Report Task 1 of Methodological studies in the field of Agro-Environmental Indicators. Lot 1 excretion factors

Final Draft

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Contents

Summary

There is a needed for accurate estimates of N excretion of livestock. The general objective of the project *Nitrogen and phosphorus excretion factors for livestock of the Methodological studies in the field of Agro-Environmental Indicators (2012/S 87-142068)* is "to bring clarity into the issue of excretion factors so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified.

This report describes the results of Task 1 "Overview of existing excretion factors". The objectives of this Task are:

- To create an overview of the different methodologies used in Europe to calculate excretion factors for nitrogen and phosphorus, and analyse their strengths and weaknesses;
- To set up a database with the excretion factors presently used in different reporting systems and describe the main factors that cause distortion within a country and across the EU.

The focus of this report is on the gross N excretion coefficients, i.e. the N excretion "under the tail of the animal", which means that coefficients have not been corrected for gaseous N losses (NH_3, N_2O, NOx and N_2) during the manure storage, in animal housing and during and after the application of manure to land.

This report and the Annex with detailed information for each member state provide an overview of the important sources of information of existing excretion factors are presented, including a description of the used methodology and overview of excretion factors. A description is presented of excretion factors used for National Inventory Reports for UNFCCC (based on the IPCC guidelines), ammonia emission reported for the Gothenborg protocol (and generally also NEC Directive), Eurostat/OECD nutrient balances, the GAINS model, the CAPRI model, the EU Nitrates Directive (Action programmes and studies carried out for the Nitrates Directive), and other sources.

Comparison of the N excretion figures between data sources and between countries for livestock categories show often large differences. It is difficult to find explanation for these differences, as the used methodologies are often not well described. Moreover, some data sources report aggregated excretion figures for animal categories (other cattle, pigs, and poultry), without showing the detailed N excretion rates for the specific animal categories. There also may differences in the age and weight considered, feeding systems, the way young animals are included, and the unit in which excretion is expressed (per place or per animal place). In some member states, excretion factors differ between years, because of changing diet of livestock. However, it may not be excluded that some countries express the N excretion of an animal basis and other on animal places basis. For sows, it is important if piglets are included (and till which weight and age).

There is a clear need for a harmonized procedure to calculate N excretions and describe the methodology. The first step would be the definition of animal categories for which excretion figures have to be calculated. These are preferably categories for which animals number are gathered, so that total manure production in regions and countries can be made. It is recommended to use animal categories in Farm Structure Survey (FSS) as a basis. The second step would be to recommend a set of methodologies (Tier approach) to estimate the N excretion for each category. The Tier 1 approach would be an approach with default N excretion figures for certain region or farming systems (depending on intensity). In other Tier levels, harmonized methodologies to calculate N excretion data are needed, which use available information for productivity and inputs.

1 Introduction

Agri-environmental indicators are important in the assessment of trends over time of (i) the effects of agriculture on the environment, and (ii) the effectiveness and efficiency of agricultural and environmental policy measures. Eurostat coordinates the work within the European Commission and with the EEA on the 28 Agri-environmental indicators. The AEIs are increasingly seen as means to report on the agri-environmental interaction and on the implementation of agri-environmental policies. The Gross Nitrogen Balance (GNB) is a key indicator for assessing the effects of agriculture on the environment. For establishing accurate GNBs, accurate information is needed of all input and output items of the GNB, at national and preferably regional scales.

The amount of nitrogen (N) in manure entering agricultural land and the amount of N leaving agricultural land in harvested grass, either via grazing or mowing, are the least accurate items on the GNB, because these flows are not measured at farm or national level. In fact, these flows are extremely difficult to measure directly; they can more easily be quantified in an indirect way. Currently, there are no uniform, standard and accepted methodologies and terminologies for estimating the amounts of N and P in animal excrements. Member States tend to use methods which they have developed and improved over time, and sometimes use different methodologies for different reporting requirements, as reported by the DireDate project[1]. This make comparisons between countries and estimates at EU-27 level complicated.

Recommendations for a uniform and standard methodology for estimating N and P excretion coefficients must be based on a thorough analysis of the strength and weaknesses of the existing methodologies and on the data availability and quality in the Member States.

The general objective of Lot 1. Nitrogen and phosphorus excretion factors for livestock of the Methodological studies in the field of Agro-Environmental Indicators (2012/S 87-142068) is "*to bring clarity into the issue of excretion factors so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified. This methodology should be flexible enough to allow local conditions to be taken into account, but without distorting the picture".*

This report describes the results of Task 1 "Overview of existing excretion factors". The objectives of this Task are:

- To create an overview of the different methodologies used in Europe to calculate excretion factors for nitrogen and phosphorus, and analyse their strengths and weaknesses;
- To set up a database with the excretion factors presently used in different reporting systems and describe the main factors that cause distortion within a country and across the EU.

The deliverables of this task are:

- A database covering all EU member states with the different excretion factors used
- A report per country on the methodologies used for the different factors.
- A report with a synthesis of the methodologies used for the different factors (this report)

The focus of this report is on the gross N excretion coefficients, i.e. the N excretion "under the tail of the animal", which means that coefficients have not been corrected for gaseous N losses (NH_3, N_2O, NOx and N_2) during the manure storage, in animal housing and during and after the application of manure to land.

In Chapter 2, an overview of the important sources of information of existing excretion factors are presented, including a description of the used methodology and overview of excretion factors. This Chapter includes description of excretion factors used for National Inventory Reports for UNFCCC and based on the IPCC guidelines, ammonia emission reported for the Gothenborg protocol (and generally also NEC Directive), Eurostat/OECD nutrient balances, the GAINS model, the CAPRI model, the EU Nitrates Directive (Action programmes and studies carried out for the Nitrates Directive), and other sources. In Chapter 3 a comparison is made of the N excretion coefficients used in different countries and in different sources of information. In Chapter 4

[1] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-11-005/EN/KS-RA-11-005-EN.PDF

reports of excretion coefficients in European countries are summarized. The detailed assessments of country reports are included in an Annex. Note that data have subtracted from reports and data bases and the end of 2011 and that in the meanwhile member states may have modified their method and excretion figures. For the most recent excretion figures, the most recent report and data base should be used (e.g. for UNFCCC and UNECE).

2 Sources of information of existing excretion factors

2.1 UNFCCC/IPCC

Countries report emissions of greenhouse gases to the UNFCCC. The method used to calculate greenhouse gas emissions is based on the IPCC guidelines. The IPCC Guidelines include recommendations for National Greenhouse Gas Inventories (NIR). These guidelines also include recommendations for the calculation of the N excretion of livestock, as these figures are needed to calculate nitrous oxide (N_2O) emission and ammonia (NH_3) emission (NH_3 is a source of indirect N_2O emission). The IPCC Guidelines contain recommendations at different levels of detail (Tier levels). The Tier 1 approach is the most simple method and includes default estimates of excretion. The Tier 2 and 3 approaches are more detailed and include country specific estimates and/or models to calculate N excretions.

The information presented in the Chapter is derived from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf)

2.1.1 Tier 1

Annual N excretion rates should be determined for each livestock category. Country-specific rates may either be taken directly from documents or scientific literature, or derived from information on animal nitrogen intake and retention.

If country-specific data cannot be collected or derived, or appropriate data are not available from another country, the IPCC default N excretion rates (Tier 1) presented in Table 1 can be used. These rates are expressed in units of N excreted per 1000 kg of animal per day. These rates can be applied to livestock sub-categories of varying ages and growth stages using a typical average animal mass (TAM) for that population sub-category, as shown in Equation 10.30.

EQUATION 10.30
ANNUAL N EXCRETION RATES

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

Where:

- Nex(T) = annual N excretion for livestock category T, kg N animal^{-1} yr^{-1}
- Nrate(T) = default N excretion rate, kg N (1000 kg animal mass)$^{-1}$ day^{-1} (see Table 1)
- TAM(T) = typical animal mass for livestock category T, kg animal^{-1}

The IPCC Guidelines includes default TAM, but it is recommended to use country-specific TAM values. Table 1 shows the default N excretion rate and TAM values for European countries and Table 2 and Table 3 the calculated N excretion rates for European countries.

Table 1. Default N excretion rates per 1000 kg animal mass per day (Source: IPCC Guidelines 2006).

TABLE 10.19
DEFAULT VALUES FOR NITROGEN EXCRETION RATE [a] (KG N (1000 KG ANIMAL MASS)$^{-1}$ DAY^{-1})

Category of animal	Region							
	North America	Western Europe	Eastern Europe	Oceania	Latin America	Africa	Middle East	Asia
Dairy Cattle	0.44	0.48	0.35	0.44	0.48	0.60	0.70	0.47
Other Cattle	0.31	0.33	0.35	0.50	0.36	0.63	0.79	0.34
Swine[b]	0.50	0.68	0.74	0.73	1.64	1.64	1.64	0.50
Market	0.42	0.51	0.55	0.53	1.57	1.57	1.57	0.42
Breeding	0.24	0.42	0.46	0.46	0.55	0.55	0.55	0.24
Poultry	0.83	0.83	0.82	0.82	0.82	0.82	0.82	0.82
Hens >/= 1 yr	0.83	0.96	0.82	0.82	0.82	0.82	0.82	0.82
Pullets	0.62	0.55	0.60	0.60	0.60	0.60	0.60	0.60
Other Chickens	0.83	0.83	0.82	0.82	0.82	0.82	0.82	0.82
Broilers	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Turkeys	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Ducks	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Sheep	0.42	0.85	0.90	1.13	1.17	1.17	1.17	1.17
Goats	0.45	1.28	1.28	1.42	1.37	1.37	1.37	1.37
Horses (and mules, asses)	0.30	0.26	0.30	0.30	0.46	0.46	0.46	0.46
Camels[c]	0.38	0.38	0.38	0.38	0.46	0.46	0.46	0.46
Buffalo[c]	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Mink and Polecat (kg N head^{-1} yr^{-1})[d]	4.59	4.59	4.59	4.59	4.59	4.59	4.59	4.59
Rabbits (kg N head^{-1} yr^{-1})	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10
Fox and Racoon (kg N head^{-1} yr^{-1})[d]	12.09	12.09	12.09	12.09	12.09	12.09	12.09	12.09

The uncertainty in these estimates is ±50%.

[a] Summarized from *1996 IPCC Guidelines*, 1997; European Environmental Agency, 2002; USA EPA National NH_3 Inventory Draft Report, 2004; and data of GHG inventories of Annex I Parties submitted to the Secretariat UNFCCC in 2004.

[b] Nitrogen excretion for swine are based on an estimated country population of 90% market swine and 10% breeding swine.

[c] Modified from European Environmental Agency, 2002.

[d] Data of Hutchings *et al.*, 2001.

Table 2. Default N excretion rates per day and animal mass for European countries (Source: IPCC Guidelines 2006).

Source: Default N excretion rates. For Western and Easter Europe. IPCC Guidelines 2006.

Category		N excretion, kg N/1000 kg animal mass/day		Animal mass, kg		
		Western Europe	Eastern Europe	Western Europe	Eastern Europe	
Dairy cattle		0.48	0.35	600	550	
Other cattle		0.33	0.35	420	391	
Swine		0.68	0.74			
	Market	0.51	0.55	50	50	
	Breeding	0.42	0.46	198	180	
Poultry		0.83	0.82			
	Hens ≥ 1yr	0.96	0.82	1.8	1.8	(developed countries)
	Pullets	0.55	0.6	1.8	1.8	(developed countries)
	Other chickens	0.83	0.82	1.8	1.8	(developed countries)
	Broilers	1.1	1.1	0.9	0.9	(developed countries)
	Turkeys	0.74	0.74	6.8	6.8	(developed countries)
	Ducks	0.83	0.83	2.7	2.7	(developed countries)
Sheep		0.85	0.9	48.5	48.5	(developed countries)
Goats		1.28	1.28	38.5	38.5	(developed countries)
Horses		0.26	0.3	377	377	(developed countries)
Mules, asses		0.26	0.3	130	130	(developed countries)
Camels		0.38	0.38	217	217	(developed countries)
Buffalo		0.32	0.32	380	380	

Mink and polecat	kg N/head/yr	4.59	4.59
Rabbits	kg N/head/yr	8.1	8.1
Fox	kg N/head/yr	12.09	12.09

Table 3. Annual N excretion rates in Western and Eastern Europe according to Tier 1 methodology of IPCC, calculated by multiplication of the daily excretion rates with 365 and the animal mass (see Table 2).

Animal	Calculated N excretion, kg/animal/yr	
	Western Europe	Eastern Europe
Dairy cattle	105	70
Other cattle	51	50
Market swine	9.3	10.0
Breeding swine	30.35	30.22
Hens ≥ 1yr	0.63	0.54
Pullets	0.36	0.39
Other chickens	0.55	0.54
Broilers	0.36	0.36
Turkeys	1.84	1.84
Ducks	0.82	0.82
Sheep	15	16
Goats	18	18
Horses	36	41
Mules, asses	12	14
Camels	30	30
Buffalo	44	44
Mink and polecat	4.6	4.6
Rabbits	8.1	8.1
Fox	12.1	12.1

2.1.2 Tier 2

The annual N excretion depends on the total annual N intake and total annual N retention of the animal. Therefore, N excretion rates can be derived from N intake and N retention data. The amount of N consumed by the animal depends on the amount of feed digested by the animal, and the protein content of that feed. Total feed intake depends on the production level of the animal (e.g., growth rate, and milk production). The annual N retention is the fraction of N intake that is retained by the animal for the production of meat, milk, or wool. Nitrogen intake and retention data for specific livestock species/categories may be available from national statistics or from animal nutrition specialists. Default N retention values are provided in the IPCC Guidelines (Table 4). Nitrogen intake can also be calculated from data on feed and crude protein intake. The rates of annual N excretion for each livestock species/category (Nex(T)) are derived as follows:

EQUATION 10.31
ANNUAL N EXCRETION RATES (TIER 2)

$$Nex_{(T)} = N_{\text{int}\,ake(T)} \bullet \left(1 - N_{retention(T)}\right)$$

Where:
$Nex_{(T)}$ = annual N excretion rates, kg N animal^{-1} yr^{-1}
$N_{intake(T)}$ = the annual N intake per head of animal of species/category T , kg N animal^{-1} yr^{-1}
$N_{retention(T)}$ = fraction of annual N intake that is retained by animal of species/category T, dimensionless

Table 4. Defaults N retention values.

TABLE 10.20
DEFAULT VALUES FOR THE FRACTION OF NITROGEN IN FEED INTAKE OF LIVESTOCK THAT IS RETAINED BY THE DIFFERENT LIVESTOCK SPECIES/CATEGORIES (FRACTION N-INTAKE RETAINED BY THE ANIMAL)

Livestock category	$N_{retention(T)}$ (kg N retained/animal/year) (kg N intake/animal/year)$^{-1}$
Dairy Cows	0.20
Other Cattle	0.07
Buffalo	0.07
Sheep	0.10
Goats	0.10
Camels	0.07
Swine	0.30
Horses	0.07
Poultry	0.30

The uncertainty in these estimates is ±50%.
Source: Judgement of IPCC Expert Group (see Co-chairs, Editors and Experts; N_2O emissions from Manure Management).

The following example to calculate the N excretion for cattle is presented in the IPCC guidelines. Nitrogen excretion may be calculated based on the same dietary assumptions used in modelling enteric fermentation emissions (see Section 10.2 of the IPCC Guidelines). The amount of N excreted by cattle can be estimated as the difference between the total N taken in by the animal and the total N retained for growth and milk production.

The total N intake rate is derived as follows:

EQUATION 10.32
N INTAKE RATES FOR CATTLE

$$N_{intake(T)} = \frac{GE}{18.45} \bullet \left(\frac{\frac{CP\%}{100}}{6.25} \right)$$

Where:

- Nintake(T) = daily N consumed per animal of category T, kg N animal^{-1} day^{-1}
- GE = gross energy intake of the animal, in enteric model, based on digestible energy, milk production, pregnancy, current weight, mature weight, rate of weight gain, and IPCC constants, MJ animal^{-1} day^{-1}
- 18.45 = conversion factor for dietary GE per kg of dry matter, MJ kg^{-1}. This value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock.
- CP% = percent crude protein in diet, input
- 6.25 = conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N)$^{-1}$

The total nitrogen retained is derived as follows:

EQUATION 10.33
N RETAINED RATES FOR CATTLE

$$N_{retention(T)} = \left[\frac{Milk \bullet \left(\frac{Milk\ PR\%}{100} \right)}{6.38} \right] + \left[\frac{WG \bullet \left[268 - \left(\frac{7.03 \bullet NE_g}{WG} \right) \right]}{\frac{1000}{6.25}} \right]$$

Where:

- Nretention(T) = daily N retained per animal of category T, kg N animal^{-1} day^{-1}
- Milk = milk production, kg animal^{-1} day^{-1} (applicable to dairy cows only)
- Milk PR% = percent of protein in milk, calculated as [1.9 + 0.4 x %Fat], where %Fat is an input, assumed to be 4% (applicable to dairy cows only)
- 6.38 = conversion from milk protein to milk N, kg Protein (kg N)$^{-1}$
- WG = weight gain, input for each livestock category, kg day^{-1}
- 268 and 7.03 = constants from Equation 3-8 in National Research Council (NRC) (1996). Nutrient Requirements of Beef Cattle, 7th Revised Ed., Nat. Acad. Press, Washington., DC
- NEg = net energy for growth, calculated in livestock characterisation, based on current weight, mature weight, rate of weight gain, and IPCC constants, MJ day^{-1}
- 1000 = conversion from grams per kilogram, g kg^{-1}
- 6.25 = conversion from kg dietary protein to kg dietary N, kg Protein (kg N)$^{-1}$

2.1.3 Tier 3

The IPCC Tier 3 method utilizes alternative estimation procedures based on a country-specific methodology, e.g. a process-based approach. Tier 3 methods should be well documented and should be clearly describe the estimation procedures.

2.1.4 Reported N excretion rates

An analyses of the national inventory reports 2011 shows that most member states use a country specific approach for N excretion estimates (note: some member states use for some categories a country specific approach and for other default values of IPCC; Table 5). The reported values are presented in Table 6. For some countries that use a country specific approaches, the N excretion may (slightly) deviate between years, because of changes in diet or productivity (see country reports in Chapter 4). It is not clear from the National Inventory Reports if countries that use a country specific approach use Tier 2 or Tier 3 excretion factors.

Table 5. Methodology to estimate N excretion of livestock in National Inventory Reports 2011.

Member state	UNFCCC; NIR 2011
	N excretion
Austria	Country specific
Belgium	Country specific
Bulgaria	IPCC default
Cyprus	IPCC default
Czech Republic	IPCC default
Denmark	Country specific
Estonia	IPCC default, except dairy cattle
Finland	Country specific
France	IPCC default
Germany	Country specific
Greece	IPCC default
Hungary	IPCC default
Ireland	Country specific
Italy	Country specific
Latvia	Country specific
Lithuania	IPCC default, except dairy cattle and pigs
Luxembourg	Country specific (Nitrates Directive)
Malta	Country specific
Netherlands	Country specific
Poland	Country specific
Portugal	Country specific
Romania	IPCC default
Slovakia	IPCC default
Slovenia	Country specific
Spain	Country specific
Sweden	Country specific
United Kingdom	Country specific

Table 6. N excretion rates reported by countries in the National Inventory Reports 2011. Data are derived from the common reporting format (CRF) files 2011 on UNFCCC website http://unfccc.int/

Country	Dairy cows	Other cattle	Young cattle	Pigs (average)	Poultry	Horses	Sheep	Goat	Fur animals and rabbits
Austria	97.11	46.57	*	9.57	0.55	47.90	13.10	12.30	
Belgium	115.07	54.26	*	10.06	0.58	58.42	7.52	8.44	
Bulgaria	70.00	50.00	50.00	20.00	0.60	25.00	14.68	17.00	
Cyprus	*	*	*	*	*	*	*	*	
Czech Republic	144.83	70.00	*	20.00	0.60	25.00	20.00	25.00	
Denmark	138.12	47.82	*	8.40	0.53	39.56	15.32	16.37	
Estonia	102.10	44.38	16.71	12.88	0.60	25.00	16.00	25.00	
Finland	126.94	50.16	*	*	0.58	61.19	9.97	10.70	
France	100.00	57.51	*	16.46	0.60	25.00	18.34	25.00	
Germany	131.52	40.85	*	12.14	0.78	49.01	7.43	11.00	
Greece	100.00	45.36	*	16.00	0.60	40.00	10.68	12.00	
Hungary	114.14	48.27	*	8.07	0.60	60.00	20.00	18.00	
Ireland	85.00	48.87	*	8.53	0.31	44.00	6.31	9.00	
Italy	116.00	48.72	*	11.78	0.53	50.00	16.20	16.20	
Latvia	70.00	50.00	*	10.00	0.60	48.00	13.00	13.00	
Lithuania	99.25	57.58	*	12.31	0.60	25.00	16.00	16.00	
Luxembourg	102.00	68.00	39.98	11.87	0.74	62.86	17.00	17.00	
Malta	*	*	*	*	*	*	*	*	
Netherlands	127.00	82.80	39.68	8.87	0.65	49.23	6.70	9.94	
Poland	86.70	58.09	*	13.56	0.35	28.03	6.78	6.70	
Portugal	115.00	51.15	*	9.49	0.56	44.00	7.14	6.02	
Romania	70.00	50.00	*	20.00	0.60	25.00	16.00	25.00	
Slovakia	100.00	60.00	*	15.82	0.73	25.00	16.00	16.00	
Slovenia	110.57	42.29	*	11.92	0.60	25.00	20.00	25.00	
Spain	67.72	52.57	*	9.42	0.45	40.00	5.18	11.28	
Sweden	126.37	41.74	*	9.14	0.40	50.00	6.11	8.75	
United Kingdom	110.01	55.32	*	10.60	0.57	50.00	5.23	20.60	
Belarus	77.09	36.42	*	9.99	0.60	25.00	16.00	25.00	4.59
Croatia	70.00	50.00	50.00	20.00	0.60	25.00	16.00	25.00	
Norway	82.00	35.00	26.47	6.41	0.21	50.00	10.41	15.50	5.84
Russia	94.49	59.06	*	21.91	0.77	25.00	16.00	25.00	4.59 -12.09
Switzerland	110.23	80.00	33.45	9.18	0.54	43.70	8.47	10.21	
Turkey	82.58	45.09	*	6.80	*	*	13.50	16.49	
Ukraine	74.52	68.40	29.75	12.65	*	25.00	16.00	25.00	8.34

2.2 Gothenborg protocol and NEC Directive

Countries report emissions of pollutants to the atmosphere to the UNECE Convention on Long-range Transboundary Air Pollution and to the European Commission (National Emission Ceilings (NEC) Directive). The 1999 Gothenborg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone is part of this convention and sets emission ceilings pollutants, including NH_3. The EU NEC Directive also set limits to emissions of pollutants to the atmosphere, including NH_3.

The EMEP/EEA air pollutant emission inventory guidebook (formerly referred to as the EMEP/CORINAIR emission inventory guidebook) provides guidance on estimating emissions from both anthropogenic and natural sources of gaseous pollutants. It is designed to facilitate reporting of emission inventories by countries to the UNECE Convention on Long-range Transboundary Air Pollution. EEA publishes the Guidebook and the UNECE's Task Force on Emission Inventories and Projections is responsible for the technical content of the chapters (source: http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009).

The Tier 1 approach in this guidebook includes default NH_3 emission factors in kg per animal for livestock categories, and is thus not based on N excretion. The Tier 2 and Tier 3 are based on emission factors on excreted N or ammoniacal nitrogen (TAN). The default Tier 2 excretion factors (Table 7) differ from the Tier 1 excretion factors of IPCC (Table 6).

2.2.1 Tier 2

Table 7 shows the default Tier 2 N excretion rates, the defaults values for the proportion of TAN in total N, the N added as bedding material, the housing period and the N excreted during grazing.

Table 7. Default N excretion for the Tier 2 methodology of EEA/EMEP for calculation of the ammonia emissions from manure management.

	N excretion (kg/yr)	Proportion of TAN in total N	Straw , kg/yr	N added in bedding, kg/animal/yr	Housing period, d	% excreta on yards (C30)
Dairy cows (100901)	105	0.6	1500	6.00	180	25
Other cattle (100902)	41	0.6	500	2.00	180	10
Fattng pigs (100903)	12.1	0.7	200	0.80	365	0
Sows (100904)	34.5	0.7	600	2.40	365	0
Sheep & goats (100905)	15.5	0.5	20	0.08	30	2
Horses etc (100906)	47.5	0.6	500	2.00	180	0
Layers (100907)	0.77	0.7	0	0.00	365	0
Broilers (100908)	0.36	0.7	0	0.00	365	0
Turkeys (100909)	1.64	0.7	0	0.00	365	0
Ducks (100909)	1.26	0.7	0	0.00	365	0
Geese (100909)	0.55	0.7	0	0.00	365	0
Fur animals (1009100	0.08	0.6	0	0.00	365	0
Buffalos (100914)	82	0.5	1500	6.00	225	0

2.2.2 Tier 3

The Tier 3 emission approach is a country-specific approach, based on modeling and country specific data. There is no restriction on the form of Tier 3, provided it can be demonstrated that the emission are more accurate than Tier 2. If data are available, emission calculations may be made for a greater number of livestock categories than listed under Tier 2.

2.2.3 N excretion in country reports

The N excretion values used for the calculation of ammonia emission for the Gothenborg protocol are presented in Table 8 and Table 9. The UNECE-CLRTAP reports partly overlap the UNFCCC reports. The following member states use a country specific methodology for the ammonia emission inventory: Austria, Denmark, Germany, Finland, Ireland, Sweden, the Netherlands, Switzerland, and United Kingdom.

Table 8. N excretion values used for the calculation of ammonia emission for the Gothenborg protocol: cattle and pigs. The year is indicated.

Animal category	N excretion kg N/animal/yr												
	Austria	Belgium Flanders	Belgium Walloon	Denmark	Finland	Germany	Italy	Netherlands	Portugal	Spain	Sweden	Switzerland	Norway
	2008	2007	2007	2008	2007	2009	2008	2010	2008	2008	2007	2010	*
Cattle													
Dairy cows	97.03	97	120.5	137.98	121.9	113.7	116	130.2	111.7	67.67	125	115	82
Other cattle													
Young cattle													
0.5 - 1 yr male			37.5					33.2					24
0.5 - 1 yr female			30.8					36					
< 1 yr	25.7	23						26.8	25			25	29
< 1 yr replacement		33											
1 - 2 yr	53.6	61							40		47	40	
1 - 2 yr replacement		56											
> 1 yr male			84.4					83.4					35
> 1 yr female			58.9					73.2					35
> 2 yr	68.4	77				84			41				
> 3 yr												55	
Heifers					50.3			26.8					
Suckler cows	74	97	97.8		63.9			83.3				80	
Calves		10.5	13.4		37.6						28	13	
white meat								12.4					
pink meat								28.2					
Bulls					66.4							33	
beef > 1 yr			97.8					53.8					
Other cattle				45.01		44.32	49.76		80	52.45	63		
Pigs				7.85		12.11							4.4
Fattening pigs	10.3				8.9	12.6		12.2		7.46	10.8	13	
20 - 110 kg		11.39											
> 110 kg		21.36											
20-50 kg			16.1						7				
>50 kg									13				
Sows			37.5			27.9	28.09	30.2		22.23	34	42	18.3
incl. piglets		21.52			28.5								
breeding	29.1							15.4	20				
pregnant									42				
Weaned pigs					2.79	3.1							
Boars		21.54	42.9		19.7	27.8		23.9	18		34	20	
Piglets													
< 20 kg													
7 - 20 kg		2.46	4.7										
< 25 kg												4.6	
20-50 kg			10.4										
Other							12.79						

Table 9. N excretion values used for the calculation of ammonia emission for the Gothenborg protocol: other livestock.

Animal category	N excretion kg N/animal/yr												
	Austria	Belgium Flanders	Belgium Walloon	Denmark	Finland	Germany	Italy	Netherlands	Portugal	Spain	Sweden	Switzerland	Norway
	2008	2007	2007	2008	2007	2009	2008	2010	2008	2008	2007	2010	*
Poultry						0.73	0.53						0.7
Laying hens	0.52	0.67	0.8	0.79	0.67	0.837			0.8	0.49	0.64	0.8	
breeding		0.36							0.6				0.147
< 18 wk						0.3		0.34					
> 18 wk								0.8					
Broilers			0.4		0.398	0.545		0.5	0.45	0.432	0.29	0.45	0.053
fattening		0.62											
parent animals , < 18 wk								0.35				0.34	
parent animals , > 18 wk								1.11					
Turkey		2.01			1.371	1.96		1.91	0.48			1.4	
female						1.7							2
male						2.18							
slaughter													0.34
Geese						0.55			0.48				
Ostriches		10.61		15.6									12
Ducks						0.528		0.79	0.48				
Pheasant				0.04									
Other poultry then laying hens	1.1		0.6							0.587			
Horses	47.9			39.56	60.9	49	50		44	40	50		50
< 200 kg		35				33.4							
200-600 kg		50											
> 600 kg		65											
heavy						53.6							
< 3 yr												42	
> 3 yr												44	
Ponies					43.5	33.4						15.7	
Mules and asses						33.4	50		22	40			
Mules												25.1	
Sheep and goats													
Sheep	13.1	10.5	8.8	16.95	9.97	7.8	16.2	14.1	6.6	5.13	13		11.6
Ewe									9.17				
meat												15	
milk												21	
< 1 yr													7.7
Lambs		4.36	4.4										
Goat	12.3	10.5	8.8	16.32	10.7	11	16.2	17.5		11.28		16	15.5
Does									7				
Fur animals and rabbits				5.29			1.02						
Rabbit		8.64						7.7	9				
Mink and fitches					1.305			2.2					
Foxes and racoon					2.34								9
Mink breeders											4.1		4.27
Other													
Buffalo						82	91.05						
Deer	13.1			16									12
Reindeer					10.7								6

2.3 Eurostat/OECD

The methodology of the Eurostat/OECD nutrient balances are described in OECD Nitrogen Balance Handbook (http://www.oecd.org/greengrowth/sustainableagriculture/40820234.pdf) and OECD Phosphorus Balance Handbook (http://www.oecd.org/greengrowth/sustainableagriculture/40820243.pdf).
Table 10 shows a summary of the methodologies used for the calculation of the N and P excretion in the Eurostat/OECD N and P balances. Part of the countries have not supplied data on N excretion to Eurostat/OECD or the data were not compliant with the guidelines in the OECD/Eurostat Handbook. For these countries, Eurostat/OECD used the N excretion coefficients reported in the 2010 submission of greenhouse gases to the UNFCCC. The P excretion coefficients vary among countries due to differences in farming practices. If N coefficients were available for the country, the average P : N ratio of available countries has been multiplied with the N coefficient to estimate the P coefficient. Though the N : P ratio of excretion may vary between countries due to differences in farming practices, Eurostat/OECD is assumed this variation is less than the variation in P excretion coefficients between countries. If N coefficients were not available, the P coefficients have been based on other country coefficients. The sources of information used for the N excretion in OECD/Eurostat are presented in the country reports in Chapter 4.
Table 11 shows the N excretion coefficients used in the OECD/Eurostat N balance and Table 12 shows the P excretion coefficients used in the OECD/Eurostat P balance. Note that some member states have delivered new data in the course of this project.

Table 10 Sources of information of N and P excretion figures used in the Eurostat/OECD N and P balances.

	N excretion	P excretion
Austria	Country specific	Country specific
Belgium	Country specific	Walloon; Eurostat
Bulgaria	Eurostat uses UNFCCC figures	Eurostat
Cyprus	Eurostat uses UNFCCC figures	Eurostat
Czech republic	Country specific	Country specific
Denmark	Country specific	Country specific
Estonia	Not available	Not available
Finland	Country specific	Country specific
France	Eurostat uses UNFCCC figures	Eurostat
Germany	Country specific	Country specific
Greece	Eurostat uses UNFCCC figures	Eurostat
Hungary	Country specific	Not available
Ireland	Country specific	Eurostat
Italy	Country specific	Eurostat
Latvia	Eurostat uses UNFCCC figures	Eurostat
Lithuania	Eurostat uses UNFCCC figures	Eurostat
Luxembourg	Eurostat uses UNFCCC figures	Eurostat
Malta	Country specific	Eurostat
Netherlands	Country specific	Country specific
Poland	Country specific	Country specific
Portugal	Country specific	Country specific
Romania	Eurostat uses UNFCCC figures	Eurostat
Slovakia	Country specific	Country specific
Slovenia	Country specific	Eurostat
Spain	based on a ratio P2O5/N	Based on a ratio P_2O_5/N. Country specific method available
Sweden	Country specific	Country specific
United Kingdom	Not available	Not available
Norway	Country specific	Country specific
Switzerland	Country specific	Country specific

Table 11. N excretion coefficients used in the OECD/Eurostat N balance.

N excretion coefficients in Eurostat/OECD data base; for each country the last available year has been selected

livestock_type	AT N 2009	BE N 2008	BE1 N 2008	BE2 N 2008	BE3 N 2008	BG N 2008	CH N 2008	CY N 2008	CZ N 2009	DE N 2009	DK N 2009	EE N 2009	GR N 1985	ES N 2008	FI N 2009	FR N 2009	HU N 2009	IE N 2009	IT N 2009
A1_OECD Total Livestock																			
PC0000 Total cattle														54.47			65.44		
PC1000 Bovine Animals < 1 year										15.60		11.25		27.24	38.35		25.00	27.60	
PC1100 Calves for Slaughter	14.94	10.64		10.50	14.23		13.00	19.37	20.20	15.60	34.85	11.25		28.85			12.00		13.78
PC1200 Other Calves	27.71							18.64	20.20		32.63	11.25		24.54					15.48
PC1210 Male calves		20.31	22.30	22.30	18.66		25.00			15.60		11.25		30.85					
PC1220 Female calves		26.82	33.00	33.00	21.46		25.00			15.60		11.25		21.09			22.00		
PC2000 Bovine Animals 1-2 years	53.65											24.00		53.62			45.00	63.40	
PC2100 Male Cattle 1-2 years		56.71	58.00	58.00	55.54		40.00	37.20	48.70	41.00	53.78	24.00		37.25	66.95				43.20
PC2200 Female Cattle 1-2 years (heifers)		53.42	58.00	58.00	47.57		40.00	42.20	48.70	51.00	51.71	24.00		58.48	52.83		42.00		42.00
PC2210 Female Cattle 1-2 years (heifers) - of which for slaughter										51.00				57.35					
PC2220 Female Cattle 1-2 years (heifers) - Other										51.00				58.66					
PC3000 Bovine > 2 years														72.99					
PC3100 Male Cattle > 2 years	64.35	77.34	77.00	77.00	77.65		50.00	47.80	59.70	51.00	56.78	45.45		72.07	66.95		65.44	74.40	50.16
PC3200 Female Cattle > 2 years												45.45							
PC3210 Heifers														60.97			51.00	74.40	
PC3211 Heifers for Slaughter	69.06	77.09		77.00	77.65		33.00	47.17		51.00	62.26	45.45		50.62	52.83				55.17
PC3212 Other heifers								41.75											55.17
A112221_OECD Other heifers - Breeding Heifers	69.06	77.40	77.00	77.00	77.65		55.00		58.50	51.00	65.57	45.45		64.38	52.83			74.40	
A112223_OECD Other heifers - Other heifers		77.29	77.00	77.00	77.65									53.09					
PC3220 Cows												62.10		74.09					
PC3221 Dairy Cows	97.41	108.95	111.37	111.37	105.88		115.31	106.66	105.26		129.39	62.10		103.29	124.68		125.00	94.00	108.90
PC3222 Other Cows	78.47	73.03	65.00	65.00	77.65		80.00	80.92	78.60	96.50	75.81	62.10		61.12	68.75		51.00	73.80	79.80
PC4000 Buffaloes						50.00	34.35	94.76									65.44		94.76
PC4100 Female breeding buffaloes																			
PC4200 Other buffaloes																			
PP0000 Total of the pig population						20.00								9.41			8.19		
A121_OECD Pigs < 50 kg														5.19	9.00		3.40		
PP1000 Piglets < 20 kg live weight	3.57	2.39		2.34	3.63			2.90	3.50	3.40	1.80	0.80		2.38	1.07			4.00	3.00
PP2000 Pigs 20 - 50 kg live weight	10.29	11.31		11.20	12.84			7.61	9.30	10.20	5.57	0.80		8.48	9.00				8.30
PP3000 Fattening Pigs > 50 kg live weight	10.29						13.00	11.41	11.00	12.00	14.63			11.21	17.60		12.00		9.70
PP3100 Fattening pigs between 50 and < 80 kg		11.32	11.20	11.20	12.84					12.00		4.00		10.25					
PP3200 Fattening pigs between 80 and < 110 kg		11.32		11.20	12.84					12.00		4.00		11.43					
PP3300 Fattening pigs of at least 110 kg		19.92		19.76	21.43					12.00		4.00		14.49					
PP4000 Breeding Pigs > 50 kg live weight														23.09			26.50		
PP4100 Boars	23.86						18.00	21.48	18.00	22.10	20.64	30.40		20.88	20.32			21.00	18.70
PP4200 Sows	20.57							24.99	20.90	25.50	23.07	30.40		23.14	29.28			26.00	23.50
PP4210 Covered sows		20.93		20.91	21.43		35.00			25.50		30.40							
PP4211 Covered sows - of which: sows covered for the first time										25.50									
PP4220 Sows not covered - total		20.10		20.53	12.84		35.00			25.50		30.40							
PP4221 Of which: gilts not yet covered										25.50									
A129_OECD Other Pigs									11.00		23.07							12.00	
A13_OECD Total Sheep and Goats														6.33			15.69		
A131_OECD Sheep and Lambs	14.00									18.40	17.00			5.93			15.75		
PS0000 Sheep		8.95	9.97	10.15	7.42	14.68		9.49	9.80			13.95		6.59	9.97	18.33		10.60	12.76
PS1000 Ewes and ewe-lambs put to the ram							21.00					13.95							
PS1100 Milk ewes and milk ewe-lambs put to the ram																			
PS1200 Other ewes and ewe-lambs put to the ram																			
PS2000 Other sheep							12.00					13.95							
A1312_OECD Lambs		4.76	5.06	4.86	4.62				5.10					2.51	8.89				6.12
PG0000 Goats	13.09	8.29	9.97	9.25	7.10	17.00		11.23	9.80	14.80		13.95		8.98	10.70	25.00	14.55	12.90	13.47
PG1000 Goats which have already kidded and goats mated		9.61	10.50	10.50	7.98		16.00					13.95							
PG1100 Goats which have already kidded														9.82					
PG1200 Goats mated for the first time														2.88					
PG2000 Other goats		4.37	4.36	4.36	4.40							13.95							
A14_OECD Total Poultry						0.60										0.60	0.69		
A141_OECD Chickens																			
FSS_J14 Broilers	0.28	0.55	0.54	0.54	0.60		0.45	0.32	0.35	0.37	0.63	0.23		0.42	0.48		0.38	0.60	0.38
FSS_J15 Layers	0.72						0.80	0.63	0.60	0.78	1.11	0.78		0.49	0.64		0.74		0.66
A1419_OECD Other Chickens	0.18						0.34		0.30	0.27	0.14	0.78			0.95		0.38		
FSS_J16 Other Poultry								0.51				0.78		0.49				1.50	0.55
FSS_J16B Ducks	0.48						0.45		0.70	0.59	1.51						0.38		
FSS_J16A Turkeys	1.18	1.70		1.70	2.20		1.40		1.20	1.84	2.58				1.50		1.65		
FSS_J16CD Other Poultry Types	0.48								0.70		1.82						0.38		
FSS_J16C Geese							1.40			0.55									
FSS_J16DI Ostriches							17.50												
FSS_J16DII Other FSS poultry		0.24	0.24	0.24	0.24		0.38												
A19_OECD Total Other Livestock														28.02					
FSS_J1 Equidae								50.00											50.00
A191_OECD Horses						25.00			60.00	49.00	43.79	54.00		28.02	58.69	25.00	55.00	47.00	64.00
A1911_OECD Foal < 1 year	12.71	53.96	47.26	47.26	65.65														
A1912_OECD Young horses 1-3 years	44.57	53.96	47.26	47.26	65.65		42.00												
A1913_OECD Horses > 3 years	52.57	65.31	65.00	65.00	65.65		44.00												
A192_OECD Donkeys		50.74	35.00	35.00	65.65	42.50	15.71							28.02		25.00	25.00	33.00	
A199_OECD Other Livestock																			
FSS_J17 Other livestock - Rabbits		7.53	7.20	7.20	8.84		9.00	5.01									5.50		1.02
A1992_OECD Other livestock - Mules														28.02					
A1999_OECD Other livestock - Other livestock	17.50						19.39											11.00	
A111911_OECD Male Cattle for milk < 1 year																			
A111912_OECD Male Cattle for meat < 1 year																			
A111921_OECD female Cattle for milk < 1 year																			
A111922_OECD female Cattle for meat < 1 year																			
A112111_OECD Male Cattle for milk from 1 to 2 years																			
A112112_OECD Male Cattle for meat from 1 to 2 years																			
A112211_OECD Bulls																			
A112212_OECD Male Cattle for meat > 2 years																			
A12121_OECD Breeding Pigs 20 - 50 kg live weight																			
A12122_OECD Fattening Pigs 20 - 50 kg live weight																			
A12311_OECD Boars		20.83		20.79	21.43														
A12312_OECD Boars not yet ready to breed		19.84		19.76	21.43														
A14121_OECD Laying hens under 18 weeks		0.37		0.37	0.42														
A14122_OECD Laying hens 18 weeks and older		0.72	0.66	0.77	0.74														
A14191_OECD Broilers, breeding females under 18 weeks																			
A14192_OECD Broilers, breeding females 18 weeks and older																			
A1995_OECD Fox											12.56				3.00				
A1996_OECD Mink											5.04				1.31				
IPCC_DC Dairy cattle																100.00			
IPCC_MDC Mature dairy cattle						70.00													
IPCC_MNDC Mature non-dairy cattle						50.00													
IPCC_NDC non-dairy cattle																57.04			
IPCC_YC Young cattle						50.00													

N excretion coefficients in Eurostat/OECD data base; for each country the last available year has been selected

livestock_type	LT N 2008	LU N 2008	LV N 2008	MT N 2009	NL N 2008	NO N 2009	PL N 2009	PT N 2008	RO N 2008	SE N 2009	SI N 2008	SK N 2009	UK N 2009
A1_OECD Total Livestock													
PC0000 Total cattle													
PC1000 Bovine Animals < 1 year				9.86		28.00	18.00			20.00	35.00	21.00	
PC1100 Calves for Slaughter				9.86	15.73			25.00		30.00			
PC1200 Other Calves				9.86				25.00		26.00		21.00	
PC1210 Male calves				9.86									31.01
PC1220 Female calves				9.86									32.00
PC2000 Bovine Animals 1-2 years							36.00				35.00		
PC2100 Male Cattle 1-2 years				28.33		39.60		40.00		53.50		50.00	56.00
PC2200 Female Cattle 1-2 years (heifers)				28.33		39.60		40.00		47.00		45.00	60.38
PC2210 Female Cattle 1-2 years (heifers) - of which for slaughter				28.33	74.50								
PC2220 Female Cattle 1-2 years (heifers) - Other				28.33	74.80								
PC3000 Bovine > 2 years													
PC3100 Male Cattle > 2 years				28.33		40.00		41.00		57.00		60.00	55.39
PC3200 Female Cattle > 2 years				28.33									
PC3210 Heifers				28.33		40.00	40.00					55.00	63.33
PC3211 Heifers for Slaughter				28.33	74.50			55.00		47.00			
PC3212 Other heifers				28.33	74.80					47.00		55.00	
A112221_OECD Other heifers - Breeding Heifers								55.00					
A112223_OECD Other heifers - Other heifers													
PC3220 Cows				102.74									
PC3221 Dairy Cows	70.00		71.00	102.74	134.50	84.80	70.00	111.70		117.00	113.03	105.00	117.00
PC3222 Other Cows				102.74	84.90	60.00	55.00	80.00		63.00	78.00	65.00	92.00
PC4000 Buffaloes									50.00				
PC4100 Female breeding buffaloes													
PC4200 Other buffaloes													
PP0000 Total of the pig population	20.00	11.62	10.00						20.00				
A121_OECD Pigs < 50 kg													
PP1000 Piglets < 20 kg live weight				3.33		0.44	2.50			1.95		3.20	1.80
PP2000 Pigs 20 - 50 kg live weight				6.66			9.00	7.00		9.80	14.00	9.00	12.50
PP3000 Fattening Pigs > 50 kg live weight				11.71	12.88		12.00	13.00		13.40	14.00	15.00	
PP3100 Fattening pigs between 50 and < 80 kg				11.71									12.50
PP3200 Fattening pigs between 80 and < 110 kg				11.71									17.40
PP3300 Fattening pigs of at least 110 kg				11.71									17.40
PP4000 Breeding Pigs > 50 kg live weight				28.33									
PP4100 Boars				28.33		16.00	15.00	18.00		17.00		20.00	25.00
PP4200 Sows				28.33		22.10	14.00				36.00	22.00	
PP4210 Covered sows				28.33	30.79			20.00		27.00			21.22
PP4211 Covered sows - of which: sows covered for the first time				28.33									19.40
PP4220 Sows not covered - total				28.33	13.54			42.00		17.00			20.54
PP4221 Of which: gilts not yet covered				28.33									19.40
A129_OECD Other Pigs						4.00							
A13_OECD Total Sheep and Goats													
A131_OECD Sheep and Lambs												10.00	
PS0000 Sheep	16.00	17.00	6.00	9.13		13.60	8.00		16.00	13.00	20.00		
PS1000 Ewes and ewe-lambs put to the ram				9.13	14.39			9.17					10.00
PS1100 Milk ewes and milk ewe-lambs put to the ram				9.13									
PS1200 Other ewes and ewe-lambs put to the ram													
PS2000 Other sheep				9.13				6.60					10.00
A1312_OECD Lambs				9.13		6.80	6.00						0.60
PG0000 Goats	16.00	17.00	6.00			19.05	7.00		25.00	11.25		10.00	
PG1000 Goats which have already kidded and goats mated				9.13	16.02			7.00			20.00		20.60
PG1100 Goats which have already kidded				9.13									
PG1200 Goats mated for the first time				9.13									
PG2000 Other goats				9.13				6.60					0.60
A14_OECD Total Poultry	0.60		0.60						0.60				
A141_OECD Chickens		0.79											
FSS_J14 Broilers				0.04	0.53	0.05	0.14	0.45		0.28	0.40	0.30	0.51
FSS_J15 Layers				0.57		0.70	0.70	0.80		0.73	0.71	0.70	1.89
A1419_OECD Other Chickens						0.05		0.60		0.23	0.40	0.50	
FSS_J16 Other Poultry		1.10				0.50		0.48					
FSS_J16B Ducks					0.76		0.70				0.60	0.70	1.60
FSS_J16A Turkeys					1.71		1.50				1.50	1.50	1.74
FSS_J16CD Other Poultry Types												1.00	
FSS_J16C Geese							1.50				0.73		1.74
FSS_J16DI Ostriches													
FSS_J16DII Other FSS poultry											0.40		1.60
A19_OECD Total Other Livestock													
FSS_J1 Equidae													
A191_OECD Horses	25.00	62.86	46.00		58.44	52.80	50.00	44.00	25.00	50.00	50.00	60.00	23.10
A1911_OECD Foal < 1 year													
A1912_OECD Young horses 1-3 years													
A1913_OECD Horses > 3 years													
A192_OECD Donkeys					32.02			22.00	25.00				
A199_OECD Other Livestock													14.80
FSS_J17 Other livestock - Rabbits		8.10			7.90			9.00					
A1992_OECD Other livestock - Mules													
A1999_OECD Other livestock - Other livestock		35.48											
A111911_OECD Male Cattle for milk < 1 year					35.95								
A111912_OECD Male Cattle for meat < 1 year					26.01								
A111921_OECD female Cattle for milk < 1 year					36.70								
A111922_OECD female Cattle for meat < 1 year					36.30								
A112111_OECD Male Cattle for milk from 1 to 2 years					85.95								
A112112_OECD Male Cattle for meat from 1 to 2 years					53.76								
A112211_OECD Bulls					85.95								
A112212_OECD Male Cattle for meat > 2 years					53.76								
A12121_OECD Breeding Pigs 20 - 50 kg live weight					13.54								
A12122_OECD Fattening Pigs 20 - 50 kg live weight					12.88								
A12311_OECD Boars					23.54								
A12312_OECD Boars not yet ready to breed					13.54								
A14121_OECD Laying hens under 18 weeks					0.34								
A14122_OECD Laying hens 18 weeks and older					0.75								
A14191_OECD Broilers, breeding females under 18 weeks					0.33								
A14192_OECD Broilers, breeding females 18 weeks and older					1.12								
A1995_OECD Fox													
A1996_OECD Mink					2.45								
IPCC_DC Dairy cattle									70.00				
IPCC_MDC Mature dairy cattle		102.00											
IPCC_MNDC Mature non-dairy cattle		68.00											
IPCC_NDC non-dairy cattle	50.00		50.00						50.00				
IPCC_YC Young cattle		40.06											

Table 12. P excretion coefficients used in the OECD/Eurostat P balance.

P excretion coefficients in Eurostat/OECD data base; for each country the last available year has been selected																			
	AT P	BE P	BE1 P	BE2 P	BE3 P	BG P	CH P	CY P	CZ P	DE P	DK P	EE P	GR P	ES P	FI P	FR P	HU P	IE P	IT P
livestock_type	2009	2008	2008	2008	2008	2009	2008	2009	2009	2008	2009	2009	2009	2008	2009	2007	2009	2009	2009
A1_OECD Total Livestock																			
PC0000 Total cattle														9.51			9.16		
PC1000 Bovine Animals < 1 year						5.65				5.28		2.00		4.76	3.60		8.29	3.00	
PC1100 Calves for Slaughter	3.10	1.59		1.57	2.13		2.00	3.09	2.60	5.28	5.11		3.60	5.04		1.78	10.47		2.32
PC1200 Other Calves	10.30							2.80	2.60		4.78		3.29	4.29		3.40			2.16
PC1210 Male calves		2.78	3.06	3.06	2.56		3.27			5.28				5.39					
PC1220 Female calves		3.55	4.37	4.37	2.84		3.27			5.28		1.20		3.68			9.16		
PC2000 Bovine Animals 1-2 years	8.55											7.02		9.37			8.73	8.00	
PC2100 Male Cattle 1-2 years		8.20	8.38	8.38	8.03	8.20	5.67	6.15	8.30	8.80	7.88	8.00	6.57	6.50	10.00	15.80			7.49
PC2200 Female Cattle 1-2 years (heifers)		7.72	8.38	8.38	6.88	7.68	5.67	7.66	6.80	8.80	7.58	6.00	7.68	10.21	7.40	16.12	7.85		7.09
PC2210 Female Cattle 1-2 years (heifers) - of which for slaughter										8.80				10.02					
PC2220 Female Cattle 1-2 years (heifers) - Other										8.80				10.25					
PC3000 Bovine > 2 years												10.10		12.75					
PC3100 Male Cattle > 2 years	10.81	12.94	12.88	12.88	12.99	10.08	7.86	8.09	11.50	10.56	8.32	10.10	9.17	12.59	13.00		9.16	10.00	8.88
PC3200 Female Cattle > 2 years																	9.03		
PC3210 Heifers						8.93						10.10		10.65			7.85		
PC3211 Heifers for Slaughter	11.12	12.90		12.88	12.99		4.80	7.68	8.20	10.56	9.12		8.77	8.84	7.40			10.00	8.74
PC3212 Other heifers								6.47					8.74						8.74
A112221_OECD Other heifers - Breeding Heifers	11.12	12.95	12.88	12.88	12.99		8.73		8.20	10.56	9.61			11.24	7.40			10.00	
A112223_OECD Other heifers - Other heifers		12.93	12.88	12.88	12.99									9.27					
PC3220 Cows														12.94					
PC3221 Dairy Cows	16.31	15.30	15.64	15.64	14.87	15.08	18.05	16.15	15.20	17.16	18.95	14.85	17.03	18.04	17.00	17.08	9.16	13.00	16.15
PC3222 Other Cows	12.30	13.74	12.23	12.23	14.60	12.00	13.00	13.79	11.50	13.20	11.11	14.85	12.61	10.67	14.00	17.38		10.00	14.09
PC4000 Buffaloes							7.23	20.08					20.08						20.08
PC4100 Female breeding buffaloes																			
PC4200 Other buffaloes																			
PP0000 Total of the pig population												1.12		2.71					
A121_OECD Pigs < 50 kg														1.50	2.60	7.82	1.48		
PP1000 Piglets < 20 kg live weight	0.87	0.56		0.55	0.85	0.80		0.89	0.80	0.90	0.40	0.20	0.92	0.68	2.60			0.90	1.05
PP2000 Pigs 20 - 50 kg live weight	1.92	1.98		1.96	2.25	2.30		1.82	2.20	2.64	1.23	0.20	1.95	2.44	2.60				1.96
PP3000 Fattening Pigs > 50 kg live weight	1.92					2.44	2.62	2.57	3.50	2.64	3.23	1.00	2.65	3.23	2.60	3.78	1.87		2.00
PP3100 Fattening pigs between 50 and < 80 kg		1.99	1.96	1.96	2.25					2.64				2.95					
PP3200 Fattening pigs between 80 and < 110 kg		1.99		1.96	2.25					2.64				3.29					
PP3300 Fattening pigs of at least 110 kg		4.73		4.69	5.08					2.64				4.18					
PP4000 Breeding Pigs > 50 kg live weight												6.40		6.65		6.41	1.72		
PP4100 Boars	5.36					5.30	4.36	5.38	4.90	3.52	4.56		5.00	6.02	4.80			4.00	4.46
PP4200 Sows	4.62					5.70		6.47	4.90	6.16	5.10	6.40	6.63	6.67	6.00		1.72	6.30	5.80
PP4210 Covered sows		5.09		5.08	5.21		8.29			6.16									
PP4211 Covered sows - of which: sows covered for the first time										6.16									
PP4220 Sows not covered - total		4.83	4.69	4.95	3.09		8.29			6.16									
PP4221 Of which: gilts not yet covered										6.16									
A129_OECD Other Pigs									3.50	2.69	5.10							1.70	
A13_OECD Total Sheep and Goats														0.94					
A131_OECD Sheep and Lambs	1.74					1.59				2.64	3.70			0.88		2.50	1.18		
PS0000 Sheep		1.54	1.72	1.75	1.28			1.68	1.90			1.50	1.67	0.98	2.70	2.33		1.50	2.38
PS1000 Ewes and ewe-lambs put to the ram							3.93									2.35			
PS1100 Milk ewes and milk ewe-lambs put to the ram																			
PS1200 Other ewes and ewe-lambs put to the ram																			
PS2000 Other sheep							1.96									2.26			
A1312_OECD Lambs		0.82	0.87	0.84	0.80				1.00					0.37	0.70				
PG0000 Goats	2.01	1.43			1.22	1.56		1.76	1.90	3.52		1.50	2.21	1.33	2.70	2.01	1.13	1.00	2.21
PG1000 Goats which have already kidded and goats mated		1.65	1.81	1.81	1.37		2.18									2.35			
PG1100 Goats which have already kidded														1.46					
PG1200 Goats mated for the first time														0.43					
PG2000 Other goats		0.75	0.75	0.75	0.76														
A14_OECD Total Poultry												0.20							
A141_OECD Chickens												0.20							
FSS_J14 Broilers	0.07	0.08	0.08	0.08	0.09	0.08	0.07	0.07	0.20	0.07	0.16	0.06	0.09	0.13	0.13	0.07	0.09	0.09	0.08
FSS_J15 Layers	0.20	0.15				0.13	0.20	0.16	0.30	0.16	0.26	0.20	0.17	0.15	0.17	0.15	0.09		0.16
A1419_OECD Other Chickens	0.04						0.09		0.10	0.08	0.03	0.20			0.60		0.09		
FSS_J16 Other Poultry		0.17				0.51		0.13				0.20	0.14	0.15		0.17	0.51	0.12	0.14
FSS_J16B Ducks	0.11						0.07		0.30	0.07	0.35								
FSS_J16A Turkeys	0.26	0.44		0.44	0.57		0.31		0.60	0.35	0.60				0.74				
FSS_J16CD Other Poultry Types	0.11								0.30		0.43								
FSS_J16C Geese							0.31			0.09									
FSS_J16DI Ostriches							3.49												
FSS_J16DII Other FSS poultry		0.08	0.08	0.08	0.08		0.09												
A19_OECD Total Other Livestock														5.38					
FSS_J1 Equidae		9.98				5.99		8.62					6.64			14.48	5.99		8.62
A191_OECD Horses									11.20	14.08	8.00	9.90		5.38	7.40			8.00	
A1911_OECD Foal < 1 year	1.96	9.65	8.45	8.45	11.74														
A1912_OECD Young horses 1-3 years	3.79	9.65	8.45	8.45	11.74		8.29												
A1913_OECD Horses > 3 years	8.02	13.16	13.10	13.10	13.23		10.04												
A192_OECD Donkeys		7.60	5.24	5.24	9.83		3.58							5.38				5.00	
A199_OECD Other Livestock					2.47					14.08									
FSS_J17 Other livestock - Rabbits		2.11	2.02	2.02	2.47	2.70	2.62	1.48					1.48			1.92	2.70		0.34
A1992_OECD Other livestock - Mules														5.38					
A1999_OECD Other livestock - Other livestock	2.31						3.31											2.00	
A111911_OECD Male Cattle for milk < 1 year																			
A111912_OECD Male Cattle for meat < 1 year																			
A111921_OECD female Cattle for milk < 1 year																			
A111922_OECD female Cattle for meat < 1 year																			
A112111_OECD Male Cattle for milk from 1 to 2 years																			
A112112_OECD Male Cattle for meat from 1 to 2 years																			
A112211_OECD Bulls																			
A112212_OECD Male Cattle for meat > 2 years																			
A12121_OECD Breeding Pigs 20 - 50 kg live weight																			
A12122_OECD Fattening Pigs 20 - 50 kg live weight																			
A12311_OECD Boars		5.03		5.02	5.17														
A12312_OECD Boars not yet ready to breed		4.71		4.69	5.08														
A14121_OECD Laying hens under 18 weeks		0.08		0.08	0.09														
A14122_OECD Laying hens 18 weeks and older		0.17	0.15	0.18	0.17														
A14191_OECD Broilers, breeding females under 18 weeks																			
A14192_OECD Broilers, breeding females 18 weeks and older																			
A1995_OECD Fox											0.48				0.54				
A1996_OECD Mink											0.19				0.28				
IPCC_DC Dairy cattle																			
IPCC_MDC Mature dairy cattle																			
IPCC_MNDC Mature non-dairy cattle																			
IPCC_NDC non-dairy cattle																			
IPCC_YC Young cattle																			

P excretion coefficients in Eurostat/OECD data base; for each country the last available year has been selected

livestock_type	LT P 2009	LU P 2008	LV P 2009	MT P 2009	NL P 2008	NO P 2009	PL P 2009	PT P 2008	RO P 2009	SE P 2009	SI P 2008	SK P 2009	UK P 2009
A1_OECD Total Livestock													
PC0000 Total cattle													
PC1000 Bovine Animals < 1 year	2.00		2.00			3.60	2.00		5.65	2.86	5.00	3.00	
PC1100 Calves for Slaughter		1.60		1.77	2.45			3.27		5.65			
PC1200 Other Calves				1.53				3.27		3.21		3.00	
PC1210 Male calves		2.74											4.68
PC1220 Female calves		3.48	1.20										4.80
PC2000 Bovine Animals 1-2 years			7.02				3.00				5.00		
PC2100 Male Cattle 1-2 years	8.00	8.20	8.00	4.57		7.00		5.68	8.20	8.49		8.20	6.88
PC2200 Female Cattle 1-2 years (heifers)	6.00	7.88	6.00			7.00		5.68	7.68	7.57		7.50	9.17
PC2210 Female Cattle 1-2 years (heifers) - of which for slaughter				4.35	10.09					7.57			
PC2220 Female Cattle 1-2 years (heifers) - Other				4.34	10.13								
PC3000 Bovine > 2 years	10.10												
PC3100 Male Cattle > 2 years	10.10	12.94	10.10	4.85		7.00		6.11	10.08	9.24		11.00	11.25
PC3200 Female Cattle > 2 years													
PC3210 Heifers	10.10		10.10			7.00	7.00		8.93			10.00	11.23
PC3211 Heifers for Slaughter		12.90		4.48	10.09			8.73		7.56		10.00	
PC3212 Other heifers		12.93		4.20	10.13					7.56		10.00	
A112221_OECD Other heifers - Breeding Heifers								8.73					
A112223_OECD Other heifers - Other heifers													
PC3220 Cows													
PC3221 Dairy Cows	14.85	14.77	14.85	14.95	18.78	13.00	11.00	17.90	15.08	15.90	16.44	21.00	19.20
PC3222 Other Cows	14.85	13.78	14.85	17.33	12.28	10.00	12.00	13.10	12.00	12.00	13.16	12.00	13.70
PC4000 Buffaloes													
PC4100 Female breeding buffaloes													
PC4200 Other buffaloes													
PP0000 Total of the pig population													
A121_OECD Pigs < 50 kg													
PP1000 Piglets < 20 kg live weight	0.20	0.55	0.20	0.89		0.08	1.00		0.80	0.40		0.80	0.59
PP2000 Pigs 20 - 50 kg live weight	0.20	1.97	0.20	1.44			3.20	1.41	2.30	2.07	3.00	2.30	1.75
PP3000 Fattening Pigs > 50 kg live weight	1.00		1.00	2.46	2.18		4.00	2.62	2.44	3.26	3.00	3.00	
PP3100 Fattening pigs between 50 and < 80 kg		1.97											2.64
PP3200 Fattening pigs between 80 and < 110 kg		1.97											3.17
PP3300 Fattening pigs of at least 110 kg		5.06											3.17
PP4000 Breeding Pigs > 50 kg live weight	6.40												
PP4100 Boars		5.13	6.40	6.87		5.50	5.00	4.37	5.30	5.00		5.30	4.64
PP4200 Sows			6.40	6.95		5.50	4.60		5.70	7.70	9.00	5.70	
PP4210 Covered sows		5.15			6.43			4.80					5.90
PP4211 Covered sows - of which: sows covered for the first time													3.56
PP4220 Sows not covered - total		5.03			2.56			10.04		5.00			5.02
PP4221 Of which: gilts not yet covered													3.56
A129_OECD Other Pigs						0.80							
A13_OECD Total Sheep and Goats													
A131_OECD Sheep and Lambs									1.59			2.00	
PS0000 Sheep	1.50	1.51	1.50			1.90	1.80			1.60	3.00		
PS1000 Ewes and ewe-lambs put to the ram				1.58	2.08			1.96					1.50
PS1100 Milk ewes and milk ewe-lambs put to the ram													
PS1200 Other ewes and ewe-lambs put to the ram													
PS2000 Other sheep				1.57				1.41					1.50
A1312_OECD Lambs						0.95	1.60						0.14
PG0000 Goats	1.50	1.40	1.50			2.60	1.70		1.56	8.00		2.00	
PG1000 Goats which have already kidded and goats mated				1.49	2.77			1.96			3.00		3.00
PG1100 Goats which have already kidded													
PG1200 Goats mated for the first time													
PG2000 Other goats				1.88				1.85					0.14
A14_OECD Total Poultry													
A141_OECD Chickens			0.20				0.26						
FSS_J14 Broilers	0.06	0.08	0.06	0.01	0.08	0.01	0.03	0.07	0.08	0.06	0.09	0.07	0.12
FSS_J15 Layers	0.20	0.18	0.20	0.14		0.20	0.26	0.20	0.13	0.15	0.18	0.17	0.44
A1419_OECD Other Chickens			0.20			0.01		0.15		0.06	0.11	0.11	
FSS_J16 Other Poultry	0.20		0.20			0.13		0.11	0.51				
FSS_J16B Ducks					0.16		0.43				0.13	0.15	0.33
FSS_J16A Turkeys					0.38		0.58				0.39	0.32	0.46
FSS_J16CD Other Poultry Types							0.65					0.20	
FSS_J16C Geese											0.15		0.46
FSS_J16DI Ostriches													
FSS_J16DII Other FSS poultry											0.11		0.33
A19_OECD Total Other Livestock													
FSS_J1 Equidae	9.90	9.81	9.90						5.99				
A191_OECD Horses			9.90		9.88	8.00	5.00	10.04		8.90	9.00	12.50	8.90
A1911_OECD Foal < 1 year													
A1912_OECD Young horses 1-3 years													
A1913_OECD Horses > 3 years													
A192_OECD Donkeys					5.13			5.02					
A199_OECD Other Livestock													2.40
FSS_J17 Other livestock - Rabbits		2.13			1.55			2.62	2.70				
A1992_OECD Other livestock - Mules													
A1999_OECD Other livestock - Other livestock													
A111911_OECD Male Cattle for milk < 1 year					4.12								
A111912_OECD Male Cattle for meat < 1 year					3.10								
A111921_OECD female Cattle for milk < 1 year					4.41								
A111922_OECD female Cattle for meat < 1 year					4.41								
A112111_OECD Male Cattle for milk from 1 to 2 years					12.02								
A112112_OECD Male Cattle for meat from 1 to 2 years					8.02								
A112211_OECD Bulls					12.02								
A112212_OECD Male Cattle for meat > 2 years					8.02								
A12121_OECD Breeding Pigs 20 - 50 kg live weight					2.56								
A12122_OECD Fattening Pigs 20 - 50 kg live weight					2.18								
A12311_OECD Boars					5.13								
A12312_OECD Boars not yet ready to breed					2.56								
A14121_OECD Laying hens under 18 weeks					0.07								
A14122_OECD Laying hens 18 weeks and older					0.17								
A14191_OECD Broilers, breeding females under 18 weeks					0.09								
A14192_OECD Broilers, breeding females 18 weeks and older					0.24								
A1995_OECD Fox													
A1996_OECD Mink					0.52								
IPCC_DC Dairy cattle													
IPCC_MDC Mature dairy cattle													
IPCC_MNDC Mature non-dairy cattle													
IPCC_NDC non-dairy cattle													
IPCC_YC Young cattle													

2.4 GAINS model

The GAINS model is a model to evaluate the interactions between the control of air pollution emissions and greenhouse gases. GAINS includes emissions of NH_3, N_2O and CH_4 from animal manure (Note: GAINS also includes the gaseous pollutants of non-agricultural sources such as energy use and industries). GAINS relies on data submitted by national experts, based on a questionnaire distributed in July 2003 (Klimont and Brink, 2004). An example for dairy cattle of this questionnaire is presented below. The questionnaire included the same questions for other cattle, fattening pigs, sows, horses, sheep and goats, laying hens, broilers, other poultry (geese, ducks, turkey, and fur animals). If no national information was available, assumptions were made.

DAIRY CATTLE

Farm characteristics

Parameter	*Small*	*Large*	*Units*
Share			%
Average herd size			heads
Percentage of animals kept on liquid manure system			%
Percentage of animals kept on solid manure system			%
Milk production			kg head^{-1}year^{-1}
N-excretion			kg head^{-1}year^{-1} N
C-excretion			kg head^{-1}year^{-1} C
Days/hours per day grazing		/	days / hours

Storage/waste management

Type	*Share**	*of which covered:*	*Units*
Lagoons			%
Open tanks			%
Closed tanks			%
Daily spreading			%
Solid storage and dry lot			%
Pasture			%
Other (specify)			%
Storage capacity			months
Slurry for anaerobic digestion			%

Application of manure

Application technique	*Slurry**	*Solid waste**	*Units*
Broadcasting			%
Low efficiency			%
Medium efficiency			%
High efficiency			%

*All categories in the indicated column should add to 100%

If no country-specific data on N excretion rates for dairy cattle are available, a relationship between milk yield and N-excretion is used:

$Nx = 0.0178 \times M + 0.2271$

where
Nx = nitrogen excretion rate (kg N/animal-year),
M = milk yield (kg/animal-year).

This regression (Figure 1) is based on data from a number of studies (ECETOC, 1994; Pain and Menzi, 2000; Klaassen, 1991; FAO, 2003) and on responses to the questionnaire used to collect data for GAINS. The available data do not allow conclusions for yields below 3500 kg milk/year. For such low milk yields, an N excretion value of 50 kg N/animal per year is assumed in GAINS.

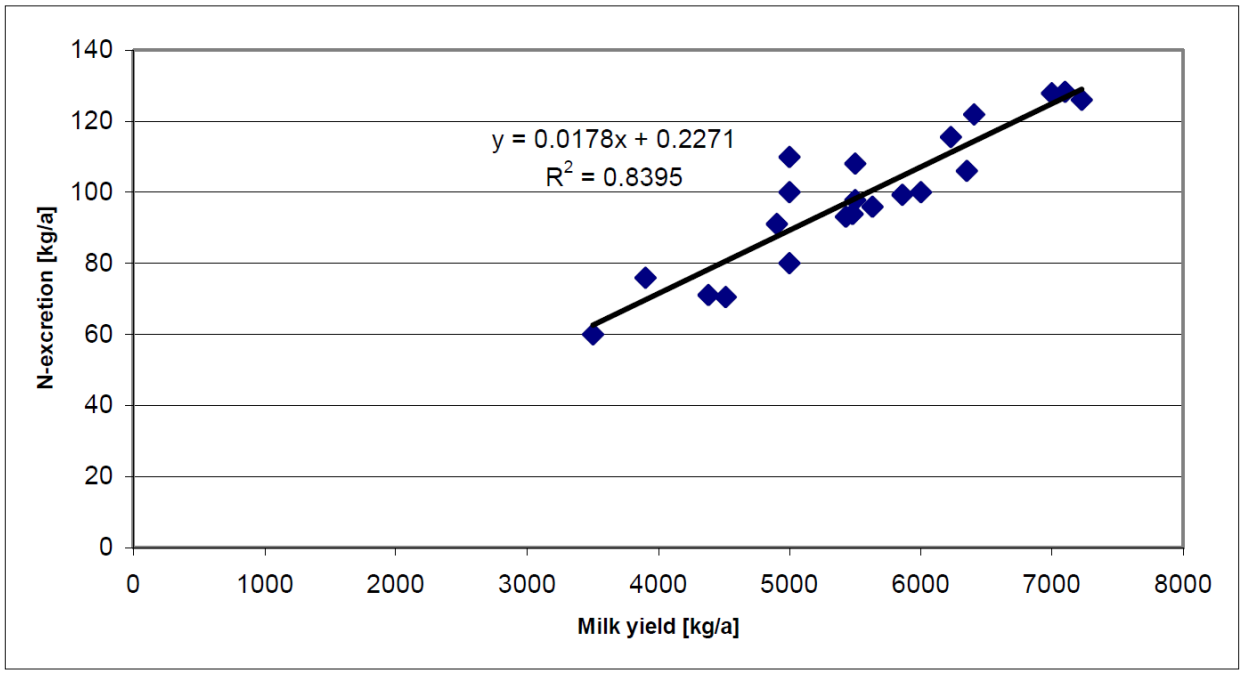

Figure 4.1: Relationship between milk yield and nitrogen excretion in Europe.

Figure 1. Relationship between milk yield and N excretion in Europe, used in GAINS.

Table 13 shows the N excretion coefficients used in the GAINS model. Differences in N excretion between 2000 and 2010 for dairy cows are due to differences in milk yields (Table 14). Milk yields used in GAINS are obtained from the CAPRI model. The German values are not calculated with the simple GAINS regression function presented above, but are probably based on an old version of the German emission inventory model which calculated too high N excretions.

Table 13. N excretion coefficients used in the GAINS model (Asman et al., 2011).

Excretion of GAINS animal types for European countries (Asman et al., 2011)									
Country	Total N excretion, kg N per animal per year								
	Dairy cows*		Other cattle	Pigs	Horses	Sheep and goats	Laying hens	Other poultry	Fur animals
	2000	2010							
Austria	89	106	46	9	48	13	0.7	0.4	4.1
Belgium	108	118	50	11	50	7	0.7	0.5	4.1
Bulgaria	67	75	45	12	50	12	0.8	0.7	1.5
Cyprus	108	103	40	12	50	12	0.8	0.7	4.1
Czech	100	131	45	12	50	12	0.8	0.6	1.5
Denmark	125	132	37	10	43	17	0.7	0.5	4.6
Estonia	91	113	45	12	50	14	0.8	0.5	4.1
Finland	99	121	53	10	50	16	0.8	0.4	1.9
France	100	112	50	12	50	12	0.8	0.9	4.1
Germany	114	130	40	15	48	8	0.8	0.6	4.1
Greece	63	111	45	12	50	12	0.8	0.7	4.1
Hungary	121	146	45	9	50	12	1.5	1.5	4.1
Ireland	94	105	69	12	50	8	0.8	0.5	4.1
Italy	109	112	47	12	50	16	0.7	0.5	4.1
Latvia	71	88	51	10	51	7	0.9	0.9	4.1
Lithuania	70	95	50	12	50	12	0.8	0.5	4.1
Luxembourg	108	114	42	10	50	12	0.8	0.7	4.1
Malta	99	98	40	12	50	12	0.8	0.7	0.7
Netherlands	126	147	40	9	50	12	0.7	0.6	2.2
Poland	76	81	35	11	50	14	0.7	0.6	4.1
Portugal	88	102	50	9	39	7	0.6	0.9	0.7
Romania	55	67	45	12	50	12	0.8	0.7	4.1
Slovakia	82	135	45	12	50	12	0.8	0.7	4.1
Slovenia	106	110	40	12	50	11	0.7	0.5	4.1
Spain	67	71	52	9	40	5	0.8	0.6	4.1
Sweden	120	132	39	11	50	6	0.6	0.3	4.1
United Kingdom	106	133	49	12	50	6	0.9	0.7	4.1
Albania	55		40	12	50	12	0.8	0.7	4.1
Belarus	55		45	12	50	12	0.8	0.7	1.5
Bosnia-Herc.	55		40	12	50	12	0.8	0.7	4.1
Croatia	55		45	12	50	12	0.8	0.7	4.1
Macedonia	55		40	12	50	12	0.8	0.7	4.1
Moldova	55		40	12	50	12	0.8	0.7	4.1
Norway	82		38	11	50	15	0.7	0.5	4.1
Russia	55		40	12	50	12	0.8	0.7	4.1
Serbia	55		40	12	50	12	0.8	0.7	4.1
Switzerland	107		36	12	44	8	0.7	0.4	4.1
Turkey	67		45	12	50	12	0.8	0.7	1.5
Ukraine	55		45	12	50	12	0.8	0.7	1.5
* dependent on milk yields									

Table 14. Milk yields and N excretion of dairy cows in 2000 and 2010 in the GAINS model. Milk yields are obtained from the CAPRI model.

Country	Milk yield, kg/animal/yr		N excretion, kg N/animal/yr	
	2000	2010	2000	2010
Austria	5210	5926	89	106
Belgium	5502	6002	108	118
Bulgaria	3273	4903	67	75
Cyprus	6106	6642	108	103
Czech	5412	6933	100	131
Denmark	7421	8745	125	132
Estonia	4960	6651	91	113
Finland	6990	8041	99	121
France	5948	6353	100	112
Germany	6072	6966	114	130
Greece	3055	5147	63	111
Hungary	5699	6971	121	146
Ireland	4674	4942	94	105
Italy	5790	5331	109	112
Latvia	3898	4620	71	88
Lithuania	3466	5145	70	95
Luxembourg	5502	6539	108	114
Malta	5535	6761	99	98
Netherlands	7296	7405	126	147
Poland	3668	4612	76	81
Portugal	5627	7664	88	102
Romania	2790	3421	55	67
Slovakia	4376	7073	82	135
Slovenia	4491	5214	106	110
Spain	5317	7461	67	71
Sweden	7710	8467	120	132
United Kingdom	5978	7527	106	133

2.5 CAPRI model

The CAPRI (Common Agricultural Policy Regional Impact) model is an agricultural sector model covering the whole of EU27, Norway and Western Balkans at regional level (250 regions) and global agricultural markets at country or country block level. Besides economic evaluations, CAPRI is also used for calculation of balances for N,P,K, and greenhouse gas emissions (sometimes in combination with other models such as GAINS or MITERRA-EUROPE), see Leip et al. (2010; 2011a; 2011b)..

In CAPRI the excretion is not an exogenous parameter but is calculated as the difference between N intake and N retention of animals. The N content of animal excretion (N_{MAN}) is calculated by subtracting the exported N (or retention) in form of animal products from the intake in form of feed. Firstly, the crude protein intake (CRP_{IN}) has to be transformed into its N-content by division by 6, then the retention (RET_N) is subtracted. The crude protein intake (CRP_{IN}) is derived from the same parameters as the net energy intake (NE) that is used in CAPRI to calculate CH_4 emissions from enteric fermentation. Among others, NE depends on live body weight (BW), daily weight gain (WG), milk yield (Milk), fat content of milk (Fat) etc. The retention (RET_N) is based on output coefficients, describing the relation between product outputs (milk) and animal activities (like dairy cows).

$$(GR\ 1) \quad N_{MAN} = \frac{CRP_{IN}}{6} - RET_N$$

There are no assumptions for the calculation of N-excretion. The animal N-budget is calculated using statistical data (N retention in products and in live animals for the output site and N in feed for the input site). CAPRI has a feed module where it distributes available feed in a region over the animals, based on energy and nutrient requirements. Feed statistics from FAO and Eurostat are used (compound feeds, market balances indicating the use of crops for feed) and N-contents in the feed stuff). The N content is based on estimates made for the MITERRA-model and some some assumptions on the mix of clover in the grass (from FSS).

A comparison of excretion data according to CAPRI 2004 and those reported to UNFCCC for 2004 show that the N excretion of dairy cattle and pigs is for most member states higher for CAPRI than for UNFCCC. The excretion figures for other cattle and poultry are more closely related. For all categories, the excretion according to CAPRI differs (sometimes slightly) from that according UNFCCC, showing that the CAPRI model does not use default IPCC excretion rates.

Table 15. N excretion per animal according CAPRI model in 2004. Source: GGELS report (Leip et al., 2010).

N output per head according CAPRI model for 2004					
	Dairy cows	Other cattle	Swine	Sheap and goats	Poultry
	kg/head/yr	kg/head/yr	kg/head/yr	kg/head/yr	kg/1000 head/year
Austria	90	40	17.3	5.2	486
Belgium	95	47	18.4	5.5	424
Bulgaria	116	49	21.6	9.5	683
Cyprus	134	43	21.5	9.2	576
Czech Republic	114	43	19.8	4.7	555
Denmark	194	62	22.8	8.8	844
Estonia	122	42	18.1	6.5	577
Finland	92	30	12.3	4	428
France	105	53	16.6	7.7	612
Germany	106	40	18.4	5	521
Greece	97	47	16.1	7.9	522
Hungary	149	51	26.9	7.9	685
Ireland	88	48	15.2	5.1	469
Italy	97	39	20	6.2	474
Latvia	139	57	24.4	10.8	825
Lithuania	99	38	17.5	6.7	607
Malta	155	51	24.1	8.3	618
Netherlands	119	38	15.8	4.8	494
Poland	91	36	16.6	6.2	577
Portugal	121	68	19.9	8.4	635
Romania	96	39	18.8	7.8	576
Slovakia	119	42	18	6.9	621
Slovenia	85	38	15	5	426
Spain	108	51	17.5	6.8	562
Sweden	180	61	21.3	8.2	732
UK	142	53	17.6	6.7	581

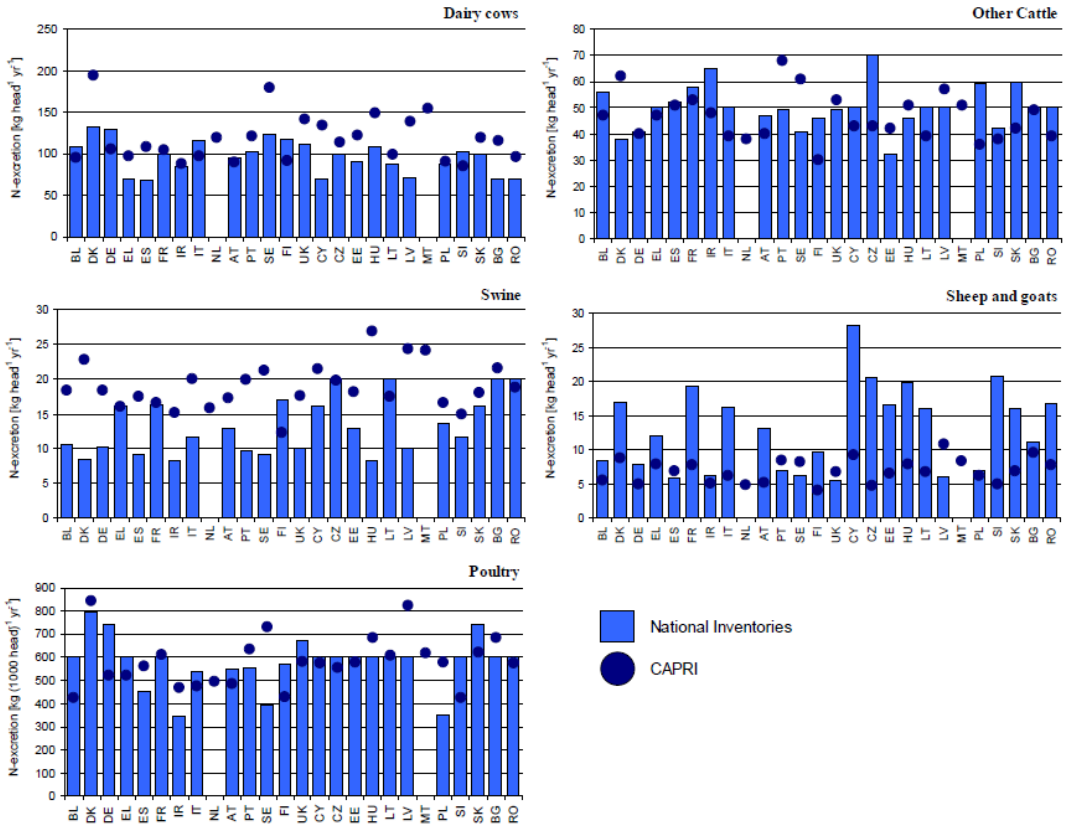

Figure ES5. Comparison of N-excretion data used in National Inventories to the UNFCCC for the year 2004 (EEA, 2010) and N-excretion data calculated with CAPRI

Table 16.Comparison of N excretion data according to CAPRI 2004 and those reported to UNFCCC for 2004.

2.6 Nitrates Directive

The Nitrates Directive has the objective to decrease nitrate leaching to groundwater and surface waters. One of the measures in the Nitrates Directive is a maximum application standard for manure. The Nitrates Directive states that the maximum amount of manure that can be applied to agricultural land is 170 kg N per ha. Farmers have to calculate the amount of manure that is produced on their farm and that can be applied to land. Basically, there are two methods to estimate amount manure N that a farm can apply to its land:

- The gross N excretion is calculated and this excretion is corrected for the gaseous N losses that occur in housing and during storage. Both defaults and country specific values of gross N excretion and gaseous losses can be used to calculate the net amount of manure N is produced on a farm.
- The net amount of manure produced is calculated from the volume of manure (i.e. volume of manure, flushing and rain water, and bedding material) and the N and P content of the manure in the storage or just before application. Both defaults values as measurements can be used for the manure volume and the N and P contents in the manure.

Table 18 shows the gross N excretion rates for member states that use gross excretion rates for the Action programme for the Nitrates Directive.

Table 17. Methodology to estimate excretion in the action programmes of the Nitrates Directive.

Country	**Nitrates Directive**
Austria	Country specific net excretion
Belgium	As UNFCCC for Flanders: net excretion Gross excretion for Walloon
Bulgaria	N content and volume of manure***
Cyprus	N content and volume of manure
Czech Republic	N content and volume of manure
Denmark	N balance as UNFCCC; corrected for gaseous N loss
Estonia	N content and volume of manure
Finland	N balance.
France	N balance; corrected for gaseous N loss
Germany	Country specific gross excretion. Method not indicated
Greece	N content and volume of manure
Hungary	Country specific net excretion, based on literature
Ireland	N balance (as Nitrates Directive)
Italy	N balance
Latvia	N content and volume of manure
Lithuania	Net excretion based on N balance and gaseous N loss
Luxembourg	Not indicated
Malta	Not indicated
Netherlands	Same as UNFCCC, but other year. Includes correction for gaseous N losses
Poland	N content and volume of manure
Portugal	N content and volume of manure
Romania	Based on UNFCCC figures
Slovakia	N content and volume of manure
Slovenia	Country specific net excretion. Method not indicated
Spain	Country specific gross excretions. Method not indicated
Sweden	STANK model. Methodology not clear
United Kingdom	N balance.

*N balance of the animal: N input as feed – N output as animal products
** Emission of NH_3 is expressed in kg NH_3 per animal; N excretion is not used in Tier 1 approach
*** The manure production/ N excretion calculated from volume of manure and the N content of the manure

Table 18. Gross N excretion in member states in Nitrates Action Programmes.

	Belgium Flanders, kg N/animal/yr		Germany (selected animals), kg N/animal/yr				Ireland, kg N/animal/yr		Lithuania, kg N/animal/yr		The Netherlands (selected animals), kg N/animal/yr		Spain, kg N/animal place/yr		Sweden, kg N/animal place/yr	
CATTLE	Dairy cows and breeding cows	97	Dairy cow	grass	6000 kg	119	Dairy cow	85	Dairy cow	120	Dairy cow, 5500 kg milk	99	Dairy cattle	89	Dairy cow 8 000 kg milk/year slurry	117
					8000 kg	132	Suckler cow	65	Suckler cow with a calf under 0.6 months	95	Dairy cow, 6500 kg milk	107	Fatting calves	6.6	Dairy cow 8 000 kg milk/year, solid manure	71
					10.000 kg	149	Cattle (0-1 yr)	24	Calf, 0-0.5 years of age (per animal)	10.5	Dairy cow, 7500 kg milk	115	beaf cattle	21	Dairy cow 8 000 kg milk/year, urine	46
				arable	6000 kg	104	Cattle (1-2 yr)	57	The young of cattle, 0-1 year of age	33	Dairy cow, 8500 kg milk	123			Dairy cow 10 000 kg milk/year, slurry	139
					8000 kg	118	Cattle (>2 yrs)	65	The young of cattle, 0.5-1 years of age	22.5	Dairy cow, 9500 kg milk	131			Dairy cow 10 000 kg milk/year, solid manure	85
					10.000 kg	138			Fattening bullocks, 1-2 years of age	69					Dairy cow 10 000 kg milk/year, urine	54
				arable, with hay	6000 kg	100			Heifers, 1-2 years of age	60	Suckler cow; slurry based	71			Dairy cow 12 000 kg milk/year, slurry	145
					8000 kg	115			Reproducing bulls	135	Young cattle > 1 yr; slurry based	67			Heifers, bullocks, 1–12 months, slurry	22
					10.000 kg	135			Fattening cattle, heifers, other cattle, > 2 years	80	Young cattle < 1 yr; slurry based	35			Bulls < 1 yr, slurry	34
			Suckling cow		500 kg	87									Heifers, bulls and bullocks > 1 year, slurry	47
					700 kg	106									Suckler cows, total 12 months, deep table manure	69
	Fatting calves	11	Young cattle	0 - 16 weeks		15.3									Suckler cows, total 12 months, slurry	63
	Cattle younger than 1 year old	23	Young cattle		conventional	60										
	Replacement cattle younger than 1 year old	33			extensive	54										
	Replacement cattle from 1 year old to younger than 2 years old	56	Bull		45-625 kg	35										
	Cattle from 1 year old to younger than 2 years old	61			45-700 kg	40										
	Other cattle	77			80 - 700 kg	44										
					200 - 700 kg	46										

	Belgium Flanders, kg N/animal/yr		Germany (selected animals), kg N/animal/yr				Ireland, kg N/animal/yr		Lithuania, kg N/animal/yr		The Netherlands (selected animals), kg N/animal/yr		Spain, kg N/animal place/yr		Sweden, kg N/animal place/yr	
PIGS	Piglets weighing from 7 to 20 kg	2.5											Piglets, 6 -20 kg	1.6	Slaughter pigs, 28.5-110 kg slurry, 3 rounds per year	11
	Boars	24							Boars	28.4	Sows incl. piglets < 6 wk; slurry	16	Fattening pigs, 20 -50 kg	8.1	Sows, slurry, 2.2 farrows per year	36
	Sows, including piglets weighing less than 7 kg	24	Sows			24.7 - 34.9	Breeding unit per sow place	35	Sow with piglets before weaning (by weaning at the age of 28 days)	28	Sows incl. piglets < 25 kg wk; slurry	22	Fattening pigs, 50 -100 kg	11.5	Sows, solid fertiliser, 2.2 farrows per year	21
	Other pigs weighing:		Fattening pigs	28 - 117 kg	Standard feed	11.9 - 13.6	Integrated unit per sow place	87	Sow with piglets before weaning (by weaning at the age of 60 days)	43	Boars	17	Fattening pigs, 20 -100 kg	9.8	Sows, urine, 2.2 farrows per year	15
	- from 20 to 110 kg	13			low N feed	9.8 - 11.2	Finishing unit per pig place	9.2	Fattening pig after weaning (28 days) up to 100 to 110 kg (6 months of age)	6.2	Fattening pigs 25 -100 kg	8.9	Mothers with piglets, 0 - 6 kg	20.3	Dry pregnant sows in hub 3 weeks, slurry, 3.1 rounds per year	22
	- 110 kg or more	24							Fattening pig after weaning (60 days) up to 100 to 110 kg (6 months of age)	5.4	Piglets up to 25 kg	3	Mothers with piglets, 20 kg	24.4	Sows in satellite, incl. piglets 3 weeks to 28.5 kg, slurry, 3.26 rounds per year	30
													Replacement sows	11.5		
													Sows in closed cycle,	78		
													Boars	24.4		

	Belgium Flanders, kg N/animal/yr		Germany (selected animals), kg N/animal/yr				Ireland, kg N/animal/yr		Lithuania, kg N/animal/yr		The Netherlands (selected animals), kg N/animal/yr		Spain, kg N/animal place/yr		Sweden, kg N/animal place/yr	
HORSES	Horses (>600 kg)	65	Horse		600 kg	63.5	Horse (> 3 yrs old)	50	Lightweight horses (around 380 kg, the *Žemaitukai* breed)	55	Pony < 250 kg	17	Horses	6.4	Horse, 500 kg, competition, solid manure	61
	Horses and ponies (200 - 600 kg)	50	Horse		500-600 kg	51.1 - 53.6	Horse (2-3 yrs old)	44	Medium-weight horses (around 500 kg, the breeds of trotters, large-type *Žemaitukai*)	80	Pony 250-450 kg	30			Horse, 500 kg, recreation solid manure	48
	Horses and ponies (< 200 kg)	35	Horse		365 kg	44.5	Horse (1-2 yrs old)	36	Heavyweight horses (around 700 kg, the breeds of heavy draught horses)	100	Horses 250 - 450 kg	37			Horse, pony (300 kg), solid manure	33
			Pony		350 kg	42.3	Horse foal (< 1 yr old)	25	Foals under 3 years of age (lightweight breeds)	39	Horses > 450 kg	48				
			Pony		300 kg	33.4 - 34.9	Donkey/small pony	30	Foals under 3 years of age (medium-weight breeds)	56						
			Pony		150 kg	31.6			Foals under 3 years of age (heavyweight breeds)	70						
OTHERS	Rabbits (per doe)	8.6	Rabbit		breeding < 0.6 kg	2.6					Rabits (breeding)	1.5				
					breeding: 3 kg	9.7					Rabits (meat)	0.5				
					fattening 0.6 - 3 kg	0.7										
	Goats and sheep younger than 1 year old	4.4	Scheep			18.1 - 18.6	Mountain ewe & lambs	7	Ewe with the young fed on milk	12						
	Goats and sheep older than 1 year old	11	Goat			14.8	Lowland ewe & lambs	13	The young of sheep from 2 months of age, weighing up to 40 kg	5.2	Sheep	7.4	Goat	8.8	Sheep + 1.8 lambs, deep stable manure	14
	Mink (per mother animal)	3.2					Mountain hogget	4	Ram (breeder)	14	Sheep + lambs	10	Lamb	10.22		
							Lowland hogget	6	Goat with the young before weaning	10	Goat; milk	5.8				
							Goat	9	The young of goat from 2 months to 1 year of age	5.5	Goat; meat	0.5				
							Dear (red) 6 months - 2 yrs	13	Male goat (breeder)	12	Other gpat	3.1				
							Dear (red) > 2 yrs	25	Rabbit	2.5						
							Dear (fallow) 6 months - 2 yrs	7	Rabbit grown for meat up to the broiler weight	0.1						
							Dear (fallow) > 2 yrs	13	Mink, marten	2.5						
							Dear (sika) 6 months - 2 yrs	6	Fox	6.7						
							Dear (sika) > 2 yrs	10	Chinchilla	0.14						
									Red deer	20						
									Fallow-deer, sika deer	11						

2.6.1 Action programmes

The focus of the project "Methodological studies in the field of Agro-Environmental Indicators. Lot 1 excretion factors" is on the gross N excretion. Therefore, only part of the information presented in the Action Programmes of the Nitrates Directive of EU member states can be used. In Chapter 4 an overview is presented of the method used by member states in their Action Programmes. Both gross and net excretion rates are presented in this Chapter. Data of manure production volumes and N and P contents are not presented.

2.6.2 Establishment of criteria for the assessment of the nitrogen content of animal manures

In 1999, the study "Establishment of criteria for the assessment of the nitrogen content of animal manures" was carried out for the European Commission, in which guidelines were presented to calculate the manure N production (Ketelaars and van der Meer, 1999). This study is used as the basis for calculation of N excretion in some member states (e.g. UK and Italy). Other member states use other N balance approaches or calculate excretion on basis of volumes and N contents. The manure production is calculated as

$$N_{manure} = N_{diet} - N_{animal\ products} - N_{losses\ from\ buildings\ and\ manure\ storage}$$

Where

- N_{manure} is the manure production in kg N per animal per year,
- N_{diet} is the feed N consumed in kg N per animal per year,
- $N_{animal\ products}$ is N retention (N in animal products) in kg N per animal per year,
- $N_{losses\ from\ buildings\ and\ manure\ storage}$ are the gaseous N losses in housing and manure storage in kg N per animal per year,

In Table 19 to Table 31 the gross N excretions (i.e. the N excretion without correction for gaseous N losses) calculated from the results of Ketelaars and van der Meer (1999) are presented for different livestock categories.

Table 32 to Table 55 show the major assumptions used for these calculations.

Table 19.

Calculated nitrogen excretion dairy cows (kg N/animal/yr)

%N in diet	small breed			large breed		
	milk production level (kg/year)			milk production level (kg/year)		
	4000	5000	6000	6000	7000	8000
low (2.4%)	75	83	90	108	115	123
medium (2.8%)	94	103	113	134	144	154
High (3.2%)	111	123	135	160	171	184

Table 20.

Calculated nitrogen excretion suckler cows (kg N/animal/yr)

%N in diet	small breed		large breed	
	milk production level (kg/year)		milk production level (kg/year)	
	0	1000	0	2000
low (2.4%)	55	63	76	91
medium (3.0%)	69	79	96	118
High (3.6%)	83	96	115	144

Table 21.

Calculated nitrogen excretion growing cattle (kg N/animal/yr)

%N in diet	small breed age (years)			large breed age (years)		
	0-1	1-2	2-3	0-1	1-2	2-3
low (2.0%)	20	34	39	27	46	52
medium (2.7%)	27	48	53	36	63	71
High (3.4%)	33	61	68	44	82	90

Table 22.

Calculated nitrogen excretion sows with piglets (till 25 kg) (kg N/animal/yr)

Protein conversion	
low (26%)	38
medium (28%)	35
High (30%)	32

Table 23.

Calculated nitrogen excretion slaughter pigs 25-100 kg (kg N/animal/yr)

Protein conversion	
low (28%)	15
medium (31%)	13
High (34%)	12

Table 24.

Calculated nitrogen excretion laying hens (kg N/animal/yr)

Feed conversion	
Good (2.13)	0.64
Medium (2.5)	0.79
Poor (2.88)	0.96

Table 25.

Calculated nitrogen excretion broilers (1.8 kg) (kg N/animal/yr)

Feed conversion	
Good (1.62)	0.41
Medium (1.80)	0.52
Poor (1.98)	0.61

Table 26.

Calculated nitrogen excretion ducks (3.3kg) (kg N/animal/yr)

Feed conversion	
Good (2.52)	1.04
Medium (2.80)	1.21
Poor (3.08)	1.39

Table 27.

Calculated nitrogen excretion turkeys (13 kg) (kg N/animal/yr)

Feed conversion	
Good (2.52)	1.63
Medium (2.80)	1.93
Poor (3.08)	2.48

Table 28.

Calculated nitrogen excretion ewes with lambs till 40 kg (kg N/animal/yr)

%N in diet	
low (2.1%)	15.2
medium (3.0%)	22.8
High (3.9%)	30.5

Table 29.

Calculated nitrogen excretion female goat with kids till 7 kg (kg N/animal/yr)

%N in diet	
low (2.3%)	15.6
medium (2.9%)	20.6
High (3.5%)	25.6

Table 30.

Calculated nitrogen excretion female rabbit with kittens (kg N/animal/yr)

%N in diet	
low (2.3%)	7
medium (2.9%)	9
High (3.5%)	12

Table 31.

Calculated nitrogen excretion horse (kg N/animal/yr)

weight	
400	39
600	53
800	67

Table 32. Performance of dairy cows in Denmark and the Netherlands together with default values for the N-balance of small and large-sized cows.

	Denmark Jersey	Denmark Large Breed	Netherlands Maize region	Netherlands grasslands region	Default value Small breed	Default value Large breed
Milk production (kg FCM/year)	7165	7402	6694	6694	500	7000
Adult cow weight					425	650
Feed use (kg Dm/year)	5349	6517	5576	5667	4250	5950
Feed use (kg Dm/kg FCM)	0.75	0.88	0.83	0.85	0.85	0.85
Marginal feed requirement (kg DM/kg milk)	0.51	0.58	0.49	0.49	0.5	0.5
Miantenance feed (kg DM/year)	1672	2247	2323	2361	1750	2450
Feed N content (%)	2.64	2.61	3	3.18	2.8	2.8
N intake, kg/year	141	170	167	180	119	167
N in milk, kg/year	33.5	39.4	33	33	26.5	37.1
N in gain cow, kg/year	0.6	1	0.8	0.8	0.6	1
N in calf, kg/year	0.4	0.7	1.1	1.1	0.4	0.9
N in animal products	34.5	41.3	35	35	27.5	39
N excretion, kg/year	106.5	128.9	132	145	92	128
N utilisation (%)	25	24	21	19	23	23

Table 33. N content (%) of cow weight gain and calf live weight.

	Denmark	Germany	Netherlands	Default value
Cow weight gain	2.56	2.5	2.53	2.5
Calf liveweight	2.96		2.94	2.95

Table 34. Performance of suckler cows in Denmark and the Netherlands together with default values for the N-balance of small and large-sized cows.

	Denmark Large Breed	Netherlands Large Breed	Default value Small breed	Default value Small breed	Default value Large breed	Default value Large breed
Milk production (kg FCM/year)	1000	2000	0	1000	0	2000
Adult cow weight		650	425	425	650	650
Feed use (kg Dm/year)	3230	3376	2050	2550	2900	3900
Marginal feed requirement (kg DM/kg milk)				0.5		0.5
Maintenance feed (kg DM/year)			2050	2050	2900	2900
Feed N content (%)	2.5	3.65	3	3	3	3
N intake, kg/year	81	123	62	77	87	117
N in milk, kg/year	5.4	10.8	-	5.3	-	10.6
N in gain cow, kg/year	0.8	0.8	0.6	0.6	1	1
N in calf, kg/year	1.4	1	0.4	0.4	0.9	0.9
N in animal products	7.6	12.5	1	6.3	1.9	12.5
N excretion, kg/year	73	111	61	70	85	104
N utilisation (%)	9	110	2	8	2	11

Table 35. Performance of growing male and female cattle of large breeds in Denmark and the Netherlands together with default values for the N-balance.

	Denmark Large Breed	Denmark Large Breed	Netherlands Large Breed	Netherlands Large Breed	Default value Large breed	Default value Large breed
Birth weight (kg)	40	40	53	43	55	45
Weight 1 year old (kg)	440	275	447	310	445	295
Weight change 1-2 year old (kg/d)	1	0.6	1.1	0.5	1	0.6
Weight change >2 year old (kg/d)	0.6	0.6			0.6	0.6
feed use (kg/year)	1770	1300	1600	1525	1700	1400
0-1 year	2700	2300	2700	2850	2700	2600
1-2 year	2900	2800			2900	2800
>2 year						
Feed N content (%)						
0-1 year	2.3	2.6	2.3	3.1/3.4	2.3-3.4	2.3-3.4
1-2 year	2.1	2.2	2.3	3.4/3.5	2.0-3.4	2.0-3.4
>2 year	2	23			2.0-3.4	2.0-3.4
N intake (kg/year)						
0-1 year	40.6	33.9	36	47/52		
1-2 year	55.7	49.7	62	97/100		
>2 year	58.9	64.8				
N in gain (kg/year)						
0-1 year	10.2	5.4	11.2	6.7		
1-2 year	8.8	4.7	9.2	6.2		
>2 year	4.6	7.7				
N excretion (kg/year)						
0-1 year	30.4	28.5	24.9	41/45		
1-2 year	46.9	45	52.8	91/94		
>2 year	54.3	57.1				

Table 36. N content (%) of liveweight gain in growing cattle

	Denmark	Germany	Netherlands	Default value
females	2.2-2.3	2.5	2.5-2.6	2.5
males	2.6	2.8	2.8	2.7

Table 37. Productivity of sows in intensive production systems in some countries together with defaults values.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Number of live pigs produced per sow per year	22	18	18	20.5	20	
Weight at weaning (kg)	7.5	8		7.5	7.5	
Weight at transfer from piglet to slaughter pigs (kg)	30	28	25	25.6	25/30	
Feed consumption per sow, excl. of piglets (kg/year)	1226*	1200	1050	1097	1140	10
Feed conversion of piglets (kg feed per kg gain of piglets)	1.74	1.8	1.9	1.7	1.8	
Feed consumption per piglet (kg)	39	36	33	30	31/40	
Feed consumption of piglets per sow per year (kg)	861	648	590	615	620/800	
Total feed consumptionper sow unit per year (kg)	2087	1848	1640	1712	1760/1940	10
Annual weight change per sow (kg)	60*			50		

*includes the feed confumption and gain of replacement gilts and boars

Table 38. N content (%) of feeds for sows and piglets.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Sows	2.58	2.64	2.56-2.96	2.54	2.6	10
Piglets	3.23	3.07	3.52-3.20	2.9	3	10

Table 39. N content (%) of weight gain in sows and of liveweight of piglets.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Sows	2.5	2.5	2.56	2.49	2.5	5
Piglets	2.6	2.5	2.56	2.4	2.5	5

Table 40. Productivity of slaughter pigs in intensive production systems in some countries together with defaults values.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Weight (kg) at transfer from piglet to slaughter pigs	30	28	25	25	25	
Liveweight at slaughter (kg)	98.3	108	110	110	105	
Feed conversion (kg feed per kg gain of pigs)	2.75	2.9	3.1	2.86	2.9	10
Feed consumption per pig (kg)	188	232	264	242	232	
Rounds per year		3	2.35	3.2	3.0*	
Feed consumption per pig place per year (kg)		696	620	748	696	10
Annual weight production per pig place (kg)		240	200	282	240	

Table 41. N content (%) of feeds for slaughter pigs.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Slaughter pigs (25-100 kg liveweight)	2.8	2.8	2.96	2.67	2.8	10

Table 42. N content (%) of liveweight gain in slaughter pigs.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Slaughter pigs (25-100 kg liveweight)	2.8	2.5	2.56	2.3	2.5	10

Table 43. Productivity of laying hens in intensive production systems in some countries together with defaults values.

	Denmark (1)	Denmark (2)	Germany	Netherlands	Default value	Range (±%)
Production cycle	413	357		405	405	
Empty period				14	14	
Occupancy					97	
Starting Weight				1.316	1.3	
Final Weight				1.938	1.9	
Feed consumption (kg/hen/cycle)	46	42	44	42	45	
Feed conversion (kg feed/kg egg mass)	2.28	2.63	2.44	2.37	2.5	15
Egg production (kg/cycle)	20.2	15.9	18	17.7	18	
Weight change (kg/cycle)	0.65	0.65		0.54	0.6	

(1): battery hens, (2): free range hens

Table 44. N content (%) of feeds for laying hens.

	Denmark	Germany	Netherlands	Default value	Range (±%)
Laying hens	2.72	2.64	2.91	2.8	10

Table 45. N content (%) of eggs and weight gain of laying hens.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Eggs	1.81	1.76	1.9	1.92	1.85	5
Gain	2.88	0.8		2.8	2.8	

Table 46. Productivity of broilers in intensive production systems in some countries together with defaults values.

	Denmark	Germany	Netherlands	Default value	Range (±%)
Production cycle	39.1		42	40	
Empty period					
Occupancy (%)		70?	100	100	
Starting Weight					
Slaughter weight (kg)	1.79		1.84	1.8	
Feed conversion (kg feed/kg gain)	1.74	1.73	1.91	1.8	10
Total feed intake (kg/animal)	3.11		3.5	3.2	
Rounds per year				9	
Total liveweight production (kg/year)		11	16	16	

Table 47. N content (%) of feeds for broilers

	Denmark	Germany	Netherlands	Default value	Range (±%)
Broilers	3.28	3.52	3.57	3.4	10

Table 48. N content (%) of liveweight gain for broilers.

	Denmark	France	Germany	Netherlands	Default value	Range (±%)
Broilers	2.88	3.2	3.5	2.8	3	10

Table 49. Overview of data on duck production systems in Denmark, UK, and the Netherlands.

	Denmark	UK	Netherlands	Default value	Range
Production cycle (days)	52	50	48	50	
Empty period (days)		10	2	3	
Occupancy (%)		83	96	95	
Rounds per year		6	7.3	6.9	
Slaughter weight (kg)	3.5	3.4	3.1	3.3	
Feed conversion (kg feed/kg gain)	3	2.8	2.7	2.8	10
Total feed intake (kg/animal)	10.5	9.5	8.4	9.2	
N content of feed (%)	2.72	3.12	2.8	2.8	10
N content of liveweight (%)	2.4	2.72	2.59	2.5	10

Table 50. Overview of data on turkey production systems in Denmark, UK, and the Netherlands.

	Denmark	UK	Netherlands	Default value	Range
Production cycle (days)	133	F: 120 M: 140	130	130	
Empty period (days)			2	7	
Occupancy (%)		80		95	
Rounds per year		F: 2.4 M: 2.1	2.8	2.7	
Slaughter weight (kg)	14	F: 6.5 M: 13.5	13	13	
Feed conversion (kg feed/kg gain)	2.6	F: 2.8 M: 3.0	2.75	2.8	
Total feed intake (kg/animal)	37	F: 18.4 M: 40.8	35.8	36.4	
N content of feed (%)	2.96	3.12	3.2	3.1	
N content of liveweight (%)	2.88	3.2	3.3	3.1	

Table 51. Overview of data on sheep production systems in Denmark, and the Netherlands.

	Denmark	Netherlands	Default value	Range
Live lamb production (per ewe per year)	1.5	1.6	1.6	
Slaughter weight lambs (kg)	50	40	40	
Adult ewe weight		75	75	
Annual Weight change ewe (kg)	10	10	10	
Wool production (kg/ewe/year)		6.4	6.4	
Feed intake (% of ewe liveweight)		2.57	3.1	15
Feed intake (kg/ewe/year)	1000*	706	850	
N content of feed (%)		3.9	3	30
N content of lambs (%)	2.72	2.5	2.5	
N content of ewe liveweight gain (%)	2.56	2.5	2.5	
N content of wool (%)		12.2	12.2	

Table 52. Overview of data on dairy goat production systems in France, and the Netherlands.

	France	Netherlands	Default value	Range
Live kid production (per female per year)	1.75	1.8	1.8	
Slaughter weight kids (kg)	6-11	5	7	
Adult female weight	60	65	65	
Annual Weight change female (kg)		2	2	
Milk production (kg/female/year)	600	600	600	
Feed intake (% of female liveweight)	3.1	3.5*	3.5	
Feed intake (kg/female/year)		825	825	
N content of feed (%)		2.9	2.9	20
N content of kids (%)	3.5		3.5	
N content of female liveweight gain (%)		2.4	2.4	
n content of milk (%)	0.45	0.5	0.5	

Table 53. Data on rabbit production in the Netherlands.

	Netherlands	Range
Live kitten production (per female per year)	50	
Slaughter weight kitten (kg)	2.1	
Annual liveweight production per female (kg)	105	
Feed conversion (kg/kg)	4	
Feed intake (kg/female/year)	420	
N content of feed (%)	2.94	20
N content of kitten (%)	3	

Table 54. Nitrogen retention as a percentage of nitrogen intake for fur species.

Species	Country	N retention (% of intake)
Mink	Denmark	6.3
Mink	Netherlands	6.6
Fox	Netherlands	10.7

Table 55. Nitrogen flows in mink production in Denmark and the Netherlands.

	Denmark	Netherlands
Live kits production (per female per year)	5.2	5
Slaughter weight kitten (kg)	1.8	1.9
Feed supplied (kg/female/year)	185	250
N content of feed (%)	2.6	1.75
N consumed (incl wasted feed)	4.9	4.4
N in carcass, pelt, fur	3	0.3
N excreted (incl. wasted feed)	4.6	4.1

2.6.3 Recommendations for establishing Action Programmes

In 2011 a study was carried out for DG Environment about recommendation for Action Programmes under the Nitrates Direct: Recommendations for establishing Action Programmes under Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources Contract number N° 07 0307/2010/580551/ETU/B1: http://ec.europa.eu/environment/water/water-nitrates/studies.html

In this study the P excretion was estimated from the N excretion of Ketelaars and van der Meer (1999; see previous paragraph) and assumptions of N/P ratio in manures. The calculated P excretions are presented in Table 56 to Table 65. It is assumed that no P losses occur in housing and during storage of manure, so that the manure P production is equal to the P excretion. The N/P ratios were based on a survey of data from the UK, France, Sweden, The Netherlands and Poland by Schröder and Stevens (2004). The N/P ratio in manures show a considerable variation: dairy cows 4.1 to 7.5 (average 5.8), fattening pigs 2.1 to 4.6 (average 3.6) and poultry 1.8 to 3.6 (average 2.7). The data also show that the N/P ratio of ruminants and horses are generally wider than those of other animals. It was assumed that the ratio for calves and sows are the same as those in dairy cows and fattening pigs, respectively. For sheep a ratio of 4.7, for goat 4.0 - 7.3 (Schmidely et al., 2002)., for rabbits a ratio of 3.5 (Maertens et al., 2005), and for horses 5.6 - 6.0 (Lawrence et al., 2003) were used. It was further implicitly assumed that effects on P-utilization within the animal follow that of N-utilization.

Table 56.
Manure-P production (kg P/head/yr) for dairy cows, as affected by breed, production level and % N in diet.

% N in DM	Small breed			Large breed		
	4000 l	5000 l	6000 l	6000 l	7000 l	8000 l
Low: 2.4%	10	11	12	15	16	17
Medium: 2.8%	13	14	16	18	20	21
High: 3.2%	15	17	19	22	24	25

Table 57.
Manure-P production (kg P/head/yr) for calves, as affected by breed, age class and % N in diet.

% N in DM	Small breed			Large breed		
	0-1 y	1-2 y	2-3 y	0-1 y	1-2 y	2-3 y
Low: 2.0%	3	5	6	4	7	8
Medium: 2.7%	4	7	8	6	10	11
High: 3.4%	5	9	11	7	13	14

Table 58.
Manure-P production (kg P/place/yr) for sow with piglets till 25 kg, as affected by protein conversion.

Protein conversion, %*	
Low: 26%	7.9
Medium: 28%	7.3
High: 30%	6.7

*share of feed protein converted to animal protein

Table 59.
Manure-P production (kg P/place/yr) for fattening pig till 105 kg, as affected by protein conversion.

Protein conversion, %*	
Low: 28%	3.2
Medium: 31%	2.8
High: 34%	2.4

*share of feed protein converted to animal protein

Table 60.

Manure-P production (kg P/100 places/yr) for laying hen, as affected by feed conversion.

Feed conversion, kg/kg*	
Good: 2.13	16
Medium: 2.50	21
Poor: 2.88	25

* share of feed weight converted to animal weight

Table 61.

Manure-P production (kg P/100 places/yr) for laying broilers till 1.8 kg, as affected by feed conversion.

Feed conversion, kg/kg*	
Good: 1.62	11
Medium: 1.80	13
Poor: 1.98	16

* share of feed weight converted to animal weight

Table 62.

Manure-P production (kg P/head/yr) for ewes with 1.5 lambs, as affected by % N in diet.

% N in DM	
Low: 2.1%	2.7
Medium: 3.0%	4.1
High: 3.9%	5.5

Table 63.

Manure-P production (kg P/head /yr) for female goat with offspring, as affected by % N in diet.

% N in DM	
Low: 2.3%	3.1
Medium: 2.9%	3
High: 3.5%	2.8

Table 64.

Manure-P production (kg P/head /yr) for female rabbit with offspring, as affected by % N in diet.

% N in DM	
Low: 2.3%	1.1
Medium: 2.9%	1.6
High: 3.5%	2

Table 65.

Manure-P production (kg P/head /yr) for a horse, as affected by % N in diet and body weight.

% N in DM	Body weight (kg):		
	400	600	800
Medium: 2%	7	9	11
High: 3%	9	12	15

2.7 Other sources

2.7.1 Sheldrick et al. (2003)

Sheldrick et al. (2003) presented estimates of N, P, and K excretion for livestock, based on different sources (Table 66). The results were used to calculate N excretion for livestock of a specific weight (Table 65), assuming that the excretion rate within a livestock category is proportional to the slaughter weight.

Table 66.

Table 1. Data for livestock excretion rates from various sources.

Animal	A kg nutrient year^{-1}			B kg nutrient year^{-1}			C kg nutrient year^{-1}		
	N	P	K	N	P	K	N	P	K
Beef cattle									
> 2 years	59	11	66	71	23	62	101	16	105
1 to 2 years	46	9	54	56	18	40	76	12	79
<1 year	35	6	24	28	9	20	33	5	31
Dairy cows	98	13	116	95	16	63			
Pigs									
Slaughter	11	2	5	15	5	10	13	4	7
Boars	13	4	5	13	4	8	33	10	17
Sows	26	6	10	38	13	11	33	10	17
Sheep	11.3	2.6	13.1	8	1	6	20.0	1.8	19.0
Goats	13.5	3.1	16.9				20.0	1.8	19.0
Horses	68	14	51	45	8	27			
Poultry									
Broilers	0.30	0.04	0.03	0.40	0.09	0.13	0.77	0.24	0.38
Layers	0.70	0.18	0.15	0.48	0.18	0.21	0.35	0.11	0.17
Ducks	0.60	0.09	0.07						
Turkeys	1.50	0.31	0.26						

A: OECD Secretariat (1997); B: Midwest Plan Service – 18 (1985); C: Levington Agriculture (1997).

Levington Agriculture 1997. A Report for the European Fertiliser Manufacturers Association. Levington Agriculture Ltd., Ipswich, UK, 111 pp.
Midwest Plan Service – 18 1985. Livestock Waste Facilities Handbook. University Missouri, USA, 112 pp.

Table 67.

Table 2. Livestock excretion rates used in the model.

Livestock	Slaughtered weight (kg)	kg nutrient year^{-1}		
		N	P	K
Cattle	250	50	10	45
Pigs	80	12	4	4.5
Sheep	15	10	2	5
Goats	12	10	2	5
Horses	250	45	8	27
Poultry	2	0.6	0.19	0.31

2.7.2 Impact of the Nitrates Directive on gaseous N emissions

In the study the impact of the Nitrates Directive on gaseous N emissions for DG Environment (Velthof et al., 2014[2]) a method has been develop to calculate N excretion from dairy cattle on regional level. This method takes regional differences into consideration. Figure 2 shows the results. The N excretion by dairy cows was calculated using the following formulae:

[2] See also: http://ec.europa.eu/environment/water/water-nitrates/pdf/Final__report_impact_Nitrates_Directive_def.pdf

$N_{excretion} = N_{diet} - N_{retained}$

$N_{diet} = q * [MW * a + LWG * b + MY * c] * N\ content\ \ feed$

$N_{retained} = (MY * N\ content\ milk) + (LWG * N\ content\ LW)$

where

- $N_{excretion}$ = total N excretion, in kg per cow per year,
- N_{diet} = total N intake, in kg per cow per year,
- $N_{retained}$ = total amount of N retained in milk and meat, in kg per cow per year,
- MW = metabolic weight = $(weigth)^{0.75}$, in kg
- LWG = liveweight gain, in kg per year
- MY = milk yield per ruminant, kg per year

a, b, c and q are empirical constants. Coefficient a was set at 55 g per kg MW per day; coefficient b was set at 5 kg per kg; coefficient c was related to milk fat and protein, as follows:
$c = 0.4 + 0.0013 * [MP + 2 * MF]$,

where
MP = milk protein content, in g per kg milk, and
MF = milk fat in g per kg milk.

Finally, coefficient q is a parameter for the quality of the feed. For concentrate feed and high-quality herbage, q was set at 1; for poor quality roughages, parameter q was set at 1.3.

In addition to the methodology to calculate N excretion on a regional level, a method was developed to estimate the effects of changes in N input on N excretion of dairy cattle (Figure 3).

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http://ec.europa.eu/environment/water/water-nitrates/pdf/Final__report_impact_Nitrates_Directive_annex.pdf

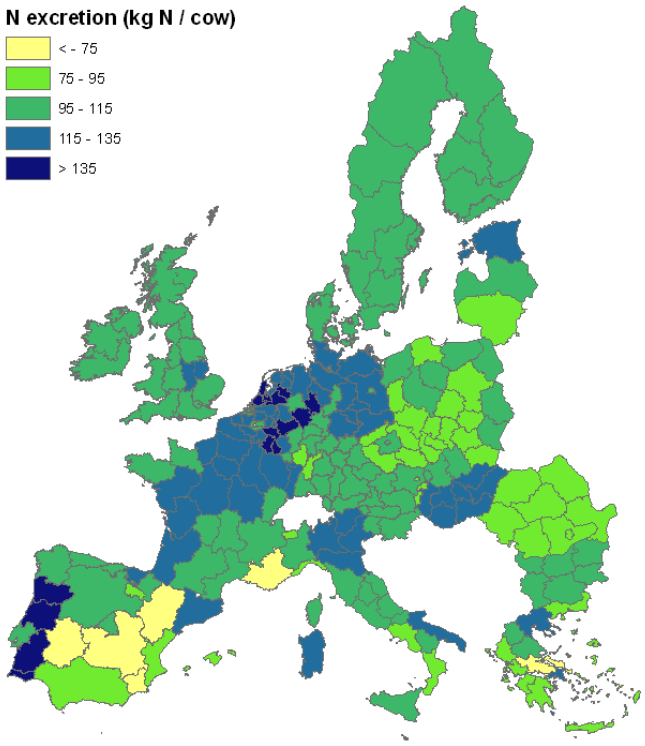

Figure 2. Regional distribution of the calculated mean N excretion, in kg per dairy cow per year per NUTS-2 region, for the year 2005.

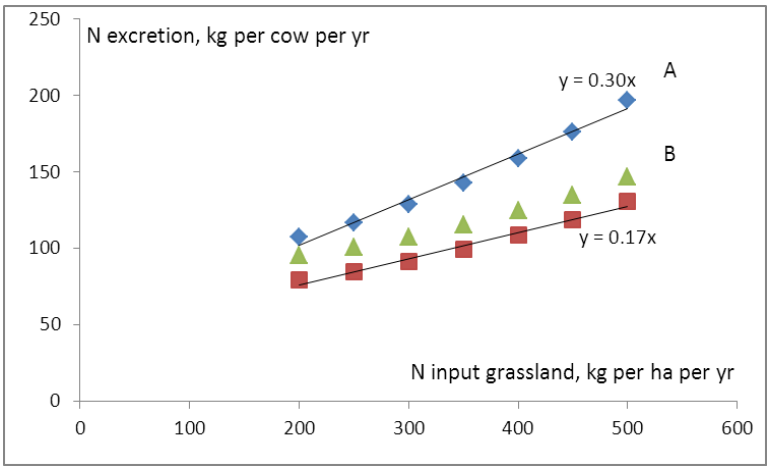

Figure 3. The relationship between N input to grassland and N excretion by dairy cows for three ratio.

Assumptions: mean milk yield of 7500 kg of milk per year, total feed requirement of 7000 kg dry matter per cow, and N retention of 42 kg N in milk and calf per year.
Ration A consists of grass only (combination of grazed grass and grass silage), ration B of 4000 kg grass (combination of grazed grass and grass silage) and 3000 kg of maize silage, and ration C of 4000 kg grass (combination of grazed grass and grass silage), 2000 kg maize silage, and 1000 kg concentrates.
The N content of the maize silage was set at 12 g/kg (7.5 % protein), and that of the concentrates at 28 g/kg (17.5 % protein).

3 Country reports

The general objective of Lot 1. Nitrogen and phosphorus excretion factors for livestock of the Methodological studies in the field of Agro-Environmental Indicators (2012/S 87-142068) is "*to bring clarity into the issue of excretion factors so that a recommendation on a single, common methodology to calculate N and P excretion coefficients can be identified. This methodology should be flexible enough to allow local conditions to be taken into account, but without distorting the picture".* This report includes the Annex of the main report of Task 1, describing all the excretion factors used in European Countries for UNFCCC (IPCC), Gothenborg protocol, Nitrates Directive, and the Eurostat/OECD balance. The focus of this report is on the gross N excretion coefficients, i.e. the N excretion "under the tail of the animal", which means that coefficients have not been corrected for gaseous N losses (NH_3, N_2O, NOx and N_2) during the manure storage, in animal housing and during and after the application of manure to land. Table S1 summarizes the sources of excretion factors that are used by the different countries for the calculation report of greenhouse gas emissions (UNFCCC; NIR 2011. Note that some member states have update their methodology after 2011) and ammonia emission (UNECE Gothenborg protocol) and those used for the Action Programme of the EU Nitrates Directive. The main conclusions for each country are presented below.

Austria uses the same approach for N excretion for reports to UNFCCC and IPCC. The method is based on the balance method of Ketelaars and Van der Meer (1999). Net excretions are reported for the Nitrates Directive for different housing systems. The assumptions of the gaseous N losses to calculate net excretion from gross excretion are not presented in the action programme. It is not possible to calculate the gross excretion from the data available in the Action Programme. The animal categories in the Action programme for the Nitrates Directive are more detailed than those used for UNFCCC and UNECE reports. The N excretion in the Action programme for the Nitrates Directive is based on stall place per year and those for UNFCCC and UNECE on animal per year. The N excretion values in the Action Programme for the Nitrates Directive depend for dairy cows on milk yield and those for piglets, fattening pigs, and breeding pigs on the feed.

Belgium Flanders uses the same methodology to calculate excretion for the report for Nitrates Directive, UNFCCC, and UNECE. In all three reports, gross excretions are presented. Walloon uses the same approach for UNFCCC and UNECE. For the Nitrates Directive, net excretions are presented. Gaseous N losses are not presented in the Action Programme of Walloon, so that it is not possible to calculate the gross N excretions.

Bulgaria uses a Tier 1 approach for the UNFCCC report and, by that, Tier 1 default excretion values;
Bulgaria uses a Tier 1 approach for the Gothenborg protocol, i.e. a method based on NH_3 emission factors per animal and not based on excretion;. Bulgaria uses for the Nitrates Directive an approach in which the manure N production is calculated from the volume of manure produced and the N content of manure. No excretion figures are presented in the action programme.

Cyprus uses the Tier 1 excretion factors from the IPCC Guidelines for Near East and Mediterranean. Cyprus uses a Tier 1 approach for the Gothenborg protocol, i.e. a method based on NH3 emission factors per animal and not based on excretion. Cyprus uses for the Nitrates Directive an approach in which the manure N production is calculated from the volume of manure produced and the N content of manure. No excretion figures are presented in the action programme.

Czech Republic uses IPCC defaults excretion factors for the UNFCCC report. The approach of how Czech Republic calculates ammonia emission for the Gothenborg protocol is not clear from the report. Probably, ammonia emission

factors per animal are used. Czech Republic uses for the Nitrates Directive an approach in which the manure N production is calculated from the volume of manure produced and the N content of manure. No excretion figures are presented in the action programme.

Denmark uses the same approach for N excretion for the UNFCCC report and Gothenborg protocol report. It is not clearly indicated how the N excretion is calculated, but it its very likely that the same approach is used as for the Nitrates Directive. The Danish normative system is used to calculate the N excretion for the Nitrates Directive. This is an "input – output" system based on values coming from actual farm statistics. Default values are given for a "standard mean animal" and there are possibilities for farmers to correct default values if the dietary protein level is lower than the default value, or different body weigths, or age of animals. The table for the Nitrates Directive does not included gaseous N losses from housing and storage, so that no calculation of the gross excretion can be made from the presented net excretion.

The N excretion used for the UNFCCC report of **Estonia** is calculated by multiplication of the N content of manure with the manure excretion per head. The manure excretion is estimated and the N content based on literature. This suggests that Estonia uses the net excretion instead of the required gross excretion for the UNFCCC report. Nitrogen excretion factors for other livestock categories were obtained from the Revised 1996 IPCC Guidelines. Estonia uses a Tier 1 approach for the Gothenborg protocol, i.e. not based on N excretion but on NH_3 emission factors per animal. The calculation of manure production in Estonia is based on volumes and N content of produced manure. The N excretion figures are not shown in the Action programme.

Finland uses animal specific nitrogen excretion rates, based on nutrient balance calculations. Excretion rates are obtained by subtracting the nitrogen included in animal products and growth from the nitrogen intake through feeding. The source of excretion rates is the same for UNFCCC report, Gothenborg protocol report, Nitrates Directive, and Eurostat balance (MIT Agrifood Research Finland). Most likely, the same methodology is used. However, there are some discrepancies between the source which are not clear. For example, the N excretions from dairy cattle is somewhat different between the UNFCCC report and the Gothenborg protocol report. Also the excretion rates in 2009 differ between these two reports. Moreover, it is not indicated if the figures for the Nitrates Directive are net or gross excretion rates. The excretion rates of dairy cattle are similar than those Gothenborg protocol, suggesting that they are gross excretion rates (or low gaseous emissions have been assumed. Those of sows, fattening pigs, and poultry are lower for the Nitrates Directive than Gothenborg protocol, suggesting that these are net excretion rates.

Germany uses for both UNFCCC and Gothenborg protocol a N feed balance methodology to calculate N excretion. The method is the same and the same animal categories are used. Sometimes data of aggregated animal categories are reported. The excretion table for the Nitrates Directive contains detailed information about the gross N excretion. The level of detail and the fact that there are differences due weight, milk production and feed suggests that these excretion values are based on N balance calculations. The livestock categories are different from those used for UNFCCC and Gothenborg reports, so that an comparison cannot be made. The values used for UNCCC and Gothenborg are be derived more recently than those of the Nitrates Directive.

Hungary uses country-specific values for dairy cattle, other cattle and swine, while IPCC default excretion values or values taken from the international scientific literature for the other categories. In the case of IPCC default values it is assumed that production level and feeding technology of animal breeding in Hungary are close to the Western European standards, therefore the Western European values are used. Hungary uses a Tier 1 approach for the report for the Gothenborg protocol, i.e. not based on N excretion but on NH_3 emission factors per animal, although the development of the Tier 2 emission factors for NH_3 emissions from cattle and swine on the basis of the N-excretion rates developed for the UNFCCC report is underway.

Ireland uses the same approach for the UNFCCC and Nitrates Directive. The approach used for the Gothenborg protocol is not based on excretion factors.

Both the UNFCCC, Gothenborg and Nitrates Directive reports indicate that **Italy** uses a N feed balance approach to calculate N excretion. In these reports it is referred to the interregional project "Nitrogen balance in livestock farms", suggesting that the same methodology to calculate N excretion is used for these three reports (Note: it is certain that Italy uses exactly the same N balance method for UNFCCC report and Gothenborg protocol). Latvia uses an N balance approach was used for estimating N excretion by farm livestock. Information on both input (N intake) and output (N products) factors are used. The N intake is calculated as feed intake (kg of dry matter) x content of the feed while N products includes the N in live weight gain, milk, etc.

Latvia uses a Tier 1 approach, i.e. not based on N excretion but on NH_3 emission factors per animal. The calculation of manure production for the Nitrate Directive is based on volumes N
and N content of produced manure. The N excretion figures are not shown in the Action programme

Lithuania uses a feed balance approach to calculate excretion for cattle and pigs for UNFCCC report. For other categories default values are used. The Tier 1 approach is used for Gothenborg protocol, i.e. not based on N excretion but on NH_3 emission factors per animal. Lithuania uses a feed balance approach to calculate excretion for the Nitrates Directive. Both net and gross excretion values are presented. It is not clear from the documentation if the approach for UNFCCC report and Nitrates Directive for cattle and pigs are equal, but the fact that excretion for dairy cattle differs between UNFCCC and Nitrates Directive indicates that the methodology (or input parameters) are not the same.

Luxembourg states in the report for the UNFCCC that most of the excretion coefficients have been prepared in the framework of the Nitrates Directive and good agricultural practice and/or for the OECD Agro-environmental Indicators Database. The methodology is not described. Luxembourg uses a Tier 1 approach for the Gothenborg protocol, i.e. not based on N excretion but on NH_3 emission factors per animal. No information was found about the methodology used by Luxembourg to calculate manure N production for the Nitrates Directive.

The methodology of calculation of excretion for the UNFCCC by **Malta** is not clear. The excretion values or other information about manure production is not presented in the Action programme of Malta for the Nitrates Directive.

The **Netherlands** uses the same methodology for calculation of N excretion for the Gothenborg protocol and UNFCCC report. The Netherlands uses legally determined forfeits for cattle and other grazing livestock and a stable balance for stabled livestock such as pigs and poultry. The excretions for dairy cows are linked to milk production on the farm concerned, and adjusted accordingly. This methodology to derive forfeits is based on a N balance. For the Nitrates Directive, the same N balance methodology is used as for UNFCCC report and Gothenborg protocol. However, for UNFCCC and Gothenborg, the excretion is calculated every year using year specific values of inputs and outputs. The excretion for the Nitrates Directive is based on assumptions about average inputs and outputs, and are not related to a specific year.

Poland calculates the nitrogen excretion rates for UNFCCC report using a model (SFOm) for cattle, horses and swine. However, it is not clear which methodology is used. Poland uses a Tier 1 approach for the Gothenborg protocol, i.e. not based on N excretion but on NH3 emission factors per animal. The calculation of manure production for the Nitrates Directive is based on volumes and N content of produced manure. The N excretion figures are not shown in the Action programme.

Portugal uses the country specific methodology to estimate excretion for the UNFCCC report and Gothenborg protocol (the same method is used). The quantity of nitrogen excreted per head is derived from expert information provided by the Ministry of Agriculture. The nitrogen excretion rates were taken from the - Analysis of the new

nitrogen excretion rates proposed in the revision of the Agriculture Good Practice Code (CBPA – Código de Boas Praticas Agrícolas). CBPA defines the nitrogen excretion rate of dairy-cattle as a function of their milk production. The methodology used to derive the N excretion values of the other livestock categories is not described. The calculation of manure production is based on volumes and N content of produced manure . The N excretion figures are not shown in the Action programme.

Romania uses default IPCC values for Eastern Europe for UNFCCC report and a Tier 1 approach based on NH_3 emission factors per animal for the Gothenborg protocol (not based on excretion). The Action Programme for the Nitrates Directive for Romania is currently under revision. Romania will base the N excretion figures for the Nitrates Directive on the IPCC defaults.

Slovakia uses the IPCC excretion defaults for the UNFCCC report. Slovakia uses a Tier 1 approach for the Gothenborg protocol based on NH_3 emission factors per animal. The calculation of manure production for the Nitrates Directive is based on volumes and N content of produced manure.

Slovenia uses a country specific approach for N excretion rates for cattle and pigs. The nitrogen excretion for dairy cows has been linked to the milk production. The methodology for estimation of the excretion of other livestock categories is not described. The excretion rates for cattle and pigs used for Gothenborg protocol are the same as for UNFCCC. However, there are some differences for other species, also due to differences in classification (poultry in UNFCCC versus individual species for Gothenborg protocol). Slovenia uses country specific net nitrogen excretion rates for the Nitrates Directive. The methodology how these excretions factors have been derived is not presented in the Action Programme.

The N excretion values for UNFCCC and Gothenborg reports of **Spain** have been obtained through calculation of nitrogen balances for the cattle, pigs, poultry, and sheep. The N excretion of the other categories are based on the IPCC default for "Near East and Mediterranean". The N excretion values in the action programme for the Nitrates Directive of Spain differ between Nitrate Vulnerable Zones. These action programmes includes a table with gross N excretion rates. The methodology is not indicated. The values are different than those used for the reports for UNFCCC and Gothenborg protocol.

The N excretions factors in the **UK** used for UNFCCC, Gothenborg protocol, and Nitrates Directive are derived from N balance calculations. The methodology is the same for these three reports, but differences may occur because of different animal categories and different years that are considered.

Norway uses a N balance approach to calculate N excretions for UNFCCC and Gothenborg protocol. The calcualtions are based on typical Norwegian feedstock ratios, the excretion of nitrogen (N) and phosphorous (P) were calculated by subtracting N and P in growth and products from assimilated N and P. The numbers were in some cases compared to numbers found in balance experiments.

Switzerland uses the Agrammon model to calculate N excretion used for UNFCCC and Gothenborg protocol. The N excretion of dairy cattle is dependent on the milk yield and that of pigs is based on the protein content of feed.

Table 68 Source/method of N excretion used for report of greenhouse gas emissions (UNFCCC), ammonia emission (UNECE Gothenborg protocol) and Action Programme of the EU Nitrates Directive.

Country	UNFCCC	Gothenborg protocol	Nitrates Directive
Austria	N balance animal: N input as feed – N output as animal products		Country specific net excretion
Belgium	Country specific (N balance?)		As UNFCCC for Flanders. Gross excretion for Walloon
Bulgaria	IPPC default	EEA/EMEP default; NH_3 based**	N content and volume of manure***
Cyprus	IPPC default	EEA/EMEP default; NH_3 based	N content and volume of manure
Czech Republic	IPPC default	Not clear	N content and volume of manure
Denmark	N balance		N balance as UNFCCC; corrected for gaseous N loss
Estonia	IPPC default, except dairy cow	EEA/EMEP default; NH_3 based	N content and volume of manure
Finland	N balance		
France	IPPC default	EEA/EMEP default; NH_3 based	N balance; corrected for gaseous N loss
Germany	Region specific N balance	Region specific N balance	Country specific gross excretion. Method not indicated
Greece	IPPC default	Not indicated	N content and volume of manure
Hungary	IPPC default	EEA/EMEP default; NH_3 based	Country specific net excretion, based on literature
Ireland	N balance (as Nitrates Directive)	EEA/EMEP default; NH_3 based	N balance (as Nitrates Directive)
Italy	N balance		N balance. Not clear if this similar as for UNFCCC and Gothenborg protocol
Latvia	N balance	EEA/EMEP default; NH_3 based	N content and volume of manure
Lithuania	N balance for cattle and pigs. Other default IPCC	EEA/EMEP default; NH_3 based	Net excretion based on N balance and gaseous N loss
Luxembourg	Country specific; method not indicated	EEA/EMEP default; NH_3 based	Not indicated
Malta	Country specific; method not indicated	Not indicated	Not indicated
Netherlands	N balance		Same as UNFCCC, but other year. Includes correction for gaseous N losses
Poland	Country specific for dairy cattle, pigs, and horses	Country specific	N content and volume of manure
Portugal	Dairy based on milk country. Other livestock country specific. Method not clear.		N content and volume of manure
Romania	IPPC default	EEA/EMEP default; NH_3 based	Based on IPCC figures
Slovakia	IPPC default	EEA/EMEP default; NH_3 based	N content and volume of manure
Slovenia	Dairy cattle based on milk production. Other not clear.	UNFCCC values	Country specific net excretion. Method not indicated.
Spain	N balance		Country specific gross excretions. Method not indicated.
Sweden	STANK model. Methodology not clear.		
United Kingdom	N balance. Differences may occur because of different livestock categories and years		
Norway	N balance		--
Switzerland	Agrammon model. Dairy cattle based on milk yield. Pigs based on protein content feed		--

** Emission of NH_3 is expressed in kg NH_3 per animal; N excretion is not used in Tier 1 approach

*** The manure production/ N excretion calculated from volume of manure and the N content of the manure

4 Comparison of N excretion of livestock in different countries and information sources

In this Chapter, a comparison is made of gross excretion rates in different sources. For the Nitrates Directive, only for a limited number of member states gross excretion rates can be derived. The main findings are:

Dairy cattle (Table 69)

- For nearly all countries, there are large differences in N excretion of dairy cattle between the considered sources. For Norway and Switzerland, differences between the sources are smallest, but no data for CAPRI and Nitrates are available for these countries.
- The excretion factors used for UNFCC (NIR 2011) and Gothenborg protocol are for most member states similar, except Germany (131.5 for NIR 2011 and 113.7 for Gothenborg).
- The CAPRI estimates are sometimes very high, e.g. 194 kg N/cow/year in Denmark and 180 kg N/cow/year in Sweden.

Other cattle (Table 70, Table 71, and Table 72)

- The group other cattle consists of categories with large differences in N excretion rates, from less than 15 kg N per animal for calves up to more than 75 kg N per animal for beef cattle and suckler cows. This hampers the estimation of an average excretion rates for a category "other cattle", as included in GAINS, CAPRI, IPCC methodology, and Gothenborg reports. Probably, the excretion figures for other cattle in these sources are based on calculations for different specific categories, but are not presented .
- Large differences are sometimes shown for the different data sources. This is due to the large diversity of cattle categories, which needs to be taken into account for the calculation.
- There also large differences for specific categories, e.g. for suckler cows from 63 to 95 kg N per animal per year for the Nitrates Directive and from 64 to 98 kg N per animal for the Eurostat/OECD data base.
- For a transparent and accurate estimation of the excretion for other cattle than dairy cattle, it is recommended to use excretion figures for the detailed cattle categories (e.g. those in FSS) instead of using excretion figures for an "other cattle" category. This is also needed because the excretion rates have to be multiplied with the number of animals and information about how animal categories should be treated is needed.

Pigs (Table 73 and Table 74)

- Like the "other cattle" category, also the pig category consists of a large number of different pig types. This hampers the estimation of an average excretion rates for an average "pig category".
- Within a pig categories, there can be large differences, e.g for sows and for fattening pigs. This is partly due to differences in age and weight, and differences in feeding. However, it may not be excluded that some countries express the N excretion of an animal basis and other on animal places basis. For sows, it is important if piglets are included (and till which weight and age).

Poultry (Table 75)

- The same comments as for other cattle and pigs hold for poultry. There is a large diversity in poultry categories, which hampers the use of one excretion figure for one poultry category.
- There are sometimes large differences in N excretion for the same category between countries, which are not clear. This may be partly due to differences in age/weight, unit (animal or animal place).

Horses (Table 77)

- An average figure of about 50 kg N per horse is often used. Countries use often the same excretion figures for horses for the UNFCCC report and Gotheborg protocol. Some countries differentiate the N excretion for different size of horses (e.g Flanders, Germany, Lithuania) showing differences between different horse classes.

Sheep and Goat (Table 78)

- Large differences between sheep categories are shown, e.g. in the UNFCCC report N excretion ranges from 5.2 kg N for Spain to 20 kg N in Slovenia. Also the figures used for the Nitrates Directive show differences. These figures may partly be due to differences in the way male, female and young animals are considered in the excretion calculation

Fur animals (Table 79)

There are large differences in the N excretion of rabbits, probably due to differences in age, including/excluding young animals and the unit (per animal and animal place).

Concluding, a comparison of the excretion figures between data sources and between countries show often large differences. It is difficult to find explanation for these differences, as the used methodologies are often not well described. Moreover, some data sources report aggregated excretion figures for animal categories (other cattle, pigs, and poultry), without showing the detailed N excretion rates for the specific animal categories. There is a clear need for a harmonized procedure to calculate N excretions and describe the methodology. The first step would be the definition of animal categories for which excretion figures have to be calculated. These are preferably categories for which animals number are gathered, so that total manure production in regions and countries can be made. It is recommended to use animal categories in FSS as a basis. The second step would be to recommend a set of methodologies (Tier approach) to estimate the N excretion for each category. The Tier 1 approach would be an approach with default N excretion figures for certain region or farming systems (depending on intensity). In other Tier levels, harmonized methodologies to calculate N excretion data are needed, which use available information for productivity and inputs.

Table 69.

Country	GAINS 2010	NIR 2011	CAPRI	Gothenborg	Nitrates Directive	Eurostat/OECD
	Dairy cows	Dairy cows	Dairy cows	Dairy cows	Dairy cows	Dairy cows
Austria	106.0	97.1	90.0	97.0		97.4
Belgium	117.7	115.1	95.0			109.0
Walloon				120.5		111.4
Flanders				97.0	97.0	105.9
Bulgaria	75.3	70.0	116.0			
Cyprus	103.1	*	134.0			106.7
Czech Republic	131.1	144.8	114.0			105.3
Denmark	131.8	138.1	194.0	138.0		129.4
Estonia	113.0	102.1	122.0			62.1
Finland	120.6	126.9	92.0	121.9		
France	112.1	100.0	105.0			124.7
Germany	130.1	131.5	106.0	113.7	100 - 149	119.0
Greece	111.1	100.0	97.0			
Hungary	146.5	114.1	149.0			125.0
Ireland	104.8	85.0	88.0		85.0	108.9
Italy	111.7	116.0	97.0	116.0		94.0
Latvia	87.9	70.0	139.0			70.0
Lithuania	95.0	99.2	99.0		120.0	
Luxembourg	114.3	102.0				71.0
Malta	98.0	*	155.0			102.7
Netherlands	146.8	127.0	119.0	130.2	99 - 131	134.5
Poland	80.8	86.7	91.0			70.0
Portugal	101.9	115.0	121.0	111.7		111.7
Romania	67.5	70.0	96.0			
Slovakia	134.6	100.0	119.0			105.0
Slovenia	110.1	110.6	85.0			113.0
Spain	70.8	67.7	108.0	67.7	89.0	103.3
Sweden	132.2	126.4	180.0	125.0	117 - 139	117.0
United Kingdom	133.3	110.0	142.0			117.0
Belarus	55.0	77.1				
Croatia	55.0	70.0				
Norway	82.0	82.0		82.0		84.8
Russia	55.0	94.5				
Switzerland	107.0	110.2		115.0		115.3
Turkey	66.5	82.6				
Ukraine	55.0	74.5				

Table 70. Other cattle part I

Country	GAINS	NIR 2011	NIR 2011	CAPRI	Gothenborg	Nitrates Directive			Eurostat/OECD
	Other cattle	Other cattle	Young cattle	Other cattle		Suckler cows	Young cattle < 1 yr	Young cattle > 1 yr	Other cattle
Austria	45.8	46.6	*	40.0					78.5
Belgium	50.0	54.3	*	47.0					73.0
Walloon									65.0
Flanders							23.0	61.0	77.7
Bulgaria	45.0	50.0	50.0	49.0					
Cyprus	40.0	*	*	43.0					80.9
Czech Republic	45.0	70.0	*	43.0					78.6
Denmark	37.2	47.8	*	62.0	45.0				75.8
Estonia	45.0	44.4	16.7	42.0					62.1
Finland	53.0	50.2	*	30.0					96.5
France	50.0	57.5	*	53.0					68.7
Germany	39.9	40.8	*	40.0	44.3	87.0		60.0	
Greece	45.0	45.4	*	47.0					
Hungary	45.0	48.3	*	51.0					51.0
Ireland	68.9	48.9	*	48.0		65.0	24.0	57-65	79.8
Italy	46.9	48.7	*	39.0	49.8				73.8
Latvia	51.0	50.0	*	57.0					
Lithuania	50.0	57.6	*	38.0		95.0	33.0	60-69	
Luxembourg	42.0	68.0	40.0						
Malta	40.0	*	*	51.0					102.7
Netherlands	40.0	82.8	39.7	38.0		71.0	35.0	66.7	84.9
Poland	35.0	58.1	*	36.0					55.0
Portugal	49.9	51.2	*	68.0	80.0				80.0
Romania	52.5	50.0	*	39.0					
Slovakia	45.0	60.0	*	42.0					65.0
Slovenia	40.1	42.3	*	38.0					78.0
Spain	45.0	52.6	*	51.0	52.5				61.1
Sweden	39.0	41.7	*	61.0	63.0	63.0	22-34	47.0	63.0
United Kingdom	49.0	55.3	*	53.0					92.0
Belarus	45.0	36.4	*						
Croatia	45.0	50.0	50.0						
Norway	38.0	35.0	26.5						60.0
Russia	40.0	59.1	*						
Switzerland	36.0	80.0	33.4						80.0
Turkey	45.0	45.1	*						
Ukraine	45.0	68.4	29.7						

Table 71. Other cattle part II.

Country	Gothenborg																		
	Other cattle 0.5 - 1 yr male	Other cattle 0.5 - 1 yr female	Other cattle < 1 yr	Other cattle < 1 yr replacement	Other cattle 1 - 2 yr	Other cattle 1 - 2 yr replacement	Other cattle > 1 yr male	Other cattle > 1 yr female	Other cattle > 2 yr	Other cattle > 3 yr	Heifers	Suckler cows	Calves	Calves white meat	Calves pink meat	Bulls, meat	Bulls, beef > 1 yr	Buffalo	Deer	Reindeer
Austria			25.7		53.6				68.4			74.0							13.1	
Belgium																				
Walloon	37.5	30.8					84.4	58.9				97.8	13.4				97.8			
Flanders			23.0	33.0	61.0	56.0			77.0			97.0	10.5							
Bulgaria																				
Cyprus																				
Czech Republic																				
Denmark																			16	
Estonia																				
Finland											50.3	63.9	37.6			66.4				10.7
France																				
Germany																				
Greece																		82		
Hungary																				
Ireland																				
Italy																				
Latvia																		91.05		
Lithuania																				
Luxembourg																				
Malta																				
Netherlands	33.2	36.0	26.8				83.4	73.2			26.8	83.3		12.4	28.2		53.8			
Poland																				
Portugal			25.0		40.0				41.0											
Romania																				
Slovakia																				
Slovenia																				
Spain																				
Sweden					47.0								28.0							
United Kingdom																				
Belarus																				
Croatia																				
Norway	24.0		29.0				35.0	35.0											12	6
Russia																				
Switzerland			25.0		40.0					55.0		80.0	13.0			33.0				
Turkey																				
Ukraine																				

Table 72. Other cattle part III.

Comparison N excretion different sources: other cattle																	
Country	Eurostat/OECD																
	Bovine Animals < 1 year	Calves for Slaughter	Other Calves	Male calves	Female calves	Bovine Animals 1-2 years	Male Cattle 1-2 years	Female Cattle 1-2 years (heifers)	Female Cattle 1-2 years (heifers) - of which for slaughter	Female Cattle 1-2 years (heifers) - Other	Bovine > 2 years	Male Cattle > 2 years	Female Cattle > 2 years	Heifers	Heifers for Slaughter	Other heifers	Buffaloes
Austria		14.9	27.7			53.6						64.4			69.1		
Belgium		10.6		20.3	26.8		56.7	53.4				77.3			77.1		
Walloon		10.5		22.3	33.0		58.0	58.0				77.0			77.0		
Flanders		14.2		18.7	21.5		55.5	47.6				77.7			77.7		
Bulgaria																	50.0
Cyprus		19.4	18.6				37.2	42.2				47.8			47.2	41.8	94.8
Czech Republic		20.2	20.2				48.7	48.7				59.7					
Denmark		34.9	32.6				53.8	51.7				56.8			62.3		
Estonia	11.3	11.3	11.3	11.3	11.3	24.0	24.0	24.0				45.5	45.5		45.5		
Finland	38.3						66.9	52.8				66.9			52.8		
France																	
Germany	15.6	15.6		15.6	15.6		41.0	51.0	51.0	51.0		51.0			51.0		
Greece																	
Hungary	25.0	12.0			22.0	45.0		42.0				65.4		51.0			65.4
Ireland	27.6					63.4						74.4		74.4			
Italy		13.8	15.5				43.2	42.0				50.2			55.2	55.2	94.8
Latvia																	
Lithuania																	
Luxembourg																	
Malta	9.9	9.9	9.9	9.9	9.9		28.3	28.3	28.3	28.3		28.3	28.3	28.3	28.3	28.3	
Netherlands		15.7							74.5	74.8					74.5	74.8	
Poland	18.0					36.0								40.0			
Portugal		25.0	25.0				40.0	40.0				41.0			55.0		
Romania																	50.0
Slovakia	21.0		21.0				50.0	45.0				60.0		55.0		55.0	
Slovenia	35.0					35.0											
Spain	27.2	28.9	24.5	30.9	21.1	53.6	37.3	58.5	57.4	58.7	73.0	72.1		61.0	50.6		
Sweden	20.0	30.0	26.0				53.5	47.0				57.0			47.0	47.0	
United Kingdom				31.0	32.0		56.0	60.4				55.4		63.3			
Belarus																	
Croatia																	
Norway	28.0						39.6	39.6				40.0		40.0			
Russia																	
Switzerland		13.0		25.0	25.0		40.0	40.0				50.0			33.0		34.4
Turkey																	
Ukraine																	

Table 73. Pigs part I.

Country	GAINS	NIR 2011	CAPRI	Nitrates Directive			Gothenborg															
	Pigs	Pigs	Pigs	Sows	Fattening pigs	Boars	Pigs	Fattening pigs	Fattening pigs 20 - 110 kg	Fattening pigs > 110 kg	Fattening pigs 20-50 kg	Fattening pigs >50 kg	Sows	Sows incl. piglets	Sows, breeding	Sows, pregnant	Weaned pigs	Boars	Piglets < 20 kg	Piglets 7 - 20 kg	Piglets < 25 kg	Piglets 20-50 kg	Other pigs
Austria	9.0	9.6	17.3					10.3							29.1								
Belgium	11.1	10.1	18.4																				
Walloon											16.1		37.5					42.9		4.7		10.4	
Flanders				24.0	13-24	24.0			11.4	21.4				21.5				21.5		2.5			
Bulgaria	12.4	20.0	21.6																				
Cyprus	12.4	*	21.5																				
Czech Republic	12.4	20.0	19.8																				
Denmark	9.6	8.4	22.8				7.9																
Estonia	12.4	12.9	18.1																				
Finland	10.1	*	12.3					8.9						28.5			2.8	19.7					
France	12.2	16.5	16.6																				
Germany	14.8	12.1	18.4	24.7-34.9	11.9-13.6		12.1	12.6					27.9				3.1	27.8					
Greece	11.5	16.0	16.1																				
Hungary	8.9	8.1	26.9																				
Ireland	12.4	8.5	15.2	35.0	9.2																		
Italy	11.5	11.8	20.0										28.1										12.8
Latvia	10.0	10.0	24.4																				
Lithuania	12.4	12.3	17.5	28-43	5.4-6.2	28.4																	
Luxembourg	9.9	11.9																					
Malta	12.4	*	24.1																				
Netherlands	9.2	8.9	15.8	15.8-21.6	8.9	17.4		12.2					30.2		15.4			23.9					
Poland	11.1	13.6	16.6																				
Portugal	9.1	9.5	19.9								7.0	13.0			20.0	42.0		18.0					
Romania	12.4	20.0	18.8																				
Slovakia	12.4	15.8	18.0																				
Slovenia	11.9	11.9	15.0																				
Spain	9.4	9.4	17.5	11.5	9.8 - 11.5	24.4		7.5					22.2										
Sweden	11.0	9.1	21.3	36.0	11.0			10.8					34.0					34.0					
United Kingdom	12.4	10.6	17.6																				
Belarus	12.4	10.0																					
Croatia	12.4	20.0																					
Norway	10.7	6.4					4.4						18.3										
Russia	12.4	21.9																					
Switzerland	11.7	9.2						13.0					42.0					20.0			4.6		
Turkey	12.4	6.8																					
Ukraine	12.4	12.7																					

Table 74. Pigs part II.

Comparison N excretion different sources: pigs										
Country	Eurostat/OECD									
	Piglets < 20 kg live weight	Pigs 20 - 50 kg live weight	Fattening Pigs > 50 kg live weight	Fattening pigs between 50 and < 80 kg	Fattening pigs between 80 and < 110 kg	Fattening pigs of at least 110 kg	Breeding Pigs > 50 kg live weight	Boars	Sows	Covered sows
Austria	3.6	10.3	10.3					23.9	20.6	
Belgium	2.4	11.3		11.3	11.3	19.9				20.9
Walloon	2.3	11.2		11.2	11.2	19.8				20.9
Flanders	3.6	12.8		12.8	12.8	21.4				21.4
Bulgaria										
Cyprus	2.9	7.6	11.4					21.5	25.0	
Czech Republic	3.5	9.3	11.0					18.0	20.9	
Denmark	1.8	5.6	14.6					20.6	23.1	
Estonia	0.8	0.8		4.0	4.0	4.0		30.4	30.4	30.4
Finland	1.1	9.0	17.6					20.3	29.3	
France										
Germany	3.4	10.2	12.0	12.0	12.0	12.0		22.1	25.5	25.5
Greece										
Hungary			12.0				26.5			
Ireland	4.0							21.0	26.0	
Italy	3.0	8.3	9.7					18.7	23.5	
Latvia										
Lithuania										
Luxembourg										
Malta	3.3	6.7	11.7	11.7	11.7	11.7	28.3	28.3	28.3	28.3
Netherlands			12.9							30.8
Poland	2.5	9.0	12.0					15.0	14.0	
Portugal		7.0	13.0					18.0		20.0
Romania										
Slovakia	3.2	9.0	15.0					20.0	22.0	
Slovenia		14.0	14.0						36.0	
Spain	2.4	8.5	11.2	10.3	11.4	14.5	23.1	20.9	23.1	
Sweden	2.0	9.8	13.4					17.0		27.0
United Kingdom	1.8	12.5		12.5	17.4	17.4		25.0		21.2
Belarus										
Croatia										
Norway	0.4							16.0	22.1	
Russia										
Switzerland			13.0					18.0		35.0
Turkey										
Ukraine										

Table 75. poultry I

Country	GAINS	GAINS	NIR 2011	CAPRI	Nitrates Directive			
	Laying hens	Other poultry	Poultry	Poultry	Laying hens	Broilers	Turkey	Duck
Austria	0.7	0.8	0.5	0.5				
Belgium	0.7	0.5	0.6	0.4				
Walloon								
Flanders					0.69	0.62	2.20	
Bulgaria	0.8	0.7	0.6	0.7				
Cyprus	0.8	0.7	*	0.6				
Czech Republic	0.8	0.6	0.6	0.6				
Denmark	0.7	0.5	0.5	0.8				
Estonia	0.8	0.5	0.6	0.6				
Finland	0.8	0.4	0.6	0.4				
France	0.8	0.9	0.6	0.6				
Germany	0.8	0.6	0.8	0.5	0.75-0.79	0.31-0.47	1.5-2.1	1.40
Greece	0.8	0.7	0.6	0.5				
Hungary	1.5	1.5	0.6	0.7				
Ireland	0.8	0.5	0.3	0.5	0.56	0.24	1.00	
Italy	0.7	0.5	0.5	0.5				
Latvia	0.9	0.9	0.6	0.8				
Lithuania	0.8	0.5	0.6	0.6	0.8-0.87	0.12	0.69	0.18
Luxembourg	0.8	0.7	0.7					
Malta	0.8	0.7	*	0.6				
Netherlands	0.7	0.6	0.7	0.5	0.37	0.36	1-1.5	0.63
Poland	0.7	0.6	0.3	0.6				
Portugal	0.6	0.9	0.6	0.6				
Romania	0.8	0.6	0.6	0.6				
Slovakia	0.8	0.7	0.7	0.6				
Slovenia	0.7	0.5	0.6	0.4				
Spain	0.8	0.7	0.5	0.6	0.80	0.60	0.80	0.40
Sweden	0.6	0.3	0.4	0.7	0.60	0.28		
United Kingdom	0.9	0.7	0.6	0.6				
Belarus	0.8	0.7	0.6					
Croatia	0.8	0.7	0.6					
Norway	0.7	0.5	0.2					
Russia	0.8	0.7	0.8					
Switzerland	0.7	0.4	0.5					
Turkey	0.8	0.7	*					
Ukraine	0.8	0.7	*					

Table 76. poultry II

Country	Gothenborg																Eurostat/OECD						
	Laying hens	Laying hens, breeding	Laying hens < 18 wk	Laying hens > 18 wk	Broilers	Broilers, fattening	Broilers, parent animals , < 18 wk	Broilers, parent animals , > 18 wk	Turkey	Turkey, female	Turkey, male	Turkey, slaughter	Geese	Ostriches	Ducks	Pheasant	Other poultry then laying hens	Broilers	Layers	Other Poultry	Ducks	Turkeys	Geese	Ostriches
Austria	0.5																1.1	0.28	0.72		0.48	1.18		
Belgium																		0.55				1.70		
Walloon	0.8				0.4												0.6	0.54				1.70		
Flanders	0.7	0.4				0.6			2.01					10.61				0.60				2.20		
Bulgaria																								
Cyprus																		0.32	0.63	0.51				
Czech Republic																		0.35	0.60		0.70	1.20		
Denmark	0.8													15.6		0.04		0.63	1.11		1.51	2.58		
Estonia																		0.23	0.78	0.78				
Finland	0.7				0.4				1.371									0.48	0.64			1.50		
France																								
Germany	0.8		0.3		0.5				1.96	1.7	2.18		0.55		0.528			0.37	0.78		0.59	1.84	0.55	
Greece																								
Hungary																		0.38	0.74		0.38	1.65		
Ireland																		0.60		1.50				
Italy																		0.38	0.66	0.55				
Latvia																								
Lithuania																								
Luxembourg																				1.10				
Malta																		0.04	0.57					
Netherlands			0.3	0.8	0.5		0.35	1.11	1.91						0.79			0.53			0.76	1.71		
Poland																		0.14	0.70		0.70	1.50	1.50	
Portugal	0.8	0.6			0.5				0.48				0.48		0.48			0.45	0.80	0.48				
Romania																								
Slovakia																		0.30	0.70		0.70	1.50		
Slovenia																		0.40	0.71		0.60	1.50	0.73	
Spain	0.5				0.4												0.587	0.42	0.49	0.49				
Sweden	0.6				0.3													0.28	0.73					
United Kingdom																		0.51	1.89		1.60	1.74	1.74	
Belarus																								
Croatia																								
Norway		0.1			0.1					2		0.34		12				0.05	0.70	0.50				
Russia																								
Switzerland	0.8				0.5		0.34		1.4									0.45	0.80		0.45	1.40	1.40	17.50
Turkey																								
Ukraine																								

Table 77. Horses

Country	GAINS	NIR 2011	Nitrates Directive		Gothenborg									Eurostat/OECD				
	Horses	Horses	Pony	Horses	Horses	Horses < 200 kg	Horses 200-600 kg	Horses > 600 kg	Horses, heavy	Horses < 3 yr	Horses > 3 yr	Ponies	Mules and asses	Horses	Foal < 1 year	Young horses 1-3 years	Horses > 3 years	Donkeys
Austria	47.9	47.9			47.9										12.7	44.6	52.6	
Belgium	50.0	58.4													54.0	54.0	65.3	50.7
Walloon															47.3	47.3	65.0	35.0
Flanders				35 - 65		35.0	50.0	65.0							65.7	65.7	65.7	65.7
Bulgaria	50.0	25.0												25.0				42.5
Cyprus	50.0	*																
Czech Republic	50.0	25.0												60.0				
Denmark	43.3	39.6			39.6									43.8				
Estonia	50.0	25.0												54.0				
Finland	50.0	61.2			60.9							43.5		58.7				
France	50.0	25.0												25.0				25.0
Germany	47.9	49.0	32-42	45 - 64	49.0	33.4			53.6			33.4	33.4	49.0				
Greece	50.0	40.0																
Hungary	50.0	60.0												55.0				25.0
Ireland	50.0	44.0	30.0	25-50										47.0				33.0
Italy	50.0	50.0			50.0								50.0	64.0				
Latvia	51.0	48.0												46.0				
Lithuania	50.0	25.0		39-100										25.0				
Luxembourg	50.0	62.9												62.9				
Malta	50.0	*																
Netherlands	50.0	49.2	17.4-29.7	36.6-47.6										58.4				32.0
Poland	50.0	28.0												50.0				
Portugal	39.4	44.0			44.0								22.0	44.0				22.0
Romania	40.0	25.0												25.0				25.0
Slovakia	50.0	25.0												60.0				
Slovenia	50.0	25.0												50.0				
Spain	50.0	40.0		6.4	40.0								40.0	28.0				28.0
Sweden	50.0	50.0	33.0	48-61	50.0									50.0				
United Kingdom	50.0	50.0												23.1				
Belarus	50.0	25.0																
Croatia	50.0	25.0																
Norway	50.0	50.0			50.0									52.8				
Russia	50.0	25.0																
Switzerland	44.0	43.7								42.0	44.0	15.7				42.0	44.0	15.7
Turkey	50.0	*																
Ukraine	50.0	25.0																

Table 78. Sheep and goat

Country	GAINS	NIR 2011	NIR 2011	CAPRI	Nitrates Directive		Gothenborg								Eurostat/OECD	
	Sheep and goats	Sheep	Goat	Sheep and goats	Sheep	Goat	Sheep	Ewe	Sheep, meat	Sheep, milk	Sheep < 1 yr	Lambs	Goat	Does	Sheep	Goats
Austria	13.0	13.1	12.3	5.2			13.1						12.3			13.1
Belgium	7.4	7.5	8.4	5.5											8.9	8.3
Walloon							8.8					4.4	8.8		10.2	9.2
Flanders					10.5	10.5	10.5					4.4	10.5		7.4	7.1
Bulgaria	12.0	14.7	17.0	9.5											14.7	17.0
Cyprus	12.0	*	*	9.2											9.5	11.2
Czech Republic	12.0	20.0	25.0	4.7											9.8	9.8
Denmark	17.0	15.3	16.4	8.8			17.0						16.3			
Estonia	14.0	16.0	25.0	6.5											14.0	14.0
Finland	16.0	10.0	10.7	4.0			10.0						10.7		10.0	10.7
France	12.0	18.3	25.0	7.7											18.3	25.0
Germany	7.5	7.4	11.0	5.0	18.1-18.6	14.8	7.8						11.0			14.8
Greece	12.0	10.7	12.0	7.9												
Hungary	12.0	20.0	18.0	7.9												14.6
Ireland	8.0	6.3	9.0	5.1	7-13	9.0									10.6	12.9
Italy	16.2	16.2	16.2	6.2			16.2						16.2		12.8	13.5
Latvia	7.0	13.0	13.0	10.8											6.0	6.0
Lithuania	12.0	16.0	16.0	6.7	12.0	10-12									16.0	16.0
Luxembourg	12.0	17.0	17.0												17.0	17.0
Malta	12.0	*	*	8.3											9.1	
Netherlands	11.5	6.7	9.9	4.8	7.4 - 10.2	3.1-5.8	14.1						17.5			
Poland	13.7	6.8	6.7	6.2											8.0	7.0
Portugal	7.0	7.1	6.0	8.4			6.6	9.2						7.0		
Romania	5.2	16.0	25.0	7.8											16.0	25.0
Slovakia	12.0	16.0	16.0	6.9												10.0
Slovenia	11.3	20.0	25.0	5.0											20.0	
Spain	12.0	5.2	11.3	6.8	10.0	8.8	5.1						11.3		6.6	9.0
Sweden	6.1	6.1	8.7	8.2	14.0		13.0								13.0	11.3
United Kingdom	6.4	5.2	20.6	6.7												
Belarus	12.0	16.0	25.0													
Croatia	12.0	16.0	25.0													
Norway	14.7	10.4	15.5				11.6				7.7		15.5		13.6	19.1
Russia	12.0	16.0	25.0													
Switzerland	8.2	8.5	10.2						15.0	21.0			16.0			
Turkey	12.0	13.5	16.5													
Ukraine	12.0	16.0	25.0													

Table 79. Fur animals

Country	GAINS	NIR 2011	Nitrates Directive	Gothenborg					Eurostat/OECD		
	Fur animals and rabbits	Fur animals and rabbits	Rabbit	Fur animals and rabbits	Rabbit	Mink and fitches	Foxes and racoon	Mink breeders	Rabbits	Fox	Mink
Austria	4.1										
Belgium	4.1								7.5		
Walloon									7.2		
Flanders			8.6		8.6				8.8		
Bulgaria	1.5										
Cyprus	4.1								5.0		
Czech Republic	1.5										
Denmark	4.6			5.3						12.6	5.0
Estonia	4.1										
Finland	1.9					1.3	2.3				
France	4.1									3.0	1.3
Germany	4.1		2.7-9.7								
Greece	4.1										
Hungary	4.1								5.5		
Ireland	4.1								1.0		
Italy	4.1			1.0							
Latvia	4.1										
Lithuania	4.1		2.5						8.1		
Luxembourg	4.1										
Malta	0.7										
Netherlands	2.2		0.5-1.53		7.7	2.2			7.9		2.4
Poland	4.1										
Portugal	0.7				9.0				9.0		
Romania	4.1										
Slovakia	4.1										
Slovenia	4.1										
Spain	1.5										
Sweden	4.1							4.1			
United Kingdom	4.1										
Belarus	1.5	4.6									
Croatia	4.1										
Norway	4.1	5.8					9	4.3			
Russia	4.1	4 -12									
Switzerland	4.1								9.0		
Turkey	1.5										
Ukraine	1.5	8.3									

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