Plan d'assurance et de contrôle qualité (AQ/CQ) de l'inventaire des gaz à effet de serre (GES) 1990–2022 : Agriculture

ICAT Initiative for Climate Action Transparency

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Initiative pour la transparence de l'action climatique – ICAT

Plan d'assurance et de contrôle qualité (QA/QC) de l'inventaire des gaz à effet de serre (GES) 1990–2022 : Agriculture

Livrable 2.d

Auteur : Traute Köther, Consultante Indépendant, Novembre 2025

PRÉPARÉ DANS LE CADRE DE

L'Initiative pour la transparence de l'action climatique (ICAT), soutenue par l'Autriche, le Canada, l'Allemagne, l'Italie, et la Children's Investment Fund Foundation.

L'ICAT est légalement hébergée par UNOPS.

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA

MINISTRY OF THE ENVIRONMENT AND QUALITY OF LIFE

QA/QC Plan to the GHG inventory 1990-2022 - Agriculture -

November 2025

CONTENT

List of Tables

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3 Agriculture (IPCC sector 3)

3.1 Overview of the sector

This chapter includes information on description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under IPCC Sector 3 Agriculture for the period 1990 to 2022.

⇨ **Crosscheck, if updated information is available and consistent with category chapters**

GHG emissions from this sector comprise emissions from the following categories:

IPCC Code	Description	CO_2	CH_4	N_2O
3.A	Enteric Fermentation	NA	✔	NA
3.B	Manure Management	NA	✔	✔
3.C	Rice Cultivation	NA	NO	NA
3.D	Agricultural soils			
3.D.1	Direct N_2O emissions from managed soils	NA	NA	✔
3.D.2	Indirect N_2O Emissions from managed soils	NA	NA	✔
3.E	Prescribed burning of savannas	NO*	NO	NO
3.F	Field burning of agricultural residues	✔*	✔	✔
3.G	Liming	NO	NA	NA
3.H	Urea application	✔	NA	NA
3.I	Other carbon-containing fertilizers	NO	NA	NA
3.J	Other (please specify)	NO	NO	NO

A '✔' indicates: emissions from this category have been estimated.
* CO_2 from biomass burning is not accounted in these categories
Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential

3.1.1 Emission trends

Folder	\06_Inventory\2024_submission\10_CRT
File	3_CRT_Tables_Input_DZA.xlsx
sheet	Table 3_GHG_T_eq, Table 3_CO2_T, Table 3_CH4_T, Table 3_CH4_T_eq, Table 3_N2O_T, Table 3_N2O_T_eq
NID CHAPTER	5.1.1 Emission trends
ToDo	Check for updated reasons for trend in sectoral chapter Update GHG emissions and AD in tables & graphs Tables and Graphs from sheet: Table 3_GHG_T_eq; Table 3_CO2_T; Table 3_CH4_T, Table 3_CH4_T_eq; Table 3_N2O_T, Table 3_N2O_T_eq Check for updated reasons for trend in chapter • Trend -> 2.2.1 Energy • Executive Summary

➪ **update information once sector agriculture inventory is ready; crosscheck for consistency with trend chapter, but also with chapters where categories are described**

[…]

3.1.2 Agricultural data collected and used

➪ **Crosscheck, if updated information is available and consistent with category chapters**

The original data provider for the national and international agricultural data were the Ministry of Agriculture and Rural Development (MADR)[1] and Statistical Office of Algeria (ONS) [2]. However, the agricultural data used and presented in this inventory are taken from the following national and international sources:

Folder	\06_Inventory\2024_submission\03_Agriculture\01_SERIE_B_statistics
File	SERIE_B_statistics.xlsx
Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx
	Evolution de la Production du lait 2017-2022 par espèces.xlsx
	Evolution des effectifs poulet de chair_ ponte_dinde 2017-2022
	Evolution_ lapin_2017-2022.xlsx
	Répartition des terres de 2000-2022.xlsx
	Rendement _lait de vaches_2012-2022.xlsx
	Rendement _laine _2012-2022.xlsx
Folder	\06_Inventory\2024_submission\03_Agriculture\ 03_ONS_Statistics
File	CH7_Agriculture1962_2020Fr.pdf
Folder	\06_Inventory\2024_submission\03_Agriculture\ 04_FAO
File	FAOSTAT-CropProduction_Livestock_all
Folder	\06_Inventory\2024_submission\03_Agriculture\ 05_Feritlizer
File	FAOSTAT_Fertilizer
	Fertilizer_CN-Codes
	Fertial_fertilizer.xlsx

Agricultural statistics [3] The official statistics (several years) of MADR provides information on

- usable land area and cultivated land area
- crop production, crop yield of agricultural products
- fruit and vegetable cultivated land area
- fruit area and production by province
- area and production of wheat, barley, maize, vegetable cultivation etc.
- annual livestock numbers
- livestock production by type
- milk production

[1] Available (03. May 2022) on https://madr.gov.dz/

[2] Available (03. May 2022) on https://www.ons.dz/

[3] Available (03. May 2022) on n https://madr.gov.dz/Statistiques agricoles

Statistical Data - Agriculture[4]	The official statistics (several years) of ONS provides information on ● usable land area and cultivated land area ● crop production, crop yield of agricultural products ● fruit and vegetable cultivated land area ● fruit area and production by province ● area and production of wheat, barley, maize etc ● annual livestock numbers
FAO agricultural data base[5]	The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGRICULTURE STATISTICAL SYSTEM 2001). The FAO data base provides data for the entire time series 1990 – 2022, provided by and for Algeria.

The results of these QA/QC checks are presented in the following chapters under "Source-specific QA/QC and verification".

3.1.3 National Circumstances

⇨ Crosscheck, if updated information is available and consistent with category chapters

Algeria is the largest country in North Africa covering an area of 238,174,100 ha (2,381,741 km²) with a width of 1,622 km and a length of 2000 km. This big extent combined with geological and geographical characteristics as well as factors climates of the country show from North to South a series of ecosystems, sheltering a diversity of habitats and a diversity of species, ranging from island and marine ecosystems, with a coastal ecosystem fringe, passing through forest and mountain ecosystems, followed by the steppe ecosystems, then the Saharan ecosystem and including the humid ecosystem which is found in these different ecosystems. In 2020, 17.4% of the national area was Agricultural land and about 0.8% Forest land. The agricultural land is divided in Cropland (3,6% of national area) and Land under permanent meadows and pastures (13.8% of national area).

Folder	\06_Inventory\2024_submission\03_Agriculture\01_SERIE_B_statistics
File	SERIE_B_statistics.xlsx
Folder	\06_Inventory\2024_submission\03_Agriculture\ 02_MARD
File	Répartition des terres de 2000-2022

[4] Available (03. May 2022) on https://www.ons.dz/spip.php?rubrique346; https://www.ons.dz/spip.php?rubrique306

[5] Available (03. May 2022) on http://www.fao.org/statistics/en/

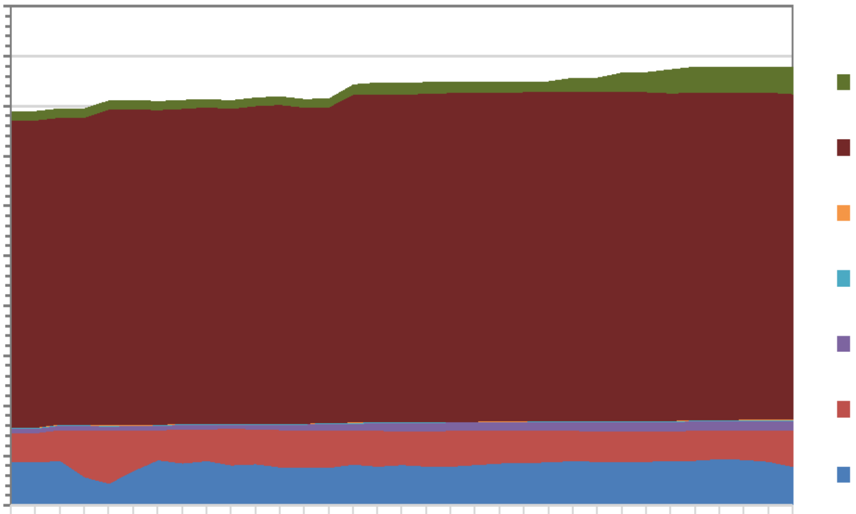


Figure 3-1 Agricultural land area

Table 3-1 Land use: Agricultural land by category and Forest land and its share and trend

	Agricultural land	Cropland	Cropland	Land under permanent crops		Grassland	Grassland	Cropland
		Temporary crops	Fallow land	Fruit plantations	Vineyards	Natural meadows	Pastures and rangelands	Unproduc-tive farmland
	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha	1000 ha
1990								
1991								
1992								
1993								
1994								
2019								
2020								
2021								
2022								
Trend								
1990 - 2022								
2010 - 2022								
2021 - 2022								
Share								
1990								
2010								
2022								

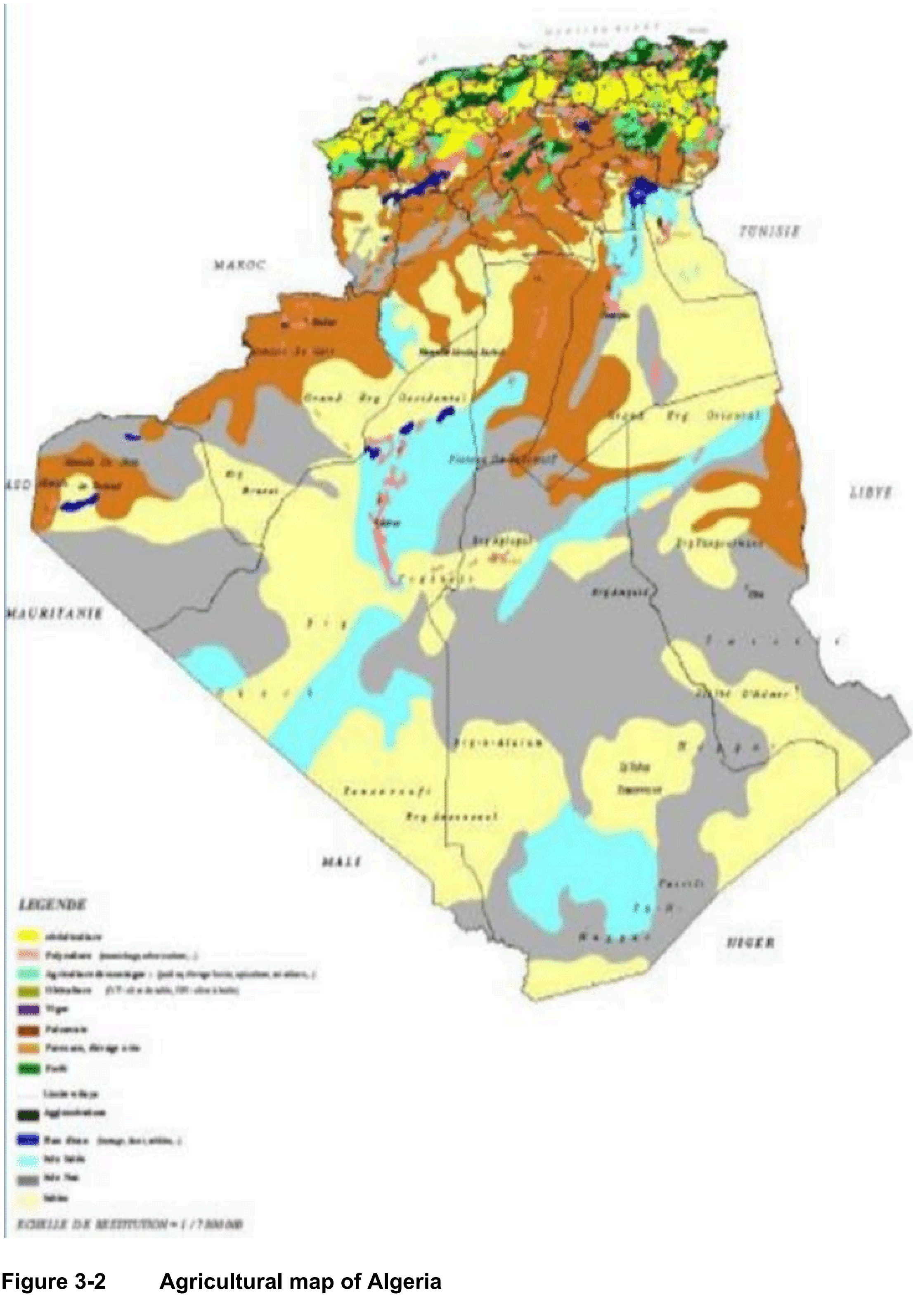


Figure 3-2 Agricultural map of Algeria

3.2 Enteric fermentation (CRT category 3.A)

This section describes the estimation of methane emissions resulting from enteric fermentation from livestock. As described in the 2006 IPCC Guidelines (Volume 4, Chapter 10) methane is produced by herbivores animals as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream.

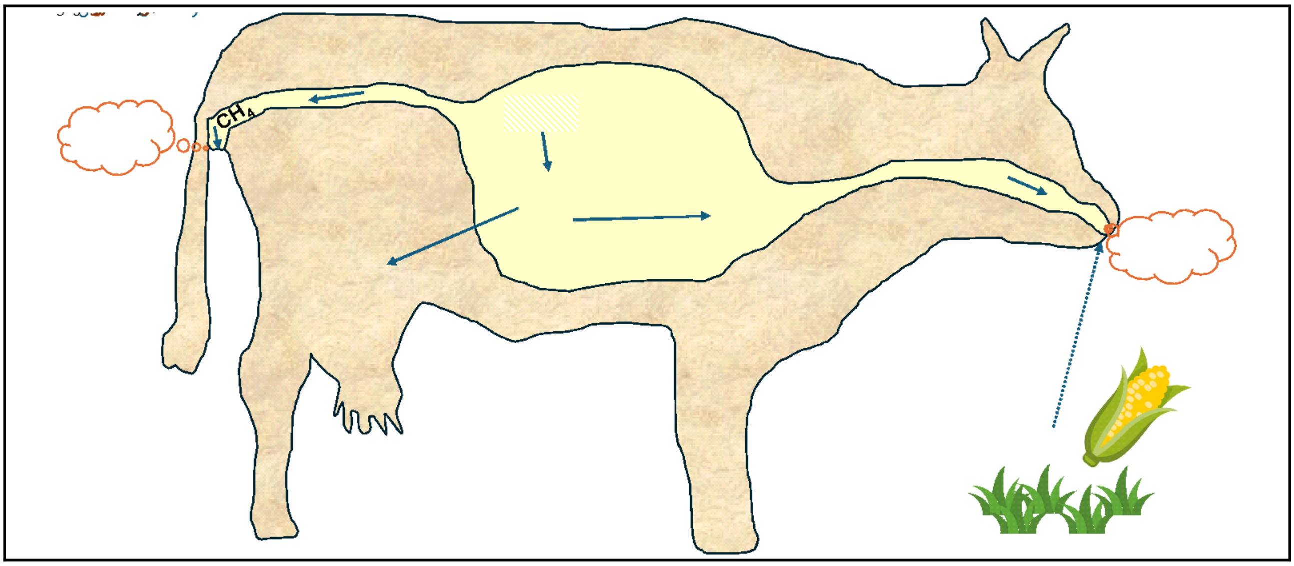


Figure 3-3 Enteric fermentation and methane production

The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal, and the quality and quantity of the feed consumed. Ruminant livestock are major sources of methane with moderate amounts produced from non-ruminant livestock:

- main ruminant livestock are cattle, buffalo, goats, sheep, deer and camels;
- non-ruminant livestock are horses, mules and asses.

Methane is produced by the fermentation of feed within the animal's digestive system. Generally, the higher the feed intake, the higher the methane emission. Although, the extent of methane production may also be affected by the composition of the diet. Feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

To reflect the variation in emission rates among animal species, the population of animals are divided into subgroups, and an emission rate per animal is estimated for each subgroup.

Natural wild ruminants are not considered in the derivation of a country's emission estimate. Emissions should only be considered from animals under domestic management (e.g., farmed deer, elk, and buffalo).

3.2.1 Category description

⇨ Crosscheck, if updated information is available and consistent with category chapters and chapter 1.4

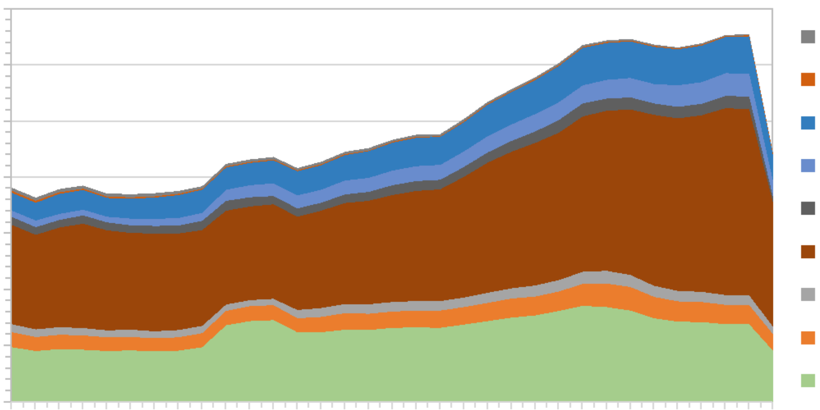
IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.A.1	**Enteric Fermentation**						
3.A.1.a	Cattle			**Option B**			
3.A.1.a.i	Mature dairy cattle	NA	NA	✔ TIER 2	LA 1990, LA 2022	NA	NA
3.A.1.a.ii	Other mature cattle	NA	NA	✔ TIER 2		NA	NA
3.A.1.a.iil	Growing cattle	NA	NA	✔ TIER 2		NA	NA
3.A.1.a.iv	Other	NA	NA	NO		NA	NA
3.A.2.a	Sheep						
3.A.2.a.i	Mature Sheep	NA	NA	✔ TIER 2	LA 1990, LA 2022, TA	NA	NA
3.A.2.a.ii	Growing Sheep (lambs)	NA	NA	✔ TIER 2		NA	NA
3.A.3	Swine	NA	NA	NO	NA	NA	NA
3.A.4	Other Livestock						
3.A.4.a	Buffalo	NA	NA	NO	NA	NA	NA
3.A.4.b	Camels	NA	NA	✔ TIER 1	-	NA	NA
3.A.4.c	Deer	NA	NA	NO	NA	NA	NA
3.A.4.d	Goats	NA	NA	✔ TIER 2	LA 1990, LA 2022	NA	NA
3.A.4.e	Horses	NA	NA	✔ TIER 1	-	NA	NA
3.A.4.f	Mules and Asses	NA	NA	✔ TIER 1	TA	NA	NA
3.A.4.g	Poultry	NA	NA	✔ TIER 1	NA	NA	NA
3.A.4.h	Other						
3.A.4.h.i	Rabbit	NA	NA	NA	NA	NA	NA
3.A.4.h.ii	Reindeer	NA	NA	NO	NA	NA	NA
3.A.4.h.iii	Ostrich	NA	NA	NO	NA	NA	NA
3.A.4.h.iv	Fur-bearing animals	NA	NA	NO	NA	NA	NA
3.A.4.h.v	Other	NA	NA	NO	NA	NA	NA

A '✔' indicates: emissions from this category have been estimated.
Notation keys: IE - included elsewhere. NO – not occurrent. NE - not estimated. NA - not applicable. C – confidential

LA – Level Assessment (in year); TA – Trend Assessment

Folder	\06_Inventory\2024_submission\10_CRT	
File	3_CRT_Tables_Input_DZA.xlsx	
sheet	Table 3_GHG_T_eq, Table 3_CO2_T, Table 3_CH4_T, Table 3_CH4_T_eq, Table 3_N2O_T, Table 3_N2O_T_eq	
NID CHAPTER	3.2.1 Category description	
ToDo	Check for updated reasons for trend in sectoral chapter Update GHG emissions and AD in tables & graphs	
	Tables and Graphs from sheet	Table 3_GHG_T_eq
		Table 3_CO2_T

		Table 3_CH4_T, Table 3_CH4_T_eq
		Table 3_N2O_T, Table 3_N2O_T_eq
	Check for updated reasons for trend in chapter ● Trend -> 2.2.1 Energy ● Executive Summary	



Note: Not occurring (NO) are CRT categories: 3.A.3. Swine, 3.A.4.a. Buffalo, 3.A.4.c. Deer, 3.A.4.g. Poultry, 3.A.4.h.i. Rabbit, 3.A.4.h.ii. Reindeer, 3.A.4.h.iii. Ostrich, 3.A.4.h.iv. Fur-bearing animals

Figure 3-4 CH_4 **emissions from CRT category 3.A Enteric fermentation**

Table 3-2 CH_4 **Emissions from CRT category 3.A *Enteric Fermentation* by sub-categories**

CH_4 emissions	3.A.1	3.A.1.a	3.A.1.a.i	3.A.1.a.ii	3.A.1.a.iii	3.A.2	3.A.2.a.i	3.A.2.a.ii	3.A.3
	Enteric Fermentation	Cattle	Mature dairy cattle	Other mature cattle	Growing cattle	Sheep	Mature Sheep	Growing Sheep	Swine
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990									
1991									
1992									
1993									
1994									
1995									
1996									
2018									
2019									
2020									
2021									
2022									
Trend									
1990-2022									

CH_4 emissions	3.A.1	3.A.1.a	3.A.1.a.i	3.A.1.a.ii	3.A.1.a.iii	3.A.2	3.A.2.a.i	3.A.2.a.ii	3.A.3
	Enteric Fermentation	Cattle	Mature dairy cattle	Other mature cattle	Growing cattle	Sheep	Mature Sheep	Growing Sheep	Swine
	kt	kt	kt	kt	kt	kt	kt	kt	kt
2010-2022									
2021-2022									

CH_4 emissions	3.A.1	3.A.4	3.A.4.a	3.A.4.b	3.B.4.c	3.A.4.d	3.A.4.e	3.A.4.f	3.A.4.g	3.A.4.h
	Enteric Fermentation	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Other
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990										
1991										
1992										
1993										
2019										
2020										
2021										
2022										
Trend										
1990 - 2022										
2010 - 2022										
2021 - 2022										

3.2.2 Methodological issues

3.2.2.1 Choice of methods

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3A

According to the 2019 Refinement to the 2006 IPCC Guidelines, the method for estimating methane emission from enteric fermentation requires three basic steps:

Step 1: Animal population and productivity system
Divide the livestock population into subgroups and characterize each subgroup (as described in Section 10.2. of Volume 4: AFOLU of the 2019 Refinement to the 2006 IPCC Guidelines) . The subgroups are presented in chapter 3.2.2.2.

Step 2: Estimate emission factors for each subgroup in terms of kilograms of methane per animal per year.

Step 3: Multiply the subgroup emission factors by the subgroup populations to estimate subgroup emission and sum across the subgroups to estimate total emission.

These three steps can be performed at varying levels of detail and complexity.

It is *good practice* to choose the method for estimating CH_4 emissions from enteric fermentation according to the decision tree.

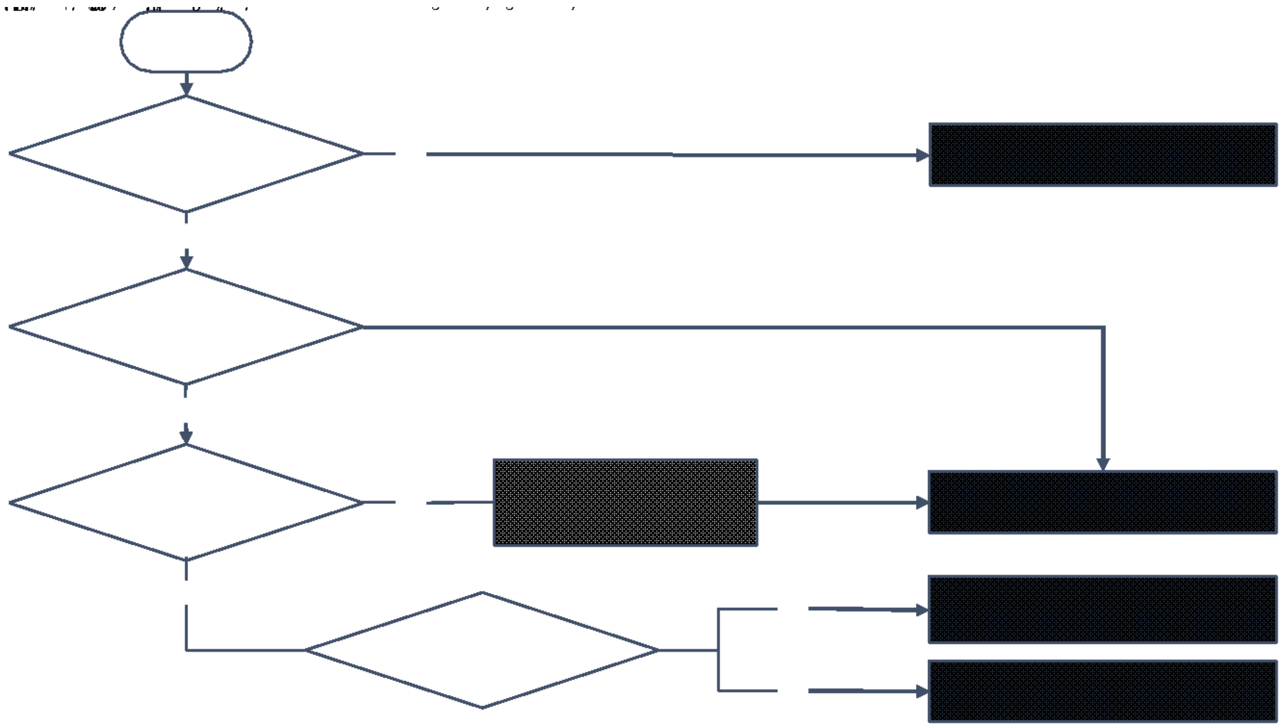


Figure 3-5 Decision Tree for CH_4 Emissions from Enteric Fermentation

For estimating the CH_4 emissions from livestock the Tier 1, and Tier 2 approach of the 2019 Refinements to the 2006 IPCC Guidelines have been applied:

- **TIER 1 approach: camel, horse, mules and asses**
- **TIER 2 approach: cattle, sheep, goats**

Tier 1 approach of the 2019 Refinement to 2006 IPCC Guidelines [41] was applied for the livestock categories camels, horses, mules and asses. Tier 1 is a simplified approach that relies on default emission factors drawn from the literature.

Equation 10.19: CH_4 emissions from enteric fermentation from a livestock category (TIER 1)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$Emissions_{CH4\,(T)} = \sum_{(P)} EF_{(T,P)} \times \frac{N_{(T,P)}}{10^6}$$

Tier 2 approach was applied for the livestock categories cattle, sheep and goats. This more complex approach required detailed country-specific data on gross energy intake and methane conversion factors for specific livestock categories. It is *good practice* to apply Tier 2 method if enteric fermentation is a key source category for the animal category that represents a large portion of the country's total emissions.

Equation 10.19: CH_4 emissions from enteric fermentation from a livestock category (TIER 2)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$Emissions_{CH4\,(T)} = \sum_{(P)} CS\,EF_{(T,P)} \times \frac{N_{(T,P)}}{10^6}$$

Where:

Emissions $_{CH4\,(T)}$	= CH_4 emissions in animal category T (Gg CH_4)
N $_{T,P}$	= the number of head of livestock species / category T in the country classified as productivity system P.
EF $_{T,P}$	= default emission factor for the defined livestock population and the productivity system P (kg CH_4 head^{-1} yr^{-1})
CS EF $_{T,P}$	= **country specific emission factor** for the defined livestock population and the productivity system P, in kg CH_4 head^{-1} yr^{-1}
T	= species/category of livestock
P	= productivity system, either high or low productivity for use in advanced Tier 1a – omitted if using Tier 1 approach

Equation 10.20 (updated): Total CH_4 emissions from livestock enteric fermentation (TIER 1)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$Total\ CH_{4\,enteric} = \sum_{i,P} E_{i,P}$$

Where:

Total $CH_{4\ enteric)}$	= total methane emissions from Enteric Fermentation (Gg CH_4)
N $_{T,P}$	= the number of head of livestock species / category T in the country classified as productivity system P.
E $_{i,P}$	= is the emissions for the *i*th livestock categories and subcategories based on production systems (P)

3.2.2.2 Choice of activity data

3.2.2.2.1 Livestock

Folder	\06_Inventory\2024_submission\03_Agriculture\01_SERIE_B_statistics
File	SERIE_B_statistics.xlsx
Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx
	Evolution de la Production du lait 2017-2022 par espèces.xlsx
	Evolution des effectifs poulet de chair ponte_dinde 2017-2022
	Evolution_ cuniculture_2017-2022
	Evolution_ lapin_2017-2022.xlsx

As described in Chapter 5.1.2 above, the original data provider for the national and international agricultural data is the Ministry of Agriculture and Rural Development (MARD)[6], and Statistical Office of Algeria (ONS) The agricultural data used and presented in this inventory are taken from the following national and international sources: FAO agricultural data base[7]. For estimating emission from enteric fermentation and manure management the following data sources were used:

	1990 - 1996		**1997 - 2022**
Livestock (all)	FAO		MARD
	1990 - 1996	**1997**	**1998 - 2022**
Cattle - **split** for BLM, BLA, BLL or BLA + BLL available	As of 1997	**MARD**	As of 1997
	1990	**1991 - 2021**	**2022**
Sheep and goat: split into in ● high productivity systems (HP) and ● low productivity systems (LP).	**Expert judgment** HP: 20% LP: 80%	linear interpolation	**Expert judgment** HP: 20% LP: 70%

The agricultural statistics provided annually by the Ministry of Agriculture and Rural Development / Directorate of Information Systems, Statistics and Forecasting are developed from data collected from the Directions of Agricultural Services of the wilayas (D.S.A). They are obtained through exhaustive surveys or by sampling, carried out at the level of the communes by the agents of the statistical services.

The duly filled-in forms for each wilaya are sent to the Directorate of Agricultural Statistics (MADR), which carries out consistency checks to avoid double counting of inter-wilaya transhumance.

[6]Available MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022): Statitisque agricole, Superficie et production, Serie “B”, Plusieurs années, Alger, Available (03 January 2024) on https://madr.gov.dz/Statistiques agricoles
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022): Statitisque agricole, Superficie et production, Serie “B” 2019, Alger, Available (03 January 2024) on https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2019.pdf
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022): Statitisque agricole, Superficie et production, Serie “B” 2018, Alger, Available (03 January 2024) on https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2018.pdf
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022): Statitisque agricole, Superficie et production, Serie “B” 2017, Alger, Available (03 January 2024) on https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2017-.pdf
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022): Statitisque agricole, Superficie et production, Serie “B” 2016, Alger, Available (03 January 2024) on https://madr.gov.dz/wp-content/uploads/2022/04/SERIE-B-2016.pdf
[7] Available (03 January 2024) on http://www.fao.org/statistics/en/

Also, an exhaustive general census of agriculture is carried out every ten years by the Ministry of Agriculture and Rural Development (MARD).

3.2.2.2.1.1 Cattle (CRT category 3.A.1.a)

Cattle in Algeria are classified into three types:

- modern dairy cattle (bovin laitier moderne - BLM)), made up of imported breeds that are farmed intensively, usually off the land intensively farmed, usually ‘off-farm’,
- local cattle (bovin local - BLL) made up of local/ indigenous cattle populations that are and farmed extensively (suckler cattle)
- improved dairy cattle (bovin laitier amélioré - BLA), made up of breeds improved by various crosses.

This classification applies to all cattle.
Cattle farms are mainly located in the northern fringe of the country, in the Tell and the high plains.

The herd of local breeds ensures only 20% of the national production.[8] Indeed, the production levels of these animals are very low, the milk production is 3 to 4 liters per day for 6 months or an average of 595 kg per lactation.

The local cattle belong to a single group called Brune de l'Atlas which is subdivided into 6 secondary breeds (Guelmoise - Cheurfa - Setifienne - Chelifienne - Djerba - Kabyle and Chouia).

Bovin Laitier Amélioré (BLA), covers the various cattle populations, resulting from multiple crossings, between the local breed Brune de l'Atlas and its variants on the one hand, and various breeds imported, these animals constitute 42% to 43% of the total national herd, and ensure about 40% of the total production of cow milk.

The imported cattle known as modern dairy cattle (BLM) are made up of imported breeds, these animals represent 9 to 10% of the national dairy cattle and ensure about 40% of the total production of cow's milk, the imported breeds are mainly represented by the Prim'Holstein breed, the Montbeliarde breed.[9]

⇨ update information

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx

The general trend of **cattle** livestock is described below.

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Total cattle						
Mature dairy cattle						
Other mature cattle						
Growing cattle						

The fluctuations are due to

- government development policies
- imports of modern dairy cattle
- lack of adaptation to the new climate conditions

[8] Bencherif A. (2001) : Stratégies des acteurs de la filière lait en Algérie : Etats des lieux et problématiques, Série B, Etudes et Recherches, n°32, 25-45.

[9] Caractéristiques de l’élevage bovin laitier en Algérie, DENNA Mohammed Lamine DERGHAL Saif Eddine (2021), Université 8 Mai 1985 Guelma.

- Intensified breeding programs
- pest and diseases, such as foot and mouth disease, bovine spongiform encephalopathy (BSE), etc.
- improved control measures,

The drop in 2022 is due to revision of national agricultural statistics[10].

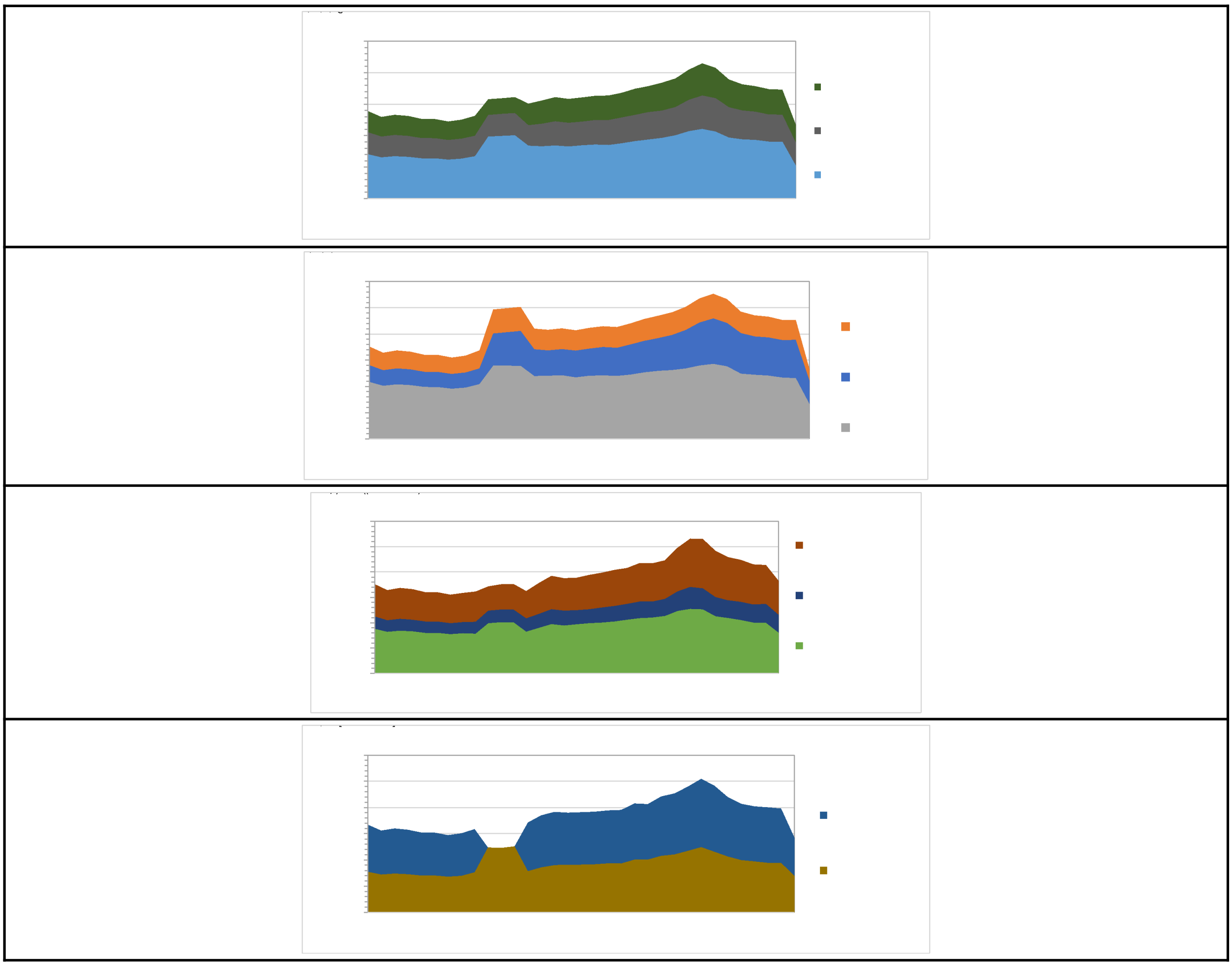


Figure 3-6 Dairy cattle population by category and its trend 1990–2022

[10] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

Table 3-3 Dairy Cattle: livestock population by category and its trend 1990–2022

	3.A.1.a		3.A.1.a.i		3.A.1.a.i.1		3.A.1.a.i.2		3.A.1.a.i.3			
	Total cattle		Dairy Cows Total		Dairy Cattle Modern (BLM)		Improved Dairy Cattle (BLL)		Local Dairy Cattle (BLA)		BLA + BLL	
	heads		heads		heads		heads		heads		heads	
1990		FAO		FAO		Based on shar in 1997		Based on shar in 1997		Based on shar in 1997		Based on shar in 1997
1991												
1992												
1993												
1994												
1995												
1996												
1997		MARD		MARD		MARD		MARD		MARD		MADR
1998								Based on shar in 1997		Based on shar in 1997		
1999												
2000												
2001												
2017												
2018												
2019												
2020												
2021												
2022												
Trend												
1990 - 2022												
2010 - 2022												
2021 - 2022												

Table 3-4 Cattle - Heifers: livestock population by category and its trend 1990–2022

	3.A.1.a		3.A.1.a.ii		3.A.1.a.ii.1	3.A.1.a.ii.2	3.A.1.a.ii.3		
	Total cattle		**Heifers Total**		**Heifers Modern (BM)**	**Heifers Improved (BA)**	**Heifers Local (BL)**	**Heifers BA + BL**	Source
	heads		**heads**		**heads**	**heads**	**heads**	**heads**	
1990									Based on share of dairy cattle 1997
1991									
1992									
1993		FAO		FAO					
1994									
1995									
1996									
1997									Based on share of dairy cattle 1997
1998									
		MARD		MARD					
2020									
2021									
2022									
Trend									
1990 - 2022									
2010 - 2022									
2021 - 2022									

Table 3-5 Cattle – Bulls and Bulldogs (12 month): livestock population by category and its trend 1990–2022

	3.A.1.a		3.A.1.a.iii		3.A.1.a.iii.1	3.A.1.a.iii.2	3.A.1.a.iii.3		
	Total cattle		Bulls and bulldogs (>12 month) Total		Bulls and bulldogs Modern (BM)	Bulls and bulldogs Improved (BA)	Bulls and bulldogs Local (BL)	Bulls and bulldogs BA + BL	Source
	heads		heads		heads	heads	heads	heads	
1990									
1991									
1992									
1993		FAO		FAO					Based on share of dairy cattle 1997
1994									
1995									
1996									
1997									
1998									
1999									
2000									Based on share of dairy cattle 1997
2017		MARD		MARD					
2018									
2019									
2020									
2021									
2022									
Trend									
1990 - 2022									
2010 - 2022									
2021 - 2022									

Table 3-6 Cattle – Growing cattle: livestock population by category and its trend 1990–2022

	3.A.1.a		3.A.1.a.iv		3.A.1.a.iv.1	3.A.1.a.iv.2	3.A.1.a.iv.3		
	Total cattle		Growing cattle (<12 month) Total		Growing cattle Modern (BM)	Growing cattle Improved (BA)	Growing cattle Local (BL)	Growing cattle BA + BL	Source
	heads		heads		heads	heads	heads	heads	
1990									
1991									
1992									
1993		FAO		FAO					Based on share of dairy cattle 1997
1994									
1995									
1996									
1997									
1998									
1999									
2000									
2001		MARD		MARD					Based on share of dairy cattle 1997
2019									
2020									
2021									
2022									
Trend									
1990 - 2022									
2010 - 2022									
2021 - 2022									

3.2.2.2.1.2 Sheep (CRT category 3.A.2.a)

Sheep farming is a fundamental part of Algeria's agricultural sector with both traditional and nomadic practices- Sheep farming is an important pillar for rural livelihoods and the national economy and it playes an important role in meeting community needs such as meat, milk, and wool. Algeria has a significant traditional background for sheep breeding with about 12 important breeds for the sheep breeding: Ouled-Djellal, Rembi, Hamra, Berbere, Barbarine, D'man, Sidaou, Tâadmit, Daraa, Ifilen, Srandi and Tazegzawt (see below figure *Geographic distribution of sheep breeds studied in the Algerian territory*. These sheep population have been raised commonly in Algeria for disease-tolerant, good productive characteristics and to adapt disease resistance, in arid, steppe and Saharan conditions.

⇨ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
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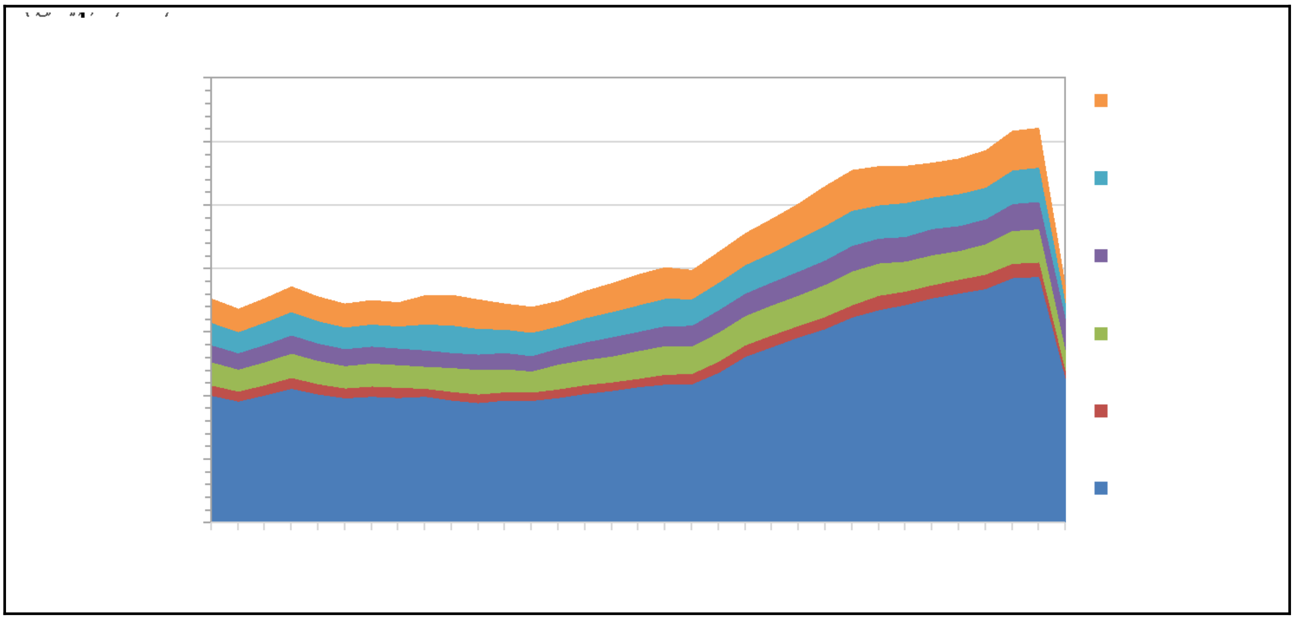

Figure 3-7 Sheep population and its trend 1990–2022

The trend in **sheep** livestock is presented below.

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Total sheep						
Eves						
Other mature sheep						
Lambs						

The drop in 2022 is due to revision of national agricultural statistics[11].

The fluctuations are due to

- **Drought:** Algeria has experienced severe drought for several years driven by factors like desertification, climate change, and a significant decrease in rainfall
- **Feed Shortage**: The pasture shortage caused by drought needed to be compensated by increased feed production and imports.
- **Pest and Diseases:**
    - plaque
    - bluetongue
    - brucellosis,
    - foot and mouth disease,
    - sheep pox
    - etc.
- **Government development policies**
- **Vaccines and Medicines**: dependency on import of veterinary vaccines and medicines
- **Intensified breeding programs**
- **Improved control measures**

[11] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

- **Stopping of sheep farming** and switch to other (agricultural) activities

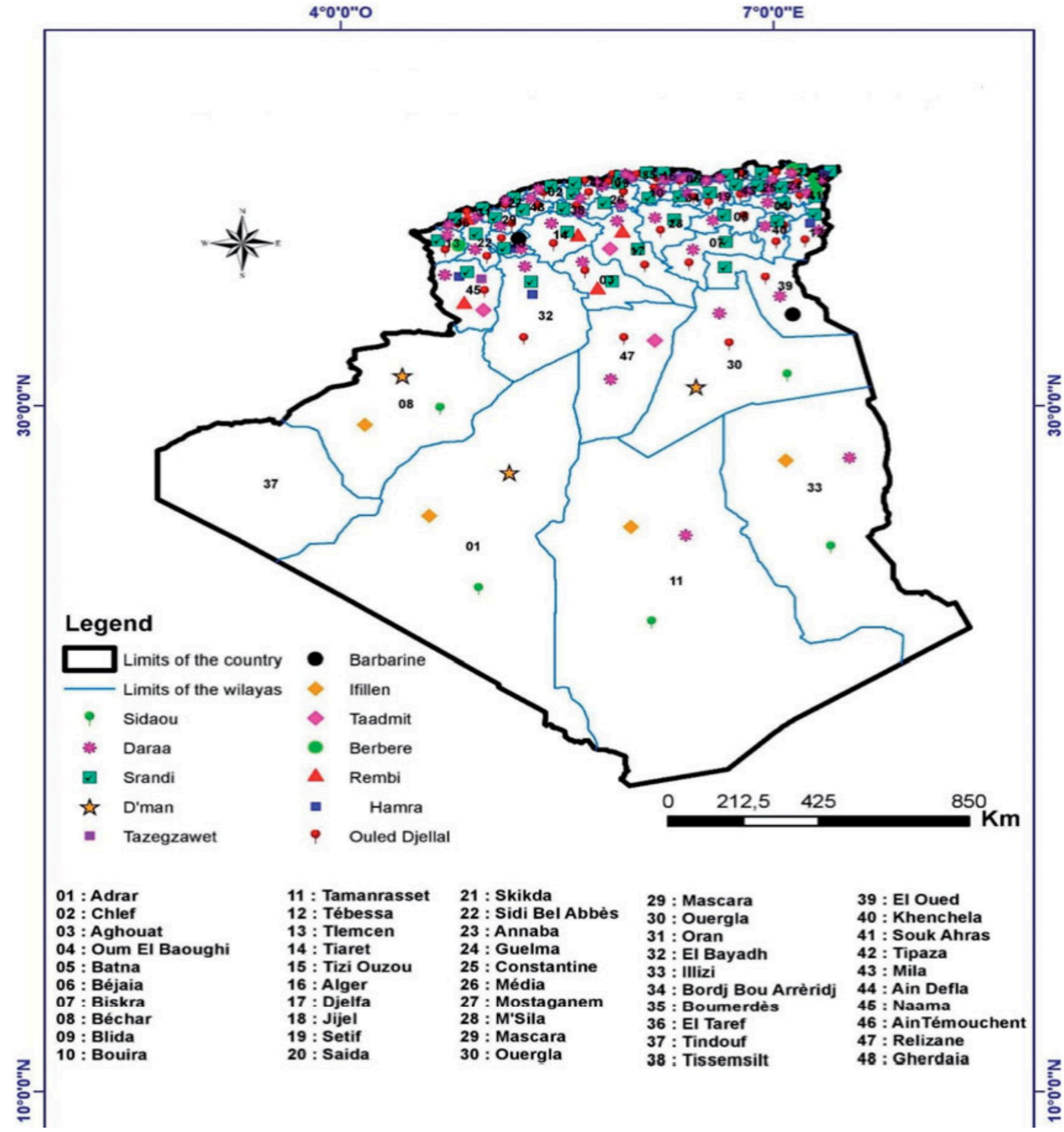

Figure 3-8 Geographic distribution of sheep breeds studied in the Algerian territory

Source: Abdelkader, A. A.; Belkaid, A. B.; Adnan, N. A., Benyoucef, M. T. and Amal. D. (2017): New genetic identification and characterisation of 12 Algerian sheep breeds by microsatellite markers. In: Italian Journal of Animal Science, June 201717(1):1-11. https://www.researchgate.net/publication/317387770_New_genetic_identification_and_characterisation_of_12_Algerian_sheep_breeds_by_microsatellite_markers

Table 3-7 Sheep: livestock population by category and its trend 1990–2022

	Total Sheep	Ewes	Other Mature sheep	Rams	Antenais	Antenaises (10 to 18 months)	Growing Sheep	Lambs (- 10 months)	Agnels (- 10 months)	Source
	heads									
1990										FAO with split based on MADR
1991										
1992										
1993										
1994										
1995										
1996										
1997										MADR
1998										
1999										
2020										
2021										
2022										
Trend										
1990 - 2022										
2010 - 2022										
2021 - 2022										

Table 3-8 Sheep: livestock population by category and its trend 1990–2022

	Total Sheep	Ewes		High Productivity Systems		Source
				high	low	
	heads					
1990						
1991						
1992						
1993			FAO with split based on MAD			
1994						
1995						
1996						Split based on expert judgment
1997						
1998						
1999						
			MADR			
2020						
2021						
2022						
Trend						
1990 - 2022						
2010 - 2022						
2021 - 2022						

3.2.2.2.1.3 Swine (CRT category 3.A.3)

There is no swine husbandry or pork production in Algeria.

3.2.2.2.1.4 Buffalo (CRT category 3.A.4.a)

There is no buffalo husbandry in Algeria.

3.2.2.2.1.5 Camels (CRT category 3.A.4.b)

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File	Evolution des effectifs animaux 1997-2022.xlsx

Camel livestock is an ancestral activity in Algeria. In arid, semiarid, and desert areas, camel (*Camelus dromedarius*) livestock plays an essential role in the lives of local populations; it provides milk, meat, hair products, transportation, racing, and tourism.

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Total Camels						

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Camels						
Other camel species	NO	NO	NO	NA	NA	NA

The drop in 2022 is due to revision of national agricultural statistics[12].

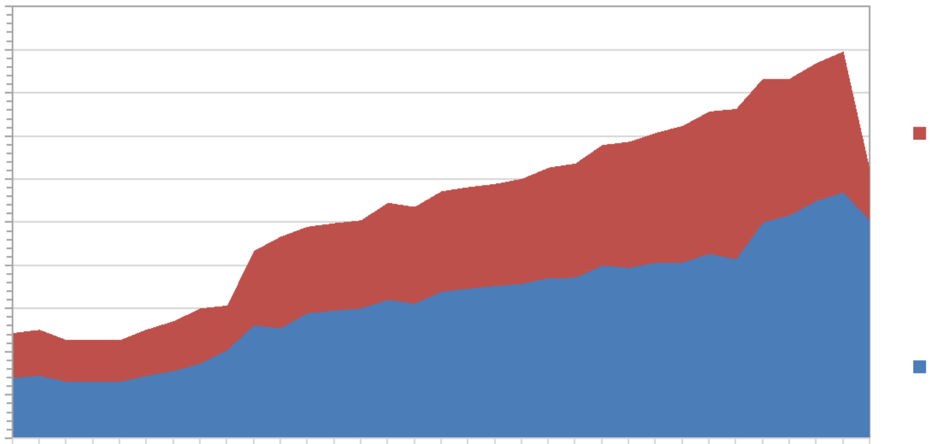


Figure 3-9 Camels: population and its trend 1990–2022

The increase and fluctuations of camel population was due to[13]

- government development policies and breeding programs;
- increased demand for camel milk, appears to be a primary reason for the renewed interest in camel husbandry;
- adaptation of camel herds to urban centres and their surroundings, following the sedentarization of camel-raising communities;
- implementation of birth incentives through the National Fund for Agricultural Regulation and Development in 2000.

[12] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

[13] Senoussi A Hakim, Brahimi Zakaria, Kadri Soumeya and Faye Bernard (2023): The dromedary in Algeria: An evolution at times of multifunctionality. https://www.veteringroup.us/articles/IJVSR-10-244.php#:~:text=At%20the%20turn%20of%20the%2021st%20century%2C%20camel%20husbandry%20experienced.%2D2022%5D%20%5B7%5D.

Table 3-9 Camel and its trend 1990–2022

	3.A.4.b	3.A.4.b.i	3.A.4.b.ii	Source
	Total Camels	Camels	Other camels	
	heads			
1990				FAO with split based on MARD
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				
2000				MARD
2001				
2002				
2019				
2020				
2021				
2022				
Trend				
1990 - 2022				
2010 - 2022				
2021 - 2022				

3.2.2.2.1.6 Goats (CRT category 3.A.4.d)

⇨ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx

Goats are often associated with sheep and are an important pillar of the national (agricultural) economy. The local goat populations are mainly found in difficult regions such as mountains, forests, steppes and the Sahara.

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Total Goats						
Goats						
Growing Goats						

The drop in 2022 is due to revision of national agricultural statistics[14].

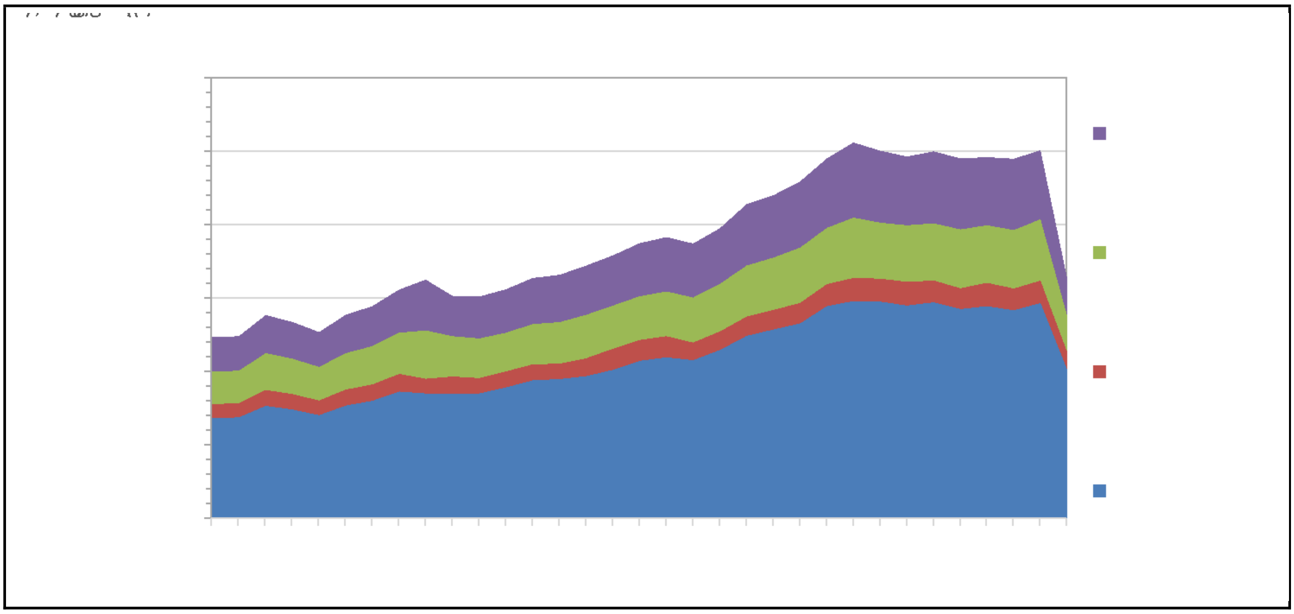


Figure 3-10 Goats by livestock category and its trend 1990–2022

The increase of goat population was due to

- government development policies
- increased demand for goat milk,
- adaptation of goat herds to urban centers and their surroundings.

The fluctuations are due to

- government development policies
- Import/export
- Intensified breeding programs
- pest and diseases, such as foot and mouth disease, goat pox, brucellosis, etc,
- improved control measures,

[14] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

Table 3-10 Goats: livestock population by category and its trend 1990–2022

	Total Goats	Mature Goats	Goats	Bucks	Growing Goats	Kids (6 months)	Cheer (6 months)	
	heads							
1990								FAO with split based on MADR
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								MADR
2001								
2002								
2020								
2021								
2022								
Trend								
1990 - 2022								
2010 - 2022								
2021 - 2022								

3.2.2.2.1.7 Horses (CRT category 3.A.4.e))

⇨ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Horses						

The decrease of horse population from 1990 to 2000 was due to

- due to an increase in the cost of food
- change in interest in racing

The fluctuations are due to

- Import/export
- Intensified breeding programs

- Equine diseases, etc,
- improved control measures,

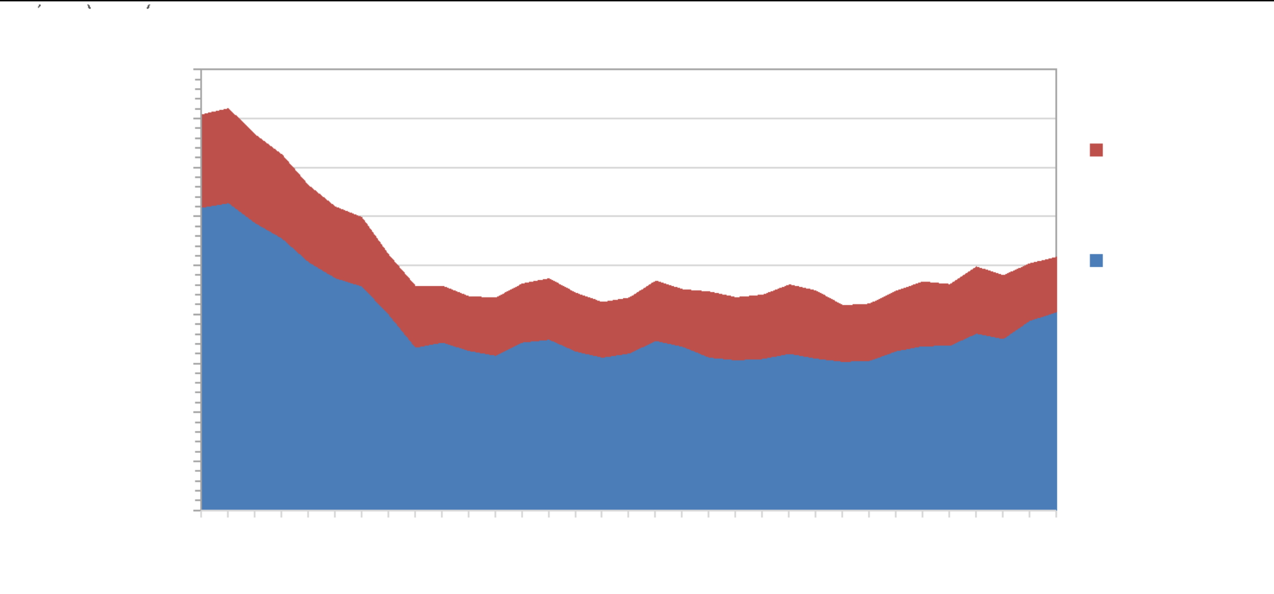


Figure 3-11 Horses population and its trend 1990–2022

Table 3-11 Horses, Mules and asses and its trend 1990–2022

	3.A.4.e	3.A.4.e.i	3.A.4.e.ii	3.A.4.f	3.A.4.f.i	3.A.4.f.ii	Source
	Total Horses	Adults	Youngs (-2 years)	Total Mules & Assess	Mules	Asses	
	heads						
1990							FAO with split based on MADR
1991							
1992							
1997							
1999							
2000							MADR
2001							
2002							
2020							
2021							
2022							
Trend							
1990 - 2022							
2010 - 2022							
2021 - 2022							

3.2.2.2.1.8 Mules and Asses (CRT category 3.A.4.f)

⇨ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs animaux 1997-2022.xlsx

Mules and asses are for transportation, hauling agricultural products to market but also conveying of farmyard manure, soil and for other purposes.

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Mules and asses						

The drop in 2022 is due to revision of national agricultural statistics[15].

The decrease of horse population from 1990 to 1998 was due to

[15] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

- mechanizations and use of tractors in agriculture and other vehicles for transportation
- due to an increase in the cost of food
- change in interest in racing.

The fluctuations are due to

- equine diseases, etc,
- improved control measures,

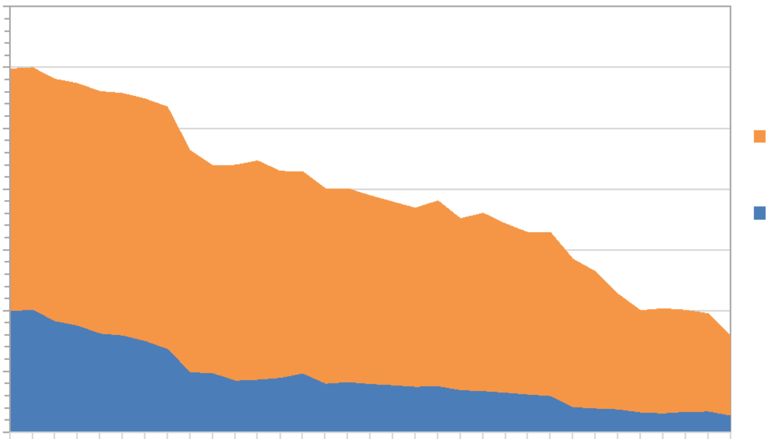


Figure 3-12 Mules and assess population and its trend 1990–2022

3.2.2.2.1.9 Poultry (CRT category 3.A.4.g)

➪ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution des effectifs poulet de chair_ ponte_dinde 2017-2022

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Total Poultry						
Chicken, broilers						
Chicken, layers						
Turkey						
Ducks						
Geese						

The drop in 2022 is due to revision of national agricultural statistics[16].

The total poultry includes chicken broilers, laying hens, turkey, ducks, and geese.

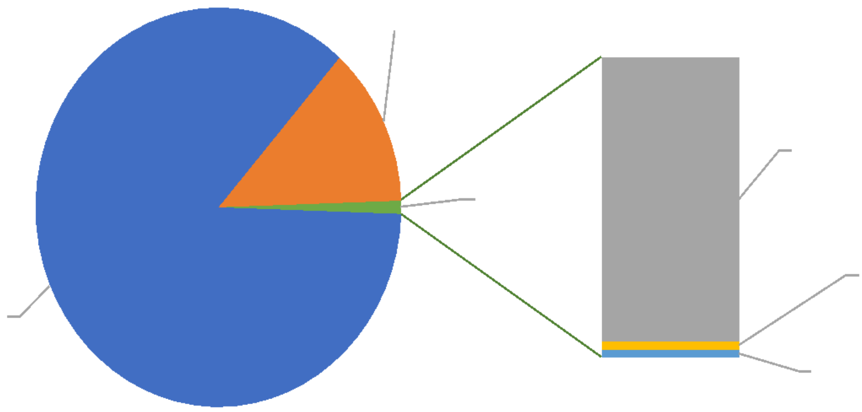


Figure 3-13 Poultry in 2022 – share of chicken (layers and broilers), turkey, ducks and geese.

The increase of chicken population, both broilers and laying hens, were mainly due to

- government development policies
- imports
- Intensified breeding programs
- improved control measures.

The fluctuations are due to

- government development policies
- imports
- lack of adaptation to the new climate conditions
- Intensified breeding programs
- pest and diseases, such as bird flu, etc.,
- improved control measures.

[16] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

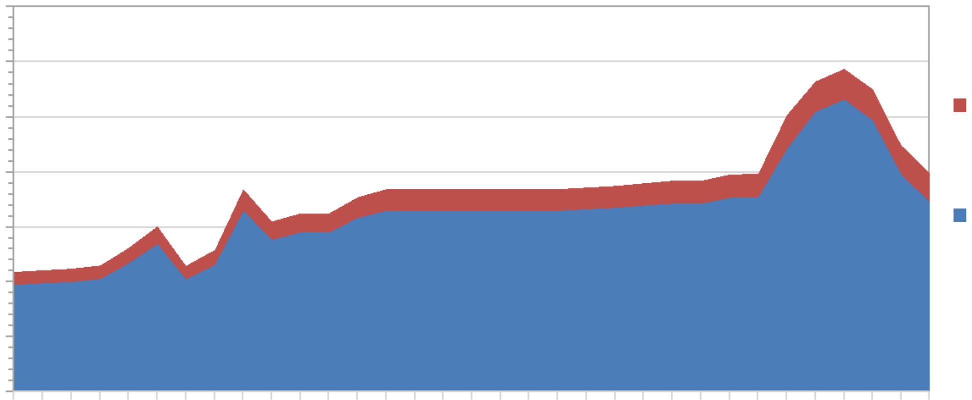


Figure 3-14 Chicken – broilers and laying hens population and its trend 1990–2022

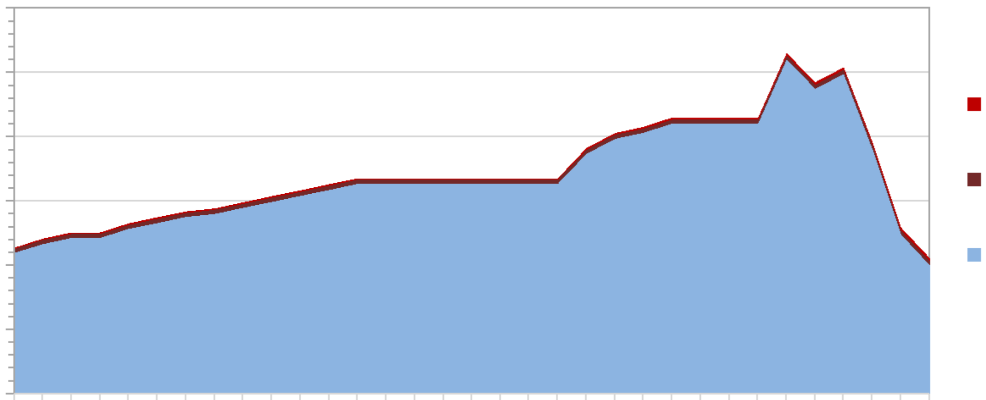


Figure 3-15 Turkey, ducks, and geese population and its trend 1990–2022

Table 3-12 Poultry: livestock population by category and its trend 1990–2022

	Total Poultry	Chickens (broilers)	Chickens, layers (hens)	Other poultry	Turkey	Ducks	Geese	Source
	head							
1990								FAO (estimates)
1991								
1992								
1993								
1994								
2014								
2015								
2016								
2017								MARD
2018								
2021								
2022								
Trend								
1990 - 2022								
2010 - 2022								
2021 - 2022								

3.2.2.2.1.10 Rabbits (CRT category 3.A.4.h.i.)

➪ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Evolution_ cuniculture_2017-2022

Livestock	Number			Trend		
	1990	2010	2022	1990-2022	2010-2022	2021-2022
Rabbit				NA	NA	NA

The fluctuations are due to

- Breeding activities
- pest and diseases, etc.

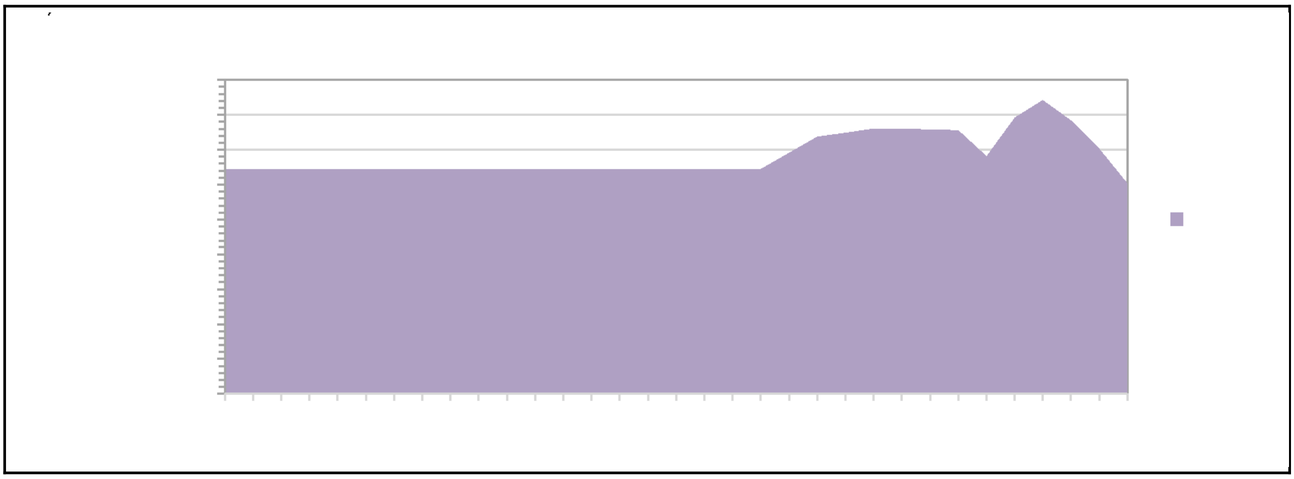


Figure 3-16 Rabbits population and its trend 1990–2022

Table 3-13 Poultry: livestock population by category and its trend 1990–2022

	Rabbits	Source		Rabbits	Source		Rabbits	Source
	head			head			head	
1990			2001			2013		
1991			2002			2014		FAO (estimates)
1992			2003			2015		
1993			2004			2016		
1994			2005			2017		
1995		FAO (estimates)	2006		FAO (estimates)	2018		
1996			2007			2019		MARD
1997			2008			2020		
1998			2009			2021		
1999			2010			2022		
2000			2011					
Trend								
1990 - 2022								
2010 - 2022								
2021 - 2022								

3.2.2.2.1.11 Reindeer (CRT category 3.A.4.h.ii.)

There is no farming of deer's/reindeers in Algeria.

3.2.2.2.1.12 Ostrich (CRT category 3.A.4.h.iii.)

There is no farming of ostriches in Algeria.

3.2.2.2.1.13 Fur-bearing animals (CRT category 3.A.4.h.iv.)

There is no farming of fur-bearing animals in Algeria.

3.2.2.2.1.14 Other (CRT category 3.A.4.h.v.)

There is no farming of other livestock than mentioned above took place in Algeria.

3.2.2.2.2 Production of milk and wool

3.2.2.2.2.1 Milk production and yield

⇨ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Rendement _lait de vaches_2012-2022.xlsx

The milk production and milk yield were taken from Ministry of Agriculture and Rural Development (MARD)[17] and FAO agricultural data base[18]. For estimating emission from enteric fermentation and manure management the following data sources were used:

<table>
<tr><th colspan="3"></th><th>1990 - 2016</th><th>2017 - 2022</th></tr>
<tr><td rowspan="3">Milk production (total)
Milk yield (total)</td><td colspan="2">cows</td><td rowspan="3">FAO</td><td rowspan="3">MARD</td></tr>
<tr><td colspan="2">sheep</td></tr>
<tr><td colspan="2">goats</td></tr>
<tr><td colspan="5"></td></tr>
<tr><th colspan="3"></th><th colspan="2">1990 - 2022</th></tr>
<tr><td rowspan="7">Milk production by productivity systems
Milk yield by productivity systems</td><td rowspan="3">cows</td><td>BLM</td><td colspan="2" rowspan="7">Share based on expert judgment on literature</td></tr>
<tr><td>BLA</td></tr>
<tr><td>BLL</td></tr>
<tr><td rowspan="2">sheep</td><td>High productivity</td></tr>
<tr><td>Low productivity</td></tr>
<tr><td rowspan="2">goats</td><td>High productivity</td></tr>
<tr><td>Low productivity</td></tr>
</table>

[17] Available MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022)

[18] Available (03 January 2024) on http://www.fao.org/statistics/en/

Table 3-14 Cow milk production and its trend 1990–2022

	TOTAL cow milk		Source	Dairy Cattle Modern (BLM)		Improved Dairy Cattle (BLA)		Local Dairy Cattle (BLL)		Source
	production	yield		production	yield	production	yield	production	yield	
	tons	hg/ head		tons	kg/ head	head	head	head	head	
1990			FAO stat							Share based on expert judgment on literature
1991										
1992										
1993										
1995										
2018										
2019										
2020										
2021										
2022										
Trend										
1990-2022										
2010-2022										
2021-2022										

Table 3-15 Sheep milk production and yield and its trend 1990–2022

	TOTAL sheep milk		Source	Sheep milk				Source
				High Productivity Systems		Low Productivity Systems		
	production	yield		production	yield	production	yield	
	tons	hg/head		tons	kg/ head	tons	kg/ head	
1990			FAO stat					Share based on expert judgment on literature
1991								
1992								
1993								
1994								
2017			MARD					
2018								
2019								
2020								
2021								
2022								
Trend								

	TOTAL sheep milk		Source	Sheep milk				Source
				High Productivity Systems		Low Productivity Systems		
1990-2022								
2010-2022								
2021-2022								

Table 3-16 Goat milk production and yield and its trend 1990–2022

	TOTAL goat milk		Source	Goat milk				Source
				High Productivity Systems		Low Productivity Systems		
	production	yield		production	yield	production	yield	
	tons	hg/ head		tons	kg/ head	tons	kg/ head	
1990			FAO stat					Share based on expert judgment on literature
1991								
1992								
1993								
1996								
1997								
2017			MARD					
2018								
2021								
2022								
Trend								
1990-2022								
2010-2022								
2021-2022								

3.2.2.2.2.2 Wool production

➪ **update information**

Folder	\06_Inventory\2024_submission\03_Agriculture\02_AD_MARD
File	Rendement _laine _2012-2022.xlsx

The wool production from sheep was taken from Ministry of Agriculture and Rural Development (MARD)[19] and FAO agricultural data base[20]. It is assumed that no wool is produced from goats. For estimating emission from enteric fermentation and manure management the following data sources were used.

Table 3-17 Wool production and yield and its trend 1990–2022

	TOTAL wool production		Source		TOTAL wool production		Source
	production	yield			production	yield	
	tonnes	kg/ head			tonnes	kg/ head	
1990			FAOstat	2007			FAOstat
1991				2008			
1992				2009			
1993				2010			
1994				2011			
1995				2012			
1996				2013			MARD
1997				2014			
1998				2015			
1999				2016			
2000				2017			
2001				2018			
2002				2019			
2003				2020			
2004				2021			
2005				2022			
2006							
Trend							
1990-2022							
2010-2022							
2021-2022							

3.2.2.2.3 Draft power for cattle

It is assumed that cattle were not used for providing draft power.

3.2.2.2.4 Average weight of livestock

Folder	\06_Inventory\2024_submission\10_CRT
File	3_Agriculture_Tool_DZA_2024.xlsx
sheet	Poid_weight AS_BH

[19] Available MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)(2022)
[20] Available (03 January 2024) on http://www.fao.org/statistics/en/

The following table represents the average weight of livestock used for calculation of enteric fermentation using TIER 2, livestock was split according to age and productivity (milk and wool). The information provided is based on expert judgment.

Table 3-18 Average Weight by livestock category

	IPCC Categories	Livestock	Average Weight				
			Unit	1990	2000	2010	2022
Cattle / Bovine	**Dairy cows**	Mature Dairy cows					
		Bovin Laitier Moderne (BLM)	kg	500	500	500	500
		Bovin Laitier Amélioré (BLA)	kg	400	400	400	400
		Bovin laitier Local (BLL)	kg	270	270	270	270
	Other Dairy cows	**Génisses /Heifers**					
		Moderne (BM)	kg	400	400	400	400
		Amélioré (BA)	kg	350	350	350	350
		Local (BL)	kg	250	250	250	250
		Bulls					
		Moderne (BM)	kg	510	510	510	510
		Amélioré (BA)	kg	450	450	450	450
		Local (BL)	kg	350	350	350	350
		Young bulls (12 - 18 month)					
		Moderne (BM)	kg	350	350	350	350
		Amélioré (BA)	kg	300	300	300	300
		Local (BL)	kg	250	250	250	250
		Growing cattle male (- 12 month)					
		Moderne (BM)	kg	200	200	200	200
		Amélioré (BA)	kg	150	150	150	150
		Local (BL)	kg	120	120	120	120
		Growing cattle female (- 12 month)					
		Moderne (BM)	kg	180	180	180	180
		Amélioré (BA)	kg	120	120	120	120
		Local (BL)	kg	90	90	90	90
Sheep / Ovine		Ewes					
		High productivity	kg	40	40	40	40
		Low productivity	kg	30	30	30	30
		Rams					
		High productivity	kg	55	55	55	55
		Low productivity	kg	45	45	45	45
		Antenaises	kg	30	30	30	30
		Antenais (10 - 18 month)	kg	30	30	30	30
		Lambs (- 10 month)	kg	8	8	8	8
		Agnelles (- 10 month)	kg	8	8	8	8
Goats / Caprine		Goats					
		High productivity	kg	35	35	35	35

	IPCC Categories	Livestock	Average Weight				
			Unit	1990	2000	2010	2022
		Low productivity	kg	34	34	34	34
		Bock / Boucs					
		Hight productivity	kg	51	51	51	51.0
		Low productivity	kg	49.8	49.8	49.8	49.8
		Kids (< 6 month)	kg	8	8	8	8.0
		Kids (< 6 month)	kg	8	8	8	8.0
Camels		Camels	kg	399	399	399	399
		Other Camels	kg	398	398	398	398
Horse, Mules and Asses	Horse	Adults	kg	500	500	500	500
	Mules and Asses	Asine	kg	250	250	250	250
Chickens		Chicken broiler	kg	3.4	3.4	3.4	3.4
		Chicken layers	kg	1.9	1.9	1.9	1.9
Rabbits			kg	2.8	2.8	2.8	2.8

3.2.2.3 Choice of emission factors

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
sheet	TIER1_EF_3.A_2019Ref
	TIER_2_PARAMETER_3A

Emission factors for TIER 1 methodology

For estimating the CH_4 emissions from the livestock categories camels, horses and mules and asses, the TIER 1 approach has been applied. Therefore, the default (D) emission factors of the 2019 Refinement to 2006 IPCC Guidelines were used.

Table 3-19 Tier 1 Emission Factor for livestock for 3.A Enteric Fermentation

Livestock	**Enteric fermentation emission factors for tier 1 method**		
	EF **kg CH_4 head-1**	**Type**	**Average liveweight** **kg**
Camels	46	**D**	570 kg
Horses	18	**D**	550 kg
Mules and Asses	10	**D**	245 kg
Note:	D	Default	
Source: TABLE 10.10 (updated): Enteric fermentation emission factors for tier 1 method, Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines			

Emission factors for TIER 2 methodology

For estimating the CH_4 emissions from the livestock categories cattle, sheep and goats the TIER 2 approach of the 2019 Refinement to 2006 IPCC Guidelines[41] has been applied. A country specific emission factors (CS EF) for methane (CH_4) was developed using the following equation and applied.

Equation 10.21 (updated): CH_4 emission factors for enteric fermentation from a livestock category (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$Emission\ factor_T = \frac{GE \times \frac{Y_m}{100} \times 365}{55.65}$$

Where:

EF = emission factor; kg CH_4 head-1 yr-1

GE = gross energy intake; MJ head-1 day-1

Ym = methane conversion factor; per cent of gross energy in feed converted to methane

55.65 = energy content of methane in MJ/kg CH_4

Obtaining the Gross energy (GE)

Gross energy (GE): As shown in Equation 10.16[21], GE requirement is derived based on the summed net energy requirements and the energy availability characteristics of the feed(s). Equation 10.16 represents

[21] *2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10*

good practice for calculating GE requirements for cattle and sheep using the results of the equations presented above.

Equation 10.16 (updated): gross energy for cattle/buffalo, sheep and goats (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$GE = \left[\frac{\frac{(NE_m + NE_a + NE_l + NE_{work} + NE_p)}{REM} + \frac{(NE_g + NE_{wool})}{REG}}{DE} \right]$$

Where:

Parameter	Description	Equations according to 2019 Refinements to the 2006 IPCC GL
GE	gross energy intake	
NE_m	net energy required by the animal for maintenance	10.3
NE_a	net energy for animal activity	10.4 and 10.5
NE_l	net energy for lactation	10.8. 10.9. 10.10
NE_{work}	net energy for work	10.11
NE_p	net energy required for pregnancy	10.13
REM	ratio of net energy available in a diet for maintenance to digestible energy	10.14
NE_g	net energy needed for growth	10.6. 10.7
REG	ratio of net energy available for growth in a diet to digestible energy consumed	10.15
DE	digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy)	

In the following the different parameters needed for estimation the gross energy intake are presented.

Net energy for maintenance: (NE_m) is the net energy required for maintenance, which is the amount of energy needed to keep the animal in equilibrium where body energy is neither gained nor lost.

The net energy required by the animal for maintenance is estimated based on the following equation:

Equation 10.16 (updated): net energy for maintenance (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$NE_m = Cf_i \times (Weight)^{0.75}$$

Where:

NEm = net energy required by the animal for maintenance (MJ day-1)
Cfi = a coefficient which varies for each animal category (MJ day-1 kg-1)
Weight = live-weight of animal (kg)

In the following table are the coefficients for calculating net energy for maintenance (NE_M) provided.

Table 3-20 Coefficients for calculating net energy for maintenance (NE_M)

Animal category	CFi (MJ D^{-1} KG^{-1})	COMMENTS
Cattle/Buffalo	0.322	All non-lactating cows, steers, heifers and calves

Animal category	CFi (MJ D^{-1} KG^{-1})	COMMENTS
Cattle/Buffalo (lactating cows)	0.386	Maintenance energy requirements are 20% higher during lactation
Cattle/Buffalo (bulls)	0.370	Maintenance energy requirements are 15% higher for intact males than non-lactating females
Sheep (lamb to 1 year	0.236	This value can be increased by 15% for intact males
Sheep (older than 1 year)	0.217	This value can be increased by 15% for intact males
Goats	0.315	
Source: TABLE 10.4 (UPDATED) Coefficients for calculating net energy for maintenance (NE_M), Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines		

Net energy for activity (NEa) is the net energy for activity, or the energy needed for animals to obtain their food, water and shelter. It is based on its feeding situation rather than characteristics of the feed itself. As presented in Table 10.3, the equation for estimating NEa for cattle and buffalo is different from the equation used for sheep and goats. Both equations are empirical with different definitions for the coefficient Ca.

(A) The net energy required by the animal for activity *for cattle and buffalo* is estimated based on the following equation:

Equation 10.4: net energy for activity (for cattle and buffalo)
(2019 Refinement to 2006 IPCC GL. Vol. 4, Chap. 10)

$$NE_a = C_a \times NE_M$$

Where:

NE_a	= net energy for animal activity (MJ day-1)
C_a	= coefficient corresponding to animal's feeding situation (MJ day^{-1} kg^{-1})
NEm	= net energy required by the animal for maintenance (MJ day-1) (calculated with Equation 10.16

(B) The net energy required by the animal for activity *for sheep and goats* is estimated based on the following equation:

Equation 10.5: net energy for activity (for sheep and goats)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$NE_a = C_a \times (Weight)$$

Where:

NE_a	= net energy for animal activity (MJ day-1)
C_a	= coefficient corresponding to animal's feeding situation (MJ day^{-1} kg^{-1})
Weight	= live-weight of animal (kg)

In the following table are the coefficients for calculating net energy for animal activity (NE_a) provided.

Table 3-21 Activity coefficients corresponding to animal's feeding situation (NE_a)

Situation	Definition	C_a	Unit
Cattle and Buffalo			
Stall	Animals are confined to a small area (i.e., tethered, pen, barn) with the result that they expend very little or no energy to acquire feed.	0	dimensionless

Situation	Definition	C_a	Unit
Pasture	Animals are confined in areas with sufficient forage requiring modest energy expense to acquire feed.	0.17	
Grazing large areas	Animals graze in open range land or hilly terrain and expend significant energy to acquire feed.	0.36	
Sheep and goats			
Housed ewes	Animals are confined due to pregnancy in final trimester (50 days).	0.0096	MJ d^{-1} kg^{-1}
Grazing flat pasture	Animals walk up to 1000 meters per day and expend very little energy to acquire feed.	0.0107	
Grazing hilly pasture	Animals walk up to 5,000 meters per day and expend significant energy to acquire feed.	0.024	
Housed fattening lambs	Animals are housed for fattening.	0.0067	
Lowland goats	Animals walk and graze in lowland pasture	0.019	
Hill and mountain goats	Animals graze in open range land or hilly terrain and expend significant energy to acquire feed.	0.024	
Source: TABLE 10.5 (UPDATED) Activity coefficients corresponding to animal's feeding situation, Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines			

Net energy for growth (NE_g) is the net energy needed for growth (i.e., weight gain). Constants for conversion from calories to joules and live to shrunk and empty body weight have been incorporated into the equation.

(A) The net energy required by the animal for growth *for cattle and buffalo* is estimated based on the following equation:

Equation 10.6: net energy for growth (for cattle and buffalo)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$NE_g = 22.02 \times \left(\frac{BW}{C \times MW}\right)^{0.75} \times WG^{1.097}$$

Where:

NE_a = net energy for animal growth (MJ day-1)

BW = the average live body weight (BW) of the animals in the population (kg)

C = a coefficient with a value of 0.8 for females
1.0 for castrates
1.2 for bulls

MW = the mature body weight of an adult animal individually, mature females, mature males and steers) in moderate body condition (kg)

WG = the average daily weight gain of the animals in the population (kg day-1)

(B) The net energy required by the animal for growth *for sheep and goats* is estimated based on the following equation:

Equation 10.7: net energy for growth (for sheep and goats)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$NE_g = \frac{WG_{lamb/kid} \times \left(a + 0.5 \times b\left(BW_i + BW_f\right)\right)}{365}$$

Where:

NE_a = net energy for animal growth (MJ day-1)

$WG_{lamb/kid}$ = weight gain (BW_f – BW_i) (kg yr^{-1})

BW_i = live bodyweight at weaning (kg)

BW_f = live bodyweight at 1-year old or at slaughter (live-weight) if slaughtered prior to 1 year of age (kg)

a, b = constants

In the following table are the coefficients for calculating net energy for animal growth (NE_g) provided.

Table 3-22 Constants for use in calculating NE_g for sheep and goats

Animal species/category	a	b	Units	Applied in Algerian Inventory
Intact males (Sheep)	2.5	0.35	**MJ kg^{-1}**	
Castrates (Sheep)	4.4	0.32		x
Females (Sheep)	2.1	0.45		x
Goats (all categories)	5.0	0.33		x
Source: TABLE 10.6 (UPDATED) Constants for use in calculating NE_g for sheep and goats, Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines				

Net energy for lactation: (NE_l) is the net energy for lactation.

(A) For cattle and buffalo, the net energy for lactation is expressed as a function of the amount of milk produced and its fat content expressed as a percentage (e.g., 4 percent):

Equation 10.8: net energy for lactation (for beef cattle, dairy cattle and buffalo)
(2019 Refinement to 2006 IPCC GL, Vol. 4. Chap. 10)

$$NE_l = Milk \times (1.47 + 0.40 \times Fat)$$

Where:

NE_l = net energy for lactation (MJ day-1)

Milk = amount of milk produced (kg of milk day-1)

Fat = fat content of milk (percent by weight)

(B) For sheep, net energy required for lactation is estimated based on the following equation[22]:

Equation 10.9: net energy for lactation (for sheep and goats – milk production known)
(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$NE_l = Milk \times EV_{milk}$$

Where:

NE_l = net energy for lactation (MJ day-1)

Milk = amount of milk produced (kg of milk day-1)

EV_{milk} = the net energy required to produce 1 kg of milk

[22] Two methods for estimating the net energy required for lactation (NEl) are presented for sheep. The first method (Equation 10.9) is used when the amount of milk produced is known, and the second method (Equation 10.10) is used when the amount of milk produced is not known. Generally, milk production is known for ewes kept for commercial milk production, but it is not known for ewes that suckle their young to weaning. With a known amount of milk production, the total annual milk production is divided by 365 days to estimate the average daily milk production in kg/day (Equation 10.9). When milk production is not known, AFRC (1990) indicates that for a single birth, the milk yield is about 5 times the weight gain of the lamb. For multiple births, the total annual milk production can be estimated as five times the increase in combined weight gain of all lambs birthed by a single ewe. The daily average milk production is estimated by dividing the resulting estimate by 365 days as shown in Equation 10.10.

Net energy for work (NE_{work}) is the net energy for work. It is used to estimate the energy[23] required for draft power for cattle and buffalo. This value is used as follows:

Equation 10.11: net energy for work (for cattle and buffalo) *(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)*

$$NE_{work} = 0.10 \times NE_m \times hours$$

Where:

NE_{work} = net energy for work (MJ day-1)

NE_m = net energy required by the animal for maintenance (Equation 10.3) (MJ day-1)

hours = number of hours of work per day

Net energy for wool production (NEwool) is the average daily net energy required for sheep to produce a year of wool. The NE_{wool} is calculated as follows:

Equation 10.12: net energy for wool production (for sheep and goats) *(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)*

$$NE_{wool} = \left(\frac{EV_{wool} \times Pr_{wool}}{365}\right)$$

Where:

NE_{wool} = net energy required to produce wool (MJ day-1)

EV_{wool} = the energy value of each kg of wool produced (weighed after drying but before scouring) (MJ kg-1)
A default value of 24 MJ kg-1 can be used for sheep estimate

PR_{wool} = annual wool production per sheep (kg)

Net energy for pregnancy (NE_p) is the energy required for pregnancy.

For cattle and buffalo, the total energy requirement for pregnancy for a 281-day gestation period averaged over an entire year is calculated as 10 percent of NE_m.

For sheep, the NE_p requirement is similarly estimated for the 147-day gestation period, although the percentage varies with the number of lambs born (Table 10.7, Constant for Use in Calculating NEp in Equation 10.13).

The net energy for pregnancy is the energy required for pregnancy is estimated based on the following equation.

Equation 10.13 (updated): net energy for pregnancy *(for cattle and buffalo, sheep and goats)* *(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)*

$$NE_{pregnancy} = C_{pregnancy} \times NE_m$$

Where:

NE_p = net energy required for pregnancy (MJ day-1)

$C_{pregnancy}$ = net energy required by the animal for maintenance (Equation 10.3) (MJ day-1)

[23] The strenuousness of the work performed by the animal influences the energy requirements, and consequently a wide range of energy requirements have been estimated. The values by Bamualim and Kartiarso show that about 10 percent of a day's NEm requirements are required per hour for typical work for draft animals.

NE_m = net energy required by the animal for maintenance (Equation 10.3) (MJ day-1)

In the following table are the constants for use in calculating NE_g for sheep and goats.

Table 3-23 Constants for use in calculating NE_g for sheep and goats

Animal category	Cpregnancy	Applied in Algerian Inventory
Cattle and Buffalo	0.10	x
Sheep/Goats		
Single birth	0.077	x
Double birth (twins)	0.126	
Triple birth or more (triplets)	0.150	
Source: TABLE 10.7 (UPDATED) Constants for use in calculating NEp in equation 10.13, Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines		

Ratio of net energy available in diet for maintenance to digestible energy consumed (REM): For cattle, buffalo, sheep and goats, the ratio of net energy available in a diet for maintenance to digestible energy (REM) is estimated using the following equation:

Equation 10.14: Ratio of net energy available in diet for maintenance to digestible energy (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$REM = \left[1.123 - \left(4.092\times10^{-3}\times DE\right) + \left(1.126\times10^{-5}\times (DE)^{2}\right) - \left(\frac{25.4}{DE}\right)\right]$$

Where:

REM = ratio of net energy available in diet for maintenance to digestible energy

DE = digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy)

Ratio of net energy available for growth in a diet to digestible energy consumed (REG): For cattle, buffalo, sheep and goats the ratio of net energy available for growth (including wool growth) in a diet to digestible energy consumed (REG) is estimated using the following equation:

Equation 10.14: Ratio of net energy available in diet for maintenance to digestible energy (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)

$$REG = \left[1.164 - \left(5.16\times10^{-3}\times DE\right) + \left(1.308\times10^{-5}\times (DE)^{2}\right) - \left(\frac{37.4}{DE}\right)\right]$$

Where:

REG = ratio of net energy available for growth in a diet to digestible energy consumed

DE = digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy)

Obtaining the methane conversion factor (Ym)

The extent to which feed energy is converted to CH_4 depends on several interacting feed and animal factors and that rate of conversion is embodied in the methane conversion factor (Ym), defined as the percentage of gross energy intake converted to methane.

There are a wide variety of factors that influence methane conversion rates and due to national circumstances related to breeds, genetic pools as well as particularities of feed and herd interactions, the Ym factors may vary from region to region. Considering interactions between feed (type and quality) and animals (breed and genetics), it is good practice for countries to derive their own Ym values considering their herds and their typical feed characteristics.

As no country specific methane conversion factor was available, the IPCC default values were used.

Table 3-24 Cattle/Buffalo methane conversion factors (Y_M)

Livestock category	Description	Feed quality Digestibility (DE)	Neutral Detergent Fibre (NDF)	MY	Ym	Applied in Algerian Inventory
		%	% DMI	g CH_4 kg DMI^{-1}		
Dairy cows and Buffalo	High-producing cows (>8500 kg/head/yr^{-1})	DE ≥ 70	NDF ≤ 35	19.0	5.7	
	High-producing cows (>8500 kg/head/yr^{-1})	DE ≥ 70	NDF ≥ 35	20.0	6.0	x
	Medium producing cows (5000 – 8500 kg yr^{-1})	DE 63-70	NDF > 37	21.0	6.3	x
	Low producing cows (<5000 kg yr^{-1})	DE ≤ 62	NDF >38	21.4	6.5	x
Non-dairy and multi-purpose Cattle and Buffalo	> 75 % forage	DE ≤ 62		23.3	7.0	x
	Rations of >75% high quality forage and/or mixed rations, forage of between 15 and 75% the total ration mixed with grain, and/or silage	DE 62–71		21.0	6.3	x
	Feedlot (all other grains, 0- 15% forage)	DE ≥ 72		13.6	4.0	x
	Feedlot (steam-flaked corn, ionophore supplement - 0-10% forage)	DE > 75		10.0	3.0	

Source: TABLE 10.12 (UPDATED) Cattle/Buffalo methane conversion factors (YM), Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines

Table 3-25 Sheep and goats CH_4 conversion factors (Y_M)

Category	Ym	Standard deviation of the mean of the Ym
Sheep	6.7%	± 0.9
Goats	5.5%	± 1.0

Source: TABLE 10.13 (UPDATED) Sheep and goats CH_4 conversion factors (YM), Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines

Comparison of CS emission factor with IPCC default emission factor

In the following table is provided a comparison of CS emission factor (for 2022) for Mature Dairy Cows (⇨ High Productivity Systems ⇨ Bovin Laitier Moderne (BLM) with IPCC default emission factors of different regions.

Table 3-26 Mature Dairy Cows: Comparison of CS emission factor with IPCC default emission factor

Category	Description	Region	EF	Unit	Source
Mature Dairy Cow in ⇨High Productivity Systems ⇨Bovin Laitier Moderne (BLM)	IPCC default emission factors (EF) for CH_4 TIER 1 method	Western Europe	**126.0**	kg CH_4 head^{-1} yr^{-1}	TABLE 10.11, Chap. 10, Vol. 4 [24]
		Africa	**86.0**		
		Eastern Europe	**93.0**		
		Middle East	**94.0**		
	Country specific emission factors (CS EF) for CH_4; TIER 2 method		**97.49**	kg CH_4 head^{-1} yr^{-1}	Country specific

In the following table is provided a comparison of CS emission factor (for 2022) for sheep ⇨ high productivity systems with IPCC default emission factors of different regions.

Table 3-27 Sheep: Comparison of CS emission factor with IPCC default emission factor

Category	Description	EF	Unit	Source	EF
sheep in high productivity systems	IPCC default emission factors (EF) for CH_4	TIER 1 method	**9.00**	kg CH_4 head^{-1} yr^{-1}	TABLE 10.10[25]
	Country specific emission factors (CS EF) for CH_4	TIER 2 method	**8.09**	kg CH_4 head^{-1} yr^{-1}	Country specific

In the following table is provided a comparison of CS emission factor (for 2022) for goats ⇨ high productivity systems with IPCC default emission factors of different regions.

Table 3-28 Goats: Comparison of CS emission factor with IPCC default emission factor

Category	Description	EF	Unit	Source	EF
goats in high productivity systems	IPCC default emission factors (EF) for CH_4	TIER 1 method	**9.00**	kg CH_4 head^{-1} yr^{-1}	TABLE 10.10[26]
	Country specific emission factors (CS EF) for CH_4	TIER 2 method	**9.81**	kg CH_4 head^{-1} yr^{-1}	Country specific

Exemplary calculation of the country specific emission factor (CS EF)

In the following tables are provided parameters used for calculation of country specific emission factor for CH_4 emissions from Enteric fermentation (TIER 2) from dairy cattle and sheep.

Table 3-29 Parameters used for calculation of country specific emission factor for CH_4 from 3.A.1.a.i Dairy cattle applying Tier 2 methodology

Paramete r	Parameter description	Unit	Formula	Source	Year 2022
$Mat_{Cow\text{-}High}$	Mature Dairy Cow High Productivity Systems Bovin Laitier Moderne (BLM)	#	-	MARD	177. 648

[24] TABLE 10.11 (UPDATED) TIER 1 and TIER 1A enteric fermentation emission factors for cattle and buffalo, Chapter 10: Emissions from Livestock and Manure Management, Volume 4: AFOLU, 2019 Refinement to the 2006 IPCC Guidelines

[25] TABLE 10.10 (UPDATED) Enteric fermentation emission factors for TIER 1 method, Chap. 10, Vol.4, 2019 Refinement to the 2006 IPCC GL

[26] TABLE 10.10 (UPDATED) Enteric fermentation emission factors for TIER 1 method, Chap. 10, Vol.4, 2019 Refinement to the 2006 IPCC GL

Parameter	Parameter description	Unit	Formula	Source	Year 2022
W (=MW)	Live Weight	kg	-	Middle East, High PS[27], TABLE 10A.5 (new) Default values for live weights for animal categories, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.104	500
BW	Calf birth weight	kg	0.266xW^0.79	Equation 7 - IPCC Ref Man 1996[28]	36.03
WG	Average Daily Weight Gain	kg/day	-	TABLE 10A.1 Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.104	NA
AMiY	Annual Milk Yield	kg/cow/year	4250x1.03	MARD	9,590.8
DMiY	Daily Milk Yield	kg/cow/day	AMiY/365	MARD	26.28
Fat	Fat Content of Milk	%	-	Table 2, Nutritional and hygienic quality of raw milk intended for consumption in the region of Guelma, Algeria[29]	3.72%
DE	Digestible Energy	%	-	Table 10.2, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	67.5%
C_{FI}	Coefficients for calculating NE_m	MJ/day/kg	-	Table 10.4, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	0.386
NE_m	Net Energy for Maintenance	MJ/day	C_{Fi}xW^0.75	Equation 10.3, Chap. 10, Vol. 4, 2006 IPCC Guidelines	40.81
C_a	Activity Coefficient	#	-	Table 10.5, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	0
NE_a	Net Energy for Activity	MJ/day	C_a x NE_m	Equation 10.4, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.00
C	Constants for conversion	#	-	Equation 10.6, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NA
NE_g	Net Energy for Growth	MJ/day	22.02x(BW/CxMW)^0.75x(WG)^1.097	Equation 10.6, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NA
NE_l	Net Energy for Lactation	MJ/day	DMiYx(1.47+0.4xFat)	Equation 10,8, Chap. 10, Vol. 4, 2006 IPCC Guidelines	32.02
NE_w	Net Energy for Draft Power (Work)	MJ/day	0.10xNEmxhours worked per day	Equation 10.11, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NO
NE_{wool}	Net Energy for wool	MJ/day	0.10xNEmxhours worked per day	Equation 10.12, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NA
$C_{pregnancy}$	Pregnancy coefficient	#	-	Table 10.7, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL,	0.08
NE_p	Net Energy for Pregnancy	MJ/day	$C_{Pregnany}$ x NE_m	Equation 10.13, Chap. 10, Vol. 4, 2006 IPCC Guidelines	3.27

[27] High PS and Low PS refer to high- and low productivity systems

[28] Revised 1996 IPCC Guidelines: Reference Manual, Agriculture, page 4.19

[29] A, Bousbia, S, Boudalia, Y, Gueroui, B, Belaize, S, Meguelati, M, Amrouchi, R, Ghebache, B, Belkheir and M, Benidir (2018): Nutritional and hygienic quality of raw milk intended for consumption in the region of Guelma, ASIAN JOURNAL OF DAIRY AND FOOD RESEARCH, Asian J, Dairy & Food Res, Print ISSN:0971-4456 / Online ISSN:0976-0563, DOI: 10,18805/ajdfr,DR-123

Paramete r	Parameter description	Unit	Formula	Source	Year 2022
REM (NEma/DE)	Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed	#	1.123-(4.092x10^-3 xDE) + (1.126x10^-5xDE^2)-(25.4/DE)	Equation 10.14, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.52
REG (NEga/DE)	Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed	#	1.164-(5.160x10^-3 xDE)+(1.308x10^-5 xDE^2)-(37.4/DE)	Equation 10.15, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.32
GE	Gross Energy Intake (average)	MJ/day	{[(NEm+NEa+NEl+NEw+NEp)/REM]+[NEg/REG]}/(DE/100)	Equation 10.16, Chap. 10, Vol. 4, 2006 IPCC Guidelines	125.15
Y_m	CH_4 conversion rate (average)	%		TABLE 10.12, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.45	6.0%
EF - CH_4	Emission Factor - CH_4	kg CH_4/ head/ year	(GExYmx365)/55.65	TABLE 10.12, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.45	97.49
CH_4 Emi	CH_4 Emissions (Tier 2)	kt CH_4	L x IEF_{CH4} x 10^-6		17.32
M	Method	-	-	-	T2
EF used	EF used	-	-	-	CS

Table 3-30 Parameters used for calculation of country specific emission factor for CH_4 from 3.A.2 Dairy sheep applying Tier 2 methodology

Parameter	Parameter description	Unit	Formula	Source	Year 2022
Mat $_{sheep\text{-}High}$	**Mature Sheep – Female High productivity systems**	#	-	MARD	3.368.335
W (=MW)	Live Weight	kg	-	expert judgment	40
BW	Calf birth weight	kg	0.266xW^0.79	Equation 7 - IPCC Ref Man 1996[30]	4.90
WG	Average Daily Weight Gain	kg/day	-	TABLE 10A.1 Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.104	NA
AMiY	Annual Milk Yield	kg/cow/year	4250x1.03	Chap 3.3, Caractéristiques de l'élevage bovin laitier en Algérie, 2021	49
DMiY	Daily Milk Yield	kg/cow/day	AMiY/365		0.13
Fat	Fat Content of Milk	%	-	Table 2, Nutritional and hygienic quality of raw milk intended for consumption in the region of Guelma, Algeria[31]	3.72%
DE	Digestible Energy	%	-	Table 10.2, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	55%

[30] Revised 1996 IPCC Guidelines: Reference Manual, Agriculture, page 4.19

[31] A, Bousbia, S, Boudalia, Y, Gueroui, B, Belaize, S, Meguelati, M, Amrouchi, R, Ghebache, B, Belkheir and M, Benidir (2018): Nutritional and hygienic quality of raw milk intended for consumption in the region of Guelma, ASIAN JOURNAL OF DAIRY AND FOOD RESEARCH, Asian J, Dairy & Food Res, Print ISSN:0971-4456 / Online ISSN:0976-0563, DOI: 10,18805/ajdfr,DR-123

Parameter	Parameter description	Unit	Formula	Source	Year 2022
C_{FI}	Coefficients for calculating NE_m	MJ/day/kg	-	Table 10.4, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	0.217
NE_m	Net Energy for Maintenance	MJ/day	C_{Fi}xW^0.75	Equation 10.3, Chap. 10, Vol. 4, 2006 IPCC Guidelines	3.45
C_a	Activity Coefficient	#	-	TABLE 10.5, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL, page 10.21	0.0107
NE_a	Net Energy for Activity	MJ/day	C_a x W	Equation 10.5, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL	0.43
C	Constants for conversion	#	-	Equation 10.6, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NA
NE_g	Net Energy for Growth	MJ/day	22.02x(BW/CxMW)^0.75x(WG)^1.097	Equation 10.9, Chap. 10, Vol. 4, 2006 Ref to 2006 IPCC GL	NA
EVmilk	energy required to produce 1 kg of milk	MJ/kg		Equation 10,10, Chap. 10, Vol. 4, 2006 Ref to 2006 IPCC GL	4.60
NE_l	Net Energy for Lactation	MJ/day	EV Milk* (DMiY)	Equation 10.9, Chap. 10, Vol. 4, 2006 Ref to 2006 IPCC GL	0.61
NE_w	Net Energy for Draft Power (Work)	MJ/day	0.10xNEmxhours worked per day	Equation 10.11, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NO
Prwool	annual wool production per sheep	kg/year		MARD	0.88
EV_{wool}	energy value of each kg of wool produced	MJ/day/kg		Default	24.0
NE_{wool}	Net Energy for wool	MJ/day	(Prwool*Ev)/365	Equation 10.12, Chap. 10, Vol. 4, 2006 Ref to 2006 IPCC GL	0.06
$C_{pregnancy}$	Pregnancy coefficient	#	-	Table 10.7, Chap. 10, Vol. 4, 2019 Ref to 2006 IPCC GL,p10,28	0.077
NE_p	Net Energy for Pregnancy	MJ/day	$C_{Pregnany}$ x NE_m	Equation 10.13, Chap. 10, Vol. 4, Ref to 2006 IPCC GL; 2006 IPCC GL	0.27
REM (NEma/DE)	Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed	#	1.123-(4.092x10^-3 xDE)+(1.126x10^-5 xDE^2)-(25.4/DE)	Equation 10.14, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.47
REG (NEga/DE)	Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed	#	1.164-(5.160x10^-3 xDE)+(1.308x10^-5 xDE^2)-(37.4/DE)	Equation 10.15, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.24
GE	Gross Energy Intake (average)	MJ/day	{[(NEm+NEa+NEl+NEw+NEp)/REM]+[NEg/REG]}/(DE/100)	Equation 10.16, Chap. 10, Vol. 4, 2006 IPCC Guidelines	18.40
Y_m	CH_4 conversion rate (average)	%		TABLE 10.13, Chap. 10, Vol. 4, Ref to 2006 IPCC GL2006 IPCC, page 10.46	6.7%
EF - CH_4	Emission Factor - CH_4	kg CH_4/ head/ year	(GExYmx365)/55.65	Equation 10.21, Chap. 10, Vol. 4, 2006 IPCC Guidelines	8.09
CH_4 Emi	CH_4 Emissions (Tier 2)	kt CH_4	L x IEF_{CH4} x 10^-6		27.26
M	Method	-	-	-	T2

Parameter	Parameter description	Unit	Formula	Source	Year 2022
EF used	EF used	-	-	-	CS

3.2.3 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	QA-QC-Checklist_3A

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
- consistent use of livestock data,
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection, unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation,
- cross-checked from different sources:
    - national statistic (Ministry of Agriculture and Rural Development (MARD)
    - ONS
    - scientific research and publications
    - international statistics (FAO)
- consistency and completeness checks are performed; time series consistency - plausibility checks of dips and jumps.

3.2.4 Uncertainty assessment and time-series consistency

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Uncertainty_3A-3B-3D

The uncertainties for activity data and emission factors used for CRT category 3.A.1 Enteric Fermentation are presented in the following table.

Table 3-31 Uncertainty for CRT category 3.A.1 Enteric Fermentation.

Uncertainty	Cattle	sheep, goats, camels, horses, mules and asses	Reference
	CH_4	CH_4	2006 IPCC GL, Vol. 4, Chap. 10
Activity data: Livestock	20%	20%	Chapter 10.2.3
Activity data: Feed digestibility (DE%)	20%	-	Chapter 10.2.3

Emission factor	20%	40%	Chapter 10.3.4
Combined Uncertainty	35%	45%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

3.2.5 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Recalculation_3A-3B-3D

The following table presents the main revisions and recalculations done since the last submission to the UNFCCC and relevant to CRT category 3.A.1 Enteric Fermentation.

Table 3-32 Recalculations done in CRT category 3.A.1 Enteric Fermentation

GHG source & sink category	Revisions of data since last NC and GHG inventory submission	Type of revision	Type of improvement

3.2.6 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	PlannedImprovements _3A-3B-3D

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-33 Planned improvements for CRT category 3.A.1 Enteric Fermentation

GHG source & sink category	Planned improvement	Type of improvement		Priority

3.3 Manure management (CRT category 3.B)

3.3.1 Category description

➯ **Crosscheck, if updated information is available and consistent with category chapters and chapter 1.4**

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.B.2	Manure Management						
3.B.2.a	Cattle	NA	-	✔	Without LULUCF: LA 1990, TA With LULUCF: LA 1990,	✔	-
3.B.2.a.i	Dairy cows	NA	-	✔	(yes, see cattle)	✔	-
3.B.2.a.ii	Other cattle	NA	-	✔	(yes, see cattle)	✔	-
3.B.2.b	Buffalo	NA	-	NO		NO	-
3.B.2.c	Sheep	NA	-	✔		✔	-
3.B.2.d	Goats	NA	-	✔		✔	-
3.B.2.e	Camels	NA	-	✔	-	✔	-
3.B.2.f	Horses	NA	-	✔	-	✔	-
3.B.2.g	Mules and Asses	NA	-	✔	-	✔	-
3.B.2.h	Swine	NA	-	NO	-	NO	-
3.B.2.i	Poultry	NA	-	✔	-	✔	-
3.B.2.i.i	Laying hens	NA	-	IE	-	IE	-
3.B.2.i.ii	Broilers	NA	-	✔	-	✔	-
3.B.2.i.iii	Turkeys	NA	-	IE	-	IE	-
3.B.2.i.iv	Other poultry	NA	-	✔	-	✔	-
3.B.2.j	Other (rabbit)	NA	-	✔	-	✔	-
A '✔' indicates: emissions from this category have been estimated. Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

The drop in 2022 is due to revision of national agricultural statistics[32].

Folder	\06_Inventory\2024_submission\10_CRT
File	3_CRT_Tables_Input_DZA.xlsx
sheet	Table 3_GHG_T_eq, Table 3_CO2_T, Table 3_CH4_T, Table 3_CH4_T_eq, Table 3_N2O_T, Table 3_N2O_T_eq

[32] For further information see **Annex V Additional information**

2. Recensement du cheptel 2022 : […] portant sur le lancement d'une opération de recensement national du cheptel, et ce, dans le but d'accroitre la connaissance précise du cheptel des grands ruminants ainsi que celui du camelin et de l'équin, un dispositif a été mis en place, conduit par un groupe de travail chargé du suivi de cette opération, […] , instaurant une forme d'organisation locale, présidée par les Walis, pour conduire les opérations de collecte des données en réquisitionnant l'ensemble des capacités matérielles et humaines pour le bon déroulement de ce recensement, dont les opérations sur terrain ont débuté le 29 novembre 2022. Les opérations de terrain ont durée trois semaine, du 29 novembre au 19 décembre, et ont été prolongés jusqu'au 31 janvier 2023, et ce, au vu de plusieurs raisons valables, relatives au fait de l'étendu des territoires à enquêter, de la dispersion des élevages ainsi qu'aux difficultés liées aux modes d'élevage notamment transhumant.

NID CHAPTER	3.2.1 Category description	
ToDo	Check for updated reasons for trend in sectoral chapter	
	Update GHG emissions and AD in tables & graphs	
	Tables and Graphs from sheet	Table 3_GHG_T_eq
		Table 3_CO2_T
		Table 3_CH4_T, Table 3_CH4_T_eq
		Table 3_N2O_T, Table 3_N2O_T_eq
	Check for updated reasons for trend in chapter ● Trend -> 2.2.1 Energy ● Executive Summary	

An overview of the methane (CH_4) and nitrous oxide (N_2O) emissions resulting of CRT category 3.B. *Manure Management* is provided in the following figure and tables.

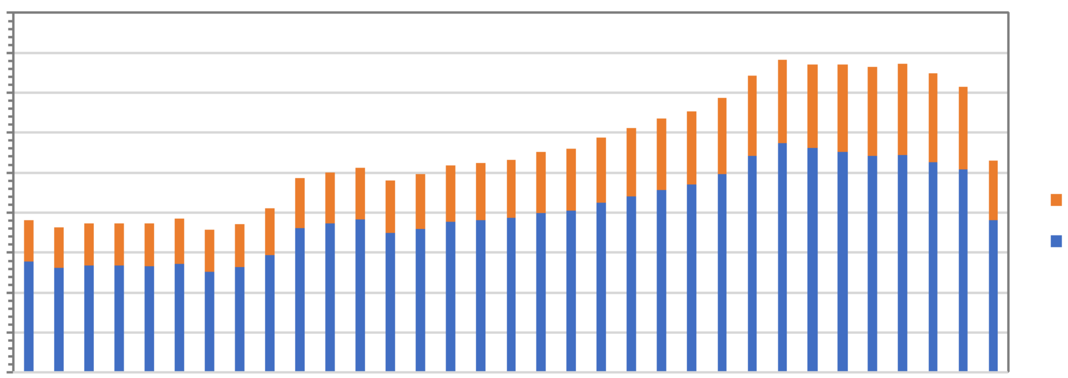
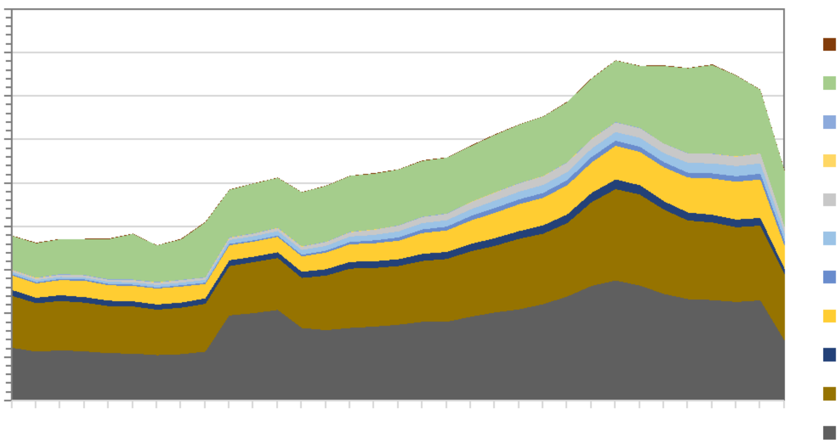


Figure 3-17 Emission of CRT category 3.B Manure management



Note: Not occurring (NO) are CRT categories:	3.B.3. Swine 3.B.4.a. Buffalo	3.B.4.c. Deer 3.B.4.h.ii. Reindeer	3.B.4.h.iii. Ostrich 3.B.4.h.iv. Fur-bearing animals

Figure 3-18 Emission of CRT category 3.B Manure management

Table 3-34 CH_4 Emissions from CRT category 3.B Manure management by sub-categories.

CH_4 emissions	3.B.1	3.B.1.a	3.B.1.a.i	3.B.1.a.ii.	3.B.1.a.iii.	3.B.2	3.B.2.a.i.	3.B.2.a.ii.	3.B.3
	Manure management	Cattle	Mature dairy cattle	Other mature cattle	Growing cattle	Sheep	Mature Swine	Growing Swine	Swine
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990									
1991									
1992									
1993									
1994									
2018									
2019									
2020									
2021									
2022									
Trend									
1990 - 2022									
2010 - 2022									
2021 - 2022									

CH_4 emissions	3.B.1	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h.i
	Manure management	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Rabbits
	kt	kt	kt	kt		kt	kt	kt	kt	kt
1990										
1991										
1992										
1993										
1994										
2019										
2020										
2021										
2022										
Trend										
1990 - 2022										
2010 - 2022										

CH_4 emissions	3.B.1	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h.i
	Manure management	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Rabbits
	kt	kt	kt	kt		kt	kt	kt	kt	kt
2021 - 2022										

Table 3-35 N_2O Emissions from CRT category 3.B Enteric Fermentation by sub-categories

N_2O emissions	3.B.1	3.B.1.a	3.B.1.a.i	3.B.1.a.ii.	3.B.1.a.iii.	3.B.2	3.B.2.a.i.	3.B.2.a.ii.	3.B.3
	Manure management	Cattle	Mature dairy cattle	Other mature cattle	Growing cattle	Sheep	Mature Swine	Growing Swine	Swine
	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990									
1991									
1992									
1993									
1994									
1995									
2019									
2020									
2021									
2022									
Trend									
1990 - 2022									
2010 - 2022									
2021 - 2022									

N_2O emissions	3.B.1	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h.i
	Manure managem ent	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Rabbits
	kt	kt	kt	kt		kt	kt	kt	kt	kt
1990										
1991										
1992										
1993										
1994										
2018										
2019										
2020										
2021										
2022										

N_2O emissions	3.B.1	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h.i
	Manure managem ent	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Rabbits
	kt	kt	kt	kt		kt	kt	kt	kt	kt
Trend										
1990 - 2022										
2010 - 2022										
2021 - 2022										

This section describes the estimation of methane and nitrous oxide emissions resulting during the storage and treatment of manure, and from manure deposited on pasture. The term ‘manure’ is used here collectively to include both dung and urine (i.e. the solids and the liquids) produced by livestock. The following figure shows a schematic overview of manure management practices.

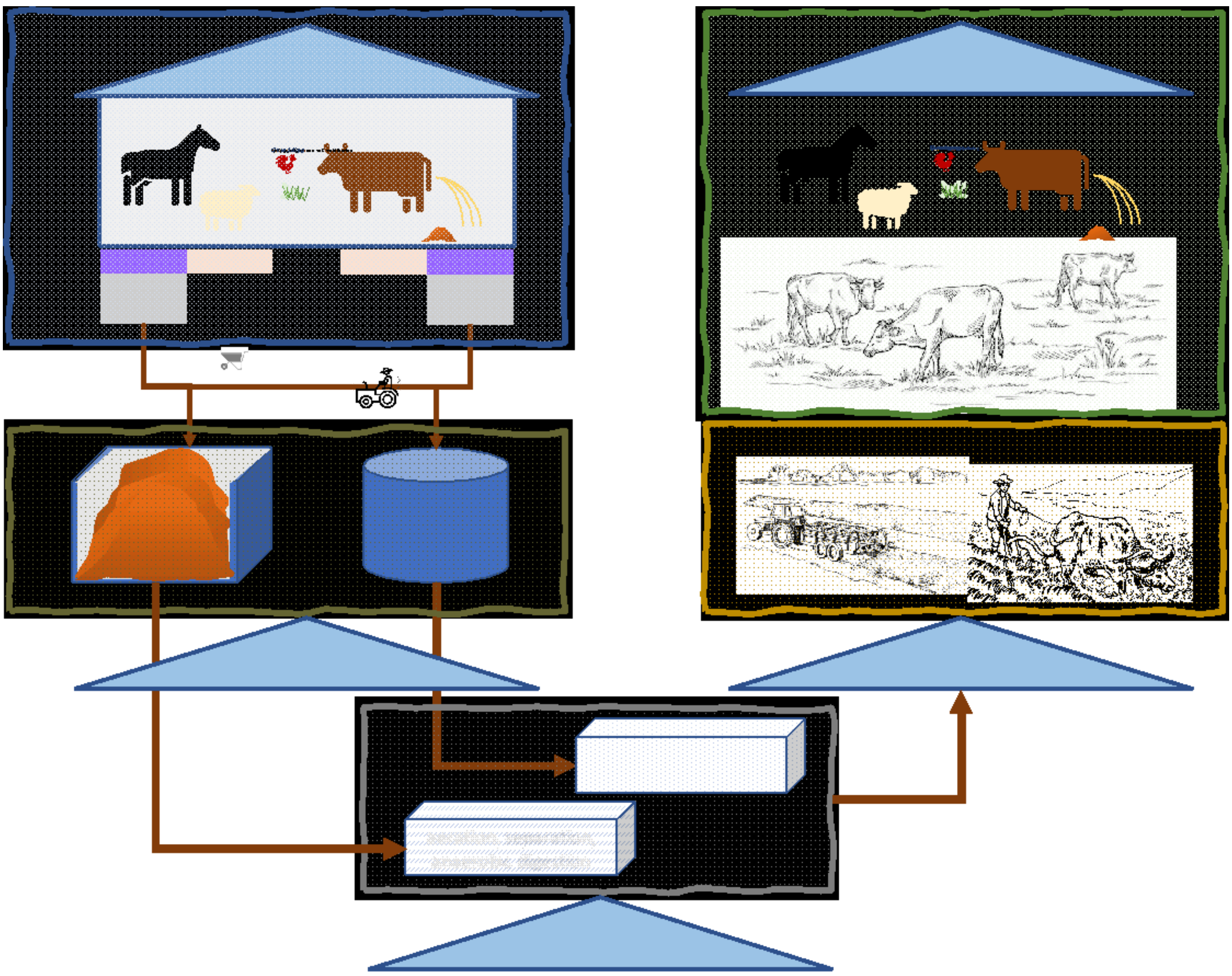


Figure 3-19 Schematic overview of manure management practices

As described in the Refinement 2019 to 2006 IPCC Guidelines (Volume 4, Chapter 10.4) methane (CH_4) is produced during decomposition of manure under anaerobic conditions (i.e., in the absence of oxygen), during storage and treatment. These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems.

The main factors affecting CH_4 emissions are:

- the amount of manure produced:
- depending on the rate of waste production per animal and the number of animals
- the portion of the manure that decomposes anaerobically
- depending on how the manure is managed
- when manure is stored or treated as a liquid (e.g., in lagoons, ponds, tanks, or pits), it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and the retention time of the storage unit greatly affect the amount of methane produced.

when manure is handled as a solid (e.g., in stacks or piles) or when it is deposited on pastures and rangelands, it tends to decompose under more aerobic conditions and less CH_4 is produced.

As described in the 2006 IPCC Guidelines (Volume 4, Chapter 10.5) nitrous oxide (N_2O) is produced, directly and indirectly, during the storage and treatment of manure before it is applied to land or otherwise used for feed, fuel, or construction purposes.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure. The emission of N_2O from manure during storage and treatment depends on the nitrogen and carbon content of manure, and on the duration of the storage and type of treatment. Nitrification (the oxidation of ammonia nitrogen to nitrate nitrogen) is a necessary prerequisite for the emission of N_2O from stored animal manures. Nitrification is likely to occur in stored animal manures provided there is a sufficient supply of oxygen. Nitrification does not occur under anaerobic conditions. Nitrites and nitrates are transformed to N_2O and dinitrogen (N2) during the naturally occurring process of denitrification, an anaerobic process.

Indirect emissions result from volatile nitrogen losses that occur primarily in the forms of ammonia and NOx. The fraction of excreted organic nitrogen that is mineralized to ammonia nitrogen during manure collection and storage depends primarily on time, and to a lesser degree temperature. Simple forms of organic nitrogen such as urea (mammals) and uric acid (poultry) are rapidly mineralized to ammonia nitrogen, which is highly volatile and easily diffused into the surrounding air. Nitrogen losses begin at the point of excretion in houses and other animal production areas (e.g., milk parlors) and continue through on-site management in storage and treatment systems (i.e. manure management systems). Nitrogen is also lost through runoff and leaching into soils from the solid storage of manure at outdoor areas, in feedlots and where animals are grazing in pastures.

The CH_4 emissions generated by manure in the system 'buildings housing livestock, manure stores or yards' are reported under

⇒ 3.B Manure Management

system 'manure handling and storage' are reported under

⇒ 3.B Manure Management

The N_2O emissions generated by manure in the system 'pasture, range, and paddock' occurs directly and indirectly from the soil, and are therefore reported under the category

⇒ 3.D.a Direct N_2O emissions from managed soils

⇒ 3.D.a.2 Organic N fertilizers

⇒ 3.D.a.2.a Animal manure applied to soils

⇒ 3.D.b IndirectN_2O Emissions from managed soils

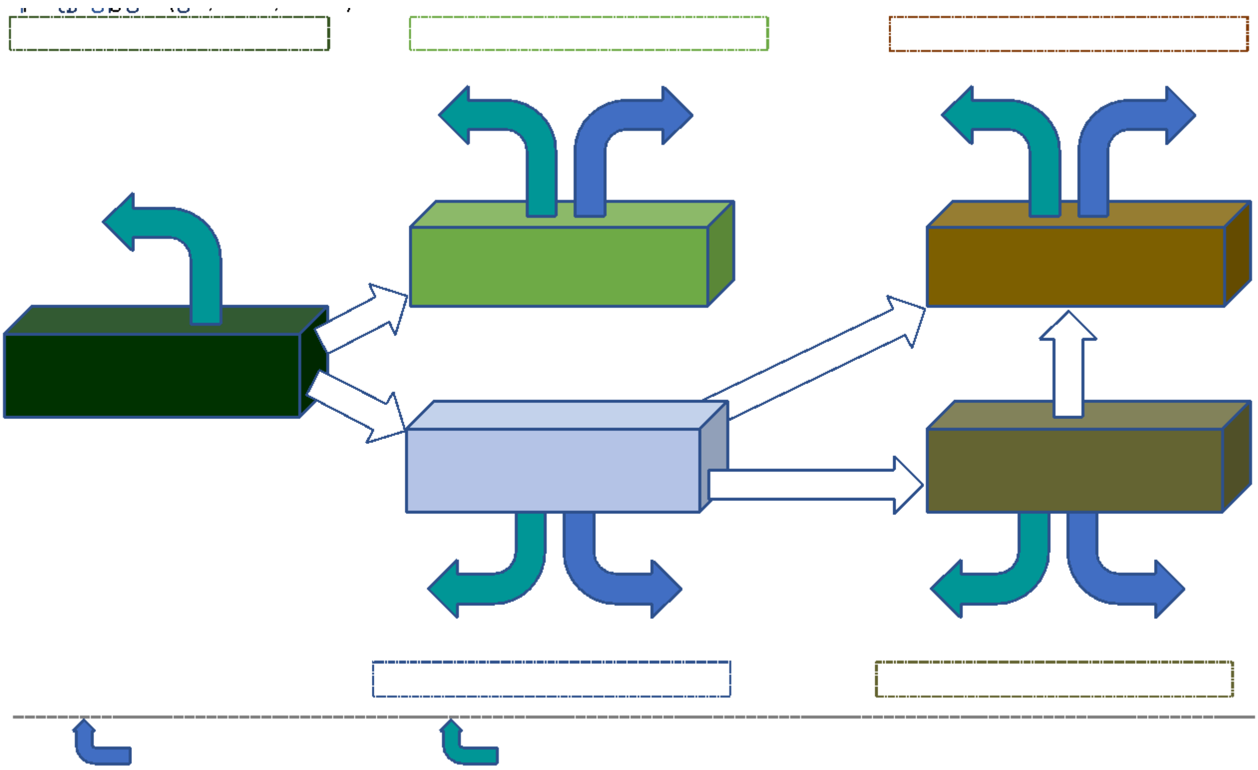


Figure 3-20 Scheme for emissions resulting from livestock feeding, livestock excreta and manure management

3.3.2 Methodological issues

3.3.2.1 Choice of methods for CH_4 emissions from Manure management

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3B-CH4

For estimating the CH_4 emissions from all livestock the Tier 1a approach[33] of the 2019 Refinements to the 2006 IPCC Guidelines has been applied.

The Tier 1 method entails multiplying the total amount of VS excreted (from all livestock species/categories) in each type of manure management system by an emission factor for that type of livestock category in the specified climate zone and manure management system (see Equation 10.22). As information on the coexistence of low and high productivity systems was available, the Tier 1 approach has been refined to TIER 1a.

The emissions from manure management systems are highly temperature dependent, it is *good practice* to estimate the average annual temperature associated with the locations where manure is managed.

The following steps were undertaken to estimate CH_4 emissions from manure management:

[33] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management, sub-chap 10.4.1 Choice of method

Step 1: Collect population data from the Livestock Population Characterization ⇨ see ***Chapter 3.2.2.2***.

Step 2: Identify default (Table 10A.5) or collect country-specific typical animal mass (TAM) values.

Calculate volatile solid excretion according to Equation 10.22a or develop country-specific volatile solid emissions according to Equation 10.24.

Step 3: Collect country-specific information on manure management system methods and develop country-specific manure management system fractions or use default manure storage fractions presented in Annex Tables 10A.6 to Tables 10A.9.

Step 4: Identify either default emission factors Table 10.14 or build country-specific emission factors for each livestock subcategory based on climate zones and, manure management system fractions.

- Tier 1: Identify default values (Table 10.14) for emission factors for each livestock category in terms of grams of methane per kg VS per year for the appropriate climate zone and productivity class if using advanced Tier 1a.
- Tier 2: Select local manure management specific methane conversion factors (MCF's, Table 10.17) for different climate zones and the animal categories specific maximum methane producing capacity (B0).

Step 5: Calculate methane emission for each livestock subcategory

Equation 10.22 (updated): CH_4 emissions from manure management (TIER 1)

$$Emissions_{CH4\ (mm)} = \left[\sum_{T,S,P} \frac{\left(N_{(T,P)} * V_{(T,P)} * AWMS_{(T,S,P)} * EF_{(T,S,P)}\right)}{10^3 * 10^6} \right]$$

Where:

$CH_{4(mm)}$	= CH_4 emissions from Manure Management in the country (kt CH_4)
$N_{(T,\ P)}$	= number of head of livestock species/category T in the country, for productivity system P
$VS_{(T,P)}$	= annual average VS excretion per head of species/category T, for productivity system P (kg VS animal^{-1} yr^{-1}) (TABLE 10.13a calculated by Equation 10.22a).
$AWMS_{(T,S,P)}$	= fraction of total annual VS for each livestock species/category T that is managed in manure management system S, for productivity system P; dimensionless, default regionally specific AWMS fractions are found in Tables 10A.6 through 10A.9 in Annex 10A.2.
$EF_{(T,S,P)}$	= emission factor for direct CH_4 emissions from manure management system S, by animal species/category T, in manure management system S, for productivity system P (Table 10.14) (g CH_4 kg VS-1)
S	= manure management system
T	= species/category of livestock
P	= high productivity system or low productivity system for use in advanced Tier 1a – omitted if using a simple Tier 1 approach

- Direct and indirect N_2O emissions from all livestock the 2006 IPCC Guidelines Tier 1 approach[34] has been applied.

3.3.2.2 Choice of methods for direct N_2O emissions from Manure Management

c	\06_Inventory\2024_submission\03_Agriculture

[34] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management, sub-chap 10.5.1 Choice of method

File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3B-N2O-dir

The Tier 1a method entails multiplying the total amount of N excretion (from all livestock species/categories/productivity system) in each type of manure management system by an emission factor for that type of manure management system (*see below Equation 10.25*). Emissions are then summed over all manure management systems. The Tier 1a method is applied using IPCC default N_2O emission factors, default nitrogen excretion data, and default manure management system data.

Equation 10.25 (updated): Direct N_2O emissions from Manure Management

$$Emissions_{N2O} = \left[\sum_{S}, \left[\sum_{T,P}\left(\left(N_{T,P} \times Nex_{(T,P)}\right) \times AWMS_{(T,S,P)}\right) + N_{cdg(s)}\right] \times EF_{3(S)}\right] \times \frac{44}{28} \times 10^{-6}$$

Where:

$N_2O_{D(mm)}$	= direct N_2O emissions from Manure Management in the country (kt N_2O)
$N_{(T,P)}$	= number of head of livestock species/category T in the country, for productivity system P
$Nex_{(T,P)}$	= annual average N excretion per head of species/category T, for productivity system P (kg N / animal)
$N_{cdg(s)}$	= annual nitrogen input via co-digestate in the country (kg N), where the system (s) refers exclusively to anaerobic digestion
$AWMS_{(T,S,P)}$	= fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country, dimensionless; to consider productivity class P, if using a Tier 1a approach
$EF_{3(S)}$	= emission factor for direct N_2O emissions from manure management system S in the country (kg N_2O-N/kg N in manure management system S)
S	= manure management system
T	= species/category of livestock
P	= productivity class, high or low, to be considered if using the Tier 1a approach
44/28	= conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions
10^{-6}	= conversion from kg N_2O to kt N_2O (for reporting)

Following the guidance provided in the 2019 Refinements to the 2006 IPCCC guidelines (Volume 4, Chapter 10.5.1) the following five steps were used to estimate direct N_2O emissions from Manure Management:

Step 1: Collect population data from the livestock population characterization;

Step 2: Use default values or develop the annual average nitrogen excretion rate per head (Nex(T)) for each defined livestock species/category T;

Step 3: Use default values or determine the fraction of total annual nitrogen excretion for each livestock species/category T that is managed in each manure management system S ($MS_{(T,S)}$);

Step 4: Use default values or develop N_2O emission factors for each manure management system S (EF3(S));

Step 5: For each manure management system type S, multiply its emission factor ($EF_{3(S)}$) by the total amount of nitrogen managed (from all livestock species/categories) in that system, to estimate N_2O emissions from that manure management system. Then sum over all manure management systems.

There may be losses of nitrogen in other forms (e.g., ammonia and NOx) as manure is managed on site. Nitrogen in the volatilized form of ammonia may be deposited at sites downwind from manure handling areas and contribute to indirect N_2O emissions (see below).

3.3.2.3 Choice of methods for indirect N_2O emissions from Manure Management

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3B-CH4-indir

The Tier 1 calculation of N volatilization in forms of NH_3 and NO_x from manure management systems is based on multiplication of the amount of nitrogen excreted (from all livestock categories) and managed in each manure management system by a fraction of volatilized nitrogen (see below Equation 10.26). Nitrogen (N) losses are then summed over all manure management systems.

The Tier 1 method was applied using

- default nitrogen excretion data,
- default manure management system data and
- default fractions of N losses from manure management systems due to volatilization.

Equation 10.26 (updated): Nitrogen (N) losses due to volatilization from manure management

$$N_{volatilzation-MMS} = \left[\sum_{S}\left[\sum_{T,P}\left(\left(\left(N_{T,P} \times Nex_{(T,P)}\right) \times AWMS_{(T,S,P)}\right) + N_{cdg(S)}\right) \times Frac_{GasAWMS_{(T,S)}}\right]\right]$$

Where:

$N_{volatilization-MMS}$ = amount of manure nitrogen that is lost due to volatilization of NH_3 and NOx (kg N)

$N_{(T,P)}$ = number of head of livestock species/category T in the country, for productivity system P

$Nex_{(T,P)}$ = annual average N excretion per head of species/category T in the country , for productivity system P (kg N / animal)

$AWMS_{(T,S)}$ = fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country, dimensionless

$Frac_{GasAWMS}$ = percent of managed manure nitrogen for livestock category T that volatilizes as NH_3 and NO_x in the manure management system S (%)

The indirect N_2O emissions from volatilisation of N in forms of NH_3 and NOx ($N_2O_{G(mm)}$) are estimated using the following equation:

Equation 10.27: Indirect N_2O emissions due to volatilization of N from manure management

$$Indirect\ emissions\ N_2O_{manure\ management} = \left(N_{volatilization-MMS} \times EF_4\right) \times \frac{44}{28}$$

Where:

$N_2O_{G(mm)}$ = indirect N_2O emissions due to volatilization of N from Manure Management in the country (kg N_2O)

EF_4 = emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kg N_2O-N (kg NH3-N + NOx-N volatilised)$^{-1}$
with default value 0.01 kg N_2O-N (kg NH3-N +NOx-N volatilised)$^{-1}$

3.3.2.4 Choice of activity data

Folder	\06_Inventory\2024_submission\03_Agriculture\06_MMS_analysis
File	Data-request_Agriculture_AMMS_2024

As described above, the original data provider for the national and international agricultural data is the Ministry of Agriculture and Rural Development (MARD) and Statistical Office of Algeria (ONS)[35].

Detailed data and relevant description are provided in Chapter 3.2.2.2.

In the following table is presented the are the manure management systems applied for the different livestock. The information is based on expert judgment from national research institution.

Table 3-36 Manure management system in Algeria

Category		Manure management system applied														
		Pasture/Range/ Paddock (PRP)				Daily spread				Solid storage				Liquid/Slurry		
		1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010
		%				%				%				%		
3.B.1.a Dairy Cattle																
Mature cows	BLL	70	75	85	85	10	10	5	5	15	10	5	5	5	5	5
	BLA	30	30	45	45	30	30	20	20	10	10	5	5	30	30	30
	BLM	20	20	15	15	40	40	40	40	5	5	5	5	35	35	40
3.B.1.b Non-Dairy Cattle																
Heifers	BLL	70	75	85	85	10	10	5	5	15	10	5	5	5	5	5
	BLA	30	30	45	45	30	30	20	20	10	10	5	5	30	30	30
	BLM	20	20	15	15	40	40	40	40	5	5	5	5	35	35	40
Mature male	BLL	10	10	10	10	40	40	40	40	10	10	10	10	40	40	40
	BLA	10	10	10	10	40	40	40	40	10	10	10	10	40	40	40
	BLM	40	40	35	35	40	40	35	35	10	10	10	10	45	45	50
Growing cattle	BLL	75	75	75	75	10	10	10	10	10	10	10	10	5	5	5
	BLA	50	50	50	50	35	35	35	35	10	10	10	10	5	5	5
	BLM	5	5	5	5	70	70	70	70	20	20	20	20	5	5	5
3.B.2 Sheep																
Ewes	HP	85	85	80	80					15	15	20	20			
	LP	95	95	95	95					5	5	5	5			
Rams	HP	85	85	85	85					15	15	15	15			
	LP	95	95	95	95					5	5	5	5			
Yearlings	HP	90	90	80	80					10	10	20	20			
	LP	95	95	95	95					5	5	5	5			
Growing sheep	HP	90	90	80	80					10	10	20	20			
	LP	95	95	80	80					5	5	20	20			

[35]Available (03. May 2022) on https://www.ons.dz/

Category		Manure management system applied															
		Pasture/Range/ Paddock (PRP)				Daily spread				Solid storage				Liquid/Slurry			
		1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010
		%				%				%				%		
3.B.4.b. Camels																
Camels' female	HP	98	98	98	98					2	2	2	2			
	LP	98	98	98	98					2	2	2	2			
Other camels	HP	98	98	98	98					2	2	2	2			
	LP	98	98	98	98					2	2	2	2			
3.B.4.d Goats																
goats (female)	HP	85	85	80	80					15	15	20	20			
	LP	95	95	80	80					5	5	20	20			
billy goats	HP	85	85	80	80					15	15	20	20			
	LP	95	95	80	80					5	5	20	20			
kids goats (12 months)	HP	90	90	80	80					10	10	20	20			
	LP	95	95	80	80					5	5	20	20			
3.B.4.e Horses																
Horses		98	98	98	98					2	2	2	2			
3.B.4.f Mules and asses																
Mules and asses		98	98	98	98					2	2	2	2			

Category		Manure management system applied															
		Pasture/Range/ Paddock (PRP)				Poultry manure with litter				Poultry manure without litter				Daily spread			
		1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010	2022	1990	2000	2010	2022
		%				%				%				%			
3.B.4.g Poultry																	
Chicken broiler		5	5	5	5	90	90	90	90	5	5	5	5				
Chicken layers		5	5	5	5	5	5	5	5	90	90	90	90				
Turkey		70	70	70	70									30	30	30	30
Geese and guinea fowl		70	70	70	70									30	30	30	30

3.3.2.5 Choice of emission factors for methane (CH_4)

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
sheet	TIER1_EF_3.B_2019Ref

	TIER_2_PARAMETER_3B

The default emission factors for methane (CH_4) were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-37 Emission factors for Tier 1 for CRT category 3.B Manure Management

Livestock	**CH_4 emission factor by average annual temperature (°C) (kg/head per year)**		**Region / average annual temperature**	**Source**
	EF	**type**	**EF**	
Dairy Cows	2	D	Middle East: 25° temperate	**2006 IPCC Guidelines Vol. 4, Chap. 10 (10.4.2)** Table 10.14 Manure management methane emission factors by temperature
Other Cattle	1	D		
Sheep	0.15	D	Developing countries / Temperate (15 to 25°C) temperate	**2006 IPCC Guidelines Vol. 4, Chap. 10 (10.4.2)** Table 10.15 Manure management methane emission factors by temperature (page 10.47)
Goats	0.17	D		
Horses	1.64	D		
Mules and Asses	0.9	D		
Poultry	0.02	D		
Camels	1.92	D		
Rabbits	0.08	D		**2006 IPCC Guidelines Vol. 4, Chap. 10**: TABLE 10.16: manure management methane emission factors for deer, reindeer, rabbits, and fur-bearing animals
Note: D Default				

Nitrous oxide (N_2O) - Annual average nitrogen excretion rates ($Nex_{(T)}$)

The TIER 1 Annual average nitrogen excretion rates ($Nex_{(T)}$) was calculated according to Equation 10.30 of 2006 IPCC GL[36] and are presented in the following table.

Equation 10.30: Annual N excretion rates (2006 IPCC GL, Vol. 4, Chap. 10)

$$Nex_{(T)} = N_{rate(T)} \times \frac{TAM}{1000} \times 365$$

Where:

- $Nex_{(T)}$ = annual N excretion for livestock category T (kg N animal^{-1} $^{yr-1}$)
- $N_{rate(T)}$ = default N excretion rate (kg N (1000 kg animal mass)$^{-1}$ day^{-1})
- $TAM_{(T)}$ = typical animal mass for livestock category T (kg animal^{-1})

Annual average nitrogen excretion rate $N_{rate(T)}$

Annual nitrogen excretion rates should be determined for each livestock category defined by the livestock population characterization. As no country specific nitrogen excretion rate $N_{rate(T)}$ were available, the default N excretion rates were used. They are presented in the following table.

[36] 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management, sub-chap 10.5.2 Choice of emission factors, Equation 10.30, page 10.57.

The direct N_2O emissions are exemplarily calculated in the following table below, (direct N_2O emissions) applying the default emission factors for direct N_2O emissions from manure management (see Table 3-38).

Table 3-38 Default emission factors for direct N_2O emissions from manure management

System	Definition		EF_3 [kg N_2O-N (kg Nitrogen excreted)$^{-1}$]
Pasture/Range/ Paddock	The manure from pasture and range grazing animals is allowed to lie as it is and is not managed.		NA
Daily spread	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion. N_2O emissions during storage and treatment are assumed to be zero. N_2O emissions from land application are covered under the Agricultural Soils category.		0
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.		0.005
Dry lot	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically. Dry lots are most typically found in dry climates but also are used in humid climates.		0.02
Liquid/Slurry	Manure is stored as excreted or with some minimal addition of water to facilitate handling and is stored in either tanks or earthen ponds.	With natural crust cover	0.005
		Without natural crust cover	0
Remark: Direct and indirect N_2O emissions associated with the manure deposited on agricultural soils and pasture, range, paddock systems are treated under 3.D N_2O emissions from managed soils.			

Source: 2006 IPCC Guidelines, Vol. 4, Chap. 10, sub-chap. 10.5.3 Choice of emission factors, Table 10.21 Default emission factors for direct N_2O emissions from manure management; page 10.62.

In Algeria it is not common to use dung as fuel. When estimating the $Nex_{(T)}$ for animals whose manure is classified in the manure management system burned for fuel, it should be kept in mind that the dung is not burned, and the urine stays in the field. As a rule of thumb, 50% of the nitrogen excreted is in the dung and 50% is in the urine. The default emission factors for direct N_2O emissions from Manure Management are provided in the following table.

3.3.3 Uncertainty assessment and time-series consistency

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Uncertainty_3A-3B-3D

The uncertainties for activity data and emission factors used for CRT category 3.B *Manure management* are presented in the following table.

Table 3-39 Uncertainty for CRT category 3.B Manure management.

Uncertainty	CH_4		N_2O		N_2O		Reference
	cattle	Other livestock	cattle	Other livestock	cattle	Other livestock	2006 IPCC GL, Vol. 4, Chap. 10

Activity data: Livestock	20%	20%	20%	20%	20%	20%	Chapter 10.2.3
Activity data: Manure Management System Usage	25%	10%	25%	10%	25%	10%	Chapter 10.4.4
Emission factor	30%						Chapter 10.4.4
Emission factor (direct emission)			30%				Chapter 10.4.4
Emission factor (indirect emission)					50%	50%	Chapter 10.4.4
Combined Uncertainty	44%	37%	44%	37%	55%	55%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

3.3.4 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	QA-QC-Checklist_3B

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
    - consistent use of livestock data (statistical yearbook and FAO stat- Live Animals),
    - documented sources,
    - use of units,
    - strictly defined interfaces between spreadsheets/calculation modules,
    - unique structure of sheets which do the same,
    - record keeping, use of write protection,
    - unique use of formulas, special cases are documented/highlighted,
    - quick-control checks for data consistency through all steps of calculation,
- cross-checked from different sources: national statistic (ONS, Agricultural Census 2003) and international statistics (FAO)
- cross checks with other relevant sectors are performed to avoid double counting or omissions
- consistency and completeness checks are performed
- time series consistency - plausibility checks of dips and jumps.

3.3.5 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Recalculation_3A-3B-3D

The following table presents the main revisions and recalculations done since the last two submission to the UNFCCC and relevant to CRT category 3.B *Manure management*.

Table 3-40 Recalculations done in CRT category 3.B *Manure management*

GHG source & sink category	Revisions of data ⇒ submission 2020	Type of revision	Type of improvement
3.B	Further application of Guidance provided in the 2019 Refinement to the 2006 IPCC Guidelines	method	Comparability
3.B	Use of CH_4 default emission factor and parameter of 2019 Refinement to the 2006 IPCC Guidelines	EF	Comparability
3.B	Use of N_2O default emission factor and parameter for direct emissions and indirect emissions of 2019 Refinement to the 2006 IPCC Guidelines	EF	Comparability
3.B	Revision of livestock data as for 1997-2022, as only national data were used	EF	Comparability
3.B.1 3.B.2 3.B.4.d	Split of livestock for TIER 2 ● cattle in modern (BM), local (BL) and improved (BA) ● sheep in high productivity and low productivity system goats in high productivity and low productivity system	AD	Accuracy

3.3.6 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	PlannedImprovements _3A-3B-3D

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-41 Planned improvements for CRT category 3.B *Manure management*

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.B.	Ensure timeseries consistency revision of agricultural statistics 2010-2021	AD	Accuracy	high
3.B.	Characteristics of livestock by climate zone	AD	Accuracy	high
3.B. 3.D.	Husbandry and Management Practice with consideration ● characteristics of Livestock Husbandry for the whole time series: ○ breed, ○ age distribution, ○ weight ○ milk yield, ○ wool yield, ● characteristics of manure management practice: ○ stall / housed and Housing period ○ pasture/range/paddock (flat/hilly)	AD	Accuracy Consistency Comparability Transparency Completeness	high

GHG source & sink category	Planned improvement	Type of improvement		Priority
	○ grazing large areas (flat/hilly) ○ daily spread ○ solid storage ○ dry lot ○ liquid/slurry with/without natural crust cover ○ uncovered anaerobic lagoon ○ pit storage below animal confinements ○ anaerobic digester ○ burned for fuel ○ cattle and swine deep bedding ○ composting ○ aerobic treatment			
3.B.2	Estimation of CH_4 and N_2O emissions applying TIER 2 approach where sub-categories are key categories	method	Transparency Comparability	high
3.B	Survey and/or research on VS excretion rates		Accuracy	medium

3.4 Rice cultivation (CRT category 3.C)

The CRT category 3.C Rice cultivation does not exist in Algeria.

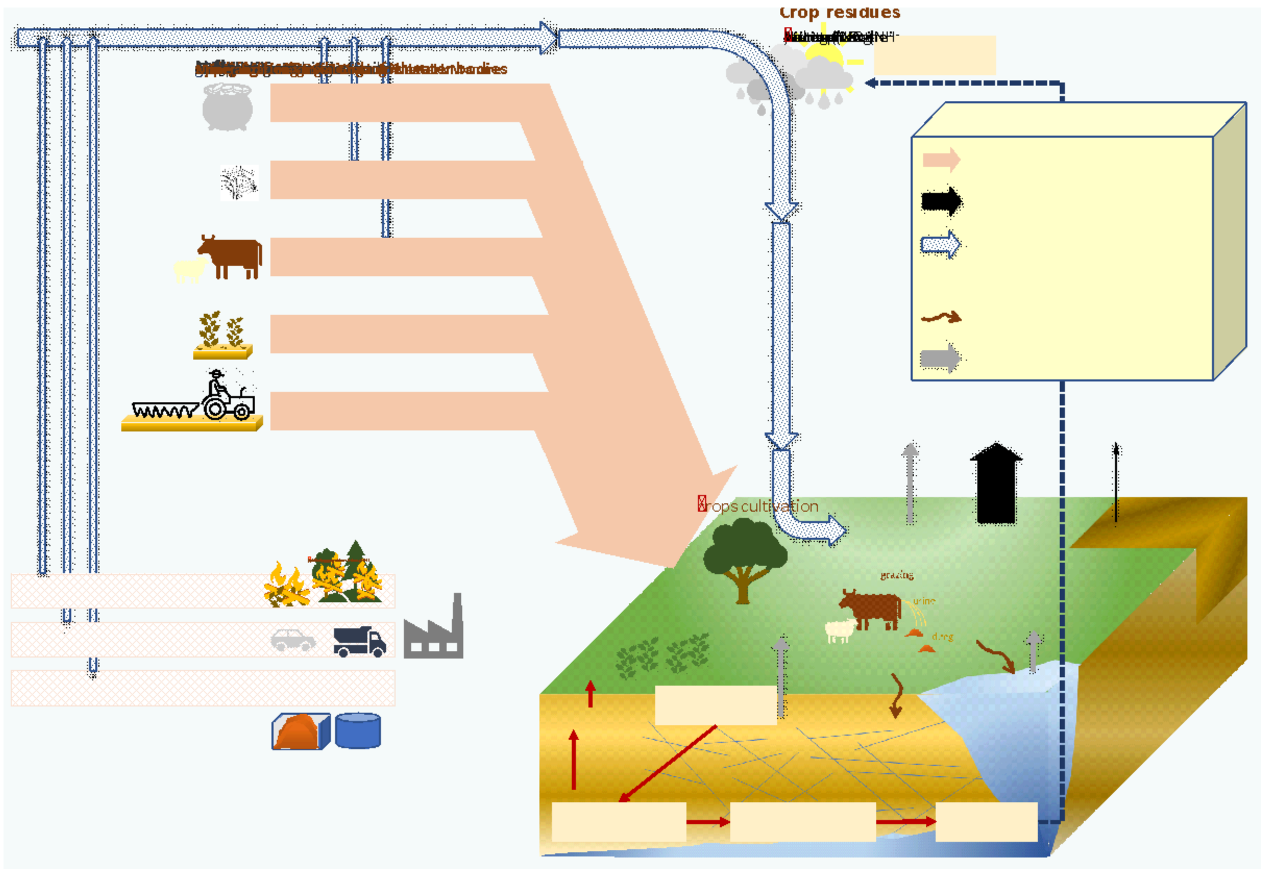
3.5 Agricultural soils (CRT category 3.D)

This section describes the estimation of nitrous oxide emissions from managed soils due to nitrogen input, including indirect N_2O emissions from additions of N to land due to deposition and leaching. As defined in 2006 IPCC GL, Vol. 4, Chap. 1.1 managed land is land where human interventions and practices have been applied to perform production, ecological or social functions. The emissions of N_2O that result from anthropogenic N inputs or N mineralization occur through both:

- direct pathway: directly from the soils to which the N is added/released
- indirect pathways: (i) following volatilization of NH_3 and NO_x from managed soils and from fossil fuel combustion and biomass burning, and the subsequent redeposition of these gases and their products NH_4^+ and NO_3^- to soils and waters; and

  (ii) after leaching and runoff of N, mainly as NO_3^-, from managed soils.

The principal pathways are illustrated in the following figure. Direct emissions of N_2O from managed soils are estimated separately from indirect emissions, though using a common set of activity data.



The nitrogen cycle: (1) uptake of nitrogen by plants from the atmosphere: (2) uptake of ammonium and nitrate by plants from soil and water: nitrogen-fixing bacteria in humus and in root nodules of leguminous plants (3) ammonification, (4) nitrification, (5) denitrification, (6) nitrate immobilization by soil sorption, (7) nitrate leaching from the soil, (8) release of ammonia (NH3), gaseous nitrogen and nitrous oxide to the atmosphere.

Figure 3-21 Schematic diagram illustrating the sources and pathways of N that result in direct and indirect N_2O emissions from soils and waters

Source: After (1) 2006 IPCC Guidelines, Volume 4, Chapter 11, Figure 11.1. page 11.8. and
(2) Bednarek, A.; Szklarek, S. & Zalewski, M. (2014): Nitrogen pollution removal from areas of intensive farming—comparison of various denitrification biotechnologies. In: Ecohydrology & Hydrobiology 14 (2014) 132–141.

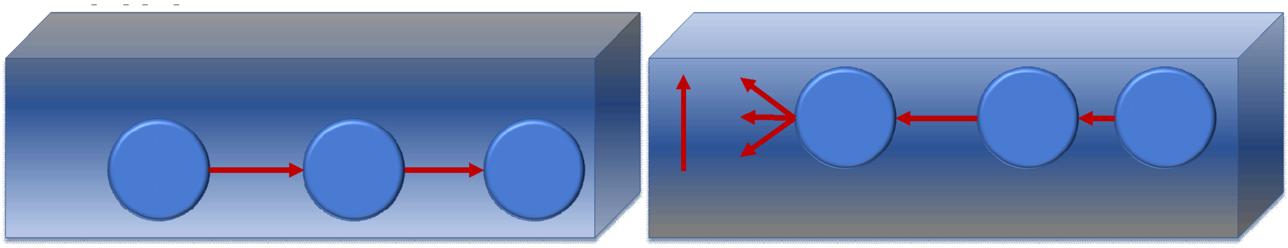


Figure 3-22 Nitrification and Denitrification

As described in Chapter 3.3 and in Figure **3-20** the N_2O emissions generated by manure in the

- system “livestock housing and holding areas” and “manure storage” are reported under the category

  ⇒ 3.B Manure management
- system ‘pasture, range, and paddock’ occur directly and indirectly from the soil, and are therefore reported under the category

⇒ 3.D.a *Direct N_2O emissions from managed soils*

⇒ 3.D.a.2 *Organic N fertilizers*

⇒ *3.D.a.2.a Animal manure applied to soils*

⇒ 3.D.b *IndirectN_2O Emissions from managed soils*

Beyond that further ‘man-made’ nitrogen applied to the soil are synthetic fertilizer application, crop residues, and mineralization of soil organic matter. Through nitrogen vitalization and combustion emissions of N from fossil fuels from all nitrogen sources a ‘nitrogen stock in the atmosphere’ is formed also depending of the amount and characteristics of the N-inputs.

The deposition of nitrogen (N) to soils and water bodies results from

- Nitrogen vitalization from
  - synthetic fertilizer application
  - application of organic N fertilizer
  - urine and dung from grazing animals
  - crop residues
  - mineralization of soil organic matter
- Nitrogen vitalization and combustion emission of N from
  - biomass burning
  - fossil fuel combustion
  - storage and management of livestock manure

3.5.1 Category description

➪ **Crosscheck, if updated information is available and consistent with category chapters and chapter 1.4**

IPCC code	Description	Description	CO_2		CH_4		N_2O	
			Estimated	Key Category	estimated	Key category	estimated	Key category
3.D	**Agricultural soils**							
3.D.1	**Direct N_2O emissions from managed soils**			-		-		-
3.D.1.a	Inorganic N fertilizers	N input from application of inorganic fertilizers to cropland and grassland	NA	-	NA	-	✔	-
3.D.1.b	Organic N fertilizers	N input from organic N fertilizers to cropland and grassland	NA	-	NA	-	✔	-
3.D.1.b.i	Animal manure applied to soils	N input from manure applied to soils	NA	-	NA	-	✔	-
3.D.1.b.ii	Sewage sludge applied to soils	N input from sewage sludge applied to soils	NA	-	NA	-	NE	-
3.D.1.b.iii	Other organic fertilizers applied to soils	N input from application of other organic fertilizers	NA	-	NA	-	✔	-
3.D.1.b	Urine and dung deposited by grazing animals	N excretion on pasture, range and paddock	NA	-	NA	-	✔	-
3.D.1.a	Crop residues	N in crop residues returned to soils	NA	-	NA	-	✔	-
3.D.1.e	Mineralization/ immobilization associated with loss/gain of soil organic matter	N in mineral soils that is mineralized in association with loss of soil C	NA	-	NA	-	NO	-
3.D.1.f	Cultivation of organic soils	Area of cultivated organic soils (i.e. histosols)	NA	-	NA	-	NO	-
3.D.1.g	Other		NA	-	NA	-	NO	
3.D.b	**Indirect N_2O Emissions from managed soils**							
3.D.b.1	Atmospheric deposition	Volatilized N from agricultural inputs of N	NA	-	NA	-	NE	-
3.D.b.2	Nitrogen leaching and run-off	N from fertilizers and other agricultural inputs that is lost through leaching and run-off	NA	-	NA	-	NE	-
A '✔' indicates: emissions from this category have been estimated. Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential								
LA – Level Assessment (in year); TA – Trend Assessment								

3.5.2 Direct N_2O emissions from managed soils (CRT category 3.D.a)

The following sources are included in CRT category 3.D.a *Direct N_2O emissions from managed soils.*

3.D.1	**Direct N_2O emissions from managed soils**		
3.D.1.a	Inorganic N fertilizers	N input from application of inorganic fertilizers to cropland and grassland	✔
3.D.1.b	Organic N fertilizers	N input from organic N fertilizers to cropland and grassland	✔
3.D.1.b.i	Animal manure applied to soils	N input from manure applied to soils	✔
3.D.1.b.ii	Sewage sludge applied to soils	N input from sewage sludge applied to soils	NO
3.D.1.b.iii	Other organic fertilizers applied to soils	N input from application of other organic fertilizers	NO
3.D.1.c	Urine and dung deposited by grazing animals	N excretion on pasture, range and paddock	✔
3.D.1.d	Crop residues	N in crop residues returned to soils	✔
3.D.1.e	Mineralization/ immobilization associated with loss/gain of soil organic matter	N in mineral soils that is mineralized in association with loss of soil C	NO
3.D.1.f	Cultivation of organic soils (i.e. histosols)	Area of cultivated organic soils	NO
3.D.1.g	Other		NO

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Table 3_CO2_T,
Table 3_CH4_T, Table 3_CH4_T_eq,
Table 3_N2O_T, Table 3_N2O_T_eq</td></tr>
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<tr><td colspan="2">Update GHG emissions and AD in tables & graphs</td></tr>
<tr><td rowspan="4">Tables and Graphs from sheet</td><td>Table 3_GHG_T_eq</td></tr>
<tr><td>Table 3_CO2_T</td></tr>
<tr><td>Table 3_CH4_T, Table 3_CH4_T_eq</td></tr>
<tr><td>Table 3_N2O_T, Table 3_N2O_T_eq</td></tr>
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• Trend -> 2.2.1 Energy
• Executive Summary</td></tr>
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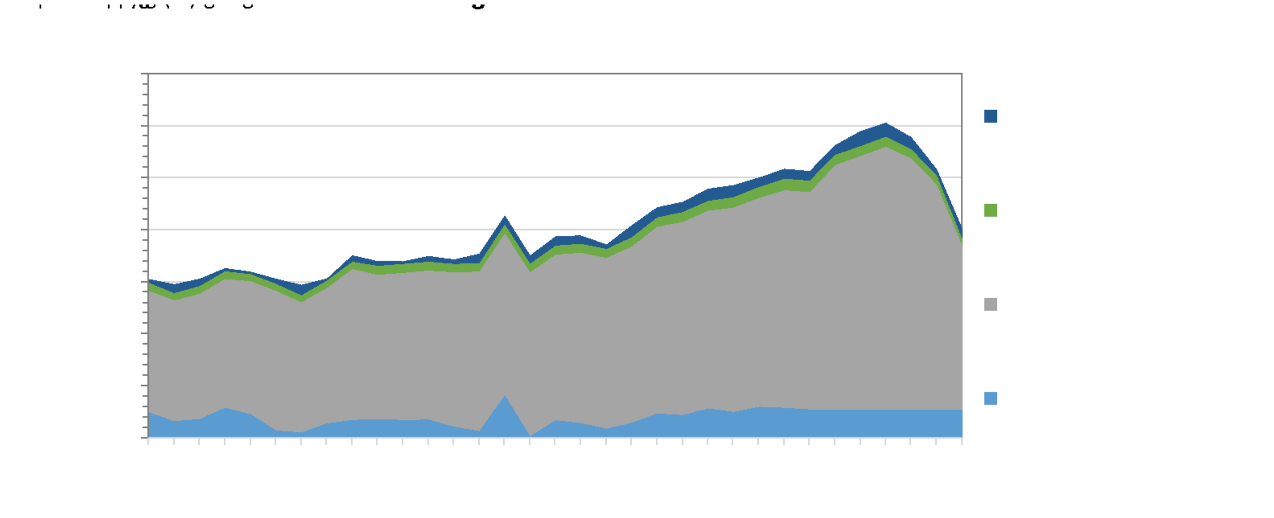

Note: Not estimated (NE) are CRT categories:	3.D.1.b.ii. Sewage sludge applied to soils 3.D.1.b.iii. Other organic fertilizers applied to soils 3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter 3.D.1.f. Cultivation of organic soils (i.e. histosols)

Figure 3-23 Direct N_2O emissions from managed soils (CRT category 3.D.1.)

N_2O emissions from CRT category 3.D.1. *Direct N_2O emissions from managed soils* amounted to 6.12 kt N_2O in 1990 and 8.08 kt N_2O in 2022, which is an increase of 31.9% due to

- amount of manure from increased number of livestock,
- amount of inorganic fertilizer applied,
- area for crop production which implicates increased
    - crop production,
    - crop residues.

Table 3-42 N_2O emissions from CRT category 3.D.1 *Direct N_2O emissions from managed soils*

	3.D.	**3.D.1**	**3.D.1.a**	**3.D.1.b**	**3.D.1.c**	**3.D.1.d**	**3.D.1.e**	**3.D.1.f**	**3.D.1.g**	**3.D.2**
N_2O	**Agricultural soils**	**Direct N_2O emissions from managed soils**	**Inorganic N fertilizers**	**Organic N fertilizers**	**Urine and dung deposited by grazing animals**	**Crop residues**	**Mineralization/immobilization associated with loss/gain of soil organic matter)**	**Cultivation of organic soils (i.e. histosols**	**Other**	**Indirect N_2O Emissions from managed soils**
		N input from application of inorganic fertilizers to cropland and grassland	N input from organic N fertilizers to cropland and grassland	N input from manure applied to soils	N in crop residues returned to soils	N input from application of inorganic fertilizers to cropland and grassland				N input from application of inorganic fertilizers to cropland and grassland
	kt	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**		
1990										
1991										

	3.D.	3.D.1	3.D.1.a	3.D.1.b	3.D.1.c	3.D.1.d	3.D.1.e	3.D.1.f	3.D.1.g	3.D.2
N_2O	Agricultural soils	Direct N_2O emissions from managed soils	Inorganic N fertilizers	Organic N fertilizers	Urine and dung deposited by grazing animals	Crop residues	Mineralization/immobilization associated with loss/gain of soil organic matter)	Cultivation of organic soils (i.e. histosols	Other	Indirect N_2O Emissions from managed soils
		N input from application of inorganic fertilizers to cropland and grassland	N input from organic N fertilizers to cropland and grassland	N input from manure applied to soils	N in crop residues returned to soils	N input from application of inorganic fertilizers to cropland and grassland				N input from application of inorganic fertilizers to cropland and grassland
	kt	kt	kt	kt	kt	kt	kt	kt		
1992										
1993										
1994										
1995										
2019										
2020										
2021										
2022										
Trend										
1990 - 2022										
2010 - 2022										
2021 - 2022										

3.5.3 Methodological issues

3.5.3.1 Choice of methods

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3D

For estimating the direct N_2O emissions from managed soils the 2006 IPCC Guidelines Tier 1 approach[37] has been applied.

TIER 1 approach – direct N_2O emissions from managed soils

[37] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.1 Choice of method. Page 11.6.

The Tier 1 method (Equation 11.1) entails adding up the

- annual direct N_2O–N emissions produced from managed soils (kg N_2O–N)
- annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)
- annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)
- annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N)

and converting the N_2O–N emissions to N_2O emissions for reporting purposes.

Equation: Conversion N_2O emissions from of N_2O–N emissions (2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O\ emissions_{direct} = N_2O - N \times \frac{44}{28}$$

Equation 11.1: Direct N_2O emissions from managed soils[38]

$$N_2O\ emissions_{direct} - N = N_2O - N_{N\ inputs} + N_2O - N_{OS} + N_2O - N_{PRP}$$

Where:

N_2O emissions $_{direct}$	= direct N_2O emissions from managed soils (kg N_2O)
N_2O_{Direct} –N	= annual direct N_2O–N emissions produced from managed soils (kg N_2O–N)
N_2O–$N_{N\ inputs}$	= annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)
N_2O–N_{OS}	= annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)
N_2O–N_{PRP}	= annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N) with PRP = pasture, range and paddock

Furthermore, the annual direct N_2O–N emissions produced from soils is estimated applying the following equations.

Annual direct N_2O–N emissions from N inputs to managed soils ***(11.1.a)***

$$N_2O - N_{N\ inputs} = \left[\left[\left(F_{SN} + F_{ON} + F_{CR} + F_{SOM}\right) \times EF_1\right] + \left[\left(F_{SN} + F_{ON} + F_{CR} + F_{SOM}\right)_{FR} \times EF_{1FR}\right]\right]$$

Annual direct N_2O–N emissions from managed organic soils ***(11.1.b)***

$$N_2O - N_{OS} = \left[\left(F_{OS,\,CG,\,Temp} \times EF_{2CG,\,Temp}\right) + \left(F_{OS,\,CG,\,Trop} \times EF_{2CG,\,Trop}\right) + \left(F_{OS,F,\,Temp,NR} \times EF\right.\right.$$

Annual direct N_2O–N emissions from urine and dung inputs to grazed soils ***(11.1.c)***

$$N_2O - N_{PRP} = \left[\left(F_{PRP,\,CPP} \times EF_{3PRP,\,CPP}\right) + \left(F_{PRP,\,SO} \times EF_{3PRP,\,SO}\right)\right]$$

Where:

N_2O–$N_{N\ inputs}$	= annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)
N_2O–N_{OS}	= annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)
N_2O–N_{PRP}	= annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N) with PRP = pasture, range and paddock
F_{SN}	= annual amount of synthetic fertilizer N applied to soils (kg N)

[38] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.1 Choice of method, Equation 11.1 direct N_2O emissions from managed soils (TIER 1), Page 11.7.

F_{ON}	= annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils
F_{CR}	= annual amount of N in crop residues (above-ground and below-ground), including N-fixing crops, and from forage/pasture renewal, returned to soils, kg N yr^{-1}
F_{SOM}	= annual amount of N in mineral soils that is mineralised, in association with loss of soil C from soil organic matter as a result of changes to land use or management, kg N yr^{-1}
F_{OS}	= annual area of managed/drained organic soils, ha
	(Note: the subscripts CG, F, Temp, Trop, NR and NP refer to Cropland and Grassland, Forest Land, Temperate, Tropical, Nutrient Rich, and Nutrient Poor, respectively)
F_{PRP}	= annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock, kg N yr^{-1} (Note: the subscripts CPP and SO refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively)
EF_1	= emission factor for N_2O emissions from N inputs, kg N_2O–N (kg N input)$^{-1}$
EF_{1FR}	= emission factor for N_2O emissions from N inputs to flooded rice, kg N_2O–N (kg N input)$^{-1}$
EF_2	= emission factor for N_2O emissions from drained/managed organic soils, kg N_2O–N ha-1 yr^{-1}
	(Note: the subscripts CG, F, Temp, Trop, NR and NP refer to Cropland and Grassland, Forest Land, Temperate, Tropical, Nutrient Rich, and Nutrient Poor, respectively)
$EF_{3\ PRP}$	= emission factor for N_2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals, kg N_2O–N (kg N input)$^{-1}$;
	(Note: the subscripts CPP and SO refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively)

For better understanding, the processes in soil and crust the following figures provide simplified illustration of nitrogen (N) transactions

● between the atmosphere and liquid manure with emphasis on critical processes involved in the emission of gases	Figure 3-24
● the atmosphere and the soil with emphasis on agronomic aspects related to plant fertilization and the reactions involved in the formation and emission of nitrous oxide (direct and indirect).	Figure 3-25

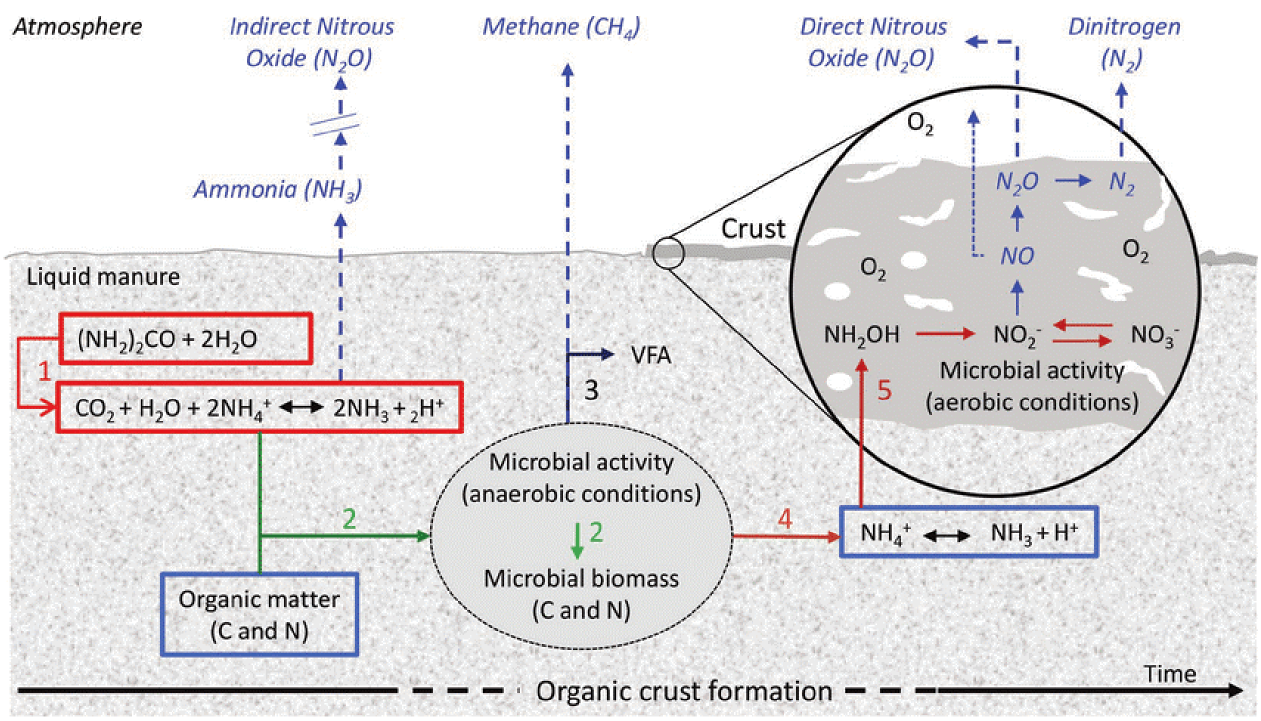

Figure 3-24 Simplified illustration of N transactions between the atmosphere and liquid manure with emphasis on critical processes involved in the emission of gases

Simplified illustration of N transactions between the atmosphere and liquid manure (data from Aguerre et al., 2012), with emphasis on critical processes involved in the emission of gases: (1) hydrolysis of urinary urea-N (giving rise to ammonia, which after emission and deposition on soils contributes to indirect nitrous oxide emission), microbial fermentation of OM under anaerobic conditions (giving rise to methane) associated with (2) microbial growth, (3) acidification of the medium through the formation of VFA, and (4) ammonia formation from the degradation of N-containing organic compounds, In addition, when an organic crust formed (5), the nitrification of ammonium under aerobic conditions was responsible for nitrous oxide and presumably dinitrogen emissions.
Nitrogen-containing structures are as follows:

$(NH_2)_2CO$ = urea; NH_4^+ = ammonium; NH_3 = ammonia; NH_2OH = hydroxylamine; NO_2^- = nitrite;
NO_3^- = nitrate; NO = nitric oxide (emitted gas); N_2O = nitrous oxide; N_2 = dinitrogen.

Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254, Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803

Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

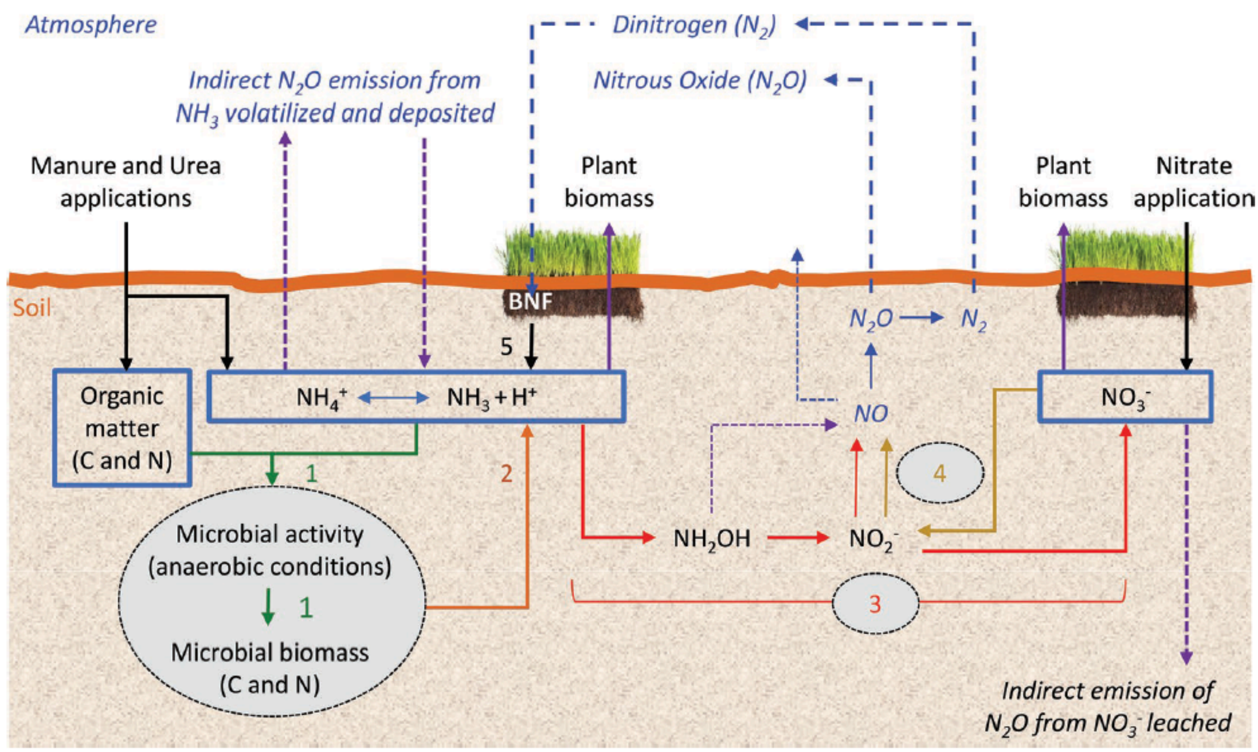

Figure 3-25 Simplified illustration of N transactions between the atmosphere and the soil with emphasis on agronomic aspects related to plant fertilization and the reactions involved in the formation and emission of nitrous oxide (direct and indirect)

Simplified illustration of N transactions between the atmosphere and the soil with emphasis on agronomic aspects related to plant fertilization and the reactions involved in the formation and emission of nitrous oxide (direct and indirect). Different types of arrows are used to identify the main transformations associated with (1) immobilization, (2) mineralization, (3) nitrification, (4) denitrification, and (5) biological nitrogen fixation (BNF) by legumes, Nitrogen-containing structures are as follows:

N_2 = dinitrogen; NH_3 = ammonia; $NH4^+$ = ammonium; NH_2OH = hydroxylamine;
NO = nitric oxide (emitted gas); NO_2^- = nitrite; NO_3^- = nitrate; N_2O = nitrous oxide

Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254. Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803
Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

3.5.3.2 Choice of activity data (AD) and emission factor (EF)

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
sheet	TIER1_EF_3.D_2019Ref

In the following subchapters/sections the activity data (AD) and emission factors (EF) as well as the emission calculations and results are presented separately for each N input from

1)	Applied synthetic fertilizer (F_{SN})	$N_2O - N_{N\,inputs} = \left[\left[\left(F_{SN}\right)\times EF_1\right] + \left[\left(F_{SN}\right)_{FR} \times EF_{1F}\right.\right.$ *See above equation 11.1.a*
2)	Applied organic N fertilizer (F_{ON})	$O - N_{N\,inputs} = \left[\left[\left(F_{ON}\right)\times EF_1\right] + \left[\left(F_{ON}\right)_{FR} \times EF_{1FR}\right]\right.$ *See above equation 11.1.a*
3)	annual amount of N in crop residues, including N-fixing crops, and from forage/pasture renewal, returned to soils (F_{CR})	$N_2O - N_{N\,inputs} = \left[\left[\left(F_{CR}\right)\times EF_1\right] + \left[\left(F_{CR}\right)_{FR} \times EF_{1FI}\right.\right.$ *See above equation 11.1.a*
4)	Mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM})	$O - N_{N\,inputs} = \left[\left[\left(F_{SOM}\right)\times EF_1\right] + \left[\left(F_{SOM}\right)_{FR} \times EF_{1FI}\right.\right.$ *See above equation 11.1.a*
5)	Area of drained/managed organic soils (F_{OS})	*See above equation 11.1.b*
6)	Urine and dung from grazing animals (F_{PRP})	*See above equation 11.1.c*

3.5.3.2.1 AD and calculation for N Input from *Applied synthetic fertilizer (F_{SN})*

Folder	\06_Inventory\2024_submission\03_Agriculture\ 05_Feritlizer
File	FAOSTAT_Fertilizer
	Fertilizer_CN-Codes
	Fertial_fertilizer.xlsx

Activity data, parameter and emission calculation for *N Input from Applied synthetic fertilizer (F_{SN})*

The data of annual amount of applied synthetic fertilizer (F_{SN}) consumption is taken from international source: FAO agricultural data base on synthetic fertilizer consumption[39].

The information on fertilizer consumption / distribution of the Algeria Statistical yearbook was used only for crosscheck.

Default emission factors (EF_1) and (EF_{1FR}) were taken from Table 11.1 of 2006 IPCC Guidelines, Vol. 4, Chap. 11[40] and are presented in the following table.

Table 3-43 Default emission factors to estimate direct N_2O emissions from managed soils

Emission factor		**N_2O (kg N_2O–N (kg N)$^{-1}$)**		**Source**
		EF	**type**	**2006 IPCC Guidelines Vol. 4, Chap. 11 (11.2.1.2)**
EF_1 for N additions from mineral fertilizers, organic amendments and crop residues, and N mineralized from mineral soil as a result of loss of soil carbon	EF_1	0.01	D	**Table 11.1** Default emission factors to estimate direct N_2O emissions from managed soils (page 11.11)
Note:				
D Default; CS Country specific		PS Plant specific		IEF Implied emission factor

With the Equation 11.1.a (see also in section 3.5.3.1 Choice of methods) and the equation for conversion N_2O-N tot N_2O the N_2O emissions from N inputs to managed soils

Annual direct N_2O–N emissions from N inputs to managed soils (2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O - N_{N\ inputs} = \left[\left[\left(F_{SN}\right) \times EF_1\right] + \left[\left(F_{SN}\right)_{FR} \times EF_{1FR}\right]\right] \quad \textbf{(11.1.a)}$$

$$N_2O\ emissions_{direct} = N_2O - N \times \frac{44}{28}$$

[39] http://www.fao.org/faostat/en/#data

[40] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.2 Choice of emission factor, Table 11.1, Page 11.11.

Table 3-44 Annual amount of applied synthetic fertilizer (CRT category 3.D.1.a. Inorganic N fertilizers)

	Nutrient nitrogen N (total)				
	Agricultural Use	Production	Import Quantity	Export Quantity	Source
	t	t	t	t	
1990	63,000	80,000	3,000	22,000	FAO database
1991	41,000	87,900	NA	25,000	
1992	46,700	64,500	NA	20,100	
1993	73,800	104,500	500	11,200	
1994	58,200	82,900	NA	6,200	
1995	18,400	12,000	NA	NA	
1996	14,000	8,300	22,800	3,800	
1997	36,000	28,400	26,300	17,000	
1998	44,000	40,700	33,800	44,400	
1999	47,000	54,400	31,800	45,300	
2000	44,300	90,700	65,200	112,800	
2001	45,300	118,200	60,900	134,400	
2002	28,036	72,600	35,775	149,439	
2003	17,076	99,660	43,121	185,007	
2004	104,717	153,790	45,618	149,703	
2005	4,086	83,100	33,775	198,615	
2006	43,847	27,440	36,121	88,570	
2007	36,626	137,780	24,060	73,378	
2008	23,102	11,040	26,482	68,094	
2009	37,100	13,400	43,046	68,510	
2010	60,100	20,800	58,610	96,368	
2011	56,300	19,500	51,519	91,528	
2012	72,600	24,500	66,010	111,144	
2013	64,000	68,000	53,005	53,485	
2014	76,500	438,300	55,421	437,934	
2015	74,400	777,600	60,966	765,726	
2016	70,200	1,043,200	36,635	1,097,907	
2017	70,200	1,043,200	34,874	706,437	
2018	70,200	1,043,200	72,756	1,442,947	
2019	70,200	1,043,200	50,571	1,257,722	
2020	70,200	1,043,200	50,571	1,257,722	As of 2019
2021	70,200	1,043,200	35,891	1,883,619	
2022	70,200	1,043,200	15,511	1,970,347	
Trend					
1990 - 2022	*11%*	*1204%*	*417%*	*8856%*	
2010 - 2022	*1618%*	*1155%*	*-54%*	*892%*	
2021 - 2022	*0%*	*0%*	*-78%*	*16%*	

3.5.3.2.2 AD and calculation for N Input from Applied organic N fertilizer (F_{ON})

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	N Input 3B to 3D

Activity data, parameter and emission calculation for N Input from *Applied organic N fertilizer (F_{ON})*

The data of annual amount of applied organic fertilizer (F_{ON}) is calculated according to the following equation taken from 2006 IPCC Guidelines, Vol. 4, Chap. 11[41].

Equation 11.3: N from organic N additions applied to soils (TIER 1) (2006 IPCC GL, Vol. 4, Chap. 11)

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

Where:

F_{ON} = total annual amount of organic N fertilizer applied to soils other than by grazing animals (kg N yr^{-1})

F_{AM} = annual amount of animal manure N applied to soils (kg N yr^{-1})

F_{SEW} = annual amount of total sewage N (coordinate with Waste Sector to ensure that sewage N is not double-counted) that is applied to soils (kg N yr^{-1})

F_{COMP} = annual amount of total compost N applied to soils (ensure that manure N in compost is not double-counted), kg N yr^{-1}

F_{OOA} = annual amount of other organic amendments used as fertilizer (e.g. rendering waste, guano, brewery waste, etc.,) (kg N yr^{-1})

F_{AM} - annual amount of animal manure N applied to soils

The term F_{AM} is determined by adjusting the amount of manure N available (N_{MMS_Avb}) for the amount of

- managed manure used for feed ($Frac_{FEED}$),
- burned for fuel ($Frac_{FUEL}$), or
- used for construction ($F_{rac\ CNST}$)

Equation 11.4: N from animal manure applied to soils (TIER 1)
(2006 IPCC GL, Vol. 4, Chap. 11)[42]

$$F_{AM} = N_{MMS\ Avb} \times \left[1 - \left(Frac_{Feed} + Frac_{Fuel} + Frac_{CNST}\right)\right]$$

Where:

F_{AM} = annual amount of animal manure N applied to soils (kg N yr^{-1})

N_{MMS_Avb} = amount of managed manure N available for soil application, feed, fuel or construction, (kg N yr^{-1}) *(Equation 10.34 in Chapter 10 of Vol. 4 of 2006 IPCC GL[43])*

$Frac_{FEED}$ = fraction of managed manure used for feed

$Frac_{FUEL}$ = fraction of managed manure used for fuel

$Frac_{CNST}$ = fraction of managed manure used for construction

[41] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.3 Choice of activity data, Page 11.13.

[42] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, Sub-Chap. 11.2.1.3, Equation 11.4, Page 11.13.

[43] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-Chap. 10.5.4 Coordination with reporting for N_2O emissions from managed soils. Page 10.64.

Figure 3-26 Fraction of of managed animal manure used for different purposes.

Data for $Frac_{FUEL}$, $Frac_{FEED}$, $Frac_{CNST}$ was not available therefore N_{MMS_Avb} was used as F_{AM} without adjusting for $Frac_{FUEL}$, $Frac_{FEED}$, $Frac_{CNST}$, which is also proposed by 2006 IPCC GL.

Finally, the managed manure nitrogen available for

- (a) application to managed soils,
- (b) for use in feed, fuel, or construction purposes (assumed be 0)

is estimated according to Equation 10.34 of Vol. 4 of 2006 IPCC GL[43].

Equation 10.34: Managed manure N available for application to managed soils, feed, fuel or construction uses (2006 IPCC GL, Vol. 4, Chap. 10.5.4)

$$N_{NMS\_Avb} = \sum_{S}\left\{\sum_{(T)}\left[\left[\left(N_{(T)} \times Nex_{(T)} \times MS_{(T,S)}\right) \times \left(1 - \frac{Frac_{LossMS}}{100}\right)\right] + \left[N_{(T)} \times MS_{(T,S)} \times N_{beddingMS}\right]\right]\right\}$$

Where:

$NMMS_{\_Avb}$	= amount of managed manure nitrogen available for application to managed soils or for feed, fuel, or construction purposes (kg N yr^{-1})
$N_{(T)}$	= number of head of livestock species/category T
$Nex_{(T)}$	= annual average N excretion per animal of species/category T (kg N $animal^{-1}$ $^{yr-1}$)
$MS_{(T,S)}$	= fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S, dimensionless
$Frac_{LossMS}$	= amount of managed manure nitrogen for livestock category T that is lost in the manure management system S (%)
$N_{beddingMS}$	= amount of nitrogen from bedding (to be applied for solid storage and deep bedding MMS if known organic bedding usage) (kg N animal-1 $^{yr-1}$)
S	= manure management system
T	= species/category of livestock

Data used for estimation the amount of managed manure nitrogen available for application to managed soils or for feed, fuel, or construction purposes were already used in other categories of IPCC Sector *Agriculture* and presented front sections.

$N_{(T)}$ - Number of head of livestock species/category T

The activity data are the same as used in category 3.A Enteric Fermentation and 3.B Manure Management and are presented.

$Nex_{(T)}$ - Annual average N excretion per animal of species/category T

The annual average N excretion per animal of species/category T ($Nex_{(T)}$) is calculated with Equation 10.30 of 2006 IPCC GL[44], presented in Table 3-38 and exemplarily calculated in (direct N_2O emissions) in Chapter 3.3.2.

$MS_{(T,S)}$ - fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S

The fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S is defined and is presented in Table 540.

$Frac_{LossMS}$ - amount of managed manure nitrogen for livestock category T that is lost in the manure management systems

Default values for total nitrogen loss from manure management was taken from Table 10.23 of 2006 IPCC GL[45] and are presented in the following table. These default values include losses that occur from the point of excretion, including animal housing losses, manure storage losses, and losses from leaching and runoff at the manure storage system where applicable.

Table 3-45 Default values for nitrogen loss due to volatilization of NH_3 and NO_x from manure management

Animal type	Manure management system (MMS)	Total N loss from MMS ($Frac_{LossMS}$)
Dairy Cow	Liquid/Slurry	40%
	Solid storage	30%
	Daily spread	7%
Poultry	Poultry without litter	55%
	Poultry with litter	40%
Other Cattle	Solid storage	45%
	Deep bedding	40%
Other (includes sheep, horses, and fur-bearing animals)	Deep bedding	25%
	Solid storage	7%

Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.5 Uncertainty assessment, Table 10.22: Default values for nitrogen loss due to volatilization of NH3 and NOx from manure management, p, 10,67,2019 refinement to 2006 IPCC Guidelines TABLE 10.22 (UPDATED) Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management.

$N_{beddingMS}$ - amount of nitrogen from bedding

Bedding materials vary greatly and are depending on the characteristics of bedding material used in their livestock industries. Due to lack of data in this inventory cycle, it was assumed that this manure management did not exist in the country. See also planned improvements.

[44] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.2 Choice of emission factors. p. 10.57.

[45] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.5 Uncertainty assessment, Table 10.23 Default values for total nitrogen loss from manure management. P. 10.67.

F_{SEW} - Annual amount of total sewage N that is applied to soils

The annual amount of total sewage sludge applied to soils depends on the sewage practices, which is quite different between rural and urban regions. Information about amount sewage sludge and related N content was not available. Therefore, this source of nitrogen was not estimated. (See also chapter planned improvements below).

N_2O emissions from wastewater treatment is entirely estimated in Chapter.

Double counting is therefore excluded.

F_{COMP} - Annual amount of total compost N applied to soil

The annual amount of compost applied to soils depends on the composting activities within the country However, information about amount of compost applied to soil and related N content was not available. Therefore, this source of nitrogen was not estimated. (See chapter planned improvement)

N_2O Emissions from biological treatment is entirely estimated in Chapter 7 Waste (IPCC sector 5).

Double counting is therefore excluded.

F_{OOA} - annual amount of other organic amendments used as fertiliser

No information about amount of other organic amendments (e.g., rendering waste, guano, brewery waste, etc.) used as fertilizer was not available. Therefore, this source of nitrogen was not estimated. (See chapter planned improvement.

3.5.3.2.3 AD and calculation for *N Input from annual amount of N in crop residues (F_{CR})*

Activity data, parameter, and emission calculation for N Input from annual amount of *N in crop residues, including N-fixing crops, and from forage/pasture renewal, returned to soils (F_{CR})*

The term F_{CR} refers to the amount of N in crop residues (above-ground and below-ground), including N-fixing crops, returned to soils annually. It also includes the N from N-fixing and non-N-fixing forages mineralised during forage or pasture renewal. It is estimated from crop yield statistics and default factors for above-/ belowground residue: yield ratios and residue N contents.

Equation 11.6: N from crop residues and forage/pasture renewal (TIER 1) *2006 IPCC GL, Vol. 4, Chap. 11.2.1.3)*

$$F_{CR} = \sum_T \Big\{ Crop_{(T)} \times Frac_{Renew(T)} \times \Big[\big(Area_{(T)} - Area_{burnt\,(T)} \times C_F \big) \times R_{AG(T)} \times N_{AG(T)} \times \big(1 - Frac_{Remove(T)} \big) \quad + Ar$$

As no country specific data were available the recommended alternative approach was applied for estimating the amount of N in crop residues (above-ground and below-ground), including N-fixing crops, returned to soils annually.

Equation 11.7A: N from crop residues and forage/pasture renewal (TIER 1) *Alternative approach to estimate F_{CR} (using Table 11.2)* *2006 IPCC GL, Vol. 4, Chap. 11.2.1.3*

$$F_{CR} = \sum_T \Big\{ Frac_{Renew(T)} \times \Big[\big(Area_{(T)} - Area_{burnt\,(T)} \times C_F \big) \times AG_{DM(T)} \times 1000 \times N_{AG(T)} \times \big(1 - Frac_{Remove(T)} \big) \quad + Area$$

Where:

F_{CR} = annual amount of N in crop residues (above and below ground), including N-fixing crops, and from forage/pasture renewal, returned to soils annually (kg N yr^{-1})

$Crop_{(T)}$ = harvested annual dry matter yield for crop T (kg dm* ha-1)

$Area_{(T)}$ = total annual area harvested of crop T (ha)

Area burnt $_{(T)}$ = annual area of crop T burnt (ha)

C_f = combustion factor (dimensionless)

referred to 2006 IPCC GL, Vol. 4, Chapter 2, Table 2.6

$AG_{DM(T)}$ = above-ground residue dry matter (Mg/ha)

see equation below

$N_{AG(T)}$ = N content of above-ground residues for crop T (kg N * (kg dm) $^{-1}$)

which is based on Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11

$Frac_{Remove(T)}$ = fraction of above-ground residues of crop T removed annually for purposes such as feed, bedding and construction (kg N *(kg crop-N)$^{-1}$)

No data for $Frac_{Remove}$ were available, thus no removal is assumed.

$R_{BG\text{-}BIO(T)}$ = Ratio of belowground residues to above-ground biomass (kg dm/ (kg dm)$^{-1}$) by the ratio of total above-ground biomass to crop yield.

it is based on Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11

$N_{BG(T)}$ = N content of below-ground residues for crop T (kg N *(kg dm)$^{-1}$)

see which is based on Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11

T = crop or forage type: wheat, potatoes, beans, etc.

The term $AG_{DM(T)}$ refers to the above-ground residue dry matter and is calculated according to the following equation.

Equation for calculation of the above-ground residue dry matter ($AG_{DM(T)}$)   *2006 IPCC GL, Vol. 4, Chap. 11.2.1.3. Table 11.2)*

$$AG_{DM(T)} = \frac{Crop_{(T)}}{1000} \times slope_{(T)} \times + intercept_{(T)}$$

The yield statistics for all crops are reported as fresh weight, a correction factor needs to be applied to estimate dry matter yields ($Crop_{(T)}$) following the Equation 11.7 of 2006 IPCC GL, Vol. 4, Chap. 11. The default values for dry matter content given in following tables and were taken from Table 11.2 of 2006 IPCC GL, Vol. 4, Chap. 11 may be used.

Equation 11.7: Dry-weight correction of reported crop yields   *(2006 IPCC GL, Vol. 4, Chap. 11.2.1.3)*

$$Crop_{(T)} = Yield\ Fresh_{(T)} \times DRY$$

Where:

$Crop_{(T)}$ = harvested dry matter yield for crop T (kg dm ha ^{1})

$Yield\_Fresh_{(T)}$ = harvested fresh yield for crop T (kg fresh weight ha ^{1})

DRY = dry matter fraction of harvested crop T (kg dm (kg fresh weight)-^{1})

In ## are presented relevant default factors for estimation of N added to soils from crop residues:

- Dry matter fraction of harvested product (DRY)
- Above-ground residue dry matter AG_{DM}(T)

- AGDM(T) = (Crop(T)/1000)*
- slope(T) +
- intercept(T)
- N content of above-ground residues (NAG)
- Ratio of below- ground residues to above-ground biomass (RBG-BIO)
- N content of below-ground residues (NBG)

With the Equation 11.1.a (see also above in 3.5.3.1 Choice of methods) and the Equation for conversion N_2O-N tot N_2O the N_2O emissions from N inputs to managed soils

Annual direct N_2O–N emissions from N inputs to managed soils (2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O - N_{N\ inputs} = \left[\left[\left(F_{CR}\right)\times EF_1\right] + \left[\left(F_{CR}\right)_{FR} \times EF_{1FR}\right]\right] \quad \textbf{(11.1.a)}$$

$$N_2O\ emissions_{direct} = N_2O - N \times \frac{44}{28}$$

3.5.4 Uncertainty assessment and time-series consistency for CRT category 3.D.a Direct N_2O emissions

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Uncertainty_3A-3B-3D

The uncertainties for activity data and emission factors used for CRT category 3.D Agricultural soils are presented in the following table.

Table 3-46 Uncertainty for CRT category 3.D.1 Direct N_2O emissions

Uncertainty	**CH_4**	**N_2O**	**N_2O**	**Reference**
				2006 IPCC GL, Vol. 4, Chap. 10
Activity data	NA	20%	NA	Chapter 11.2.1.4
Emission factor (direct emission)		250%		Chapter 10.4.4
Combined Uncertainty		254%		

3.5.5 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	QA-QC-Checklist_3D

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
  - consistent use of livestock data (statistical yearbook and FAOstat- Live Animals),
  - consistent use of data on area and yield of crops (statistical yearbook and FAOstat- crops),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation,
- cross-checked of different sources: national statistic (ONS) and international statistics (FAO)
- cross checks with other relevant sectors are performed to avoid double counting or omissions;
- consistency and completeness checks are performed;
- time series consistency - plausibility checks of dips and jumps.

3.5.6 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Recalculation_3A-3B-3D

The following table presents the main revisions and recalculations done since the last two submission to the UNFCCC and relevant to CRT category 3.D Agricultural soils.

Table 3-47 Recalculations done since NC in CRT category 3.D Agricultural soils

GHG source & sink category	Revisions of data NC / BUR ⇒ submission 2022	Type of revision	Type of improvement
3.D	Further application of Guidance provided in the 2019 Refinement to the 2006 IPCC Guidelines	method	Comparability
3.D.1	Use of N_2O default emission factor and parameter for direct emissions and indirect emissions of 2019 Refinement to the 2006 IPCC Guidelines	EF	Comparability
3.D.1.a.	Revision of 3.D.1.a. activity data of inorganic N fertilizers	AD	Accuracy
3.D.1.b.i.	Revision of 3.D.1.a. activity data due to revision of ● livestock data as for 1997-2022, as only national data were used (3.B) ● Split of livestock for TIER 2 (3.B) ● Revision of use of N_2O default emission factor and parameter for direct emissions (3.B)	AD	Accuracy

3.5.7 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture

File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	PlannedImprovements _3A-3B-3D

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-48 Planned improvements for CRT category 3.D Agricultural soils

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.D	F_{SN} - Annual amount of applied synthetic fertilizer consumption applied to soils ● amount and type (fertilizers by product and/or nutrient) of annual amount of applied synthetic fertilizer	AD	Accuracy Consistency Transparency	high
3.D	F_{ON} - annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils ● amount of animal manure and N content, ● amount of compost and N content, ● amount of sewage sludge and N content (cross-check with Waste Sector to ensure there is no double counting), ● annual amount of other organic amendments used as fertiliser (e.g., rendering waste, guano, brewery waste, etc,) and N content	AD	Accuracy Consistency Transparency	high
3.D	(1) $Area_{(T)}$ - Total annual area harvested of crops (types) (2) $Yield_{\_Fresh(T)}$ - Harvested fresh yield for crop T (3) Area burnt $_{(T)}$ - annual area of crop T burned (4) Dry matter (dm) fraction (DRY) ● grains: e.g., wheat (split in winter and summer harvest), barley, oats, rice, rye, millet, maize (corn), sorghum, spelt, teff, (wild) rice, etc, ● beans & pulses: e.g., beans, lentils, peas, etc, ● tubers: e.g., (sweet) potato, yam, cassava, sweet lupins, etc, ● root crops: beets-roots, sugar beet, pigweed, sunflower, mustard, carrots, etc. ● N-fixing forages ● Non-N-fixing forages ● Perennial grasses ● Grass-clover mixtures	AD	Accuracy Consistency Transparency	high
3.D	SOC_0 - soil organic carbon stock in the last year of an inventory time period (tonnes C) $SOC_{(0-T)}$ - soil organic carbon stock at the beginning of the inventory time period (tonnes C) *See Planned Improvements for LULUCF*	AD	Accuracy Transparency Consistency Comparability Completeness	medium
3.D	(1) number of head of livestock species/category T fraction of total annual N excretion for each livestock (2) species/category T that is deposited on pasture, range and paddock (PRP)	AD	Accuracy Consistency	High

GHG source & sink category	Planned improvement	Type of improvement	Priority
	(3) annual average N excretion per head of species/category T *see Planned Improvements for* *3.B. Enteric Fermentation and 3.A. Manure management*		

3.6 Indirect N_2O emissions from managed soils (CRT category 3.D.2)

3.D.2	**Indirect N_2O Emissions from managed soils**	
3.D.2.a	Atmospheric deposition	Volatilized N from agricultural inputs of N
3.D.2.b	Nitrogen leaching and run-off	N from fertilizers and other agricultural inputs that is lost through leaching and run-off

In addition to the direct emissions of N_2O from managed soils. Emissions of N_2O also take place through two indirect pathways.

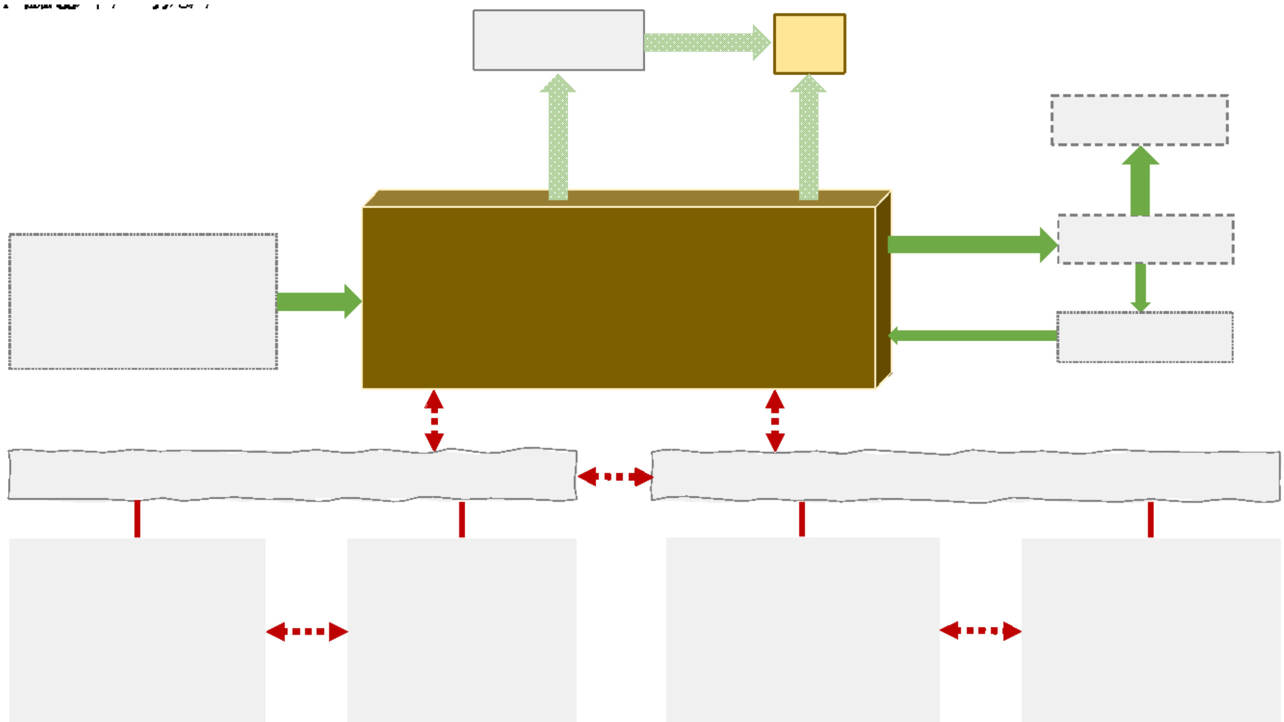

Figure 3-27 Factors influencing direct and indirect emissions of N_2O from agricultural soils

Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254, Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803
Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

The first pathways is the volatilisation of N as NH_3 and oxides of N (NO_x). and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters (see also Figure 3-27). As described in the 2006 IPCC GL, Vol. 4, Chapter 11.2.2 the sources of N as NH_3 and NO_x are not confined to agricultural fertilisers and manures, but also include fossil fuel combustion, biomass burning, and processes in the chemical industry. Thus, these processes cause N_2O emissions in an exactly analogous way to those resulting from deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic N fertilizers and /or urine and dung deposition from grazing animals (see also Figure **3-21**).

The <u>second pathway is the leaching and runoff</u> from land of N from synthetic and organic fertilizer additions, crop residues, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. As described in the 2006 IPCC GL, Vol. 4, Chapter 11.2.2 some of the inorganic N in or on the soil, mainly in the NO_3^- form, may bypass biological retention mechanisms in the soil/vegetation system by transport in overland water flow (runoff) and/or flow through soil macropores or pipe drains. Where NO_3^- is present in the soil in excess of biological demand, e.g., under cattle urine patches, the excess leaches through the soil profile. The nitrification and denitrification processes described at the beginning of this chapter transform some of the NH_4^+ and NO_3^- to N_2O. This may take place in the groundwater below the land to which the N was applied, or in riparian zones receiving drain or runoff water, or in the ditches, streams, rivers and estuaries (and their sediments) into which the land drainage water eventually flows.

<table>
<tr><td>Folder</td><td colspan="2">\06_Inventory\2024_submission\10_CRT</td></tr>
<tr><td>File</td><td colspan="2">3_CRT_Tables_Input_DZA.xlsx</td></tr>
<tr><td>sheet</td><td colspan="2">Table 3_GHG_T_eq,
Table 3_CO2_T,
Table 3_CH4_T, Table 3_CH4_T_eq,
Table 3_N2O_T, Table 3_N2O_T_eq</td></tr>
<tr><td>NID CHAPTER</td><td colspan="2">3.2.1 Category description</td></tr>
<tr><td rowspan="6">ToDo</td><td colspan="2">Check for updated reasons for trend in sectoral chapter
Update GHG emissions and AD in tables & graphs</td></tr>
<tr><td rowspan="4">Tables and Graphs from sheet</td><td>Table 3_GHG_T_eq</td></tr>
<tr><td>Table 3_CO2_T</td></tr>
<tr><td>Table 3_CH4_T, Table 3_CH4_T_eq</td></tr>
<tr><td>Table 3_N2O_T, Table 3_N2O_T_eq</td></tr>
<tr><td colspan="2">Check for updated reasons for trend in chapter
● Trend -> 2.2.1 Energy
● Executive Summary</td></tr>
</table>

Thus, agricultural nitrogen (N) sources of indirect N_2O emissions from managed soils arise from

- synthetic N fertilizers (F_{SN});
- organic N applied as fertilizer (e.g., applied animal manure, compost, sewage sludge, rendering waste and other organic amendments) (F_{ON});
- urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP});
- N in crop residues (above- and below-ground), including N-fixing crops and forage/pasture renewal returned to soils (F_{CR}); and
- N mineralization associated with loss of soil organic matter resulting from change of land use or management on mineral soils (F_{SOM}).

3.6.1 Methodological issues

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	ChoiceMethology-3D-indir

3.6.1.1 Choice of methods

TIER 1 approach - $N_2O_{(ATD)}$ Volatilization

For estimating the N_2O emissions from atmospheric deposition of N volatilized from managed the 2006 IPCC Guidelines Tier 1 approach[46] has been applied.

Equation 11.9: N_2O from atmospheric deposition of N volatilized from managed soils (TIER 1)
(2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O_{(ATD)} - N = \left[\left(F_{SN} \times Frac_{GASF}\right) + \left(\left(F_{ON} \times Frac_{PRP}\right) \times Frac_{GASF}\right)\right] \times EF_4$$

Where:

$N_2O_{(ATD)}$–N = annual amount of N_2O–N produced from atmospheric deposition of N volatilized from managed soils (kg N_2O–N yr^{-1})

F_{SN} = annual amount of synthetic fertiliser N applied to soils (kg N yr^{-1})

$Frac_{GASF}$ = fraction of synthetic fertiliser N that volatilises as NH_3 and NOx (kg N volatilized (kg of N applied)$^{-1}$)

F_{ON} = annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils (kg N yr^{-1})

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N yr^{-1})

$Frac_{GASM}$ = fraction of applied organic N fertiliser materials (FON) and of urine and dung N deposited by grazing animals (FPRP) that volatilises as NH_3 and NOx (kg N volatilized (kg of N applied or deposited)$^{-1}$) (Table 11.3)

EF_4 = emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces ([kg N–N_2O (kg NH_3–N + NOx–N volatilized)$^{-1}$])

Conversion of $N_2O_{(ATD)}$-N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

Equation 11.10: Indirect N_2O emissions due to volatilization of N from manure management

$$N_2O_{(ATD)} = N_2O_{(ATD)} - N \times \frac{44}{28}$$

Where:

$N_2O_{(ATD)}$ = indirect N_2O emissions due to volatilization of N from Manure Management (kg N_2O)

$N_2O_{(ATD)}$–N = annual amount of N_2O–N produced from atmospheric deposition of N volatilized from managed soils (kg N_2O–N yr^{-1})

44/28 = conversion of kg N_2O-N into kg N_2O.

TIER 1 approach - $N_2O_{(L)}$ Leaching/Runoff

For estimating the N_2O emissions from leaching and runoff in regions where leaching and runoff occurs the 2006 IPCC Guidelines Tier 1 approach[47] has been applied.

[46] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chap. 11, sub-Chap. 11.2.2.1 Choice of method

[47] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chap. 11, sub-Chap. 11.2.2.1 Choice of method

Equation 11.10: N_2O from N leaching/runoff from managed soils in regions where leaching/runoff occurs (TIER 1) (2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O_{(L)} - N = \left(F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}\right) \times Frac_{LEACH-(H)} \times EF_5$$

Where:

$N_2O_{(L)}$–N = annual amount of N_2O–N produced from leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O–N yr^{-1})

F_{SN} = annual amount of synthetic fertilizer N applied to soils in regions where leaching/runoff occurs (kg N yr^{-1})

F_{ON} = annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in regions where leaching/runoff occurs (kg N yr^{-1})

F_{PRP} = annual amount of urine and dung N deposited by grazing animals in regions where leaching/runoff occurs (kg N yr^{-1})

from Equation 11.5, page 11.13, Chap. 11.2.1.3 Choice of activity data, Vol. 4 of 2006 IPCC GL

F_{CR} = amount of N in crop residues (above- and below-ground), including N-fixing crops, and from forage/pasture renewal, returned to soils annually in regions where leaching/runoff occurs (kg N yr^{-1})

F_{SOM} = annual amount of N mineralized in mineral soils associated with loss of soil C from soil organic matter as a result of changes to land use or management in regions where leaching/runoff occurs (kg N yr^{-1})

from Equation 11.8, page 11.16, Chap. 11.2.1.3 Choice of activity data, Vol. 4 of 2006 IPCC GL

$Frac_{LEACH-(H)}$ = fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (kg N (kg of N additions)-1)

from Table 11.3, page 11.23, Chap. 11.2.2.3 Choice of activity data, Vol. 4 of 2006 IPCC GL and presented in Table 3-49

EF_5 = emission factor for N_2O emissions from N leaching and runoff (kg N_2O–N (kg N leached & runoff)$^{-1}$)

from Table 11.3, page 11.23, Chap. 11.2.2.3 Choice of activity data, Vol. 4 of 2006 IPCC GL and presented in Table 3-49 *in*

Conversion of $N_2O_{(L)}$-N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

Equation 11.10: Indirect N_2O emissions due to volatilization of N from manure management

$$N_2O_{(AL)} = N_2O_{(L)} - N \times \frac{44}{28}$$

Where:

$N_2O_{(L)}$ = indirect N_2O emissions due to leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O)

$N_2O_{(L)}$–N = annual amount of N_2O–N produced from leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O–N yr^{-1})

44/28 = conversion of kg N_2O-N into kg N_2O.

3.6.1.2 Choice of volatilization and leaching factors

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx

sheet	TIER1_EF_3.D_2019Ref

The method for estimating indirect N_2O emissions includes two emission factors:

- associated with volatilised and re-deposited N (EF_4),
- associated with N lost through leaching/runoff (EF_5).

The method also requires values for the fractions of N that are lost through volatilisation ($Frac_{GASF}$ and $Frac_{GASM}$) or leaching/runoff ($Frac_{LEACH-(H)}$).

As no country specific emission factors and values for the fractions of N that are lost were available, default emission factors and parameter were used.

Table 3-49 Default emission, volatilization and leaching factors for indirect soil N_2O emissions

Factor	Description	Unit	Default value
EF_4	N volatilisation and re-deposition	kg N_2O–N / (kg NH3–N + NOX–N volatilised)	0.010
EF_5	leaching/runoff	kg N_2O–N / (kg N leaching/runoff)	0.0075
$Frac_{GASF}$	Volatilization from synthetic fertilizer	(kg NH3–N + NOx–N) / (kg N applied)	0.10
$Frac_{GASM}$	Volatilization from all organic N fertilizers applied, and dung and urine deposited by grazing animals	(kg NH3–N + NOx–N) / (kg N applied or deposited)	0.20
$Frac_{LEACH-(H)}$	N losses by leaching/runoff for regions where ∑ (rain in rainy season) - ∑ (PE in same period) > soil water holding capacity, OR where irrigation (except drip irrigation) is employed	kg N / (kg N additions or deposition by grazing animals)	0.30
	N losses by leaching/runoff for dryland regions where precipitation is lower than evapotranspiration throughout most of the year and leaching is unlikely to occur		0

Source: 2006 IPCC GL, Vol. 4, Chap. 11, sub-Chap. 11.2.2.3, Choice of activity data, Table 11.3. page 11.23

3.6.1.3 Choice of activity data

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	N Input 3B to 3D

In order to estimate indirect N_2O emissions from the various N additions to managed soils, the parameters F_{SN}, F_{ON}, F_{PRP}, F_{CR}, F_{SOM} need to be estimated. These parameters are already described in Chapter 0 of this report described.

Applied synthetic fertiliser (F_{SN})

The term F_{SN} refers to the annual amount of synthetic fertiliser N applied to soils.

Relevant information is provided in Chapter 3.5.3.2.1 of this report.

Applied organic N fertilisers (F_{ON})

The term FON refers to the amount of organic N fertiliser materials intentionally applied to soils. Relevant information is provided in Chapter 3.5.3.2.1, 3.5.3.2.2, 3.5.3.2.3 of this report.

Urine and dung from grazing animals (F_{PRP})

The term F_{PRP} refers to the amount of N deposited on soil by animals grazing on pasture, range and paddock.

Relevant information is provided in Chapter 6.5.2 of this report.

Crop residue N, including N from N-fixing crops and forage/pasture renewal, returned to soils (F_{CR})

The term FCR refers to the amount of N in crop residues (above- and below-ground), including N-fixing crops, returned to soils annually. It also includes the N from N-fixing and non-N-fixing forages mineralised during forage/pasture renewal.

Relevant information is provided in Chapter 3.5.3.2.1 of this report.

Mineralised N resulting from loss of soil organic C stocks in mineral soils (F_{SOM})

The term F_{SOM} refers to the amount of N mineralised from the loss of soil organic C in mineral soils through land-use change or management practices.

Relevant information is provided in Chapter 6 of this report.

3.6.2 Uncertainty assessment and time-series consistency for CRT category 3.D Agricultural soils

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Uncertainty_3A-3B-3D

The uncertainties for activity data and emission factors used for CRT category 3.D Agricultural soils are presented in the following table.

Table 3-50 Uncertainty for CRT category 3.D Agricultural soils.

Uncertainty		**N_2O**	**Reference**
			2006 IPCC GL, Vol. 4, Chap. 11
Activity data			
$Frac_{loss}$	amount of managed manure nitrogen for livestock category that is lost in the manure management system	20%	Table 10.32 p 10.67
F_{sn}	activity data on synthetic fertilizer	20%	Expert judgment
F_{cr}	activity data crop residues	20%	Expert judgment
EF_1	N_2O emission factor for soils	250%	Table 11.1. page 11.11
EF_{PRP}	emission factor N deposited by grazing animals on pasture, range and paddock	200%	Table 11.1 page 11.11
EF_4	N volatilization and re-deposition	50%	Table 11.1 page 11.11
Combined Uncertainty		326%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

3.6.3 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	QA-QC-Checklist_3D

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
  - consistent use of livestock data (statistical yearbook and FAOstat- Live Animals),
  - consistent use of data on area and yield of crops (statistical yearbook and FAOstat- crops),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation,
- cross-checked of different sources: national statistic (ONS) and international statistics (FAO)
- cross checks with other relevant sectors are performed to avoid double counting or omissions;
- consistency and completeness checks are performed;
- time series consistency - plausibility checks of dips and jumps.

3.6.4 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	Recalculation_3A-3B-3D

The following table presents the main revisions and recalculations done since the last two submission to the UNFCCC and relevant to CRT category 3.D Agricultural soils.

Table 3-51 Recalculations done since NC in CRT category 3.D Agricultural soils

GHG source & sink category	Revisions of data NC / BUR ⇒ submission 2022	Type of revision	Type of improvement
3.D.2	First time calculated		

3.6.5 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3_Agriculture_Tool_DZA_2024.xlsx
Sheet	PlannedImprovements _3A-3B-3D

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-52 Planned improvements for CRT category 3.D Agricultural soils

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.D	F_{SN} - Annual amount of applied synthetic fertilizer consumption applied to soils ● amount and type (fertilizers by product and/or nutrient) of annual amount of applied synthetic fertilizer	AD	Accuracy Consistency Transparency	high
3.D	F_{ON} - annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils ● amount of animal manure and N content, ● amount of compost and N content, ● amount of sewage sludge and N content (cross-check with Waste Sector to ensure there is no double counting), ● annual amount of other organic amendments used as fertiliser (e.g., rendering waste, guano, brewery waste, etc,) and N content	AD	Accuracy Consistency Transparency	high
3.D	(1) number of head of livestock species/category T fraction of total annual N excretion for each livestock (2) species/category T that is deposited on pasture, range and paddock (PRP) (3) annual average N excretion per head of species/category T *see Planned Improvements for 3.B. Enteric Fermentation and 3.A. Manure management*	AD	Accuracy Consistency	High

3.7 Prescribed burning of savannas (CRT category 3.E)

GHG emission from CRT category 3.E Prescribed burning of savannas were not estimated because these kinds of forest don’t exist in Algeria.

3.8 Field burning of agricultural residues (CRT category 3.F)

Crop residues are sometimes burned, for convenience and as a means of disease control through residue removals. As described in the *2006 IPCC Guidelines Volume 4, Chapter 5.2.4.* CH_4 and N_2O emissions from *Cropland* are usually associated with burning of agriculture residues, which vary by crop and management system. Field burning of agricultural residues emits CH_4 and N_2O. CO_2 emissions from biomass burning do not have to be reported included in national total GHG emissions, since the carbon released during the combustion process is assumed to be reabsorbed by the vegetation during the next growing season.
This chapter includes information on, and description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT category 3.F. *Field burning of agricultural residues* for the period 1990 to 2022.
CO_2 emissions from category 3.F. *Field burning of agricultural residues* is accounted in CRT category 4.B *Cropland* under LULUCF, where live biomass loss from any type of disturbance has to be reported.

3.8.1 Category description

➩ **Crosscheck, if updated information is available and consistent with category chapters and chapter 1.4**

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.F	**Field burning of agricultural residues**	✔*	-	✔	-	✔	-

A '✔' indicates emissions from this category have been estimated.
Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential
CO_2*: from biomass burning residues is accounted in CRT category 4.B *Cropland* under LULUCF.

LA – Level Assessment (in year); TA – Trend Assessment

An overview of the *Field burning of agricultural residues* (CRT category 3.F) related GHG emissions is provided in the following figure and table.

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Trend_3F

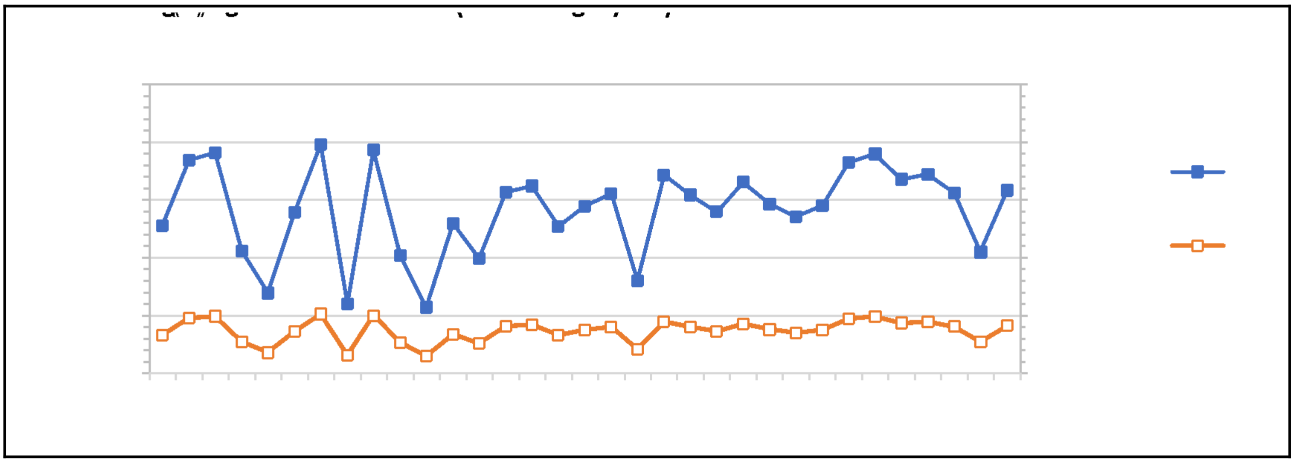

Figure 3-28 CH_4 and N_2O emissions from CRT category 3.F. *Field burning of agricultural residues*

Table 3-53 CH_4 emissions from CRT category 3.F Field burning of agricultural residues

CH_4	3.F	3.F.1.	3.F.1.a.	3.F.1.b.	3.F.1.c.	3.F.1.d.	3.F.2.	3.F.3.	3.F.4.	3.F.5.
	Field burning of agricultural residues	Cereals	Wheat	Barley	Maize	Oat and Sorghum	Pulses	Tubers and roots	Sugar cane	Other
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990										
1991										
1992										
1993										
1994										
2019										
2020										
2021										
2022										
Trend										
1990 - 2022										
2010 - 2022										
2021 - 2022										

Table 3-54 N_2O emissions from CRT category 3.F Field burning of agricultural residues

N_2O	3.F	3.F.1.	3.F.1.a.	3.F.1.b.	3.F.1.c.	3.F.1.d.	3.F.2.	3.F.3.	3.F.4.	3.F.5.
	Field burning of agricultural residues	Cereals	Wheat	Barley	Maize	Oat Sorghum	Pulses	Tubers and roots	Sugar cane	Other
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1990										
1991										
1992										
1993										
1994										
1995										
1996										
2019										
2020										
2021										
2022										
Trend										
1990 - 2022										

N_2O	3.F Field burning of agricultural residues	3.F.1. Cereals	3.F.1.a. Wheat	3.F.1.b. Barley	3.F.1.c. Maize	3.F.1.d. Oat Sorghum	3.F.2. Pulses	3.F.3. Tubers and roots	3.F.4. Sugar cane	3.F.5. Other
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
2010 - 2022										
2021 - 2022										

3.8.2 Methodological issues

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	ChoiceMethology_3F

3.8.2.1 Choice of methods

For estimating the CH_4 and N_2O emissions from CRT category 3.F *Field burning of agricultural residues* the 2006 IPCC Guidelines Tier 1 approach[48] has been applied.

Equation 2.27 Estimation of greenhouse gas emissions from fire

(2006 IPCC Guidelines, Vol. 4, Chap 2)

$$L_{fire} = A \times M_B \times C_f \times G_{ef} \times 10^{-3}$$

Where

- L_{fire} = amount of greenhouse gas emissions from fire, tonnes of each GHG: CH_4, N_2O, etc,
- A = area burnt (ha)
- M_B = mass of fuel available for combustion (tonnes * ha^{-1})
- C_f = combustion factor, dimensionless (default values in Table 2.6)
- G_{ef} = emission factor (g kg^{-1} dry matter burnt) (default values in Table 2.5, Chap. 2, Vol 4, 2006 IPCC GL).

3.8.2.2 Choice of activity data

Folder	\06_Inventory\2024_submission\03_Agriculture\01_SERIE_B_statistics
File	SERIE_B_statistics.xlsx
Folder	\06_Inventory\2024_submission\03_Agriculture\ 03_ONS_Statistics
File	CH7_Agriculture1962_2020Fr.pdf
Folder	\06_Inventory\2024_submission\03_Agriculture\ 04_FAO
File	FAOSTAT-CropProduction_Livestock_all

[48] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 5 Cropland, sub-chap 5.2.4.1 Choice of method and chapter 2.4 Non-CO_2 emissions

The agricultural data used and presented in this inventory are taken from national and international sources:

- Statistiques agricoles [49]
- FAO agricultural data base[50]

In the following Figures and Tables are provided the data on cultivated and harvested crops presented.

It is assumed that no agricultural crop residues were burnt on-site took place, thus no double counting.

For estimating the biomass burnt on field, the parameter (1) residue/crop ratio, (2) dry matter fraction and (3) fraction of crop residue burnt in fields were used and presented in the following table.

Table 3-55 Fraction of crop residue burned in fields, dry matter fraction and residue/crop ratio

	dry matter fraction (dry)	combustion factor Cf
	unit	unit
Wheat	0.89	0.90
Barley	0.89	0.85
Oats	0.89	0.85
Maize	0.87	0.80
Sorghum	0.89	
Source	Table 11.2, Chap. 11, Vol. 4, 2006 IPCC Guidelines	Table 2.6, Chap 2, Vol 4., 2019 Refinements to the 2006 IPCC Guidelines

Table 3-56 Area harvested (annual) and share of burned area

	Wheat		Barley		Oats		Maize		Sorghum	
	Area harvested	Share area burned	Area harvested	Share area burned	Area harvested	Share area burned	Area harvested	Share area burned	Area harvested	Share area burned
	ha		ha		ha		ha		ha	
1990										
1991										
1992										
1993										
2016										
2017										
2018										
2019										
2020										
2021										
2022										

[49] Available (03. May 2022) on n https://madr.gov.dz/Statistiques agricoles

[50] Available (03. May 2022) on http://www.fao.org/faostat/en/#data/QC

In the following table is provided an exemplary calculation of CH_4 and N_2O emissions from *Field burning of agricultural residues* (TIER 1) from wheat.

Table 3-57 Exemplary calculation of CH_4 and N_2O emissions from Field burning of agricultural residues (TIER 1) from wheat

	Parameters	Parameter description	Unit	Formula	Sources	2022
1	T	Crop: Wheat	-	-	-	-
2	Area (T)	Area harvested (annual)	ha		MADR/FAO	1,821,702
3	Crop F	Yield (harvested fresh yield)	kg/ha		MADR/FAO	1,647
4	Prod	Crop Production	tonnes		MADR/FAO	3,000,000
5	Area $_{burned-share}$	Share area burned (annual)	%		Expert judgment	10%
6	Area burned	Area burned (annual)	ha	Area(T) x Area $_{burned-share}$		182,170
7	DRY	dry matter fraction of harvested crop	kg dm / kg fresh weight			0.89
8	Crop(T)	harvested annual dry matter yield	kg dm ha-1	Yield Fresh (T) x DRY	Equation 11.7	1,465.65
9	Mb*Cf	fuel (dead organic matter plus live biomass) biomass consumption values	tonnes dm/ha		Table 2.4 (updated), Chap. 2, Vol 4, 2019 Refinements to 2006 IPCC GL	4.00
10	AGR(T)	Total amount of above-ground crop residue	Mg dm yr-1	Crop(T) + AGDM(T)	[51]	3,679.31
11	Frac Burnt (T)	fraction of annual harvested area of crop T burnt	-			0.10
12	Cf	Combustion factor	-		Table 2.6 Chap. 2, Vol 4, 2019 Refinements to 2006 IPCC GL	0.9
13	EF CO_2	CO_2 emission factor	g / kg dm burnt		Table 2.5	1,515
14	CO_2	CO_2 emission from Agricultural residues	kt	Area $_{burned}$ x Mb*Cf x EF CO_2 x 10^-6	Equation 2.27	1,103,95
15	EF CH_4	CH_4 emission factor	g / kg dm burnt		Table 2.5	2.7
16	CH_4	CH_4 emission from Agricultural residues	kt	Area $_{burned}$ x Mb* Cf x EF CH_4 x 10^-6	Equation 2.27	1.97
17	EF N_2O	N_2O emission factor	g / kg dm burnt		Table 2.5	0.07
18	N_2O	N_2O emission from Agricultural residues	kt	Area $_{burned}$ x Mb* Cf x EF N_2O x 10^-6	Equation 2.27	0.05

3.8.2.3 Choice of emission factors

The default emissions factors used were taken from Table 2.5, Chap. 2, Vol. 4, 2019 Refinement to 2006 IPCC Guidelines.

[51] *Doctoral dissertations University of Tennessee. Knoxville*

Table 3-58 Fraction of Crop Residue Burned in Fields, Dry Matter Fraction and Residue/Crop Ratio

	CO_2	CH_4	N_2O	CO	NOx
	g / kg dry matter burnt				
Default Emission factor	1515	3	0.07	92	2.5
Source	Table 2.5, Chap 2, Vol 4., 2019 Refinements to the 2006 IPCC Guidelines				

3.8.3 Uncertainty assessment and time-series consistency

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Uncertainty_3F

The uncertainties for activity data and emission factors used for CRT category 3.F Field burning of agricultural residues are presented in the following table.

Table 3-59 Uncertainty for CRT category 3.F Field burning of agricultural residues.

Uncertainty	CO_2	CH_4	N_2O	Reference
				2019 Refinements to the 2006 IPCC GL, Vol. 4
Activity data (AD)	20%	20%	20%	Expert judgment based on Chapter 11.2.1.4
Emission factor (EF)	±177%	±180%	±180%	Table 2.5, Chapter 2
Combined Uncertainty	178%	181%	181%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

3.8.4 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	QA-QC-Checklist_3F

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
  - consistent use of data on area under crop cultivation,
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation,
- cross-checked from different sources: national statistic (ONS) and international statistics (FAO)
- consistency and completeness checks are performed;
- time series consistency - plausibility checks of dips and jumps.

3.8.5 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Recalculation_3F

The following table presents the main revisions and recalculations done since the last two submission to the UNFCCC and relevant to CRT category 3.F Field burning of agricultural residues.

Table 3-60 Recalculations done in CRT category 3.F Field burning of agricultural residues

GHG source & sink category	Revisions	Type of revision	Type of improvement
3.F	Correction of typos and technical mistakes	Emi	Accuracy

3.8.6 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	PlannedImprovements_3F

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-61 Planned improvements for CRT category 3.F *Field burning of agricultural residues*

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.F	Application of emission factor of Table 2.5 Chap. 2, Vol 4, 2019 Refinements to 2006 IPCC GL	AD	Accuracy	high
3.F	Consideration of cultivated crops and crop residues which are burnt and if possible, by provinces ● Which crop residues are burned ● Share of crop residues burned ● Use of crop residues: biofuel, domestic livestock feed, building materials, burning in the field etc, ● Dry matter fraction ● Estimation of above-ground (and below ground) biomass, dead organic matter (dead wood and litter)	AD	Transparency Accuracy	medium
3.F	Cross-check with FAO statistics[52] (Emissions – Agriculture) where emissions from crop residues were estimated	EMI	Consistency	low

[52] Available (03. March 2019) on http://www.fao.org/faostat/en/#data/GA

3.9 Liming (CRT category 3.G)

The CRT category 3.G Liming does not exist in Algeria.

3.10 Urea application (CRT category 3.H)

This chapter includes information on and description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT category3.H *Urea application*.

As described in the 2006 IPCC GL, Vol. 4, Chap. 11, adding urea to soils during fertilisation leads to a loss of CO_2 that was fixed in the industrial production process. Urea ($CO(NH_2)_2$) is converted into ammonium (NH_4^+), hydroxyl ion (OH^-), and bicarbonate (HCO_3^-), in the presence of water and urease enzymes. Similar to the soil reaction following addition of lime, bicarbonate that is formed evolves into CO_2 and water.

(1) $CO(NH_2)_2 + 2H_2O \xrightarrow{\text{Urease enzyme}} (NH_4)_2CO_3$

Urea Water Ammonium carbonate

(2) $NH_4)_2CO_3 + 2H^+ \longrightarrow 2NH_4 + CO_2 + 2H_2O$

Ammonium carbonate Ammonium Carbon dioxide Water

(3) $NH_4 + OH^+ \longrightarrow Ca(NO_3)_2 + H_2O$

Ammonium Hydroxide Ammonia Water

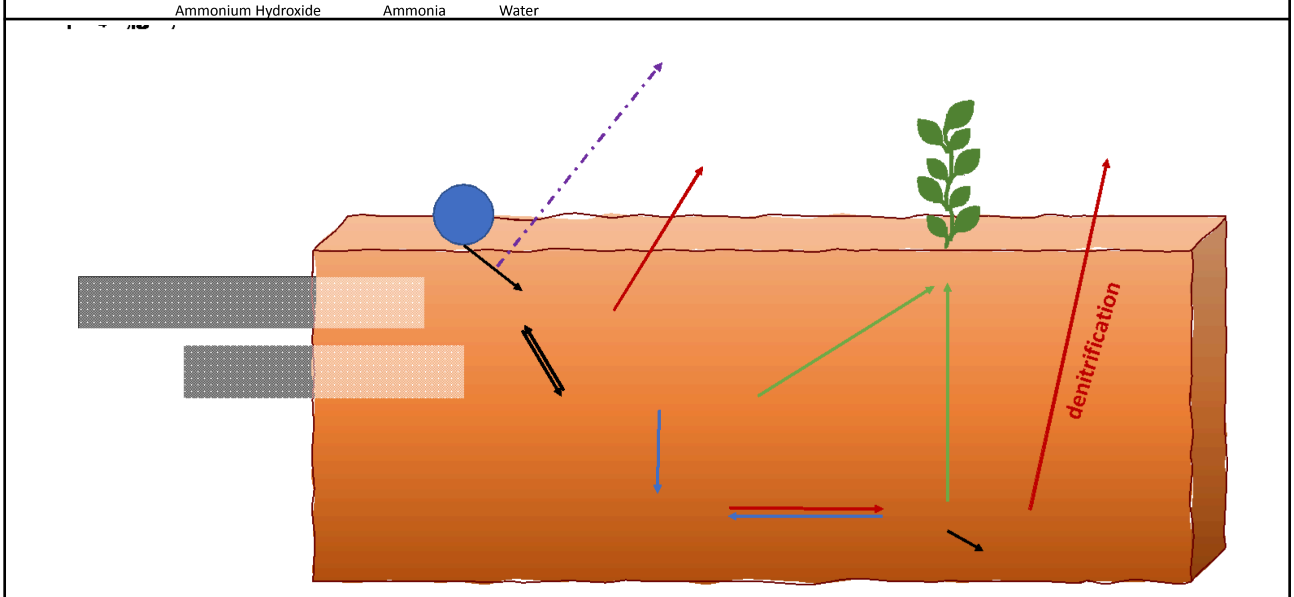

Figure 3-29 Urea hydrolysis reaction (equation)

The source category *Urea application* is included because the CO_2 removal from the atmosphere during urea manufacturing is estimated in the IPCC sector *Industrial Processes and Product Use Sector (IPPU).*

3.10.1 Category description

⇨ Crosscheck, if updated information is available and consistent with category chapters and chapter 1.4

GHG emissions from this sector comprise emissions from the following categories:

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.H	Urea application	✔	-	NA	-	NA	-

A '✔' indicates emissions from this category have been estimated. Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential
LA – Level Assessment (in year); TA – Trend Assessment

The CRT category 3.H *Urea application* was responsible for 44.53 kt CO_2 emissions in 1990 and for 67.47 kt CO_2 emissions in 2022. However, the data for 1990-2008 are based on 2019 and 2017-2022 on 2016 as no data amount of urea applied was available.

An overview of the *Urea application* (CRT category 3.H) related CO_2 emissions is provided in the following figure and table.

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Trend-3H

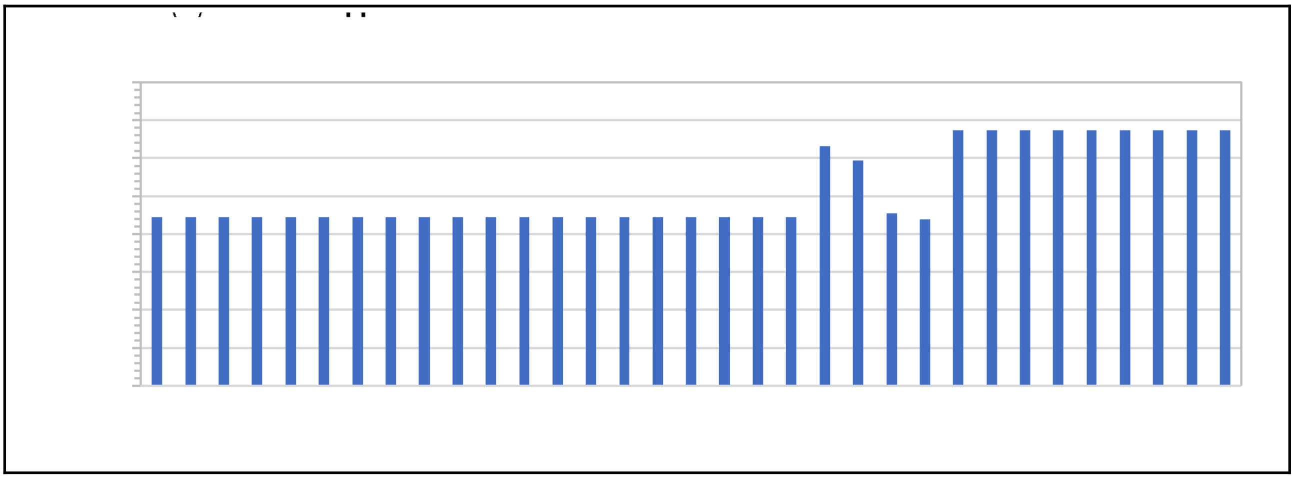

Figure 3-30 CO_2 Emissions from CRT category 3.H *Urea application*

Table 3-62 Annual amount of urea applied, emission factor and CO_2 emissions from CRT category 3.H *Urea application*

	Urea application		Emission factor CO_2-C		CO_2 emissions
	tonnes	Source	t of C/t of urea	Source	kt
1990		As of 2009		2006 IPCC GL, Vol. 4, Chap. 11, sub-Chap. 11.4.2	
1991					
1992					
1993					
2000					
2001					
2002				2006 IPCC GL, Vol. 4, Chap. 11, sub-Chap. 11.4.2	
2003					
2004					
2005					

	Urea application		Emission factor CO_2-C		CO_2 emissions
	tonnes	Source	t of C/t of urea	Source	kt
2006					
2007					
2008					
2009		FAO stat -Fertilizers by Product[53]			
2010					
2016					
2017		As of 2019			
2018					
2019					
2020					
2021					
2022					
Trend					
1990 – 2022					
2010 – 2022					
2021 – 2022					

3.10.2 Methodological issues

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	ChoiceMethology-3H

3.10.2.1 Choice of methods

For estimating the CO_2 emissions from urea application/fertilisation, the 2006 IPCC Guidelines Tier 1 approach[54] has been applied.

Equation 11.13: Annual CO_2 emissions from urea application (2006 IPCC GL, Vol. 4, Chap. 11)

$$CO_2 - C\ emission = AD \times EF$$

$$CO_2\ emissions = \frac{CO_2O - C \times \frac{44}{12}}{1000}$$

Where:

- CO_2 emission = annual CO_2 emissions from urea application (kt)
- CO_2–C emission = annual C emissions from urea application (tonnes C)
- AD = annual amount of urea fertilisation (tonnes urea)
- EF = emission factor (tonne of C / tonne of urea)

[53] FAO (2024): Available on 18.07.2024 at: http://www.fao.org/faostat/en/#data/RFB

[54] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11 - N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-Chap. 11.4.1, page 11.32.

44/12 = conversion factor from C to CO_2

1000 = conversion factor from tonnes to kt (=Gg)

3.10.2.2 Choice of activity data

Folder	\06_Inventory\2024_submission\03_Agriculture\ 05_Feritlizer
File	FAOSTAT_Fertilizer
	Fertilizer_CN-Codes
	Fertial_fertilizer.xlsx

The agricultural data used and presented in this inventory were taken from FAO agricultural data base[55]. The annual amount of urea in used IPCC sector Agriculture is determined by national production, import and export, as well as 'other uses of urea'.

Agricultural use of Urea = production + import – export – Other Uses of Urea

However, no data for import, export and other uses of urea were not available for periods 1990-2008 and 2017-2022. For the period 1990-2008 the amount of urea used in agricultural of 2016 was used and for the period 2017-2022 the amount of urea used in agricultural of 2016 was used.

3.10.2.3 Choice of emission factors

The default emission factor was taken from IPCC 2006 Guidelines and presented in the following table. An overall emission factor (EF) of 0.20 for urea, which is equivalent to the carbon content of urea on an atomic weight basis (20% for $CO(NH_2)_2$) was applied.

Table 3-63 CO_2 Emission factor TIER 1 for CRT category 3.H *Urea application*

	EF CO_2-C (t of carbon/t of urea)			Source
	Method	**EF**	**type**	
Urea application	T1	0.20	D	2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11 - N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap. 11.4.2, page 11.34.
Note: D Default CS Country specific PS Plant specific IEF Implied emission factor				

3.10.3 Uncertainty assessment and time-series consistency

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Uncertainty_3H

The uncertainties for activity data and emission factors used for CRT category 3.D *Urea Application are* presented in the following table.

[55] FAO (2024): Available on 18.07.2024 at: http://www.fao.org/faostat/en/#data/RFB

Table 3-64 Uncertainty for CRT category 3.H *Urea Application*.

Uncertainty	CO_2	CH_4	N_2O	Reference
Activity data (AD)	50%	-	-	Based on Chapter 11.4.4, 2006 IPCC GL, Vol. 4, Chap. 11
Emission factor (EF)	50%	-	-	
Combined Uncertainty	50 %	-	-	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

3.10.4 Category-specific QA/QC and verification

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	QA-QC-Checklist_3H

The following source-specific QA/QC activities were performed out:

- Checked of calculations by spreadsheets
    - documented sources,
    - use of units,
    - strictly defined interfaces between spreadsheets/calculation modules,
    - unique structure of sheets which do the same,
    - record keeping, use of write protection,
    - unique use of formulas, special cases are documented/highlighted,
    - quick-control checks for data consistency through all steps of calculation,
- cross-checked from different sources: national statistic (ONS) and international statistics (FAO)
- time series consistency - plausibility checks of dips and jumps.

3.10.5 Category-specific recalculations including explanatory information and justifications

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	Recalculation_3H

The following table presents the main revisions and recalculations done since the last two submission to the UNFCCC and relevant to CRT category 3.H *Urea application*.

Table 3-65 Recalculations done since submission 2010 CRT category 3.H *Urea application*

GHG source & sink category	Revisions	Type of revision	Type of improvement
3.H	No recalculation as this source was estimated the first time.	-	-

3.10.6 Category-specific planned improvements

Folder	\06_Inventory\2024_submission\03_Agriculture
File	3D-J_Crop_Production.xlsx
Sheet	PlannedImprovements_3H

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 3-66 Planned improvements for CRT category 3.H *Urea application*

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.H	Collection of activity data for the time series 1990 – 2022	AD	Accuracy Completeness	medium

3.11 Other carbon-containing fertilizers (CRT category 3.I)

The CRT category 3.I Other carbon-containing fertilizers does not exist in Algeria.

3.12 Other (CRT category 3.J)

The CRT category 3.J Other does not exist in Algeria