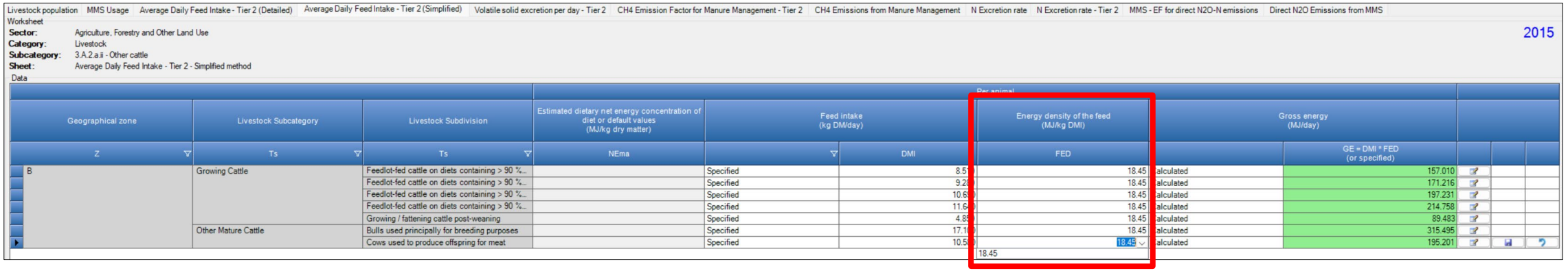
Data

Geographical zone	Livestock Subcategory	Livestock Subdivision	Per animal: Estimated dietary net energy concentration of diet or default values (MJ/kg dry matter)	Per animal: Fee intake (kg M/day)		Per animal: Energy density of the feed (MJ/kg DMI)	Per animal: Gross energy (MJ/day)	
Z	Ts	Ts	NEma		DMI	FED		GE = DMI * FED (or specified)
B	Growing Cattle	Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Feedlot-fed cattle on diets containing > 90 %...		Specified	0.000		Calculated	0.000
		Growing / fattening cattle post-weaning		Growing and finishing (Eq.10.17)	0.000		Calculated	0.000
	Other Mature Cattle	Bulls used principally for breeding purposes			0.000		Calculated	0.000
		Cows used to produce offspring for meat			0.000		Calculated	0.000

Diet type	NEma range
High grain diet > 90%	7.5 - 8.5
High quality forage (e.g., vegetative legumes & grasses)	6.5 - 7.5
Moderate quality forage (e.g., mid season legume & grasses)	5.5 - 6.5
Low quality forage (e.g., straws, mature grasses)	3.5 - 5.5

Parameters – *Average Daily Feed Intake (Simplified)* Worksheet

11. Enter the *Energy density of feed (MJ/kg DMI)*, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

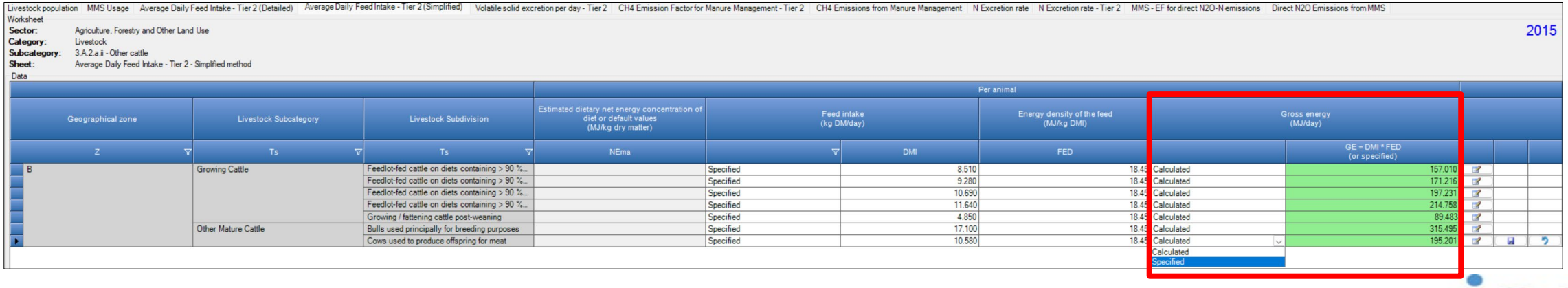
Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Average Daily Feed Intake - Tier 2 - Simplified method

2015

Data

	Geographical zone	Livestock Subcategory	Livestock Subdivision	Per animal: Estimated dietary net energy concentration of diet or default values (MJ/kg dry matter)	Feed intake (kg DM/day)		Energy density of the feed (MJ/kg DMI)	Gross energy (MJ/day)		
	Z	Ts	Ts	NEma		DMI	FED		GE = DMI * FED (or specified)	
	B	Growing Cattle	Feedlot-fed cattle on diets containing > 90 %...		Specified	8.510	18.45	alculated	157.010	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	9.280	18.45	alculated	171.216	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	10.690	18.45	alculated	197.231	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	11.640	18.45	alculated	214.758	
			Growing / fattening cattle post-weaning		Specified	4.850	18.45	alculated	89.483	
		Other Mature Cattle	Bulls used principally for breeding purposes		Specified	17.100	18.45	alculated	315.495	
▶			Cows used to produce offspring for meat		Specified	10.580	18.45	alculated	195.201	
							18.45			

Alternatively, the *Average Daily Feed Intake* estimated as ***Gross Energy (MJ/day)*** **can be entered** instead of calculated



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Average Daily Feed Intake - Tier 2 - Simplified method

2015

Data

	Geographical zone	Livestock Subcategory	Livestock Subdivision	Per animal: Estimated dietary net energy concentration of diet or default values (MJ/kg dry matter)	Feed intake (kg DM/day)		Energy density of the feed (MJ/kg DMI)	Gross energy (MJ/day)		
	Z	Ts	Ts	NEma		DMI	FED		GE = DMI * FED (or specified)	
	B	Growing Cattle	Feedlot-fed cattle on diets containing > 90 %...		Specified	8.510	18.45	Calculated	157.010	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	9.280	18.45	Calculated	171.216	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	10.690	18.45	Calculated	197.231	
			Feedlot-fed cattle on diets containing > 90 %...		Specified	11.640	18.45	Calculated	214.758	
			Growing / fattening cattle post-weaning		Specified	4.850	18.45	Calculated	89.483	
		Other Mature Cattle	Bulls used principally for breeding purposes		Specified	17.100	18.45	Calculated	315.495	
▶			Cows used to produce offspring for meat		Specified	10.580	18.45	Calculated	195.201	
								Calculated		
								Specified		

3.A.1 – Enteric Fermentation CH_4 estimates

Worksheets:

CH_4 emissions from Enteric Fermentation

CH_4 emissions from Enteric Fermentation – Tier 2

3.A.1 *(Enteric Fermentation)* – CH_4 EF

subdivision	Ym % 2015	Ym % 2020	Enteric Fermentation CH_4 EF $kgCH_4/head/yr$
Dairy cows			117
Other cattle			57
High-producing cows for milk production, calved at least once (stall)	6.50	5.98	
Calves pre-weaning			0.00
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	6.30	5.80	
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	6.30	5.80	
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	6.30	5.80	
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	6.30	5.80	
Growing/Fattening cattle post-weaning	6.30	5.80	
Replacement dairy heifers	6.50	5.98	
Bulls used principally for breeding purposes	7.00	6.44	
Cows used to produce offspring for meat	7.00	6.44	
High-producing cows for milk production, calved at least once (mix)	6.50	5.98	
Replacement dairy heifers	6.50	5.98	

3.A.1 *(Enteric Fermentation)* – CH_4 EF
Cows: Deriving an EF from milk production data

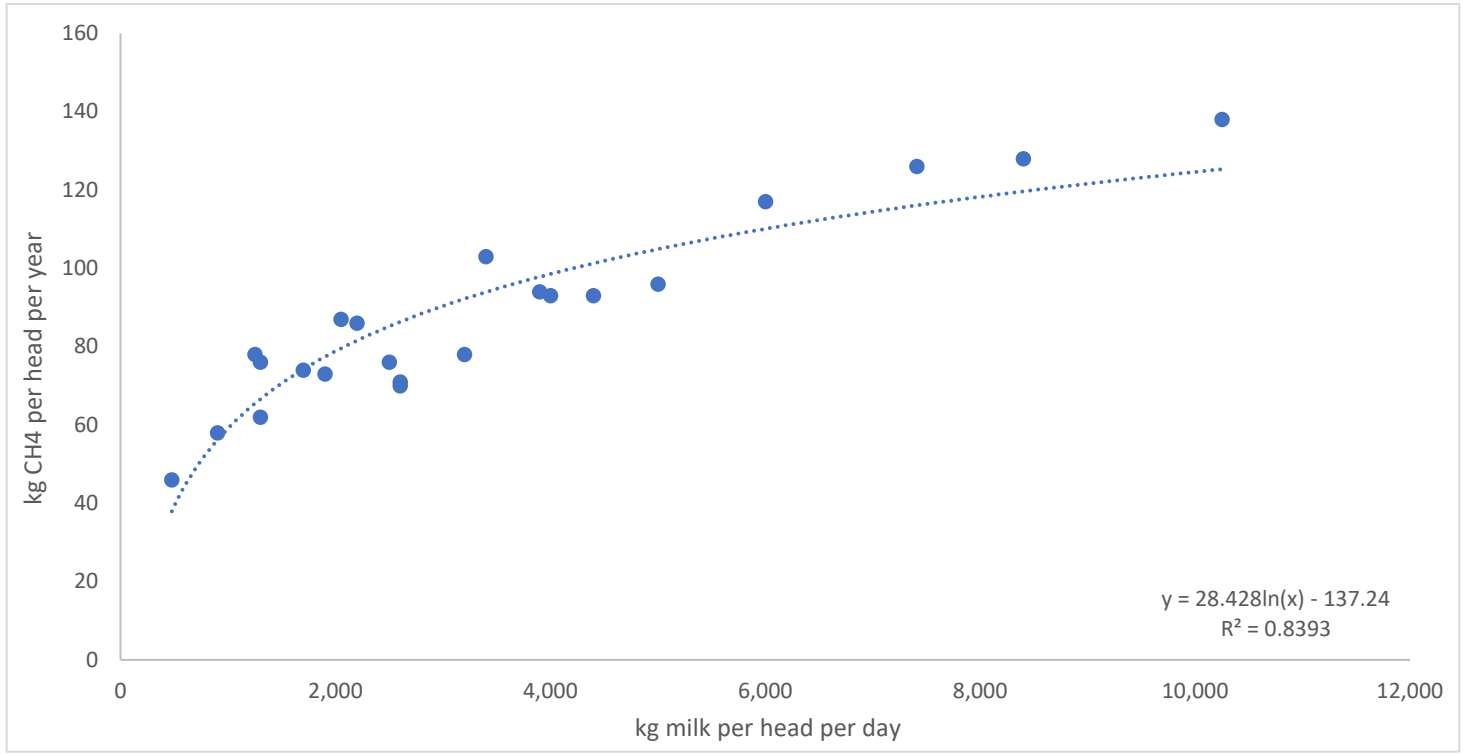


Table 10.11

3.A.1 – Enteric Fermentation CH_4 estimates
CH_4 emissions from Enteric Fermentation Worksheet

13. **Enter or Calculate the CH_4 EF,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ **<u>IPCC Tier 1</u>, select the IPCC EF default value** from the dropdown menu **or enter a user-specific**.

Livestock population | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | CH4 Emission Factor for Enteric Fermentation - Tier 2 | CH4 Emissions from Enteric Fermentation

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Enteric fermentation
Subcategory: 3.A.1.a.ii - Other Cattle
Sheet: CH4 Emissions from Enteric Fermentation

2015

Data
Gas METHANE (CH4)

Geographical zone	Livestock Subcategory	Livestock Subdivision	Number of Animals (head)	Emission Factor [kg CH4/(head yr)]	CH4 Emissions (Gg CH4/yr)
Z	Ts	Ts	N(T)	EF(T)	CH4 = N(T) * EF(T) * 10^-6
A	Unspecified	Unspecified	5,029.0	57.000	0.287
B	Growing Cattle	Calves pre-weaning	300,000.0	0.000	0.000
		Feedlot-fed cattle on diets containing > 90 % concentrates (fem...	749,111.0		0.000
		Feedlot-fed cattle on diets containing > 90 % concentrates (fem...	186,060.000	0.000	0.000
		Feedlot-fed cattle on diets containing > 90 % concentrates (mal...	72,461.000	0.000	0.000
		Feedlot-fed cattle on diets containing > 90 % concentrates (mal...	708,329.000	0.000	0.000
		Growing / fattening cattle post-weaning	2,127,959.000	0.000	0.000
		Replacement dairy heifers (Region B)	443,855.000	0.000	0.000
	Other Mature Cattle	Bulls used principally for breeding purposes	128,958.000	0.000	0.000
		Cows used to produce offspring for meat	312,649.000	0.000	0.000
C	Growing Cattle	Replacement dairy heifers (Region C)	23,361.000	0.000	0.000
Total					0.287

- ❑ The Software calculates CH_4 emissions in the “green” column

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3.A.1 – Enteric Fermentation CH_4 estimates

CH_4 emissions from Enteric Fermentation – Tier 2 Worksheet

13. **Enter or Calculate the CH_4 EF,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ **IPCC Tier 2**, select the IPCC default *Methane Conversion factor (Ym)* from the dropdown menu or enter a user-specific value

Livestock population | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | CH4 Emission Factor for Enteric Fermentation - Tier 2 | CH4 Emissions from Enteric Fermentation

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Enteric fermentation
Subcategory: 3.A.1.a.i - Dairy Cows
Sheet: CH4 Emission Factor for Enteric Fermentation - Tier 2

2015

Data

				Per animal			
Geographical zone	Livestock Subcategory	Livestock Subdivision		Gross energy (MJ/day)	Methane conversion factor, percent of gross energy in feed converted to methane (%)	CH4 Emission Factor (kg CH4/head/yr)	
Z	Ts	Ts	Ts	GE	Ym	EF = (GE * (Ym / 100) * 365) / 55.65	
B	Mature Dairy Cows	High-producing cows that have calved at least once and...		212.3	6.5	90.516	
C		High-producing cows that have calved at least once and...		275.2	6.5	117.328	

- ❑ The Software calculates CH_4 emissions in the "green" column

3.A.2 – Manure Management CH_4 and direct N_2O estimates

Worksheet:

MMS Usage

3.A.2 *(Manure Management)* – MMS Usage & MCF%

subdivision	Pasture/Range/Paddock				Pasture/Paddock (6 months) + Solid Storage & Spread				Liquid Slurry (6 months) + Spread				Anaerobic Digester				
	2015	2020	EF_3 kgN_2O-N/kgN	MCF %	2015	2020	EF_3 kgN_2O-N/kgN	MCF %	2015	2020	EF_3 kgN_2O-N/kgN	MCF %	2015	2020	EF_3 kgN_2O-N/kgN	MCF% 2015	MCF% 2020
Dairy cows					1.000	1.000	0.005										
Other cattle	1.000	1.000															
High-producing cows for milk production, calved at least once (stall)									1.000	0.500	0.005	37.000	0.000	0.500		---	10.850
Calves pre-weaning									1.000	0.750	0.005		0.000	0.250			
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)									1.000	0.750	0.005	37.000	0.000	0.250		---	10.850
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)									1.000	0.750	0.005	37.000	0.000	0.250		---	10.850
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)									1.000	0.750	0.005	37.000	0.000	0.250		---	10.850
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)									1.000	0.750	0.005	37.000	0.000	0.250		---	10.850
Growing/Fattening cattle post-weaning									1.000	0.750	0.005	37.000	0.000	0.250		---	10.850
Replacement dairy heifers									1.000	0.500	0.005	37.000	0.000	0.500		---	10.850
Bulls used principally for breeding purposes					1.000	1.000	0.005	2.000									
Cows used to produce offspring for meat					1.000	1.000	0.005	2.000									
High-producing cows for milk production, calved at least once (pasture)					1.000	1.000	0.005	2.000									
Replacement dairy heifers					1.000	1.000	0.005	2.000									

3.A.2 MMS – *MMS Usage* Worksheet

13. Manure is to be apportioned to the relevant Manure Management Systems, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock./Manure management
Subcategory: 3.A.2.a.i - Dairy cows
Sheet: Fraction of livestock category's manure handled using MMS and Methane conversion factor

2015

Data

Geographical zone	Livestock Subcategory	Livestock Subdivision
Z	Ts	Ts
A	Unspecified	Unspecified

Manure Management System	Methane conversion factor for MMS in Geographical Zone (%) (Tier 2 only)	Fraction of livestock category's manure handled using MMS in geographical zone
S	MCF(T,S)	MS(T,S)
Pasture/Paddock (6 months) + Solid Storage		1.000
Total		1.000

Geographical zone	Livestock Subcategory	Livestock Subdivision
Z	Ts	Ts
B	Mature Dairy Cows	High-producing cows that have calved at least once and are used principally for milk production (Region BI)

Manure Management System	Methane conversion factor for MMS in Geographical Zone (%) (Tier 2 only)	Fraction of livestock category's manure handled using MMS in geographical zone
S	MCF(T,S)	MS(T,S)
Liquid Slurry (6 months) + Spread	37	1.000
Total		1.000

Geographical zone	Livestock Subcategory	Livestock Subdivision
Z	Ts	Ts
C	Mature Dairy Cows	High-producing cows that have calved at least once and are used principally for milk production (Region C)

Manure Management System	Methane conversion factor for MMS in Geographical Zone (%) (Tier 2 only)	Fraction of livestock category's manure handled using MMS in geographical zone
S	MCF(T,S)	MS(T,S)
Pasture/Paddock (6 months) + Solid Storage	2	1.000
Total		1.000

14. Further, for **Tier 2** only, **a Methane Conversion Factor value is to be assigned,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

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3.A.2 – Manure Management CH_4

Worksheet:

CH_4 Emissions from Manure Management

Volatile solid excretion per day – Tier 2

CH_4 Emissions from Manure Management – Tier 2

3.A.2 *(Manure Management)* – CH_4 EF & Parameters

subdivision	UE	ASH	Bo		Manure Management
			$m^3CH_4/kgVS$		Tier 1 CH_4 EF
	fraction	fraction	2015	2020	$kgCH_4/head/yr$
Dairy cows					62
Other cattle					2.9
High-producing cows for milk production, calved at least once (stall)	0.04	0.08	0.192	0.222	
Calves pre-weaning					17
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)	0.02	0.07	0.162	0.224	
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)	0.02	0.07	0.162	0.224	
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)	0.02	0.07	0.181	0.253	
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)	0.02	0.07	0.181	0.253	
Growing/Fattening cattle post-weaning	0.02	0.06	0.283	0.282	
Replacement dairy heifers	0.04	0.08	0.192	0.222	
Bulls used principally for breeding purposes	0.04	0.08	0.181	0.253	
Cows used to produce offspring for meat	0.04	0.08	0.162	0.224	
High-producing cows for milk production, calved at least once (pasture)	0.04	0.08	0.192	0.222	
Replacement dairy heifers	0.04	0.08	0.192	0.222	

3.A.2 – Manure Management CH_4 estimates
CH_4 emissions from Manure Management Worksheet

14. Enter the CH_4 EF, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ **<u>IPCC Tier 1</u>, select the IPCC EF default value** from the dropdown menu **or enter a user-specific**

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock./Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: CH4 Emissions from Manure Management

2015

Data
Gas METHANE (CH4)

Geographical zone	Livestock Subcategory	Livestock Subdivision	Number of Animals (head)	Emission factor for Manure Management (kg CH4/head/yr)	CH4 emissions from Manure Management (Gg CH4/yr)
Z	Ts	Ts	N(T)	EF(T)	CH4 = N(T) * EF(T) * 10^-6
A	Unspecified	Unspecified	5,029.0	29.000	0.146
B	Growing Cattle	Calves pre-weaning	300,000.0	17.000	5.100
		Feedlot-fed cattle on diets containing > 90 % concentrates (fem...	749,111.0		
		Feedlot-fed cattle on diets containing > 90 % concentrates (fem...	186,060.000		
		Feedlot-fed cattle on diets containing > 90 % concentrates (mal...	72,461.000		
		Feedlot-fed cattle on diets containing > 90 % concentrates (mal...	708,329.000		
		Growing / fattening cattle post-weaning	2,127,959.000		
		Replacement dairy heifers (Region B)	443,855.000		
	Other Mature Cattle	Bulls used principally for breeding purposes	128,958.000		
		Cows used to produce offspring for meat	312,649.000		
C	Growing Cattle	Replacement dairy heifers (Region C)	23,361.000		

- ❑ The Software calculates CH_4 emissions in the “green” column

3.A.2 – Manure Management CH_4 estimates
Volatile Solid excretion per day – Tier 2 Worksheet

IPCC Tier 2, to calculate the CH_4 EF, **Either Enter or Calculate** the ***Volatile Solid excretion rate (kg VS/day)***

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Volatile solid excretion per day - Tier 2

2015

Data

				Per animal							
Geographical zone	Livestock Subcategory	Livestock Subdivision	Gross energy (MJ/day)	Digestible energy (%)	Urinary Energy fraction	Urinary energy expressed as fraction of GE	Ash content of feed calculated as a fractio of the dry matter feed intake	Volatile solid excretion per day on a dry-organic matter basis (kg VS/day)			
Z	Ts	Ts	GE	DE%	UE	UE * GE	ASH		VS = Eq. 10.24		
B	Growing Cattle	Feedlot-fed cattle on diets containing > 90..	157.010	77.000	0.02	3.140	0.07	Calculated	1.979		
		Feedlot-fed cattle on diets containing > 90..	171.216	77.000	0.02	3.424	0.07	Calculated	2.158		
		Feedlot-fed cattle on diets containing > 90..	197.231	77.000	0.02	3.945	0.07	Calculated	2.485		
		Feedlot-fed cattle on diets containing > 90..	214.758	77.000	0.02	4.295	0.07	Calculated	2.706		
		Growing / fattening cattle post-weaning	89.483	70.300	0.02	1.790	0.06	Calculated	1.445		
		Replacement dairy heifers (Region B)	141.512	70.300	0.02	2.830	0.0	Calculated	2.237		
	Other Mature Cattle	Bulls used principally for breeding purposes	315.495	70.300	0.04	12.620	0.0	Calculated	5.302		
		Cows used to produce offspring for meat	195.201	70.300	0.04	7.808	0.0	Calculated	3.280		
C	Growing Cattle	Replacement dairy heifers (Region C)						Specified	3.834		

Calculated
Specified

If the ***Volatile Solid excretion rate (kg VS/day)*** is entered next step is to calculate CH_4 EF in worksheet *CH_4 EF for Manure Management*; **Otherwise**, steps 15 & 16 apply

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3.A.2 – Manure Management CH_4 estimates
Volatile Solid excretion per day – Tier 2 Worksheet

15. select the IPCC default ***Urinary Energy fraction (UE)*** from the dropdown menu or enter a user-specific value , at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

16. select the IPCC default ***Ash content of feed*** from the dropdown menu or enter a user-specific value , at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Volatile solid excretion per day - Tier 2

2015

Data

				Per animal							
Geographical zone	Livestock Subcategory	Livestock Subdivision	Gross energy (MJ/day)	Digestible energy (%)	Urinary Energy fraction	Urinary energy expressed as fraction of GE	Ash content of feed calculated as a fraction of the dry matter feed intake	Volatile solid excretion per day on a dry-organic matter basis (kg VS/day)			
Z	Ts	Ts	GE	DE%	UE	UE * GE	ASH		VS = Eq. 10.24		
B	Growing Cattle	Feedlot-fed cattle on diets containing > 90..	157.010	77.000	0.02	3.140	0.070	Calculated	1.979		
		Feedlot-fed cattle on diets containing > 90..	171.216	77.000	0.02	3.424	0.070	Calculated	2.158		
		Feedlot-fed cattle on diets containing > 90..	197.231	77.000	0.02	3.945	0.070	Calculated	2.485		
		Feedlot-fed cattle on diets containing > 90..	214.758	77.000	0.02	4.295	0.070	Calculated	2.706		
		Growing / fattening cattle post-weaning	89.483	70.300	0.02	1.790	0.060	Calculated	1.445		
		Replacement dairy heifers (Region B)	141.512	70.300	0.02	2.830	0.08	Calculated	2.237		
	Other Mature Cattle	Bulls used principally for breeding purposes	315.495	70.300	0.04	12.620	0.08	Calculated	5.302		
		Cows used to produce offspring for meat	195.201	70.300	0.04	7.808	0.08	Calculated	3.280		
C	Growing Cattle	Replacement dairy heifers (Region C)	199.713	65.500	0.04	7.989	0.08	Calculated	3.834		

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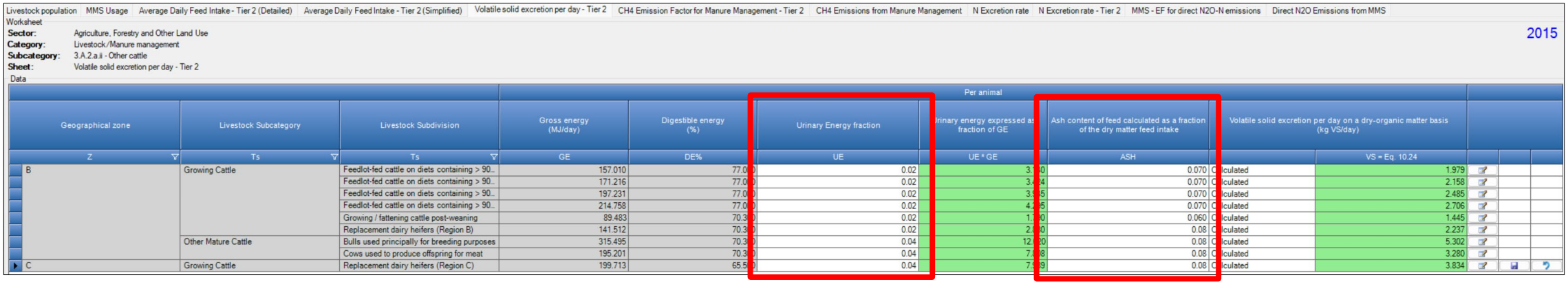
3.A.2 – Manure Management CH_4 estimates
CH_4 EF – Tier 2 Worksheet

15. select the IPCC default ***Urinary Energy fraction (UE)*** from the dropdown menu or enter a user-specific value , at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

16. select the IPCC default ***Ash content of feed*** from the dropdown menu or enter a user-specific value , at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: Volatile solid excretion per day - Tier 2

2015

Data

				Per animal							
	Geographical zone	Livestock Subcategory	Livestock Subdivision	Gross energy (MJ/day)	Digestible energy (%)	Urinary Energy fraction	Urinary energy expressed as fraction of GE	Ash content of feed calculated as a fraction of the dry matter feed intake	Volatile solid excretion per day on a dry-organic matter basis (kg VS/day)		
	Z	Ts	Ts	GE	DE%	UE	UE * GE	ASH		VS = Eq. 10.24	
	B	Growing Cattle	Feedlot-fed cattle on diets containing > 90...	157.010	77.0	0.02	3.1	0.070	Calculated	1.979	
			Feedlot-fed cattle on diets containing > 90...	171.216	77.0	0.02	3.4	0.070	Calculated	2.158	
			Feedlot-fed cattle on diets containing > 90...	197.231	77.0	0.02	3.9	0.070	Calculated	2.485	
			Feedlot-fed cattle on diets containing > 90...	214.758	77.0	0.02	4.2	0.070	Calculated	2.706	
			Growing / fattening cattle post-weaning	89.483	70.3	0.02	1.7	0.060	Calculated	1.445	
			Replacement dairy heifers (Region B)	141.512	70.3	0.02	2.8	0.08	Calculated	2.237	
		Other Mature Cattle	Bulls used principally for breeding purposes	315.495	70.3	0.04	12.6	0.08	Calculated	5.302	
			Cows used to produce offspring for meat	195.201	70.3	0.04	7.8	0.08	Calculated	3.280	
	C	Growing Cattle	Replacement dairy heifers (Region C)	199.713	65.5	0.04	7.9	0.08	Calculated	3.834	

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3.A.2 – Manure Management CH_4 estimates
CH_4 Emissions from Manure Management Worksheet

17. **s**elect the IPCC default ***Maximum methane producing capacity (m^3 CH_4/kg VS)*** from the dropdown menu or enter a user-specific value , at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.i - Dairy cows
Sheet: CH4 Emission Factor for Manure Management - Tier 2

2015

Data

	Geographical zone	Livestock Subcategory	Livestock Subdivision	Volatile solid excretion per day on a dr... organic matter basis (kg VS/day)	Maximum methane producing capacity (m^3 CH4/kg VS)	Weighted Average MCF	CH4 Emission Factor (kg CH4/head/yr)			
	Z	Ts	Ts	VS	Bo	MCFavg	EF = VS * 365 * Bo *0.67 * MCFavg			
	B	Mature Dairy Cows	High-producing cows that have calved at least onc...	3.07	0.192	0.370	53.339			
▶	C		High-producing cows that have calved at least onc...	5.99	0.192	0.020	5.633			

❑ The Software calculates CH_4 emissions in the “green” column

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3.A.2 – Manure Management N_2O

Worksheet:

N excretion rate

N excretion rate – Tier 2

MMS EF for direct N_2O-N Emissions

Direct N_2O Emissions from MMS

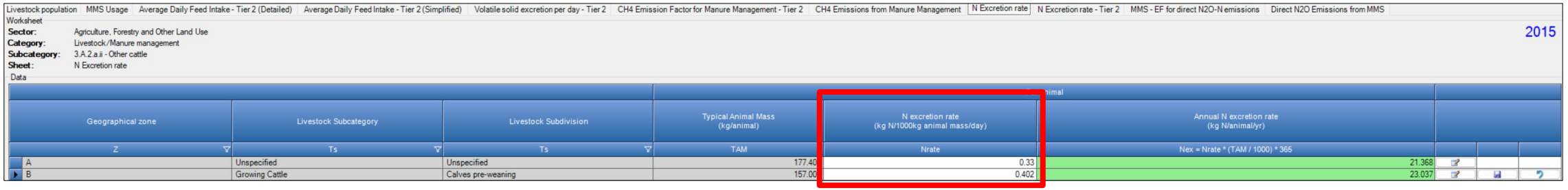
3.A.2 *(Manure Management)* – Parameters

subdivision	Nrate kgN/1,000 kg animal mass/day	CP %	
		2015	2020
Dairy cows	0.47		
Other cattle	0.33		
High-producing cows for milk production, calved at least once (stall)		10.74	12.88
Calves pre-weaning	0.402		
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)		12.09	14.50
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)		12.09	14.50
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)		10.01	12.00
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)		11.67	14.00
Growing/Fattening cattle post-weaning		13.34	16.00
Replacement dairy heifers		10.74	12.88
Bulls used principally for breeding purposes		10.01	12.00
Cows used to produce offspring for meat		10.01	12.00
High-producing cows for milk production, calved at least once (pasture)		10.74	12.88
Replacement dairy heifers		10.74	12.88

3.A.2 – Manure Management N_2O estimates
N excretion rate Worksheet

14. **To calculate the total N excreted in each MMS, the annual N excretion rate is to be entered or calculated,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- ❑ **IPCC Tier 1, select the IPCC default value** from the dropdown menu **or enter a user-specific**



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: N Excretion rate

2015

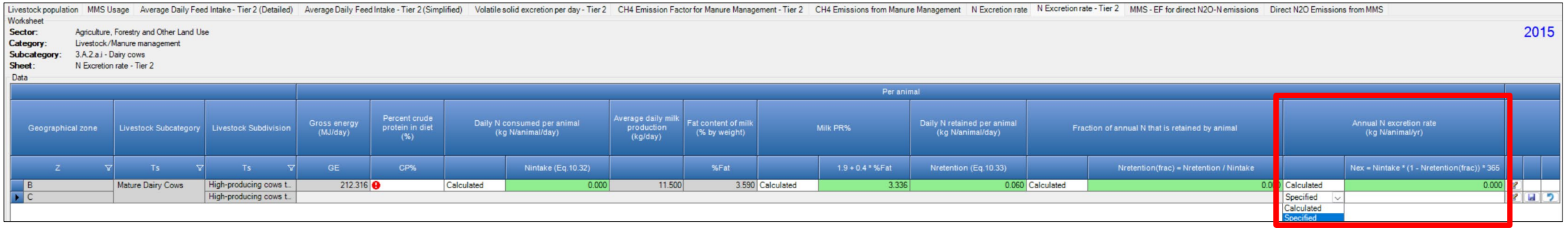
Data

Geographical zone	Livestock Subcategory	Livestock Subdivision	Typical Animal Mass (kg/animal)	N excretion rate (kg N/1000kg animal mass/day)	Annual N excretion rate (kg N/animal/yr)
Z	Ts	Ts	TAM	Nrate	Nex = Nrate * (TAM / 1000) * 365
A	Unspecified	Unspecified	177.40	0.33	21.368
B	Growing Cattle	Calves pre-weaning	157.00	0.402	23.037

3.A.2 – Manure Management N_2O estimates
N excretion rate – Tier 2 Worksheet

14. **To calculate the total N excreted in each MMS, the annual N excretion rate is to be entered or calculated,** at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

- **IPCC Tier 2**, Either Enter or Calculate it, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.i - Dairy cows
Sheet: N Excretion rate - Tier 2

2015

Data

				Per animal														
	Geographical zone	Livestock Subcategory	Livestock Subdivision	Gross energy (MJ/day)	Percent crude protein in diet (%)	Daily N consumed per animal (kg N/animal/day)		Average daily milk production (kg/day)	Fat content of milk (% by weight)	Milk PR%		Daily N retained per animal (kg N/animal/day)	Fraction of annual N that is retained by animal		Annual N excretion rate (kg N/animal/yr)			
	Z	Ts	Ts	GE	CP%		Nintake (Eq.10.32)		%Fat		1.9 + 0.4 * %Fat	Nretention (Eq.10.33)		Nretention(frac) = Nretention / Nintake		Nex = Nintake * (1 - Nretention(frac)) * 365		
	B	Mature Dairy Cows	High-producing cows t..	212.316	!	Calculated	0.000	11.500	3.590	Calculated	3.336	0.060	Calculated	0.0	Calculated	0.000		
▶	C		High-producing cows t..												Specified			
															Calculated			
															Specified			

If the ***annual N excretion rate*** is entered next step is to enter the N_2O-N EF in worksheet *MMS-EF for direct N_2O-N emissions*; **Otherwise**, steps 15 & 16 apply

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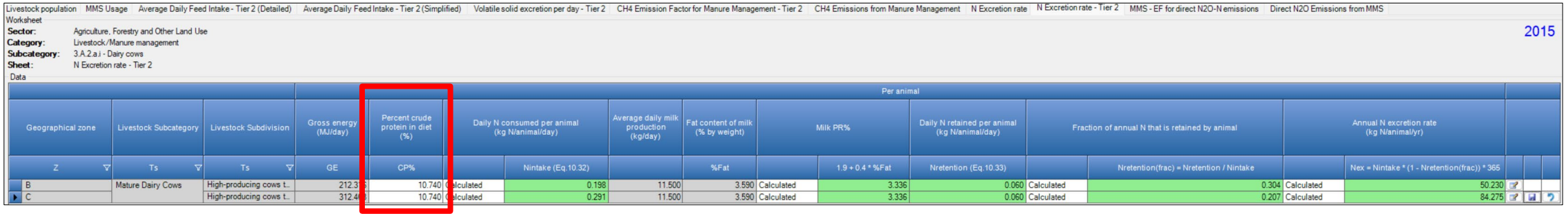
3.A.2 – Manure Management N_2O estimates
N excretion rate – Tier 2 Worksheet

15. select the IPCC default ***Percent Crude protein in diet (%)*** from the dropdown menu or enter a user-specific value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.i - Dairy cows
Sheet: N Excretion rate - Tier 2
Data

2015

					Per animal													
	Geographical zone	Livestock Subcategory	Livestock Subdivision	Gross energy (MJ/day)	Percent crude protein in diet (%)	Daily N consumed per animal (kg N/animal/day)		Average daily milk production (kg/day)	Fat content of milk (% by weight)	Milk PR%		Daily N retained per animal (kg N/animal/day)	Fraction of annual N that is retained by animal		Annual N excretion rate (kg N/animal/yr)			
	Z	Ts	Ts	GE	CP%		Nintake (Eq.10.32)		%Fat		1.9 + 0.4 * %Fat	Nretention (Eq.10.33)		Nretention(frac) = Nretention / Nintake		Nex = Nintake * (1 - Nretention(frac)) * 365		
B		Mature Dairy Cows	High-producing cows t..	212.3	10.740	Calculated	0.198	11.500	3.590	Calculated	3.336	0.060	Calculated	0.304	Calculated	50.230		
C			High-producing cows t..	312.4	10.740	Calculated	0.291	11.500	3.590	Calculated	3.336	0.060	Calculated	0.207	Calculated	84.275		

16. For each of the following variables:

- Daily N consumed
- Milk Protein Content (PR%)
- Fraction of N retained

either Enter or Calculate the value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

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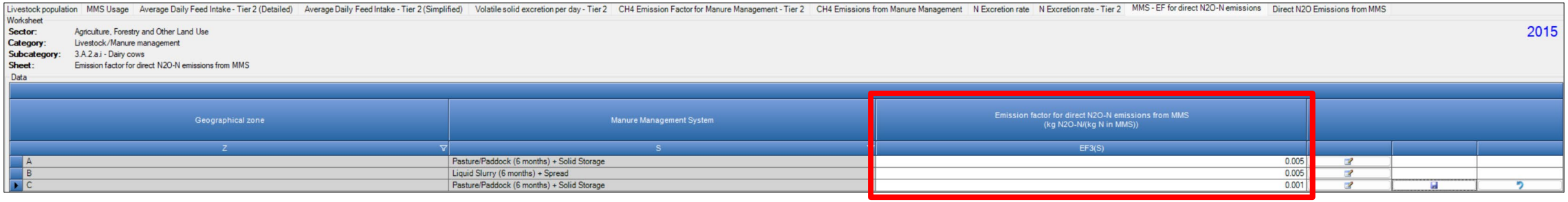
3.A.2 *(Manure Management)* – N_2O-N EF_3

subdivision	Pasture/Paddock (6 months) + Solid Storage & Spread					Liquid Slurry (6 months) + Spread					Anaerobic Digester				
	N Fraction		EF_3	EF_4	EF_5	N Fraction		EF_3	EF_4	EF_5	N Fraction		EF_3	EF_4	EF_5
	volatilised Frac(gas)	leaked Frac(leach)				volatilised Frac(gas)	leaked Frac(leach)				volatilised Frac(gas)	leaked Frac(leach)			
	%		kgN_2O-N/kgN			%		kgN_2O-N/kgN			%		kgN_2O-N/kgN		
Dairy cows	17	2	0.005	0.01	0.0075										
Other cattle															
High-producing cows for milk production, calved at least once (stall)						23	4	0.005	0.01	0.0075					
Calves pre-weaning						23	4	0.005	0.01	0.0075					
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)						23	4	0.005	0.01	0.0075					
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)						23	4	0.005	0.01	0.0075					
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)						23	4	0.005	0.01	0.0075					
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)						23	4	0.005	0.01	0.0075					
Growing/Fattening cattle post-weaning						23	4	0.005	0.01	0.0075					
Replacement dairy heifers						23	4	0.005	0.01	0.0075					
Bulls used principally for breeding purposes	26	2	0.005	0.01	0.0075										
Cows used to produce offspring for meat	26	2	0.005	0.01	0.0075										
High-producing cows for milk production, calved at least once (pasture)	17	2	0.005	0.01	0.0075										
Replacement dairy heifers	17	2	0.005	0.01	0.0075										

3.A.2 – Manure Management N_2O estimates
MMS – EF for direct N_2O emissions Worksheet

17. **Enter the N_2O-N EF**, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock/Manure management
Subcategory: 3.A.2.a.i - Dairy cows
Sheet: Emission factor for direct N2O-N emissions from MMS

2015

Data

Geographical zone	Manure Management System	Emission factor for direct N2O-N emissions from MMS (kg N2O-N/(kg N in MMS))
Z	S	EF3(S)
A	Pasture/Paddock (6 months) + Solid Storage	0.005
B	Liquid Slurry (6 months) + Spread	0.005
C	Pasture/Paddock (6 months) + Solid Storage	0.001

3.A.2 – Manure Management N_2O estimates
Direct N_2O emissions from MMS Worksheet

Livestock population | MMS Usage | Average Daily Feed Intake - Tier 2 (Detailed) | Average Daily Feed Intake - Tier 2 (Simplified) | Volatile solid excretion per day - Tier 2 | CH4 Emission Factor for Manure Management - Tier 2 | CH4 Emissions from Manure Management | N Excretion rate | N Excretion rate - Tier 2 | MMS - EF for direct N2O-N emissions | Direct N2O Emissions from MMS

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Livestock./Manure management
Subcategory: 3.A.2.a.ii - Other cattle
Sheet: N2O Emissions from Manure Management Systems

2015

Data
Gas NITROUS OXIDE (N2O)

Geographical zone	Manure Management System	Total N excretion for the MMS (kg N/yr)	Emission factor for direct N2O-N emissions from MMS (kg N2O-N/(kg N in MMS))	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Z	S	NE(S) = ∑NE(T,S)	EF3(S)	N2O(S) = NE(S) * EF3(S) * 44 / 28	N2O(S) * 10^-6
B	Pasture/Paddock (6 months) + Solid Storage	32,228,163.973	0.005	253,221.288	0.253

Livestock Subcategory	Livestock Subdivision	Number of Animals (head)	Annual N excretion rate (kg N/animal/yr)	Fraction of livestock category's manure handled using MMS in geographical zone	Total N excretion for the MMS (kg N/yr)	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Ts	Ts	N(T)	Nex(T)	MS(T,S)	NE(T,S) = N(T) * Nex(T) * MS(T,S)	N2O(T,S) = NE(T,S) * EF3(S) * 44/28	N2O(T,S) * 10^-6
Other Mature Cattle	Bulls used principally for breeding purpo...	128,958.000	99.964	1.000	12,891,139.974	101,287.528	0.101
	Cows used to produce offspring for meat	312,649.000	61.849	1.000	19,337,023.999	151,933.760	0.152
Total					32,228,163.973	253,221.288	0.253

Geographical zone	Manure Management System	Total N excretion for the MMS (kg N/yr)	Emission factor for direct N2O-N emissions from MMS (kg N2O-N/(kg N in MMS))	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Z	S	NE(S) = ∑NE(T,S)	EF3(S)	N2O(S) = NE(S) * EF3(S) * 44 / 28	N2O(S) * 10^-6
B	Liquid Slurry (6 months) + Spread	225,163,469.120	0.005	1,769,141.543	1.769

Livestock Subcategory	Livestock Subdivision	Number of Animals (head)	Annual N excretion rate (kg N/animal/yr)	Fraction of livestock category's manure handled using MMS in geographical zone	Total N excretion for the MMS (kg N/yr)	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Ts	Ts	N(T)	Nex(T)	MS(T,S)	NE(T,S) = N(T) * Nex(T) * MS(T,S)	N2O(T,S) = NE(T,S) * EF3(S) * 44/28	N2O(T,S) * 10^-6
Growing Cattle	Calves pre-weaning	300,000.000	23.037	1.000	6,910,983.000	54,300.581	0.054
	Feedlot-fed cattle on diets containing >...	749,111.000	60.085	1.000	45,010,608.310	353,654.780	0.354
	Feedlot-fed cattle on diets containing >...	186,060.000	65.522	1.000	12,191,022.725	95,786.607	0.096
	Feedlot-fed cattle on diets containing >...	72,461.000	62.492	1.000	4,528,234.957	35,578.989	0.036
	Feedlot-fed cattle on diets containing >...	708,329.000	79.330	1.000	56,191,639.837	441,505.742	0.442
	Growing / fattening cattle post-weaning	2,127,959.000	37.784	1.000	80,403,262.495	631,739.920	0.632
	Replacement dairy heifers (Region B)	443,855.000	44.897	1.000	19,927,717.796	156,574.926	0.157
Total					225,163,469.120	1,769,141.543	1.769

Geographical zone	Manure Management System	Total N excretion for the MMS (kg N/yr)	Emission factor for direct N2O-N emissions from MMS (kg N2O-N/(kg N in MMS))	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Z	S	NE(S) = ∑NE(T,S)	EF3(S)	N2O(S) = NE(S) * EF3(S) * 44 / 28	N2O(S) * 10^-6
C	Pasture/Paddock (6 months) + Solid Storage	1,523,952.442	0.005	11,973.912	0.012

Livestock Subcategory	Livestock Subdivision	Number of Animals (head)	Annual N excretion rate (kg N/animal/yr)	Fraction of livestock category's manure handled using MMS in geographical zone	Total N excretion for the MMS (kg N/yr)	Annual direct N2O emissions from Manure Management (kg N2O/yr)	Annual direct N2O emissions from Manure Management (Gg N2O/yr)
Ts	Ts	N(T)	Nex(T)	MS(T,S)	NE(T,S) = N(T) * Nex(T) * MS(T,S)	N2O(T,S) = NE(T,S) * EF3(S) * 44/28	N2O(T,S) * 10^-6
Growing Cattle	Replacement dairy heifers (Region C)	23,361.000	65.235	1.000	1,523,952.442	11,973.912	0.012
Total					1,523,952.442	11,973.912	0.012

Total					
	258,915,585.535		2,034,336.743	2.034	

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3.C – Aggregate Sources and non-CO_2 emissions

Category	Activity	GHGs
3.C.6	Indirect N_2O emissions from Manure Management	N_2O

Volume 4, Chapter 10

3.C.6 – Indirect N_2O emissions from Manure Management

Worksheet:

Amount of N loss due to volatilisation

Amount of N loss due to leaching

Indirect N_2O emissions due to N volatilisation

Indirect N_2O emissions due to N leaching/runoff

3.C.6 *(Indirect N_2O emissions from Manure Management)* – Parameters & N_2O-N EFs

subdivision	Pasture/Paddock (6 months) + Solid Storage & Spread					Liquid Slurry (6 months) + Spread				
	N Fraction		EF_3	EF_4	EF_5	N Fraction		EF_3	EF_4	EF_5
	volatilised Frac(gas)	leaked Frac(leach)				volatilised Frac(gas)	leaked Frac(leach)			
	%		kgN_2O-N/kgN			%		kgN_2O-N/kgN		
Dairy cows	17	2	0.005	0.01	0.0075					
Other cattle										
High-producing cows for milk production, calved at least once (stall)						23	4	0.005	0.01	0.0075
Calves pre-weaning						23	4	0.005	0.01	0.0075
Feedlot-fed cattle on diets containing > 90 % concentrates (female for breeding)						23	4	0.005	0.01	0.0075
Feedlot-fed cattle on diets containing > 90 % concentrates (female for slaughter)						23	4	0.005	0.01	0.0075
Feedlot-fed cattle on diets containing > 90 % concentrates (male for breeding)						23	4	0.005	0.01	0.0075
Feedlot-fed cattle on diets containing > 90 % concentrates (male for slaughter)						23	4	0.005	0.01	0.0075
Growing/Fattening cattle post-weaning						23	4	0.005	0.01	0.0075
Replacement dairy heifers						23	4	0.005	0.01	0.0075
Bulls used principally for breeding purposes	26	2	0.005	0.01	0.0075					
Cows used to produce offspring for meat	26	2	0.005	0.01	0.0075					
High-producing cows for milk production, calved at least once (pasture)	17	2	0.005	0.01	0.0075					
Replacement dairy heifers	17	2	0.005	0.01	0.0075					

3.C.6 – Indirect N_2O Emissions from Manure Management
Amount of N loss due to volatilization Worksheet

18. select the IPCC default ***Fraction of N volatilized (%)*** from the dropdown menu or enter a user-specific value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population

Amount of manure N loss due to volatilisation of NH3 and NOx | Indirect N2O emissions due to volatilisation from Manure Management | Amount of manure N loss due to leaching | Indirect N2O emissions due to leaching and runoff from Manure Management

Worksheet
Sector: Agriculture, Forestry and Other Land Use
Category: Aggregate Sources and Non-CO2 Emissions Sources on Land
Subcategory: 3.C.6 - Indirect N2O Emissions from manure management
Sheet: Amount of manure N loss due to volatilisation of NH3 and NOx

2015

Data

	Equation 10.26, 10.27							
	Geographical zone	Manure Management System	Livestock Category	Livestock Subcategory	Livestock Subdivision	Total N excretion for the MMS (kg N/yr)	Fraction of managed livestock manure N that volatilises (%) Table 10.22	Amount of manure N loss due to volatilisation of NH3 and NOx (kg N / yr)
	Z	S	T	Ts	Ts	NEmms = N(T) * Nex(T) * MS(T,S)	Frac(GasMS)	Nvolatilisation-MMS = NEmms * Frac(GasMS)
	A	Pasture/Paddock (6 months) + Solid...	Dairy Cows	Unspecified	Unspecified	213,917,3[illegible]0	17.000	36,365,951
	B		Other Cattle	Other Mature Cattle	Bulls used principally for breeding p...	12,891,139.[illegible]4	26.000	3,351,696.393
					Cows used to produce offspring for...	19,337,023.[illegible]9	26.000	5,027,626.240
		Liquid Slurry (6 months) + Spread	Dairy Cows	Mature Dairy Cows	High-producing cows that have calv...	126,060,077.[illegible]4	23.000	28,993,817.886
			Other Cattle	Growing Cattle	Calves pre-weaning	6,910,983.[illegible]0	23.000	1,589,526.090
					Feedlot-fed cattle on diets containin...	45,010,608.[illegible]0	23.000	10,352,439.911
					Feedlot-fed cattle on diets containin...	12,191,022.[illegible]5	23.000	2,803,935.227
					Feedlot-fed cattle on diets containin...	4,528,234.[illegible]7	23.000	1,041,494.040
					Feedlot-fed cattle on diets containin...	56,191,639.[illegible]7	23.000	12,924,077.163
					Growing / fattening cattle post-weani...	80,403,262.[illegible]5	23.000	18,492,750.374
					Replacement dairy heifers (Region B)	19,927,717.[illegible]6	23.000	4,583,375.093
	C	Pasture/Paddock (6 months) + Solid...	Dairy Cows	Mature Dairy Cows	High-producing cows that have calv...	11,131,750.[illegible]9	17.000	1,892,397.544
			Other Cattle	Growing Cattle	Replacement dairy heifers (Region C)	1,523,952.[illegible]2	17.000	259,071.915
	Total					396,321,330.[illegible]8		91,348,573.827

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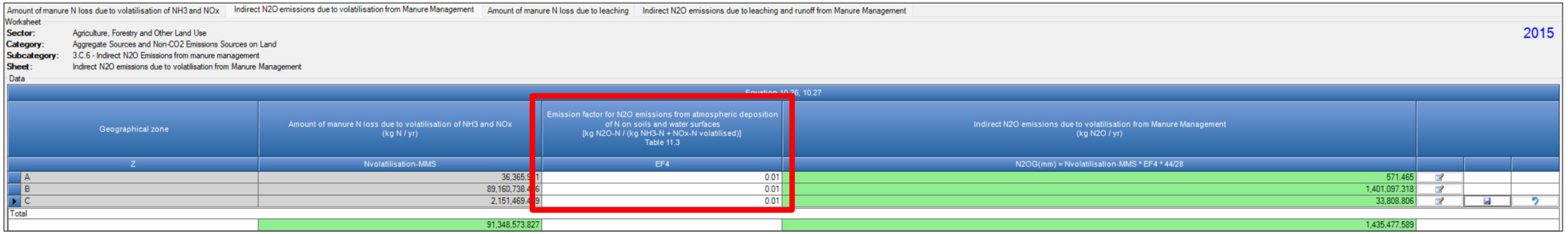
3.C.6 – Indirect N_2O Emissions from Manure Management
Indirect N_2O emissions due to volatilization Worksheet

19. **s**elect the IPCC default ***EF_4*** from the dropdown menu or enter a user-specific value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Amount of manure N loss due to volatilisation of NH3 and NOx | Indirect N2O emissions due to volatilisation from Manure Management | Amount of manure N loss due to leaching | Indirect N2O emissions due to leaching and runoff from Manure Management

Worksheet

Sector: Agriculture, Forestry and Other Land Use

Category: Aggregate Sources and Non-CO2 Emissions Sources on Land

Subcategory: 3.C.6 - Indirect N2O Emissions from manure management

Sheet: Indirect N2O emissions due to volatilisation from Manure Management

2015

Data

Equation 10.26, 10.27

Geographical zone	Amount of manure N loss due to volatilisation of NH3 and NOx (kg N / yr)	Emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces [kg N2O-N / (kg NH3-N + NOx-N volatilised)] Table 11.3	Indirect N2O emissions due to volatilisation from Manure Management (kg N2O / yr)			
Z	Nvolatilisation-MMS	EF4	N2OG(mm) = Nvolatilisation-MMS * EF4 * 44/28			
A	36,365.9[illegible]1	0.01	571.465			
B	89,160,738.4[illegible]6	0.01	1,401,097.318			
C	2,151,469.4[illegible]9	0.01	33,808.806			
Total						
	91,348,573.827		1,435,477.589			

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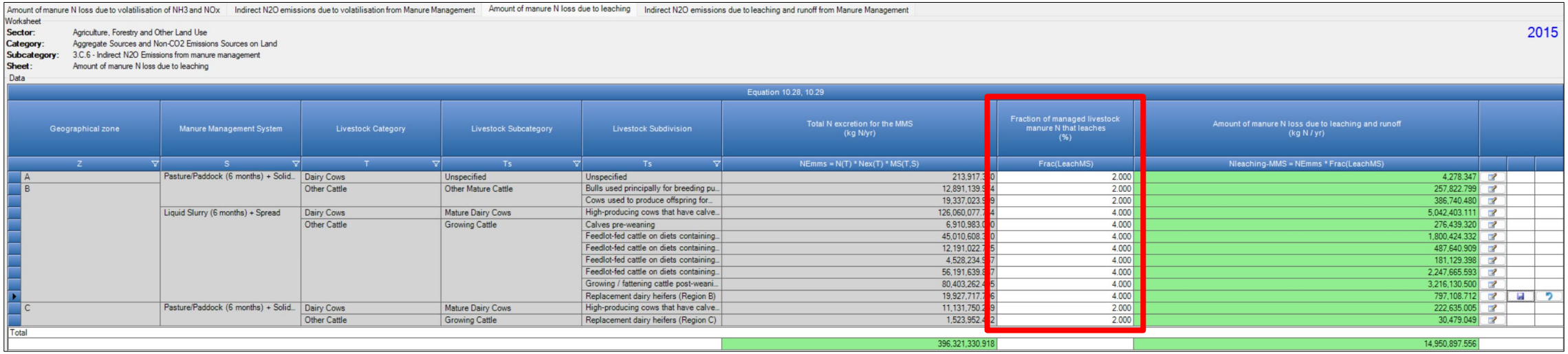
3.C.6 – Indirect N_2O Emissions from Manure Management
Amount of N loss due to leakage/runoff Worksheet

20. select the IPCC default ***Fraction of N leaked (%)*** from the dropdown menu or enter a user-specific value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Amount of manure N loss due to volatilisation of NH3 and NOx | Indirect N2O emissions due to volatilisation from Manure Management | Amount of manure N loss due to leaching | Indirect N2O emissions due to leaching and runoff from Manure Management

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Aggregate Sources and Non-CO2 Emissions Sources on Land
Subcategory: 3.C.6 - Indirect N2O Emissions from manure management
Sheet: Amount of manure N loss due to leaching

2015

Data

Equation 10.28, 10.29

Geographical zone	Manure Management System	Livestock Category	Livestock Subcategory	Livestock Subdivision	Total N excretion for the MMS (kg N/yr)	Fraction of managed livestock manure N that leaches (%)	Amount of manure N loss due to leaching and runoff (kg N / yr)
Z	S	T	Ts	Ts	NEmms = N(T) * Nex(T) * MS(T,S)	Frac(LeachMS)	Nleaching-MMS = NEmms * Frac(LeachMS)
A	Pasture/Paddock (6 months) + Solid...	Dairy Cows	Unspecified	Unspecified	213,917,3[illegible]0	2.000	4,278,347
B		Other Cattle	Other Mature Cattle	Bulls used principally for breeding pu...	12,891,139,9[illegible]4	2.000	257,822,799
				Cows used to produce offspring for...	19,337,023,9[illegible]9	2.000	386,740,480
	Liquid Slurry (6 months) + Spread	Dairy Cows	Mature Dairy Cows	High-producing cows that have calve...	126,060,077,[illegible]4	4.000	5,042,403,111
		Other Cattle	Growing Cattle	Calves pre-weaning	6,910,983,0[illegible]0	4.000	276,439,320
				Feedlot-fed cattle on diets containing...	45,010,608,3[illegible]0	4.000	1,800,424,332
				Feedlot-fed cattle on diets containing...	12,191,022,[illegible]5	4.000	487,640,909
				Feedlot-fed cattle on diets containing...	4,528,234,[illegible]7	4.000	181,129,398
				Feedlot-fed cattle on diets containing...	56,191,639,[illegible]7	4.000	2,247,665,593
				Growing / fattening cattle post-weani...	80,403,262,4[illegible]5	4.000	3,216,130,500
				Replacement dairy heifers (Region B)	19,927,717,[illegible]6	4.000	797,108,712
C	Pasture/Paddock (6 months) + Solid...	Dairy Cows	Mature Dairy Cows	High-producing cows that have calve...	11,131,750,[illegible]9	2.000	222,635,005
		Other Cattle	Growing Cattle	Replacement dairy heifers (Region C)	1,523,952,4[illegible]2	2.000	30,479,049
Total					396,321,330,918		14,950,897,556

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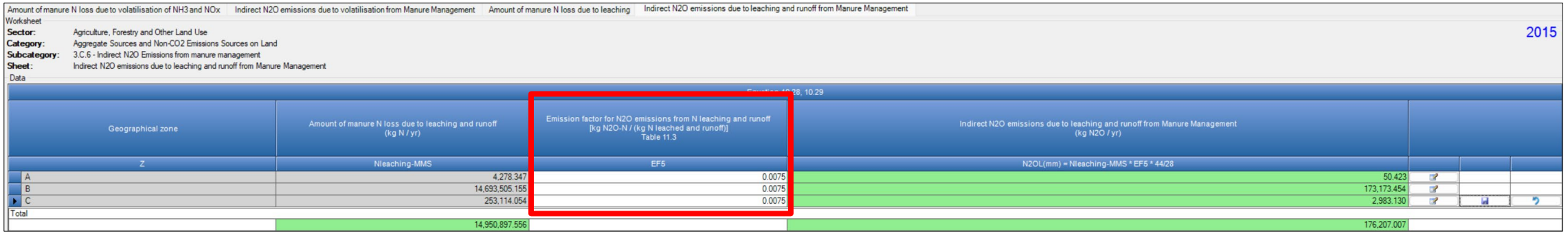
3.C.6 – Indirect N_2O Emissions from Manure Management
Indirect N_2O emissions due to volatilization Worksheet

21. select the IPCC default ***EF_5*** from the dropdown menu or enter a user-specific value, at the lower stratum (category/subcategory/subdivision) of the Livestock Characterisation applied to the Population



Amount of manure N loss due to volatilisation of NH3 and NOx | Indirect N2O emissions due to volatilisation from Manure Management | Amount of manure N loss due to leaching | Indirect N2O emissions due to leaching and runoff from Manure Management

Worksheet

Sector: Agriculture, Forestry and Other Land Use
Category: Aggregate Sources and Non-CO2 Emissions Sources on Land
Subcategory: 3.C.6 - Indirect N2O Emissions from manure management
Sheet: Indirect N2O emissions due to leaching and runoff from Manure Management

2015

Data

Equations 10.28, 10.29

Geographical zone	Amount of manure N loss due to leaching and runoff (kg N / yr)	Emission factor for N2O emissions from N leaching and runoff [kg N2O-N / (kg N leached and runoff)] Table 11.3	Indirect N2O emissions due to leaching and runoff from Manure Management (kg N2O / yr)
Z	Nleaching-MMS	EF5	N2OL(mm) = Nleaching-MMS * EF5 * 44/28
A	4,278.347	0.0075	50.423
B	14,693,505.155	0.0075	173,173.454
C	253,114.054	0.0075	2,983.130
Total	14,950,897.556		176,207.007

Thank you

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3.A – Livestock

Category	Activity	GHGs
3.A.1	Enteric Fermentation	CH_4
3.A.2	Manure Management	$CH_4 – N_2O$

Volume 4, Chapter 10

Activity Data – Livestock 3.A – CH_4 & N_2O

Category	Activity Data		Equation	IPCC Default
3.A.1 & 3.A.2	*Any Approach*	Annual Average Population (AAP)	10.1	
	Tier 1 Approach	Basic Characterisation of Population		*Section 10.2.2 (para 2)*
	Tier 2 Approach	Enhanced Characterisation of Population		Table 10.1
3.A.2	*Any Approach*	Manure Management Systems (MMS)		Table 10.18

Methodology – Livestock 3.A.1

Methodological Approach	Equation	IPCC Default
IPCC Tier 1 methodological approach	10.19 – 10.20	Table 10.11 EF *for* Cattle & Table 10.10 EF *for* Others
IPCC Tier 2 methodological approach	10.19 – 10.20	
Emission Factor (EF)	10.21	Table 10.12 Ym for Cattle/Buffalo & Table 10.13 Ym for Sheep
Daily Gross Energy Intake (GE)	***As calculated from Average Daily Feed Intake***	

Average Daily Feed Intake – Tier 2 – Livestock 3.A – CH_4, N_2O

Tier 2 Approach	Average Daily Feed Intake		Parameter		Equation	IPCC Default
		Detailed	Net Energy for Maintenance [NEm]		10.3 & 10.2 *for* Cf_{i_cold}	Table 10.4 *for* Cf_i – Tables 10.10 & 10A.1-9 *for* animal weight
			Net Energy for Activity [NEa]		10.4 (Cattle/Buffalo) – 10.5 (Sheep)	Tables 10.5 *for* Ca – Table 10A.1-3 *for* feeding situation – Table 10.10 & 10A.9 *for* animal weight
			Net Energy for Growth [NEg]		10.4 (Cattle/Buffalo) – 10.5 (Sheep)	Tables 10A.1-6 *for* animal weight & gain – Table 10.6 *for* constants
			Net Energy for Lactation [NEl]		10.8 (Cattle/Buffalo) – 10.9-10 (Sheep)	Tables 10A.1-3 *for* milk production – Fat content
			Net Energy for Work - Net energy for Wool		10.11 - 10.12	Tables 10A.1-3 *for* work
			Net Energy for Pregnancy [NEp]		10.13	Tables 10.7 *for* Cpregnancy – Tables 10A.1-3 *for* pregnancy
			Ratio of Net Energy available for:	- Maintenance (REM) - Gain (REG)	10.14 10.15	Table 10.2 *for* Digestibility
			Daily Gross Energy Intake (GE)		10.16	Table 10.2 *for* Digestibility
		simplified	Daily Dry Matter Intake (DMI)		10.17 10.18a 10.18b	Table 10.8 *for* dietary net energy concentration Tables 10A.1-3 *for* animal weight Table 10.2 *for* Digestibility

Methodology – Livestock 3.A.2 – CH_4

3.A.2 - Methodological Approach	Equation	IPCC Default
IPCC Tier 1 methodological approach [CH_4]	10.22	Table 10.14 EF *for* Cattle/Buffalo/Swine & Table 10.15 EF *for* Others
IPCC Tier 2 methodological approach [CH_4]	10.22	
Emission Factor (EF)	10.23	Tables 10A.4-9 *for* B_0 – Table 10.17 *for* MCF
Volatile Solid Excretion Rate (VS)	*10.24*	***Table 10.2*** *for* ***Digestibility - ASH*** *no default*
Urinary energy (UE)	*UE*GE*	***0.02 UE*** *for* ***ruminants*** *fed with ≥85% grain or* ***swine – 0.04 UE*** *for* ***other ruminants***
Daily Gross Energy Intake (GE)	*As calculated from Average Daily Feed Intake*	
Any IPCC methodological approach [Direct N_2O]	10.25	Table 10.21 EF

Population's Parameters – Livestock 3.A.2 – Direct N_2O

Parameter		Equation	IPCC Default
Tier 1 Approach	N excretion rate	10.30	Table 10.19 *for* Nrate - Tables 10.10 & 10A.1-9 *for* animal weight
Tier 2 Approach	N excretion rate	10.31	Table 10.20 for N retention
	N intake	*10.32*	*Table 10.20 for N retention*
	CP%	*[1.9 + 0.4 * %Fat]*	*Tables 10A.1-3 for Fat content*
	Daily Gross Energy Intake (GE)	*As calculated from Average Daily Feed Intake*	
	N retention	*10.33*	*Tables 10A.1-3 for weight gain - Tables 10A.1-3 for milk production - Milk PR% no default*

3.C – Aggregate Sources and Non-CO_2 emissions sources on land

Category	Activity	GHGs
3.C.6	Indirect N_2O emissions from Manure Management	N_2O

Methodology – *(Livestock)* 3.C.6 – Indirect N_2O

3.C.6 - Methodological Approach		Equation	IPCC Default
IPCC Tier 1 methodological approach	Volatilization	10.27	Table 11.3 EF
IPCC Tier 2 methodological approach	Leakage	10.29	Table 11.3 EF

Activity Data – *(Livestock)* 3.C.6 – Indirect N_2O

Activity Data		Equation	IPCC Default
Any Approach	Total N in manure	As calculated in 3.A.2	
Any Approach	Manure management systems (MMS)		Table 10.18

Population's Parameters – *(Livestock)* 3.C.6 – Indirect N_2O

Parameter		Equation	IPCC Default
Tier 1 Approach	N_volatilization	10.26	Table 10.22 for $Frac_{GasMS}$
Tier 2 Approach	N_leaching	10.28	$Frac_{LeachMS}$ [Typical 1-20]