LITHUANIA'S INFORMATIVE INVENTORY REPORT 2023

Air Pollutant Emissions 1990-2021

under the UNECE CLRTAP and the EU NECD

Part 5 – AGRICULTURE

Lithuanian Environmental Protection Agency

Contents

1. MANURE RELATED AGRICULTURE ACTIVITIES

In Lithuania this group of NFR sectors, covers the folowing activities:

- Manure management of dairy cattle, non-dairy cattle, sheep, swine, goats, horses, laying hens, broilers, turkeys, ducks, geese, other poultry and fur animals;
- Animal manure applied to soils;
- Urine and dung deposited by grazing animals.

Activity data

Annual average livestock population numbers were derived from the Statistics Lithuania data on livestock numbers at January 1st: annual average population number in n-th year =(livestock number at January 1st of n-th year+ livestock number at January 1st of (n+1)-th year)/2. The same data are used in the GHG inventory of Lithuania.

Methodological issues

NOx and NH3 emissions were calculated by the Tier2 method using N-flow tool provided by the European Environment Agency. Please refer to the attached Annex "NIIR agriculture Annex I LT N-flow tool Manure Management 1990-2021.xlsx" for more details. NMVOC and PM emissions were estimated using the Tier 1 methodology (Emission factors in Table 3.4 and Table 3.5 provided in the EMEP/EEA air pollutant emission inventory Guidebook 2019, chapter 3.B Manure management). Emissions of NMVOC were calculated using EF with silage feeding for housed period and EF without silage feeding for grazing period. For calculation of PM emissions, only housed period was taken into account.

Parameters (length of housed period; amount of nitrogen (N) excreted in grazing, yards, housing; fraction of TAN deposited in housing as slurry; mass of straw; N added in straw) were derived / taken from data used in GHG inventory and can be found in the attached Annex "NIIR Agriculture Annex II".

Note regarding TERT recommendations

The answer to the TERT recommendation that Lithuania clearly explain the reasons behind pollutant emission time series variability which occured in this group of NFR sectors is as follows: in the 2022 submission only values for years 2005, 2019, 2020 were renewed / calculated based on the latest GHG data version that was available in February 2022.

Emissions

Manure related agriculture activities was and remains the biggest source of ammonia (NH3) anthropogenic emissions, but contribution of them in the national total has dropped from 91% in 1993 to 64% in 2021.

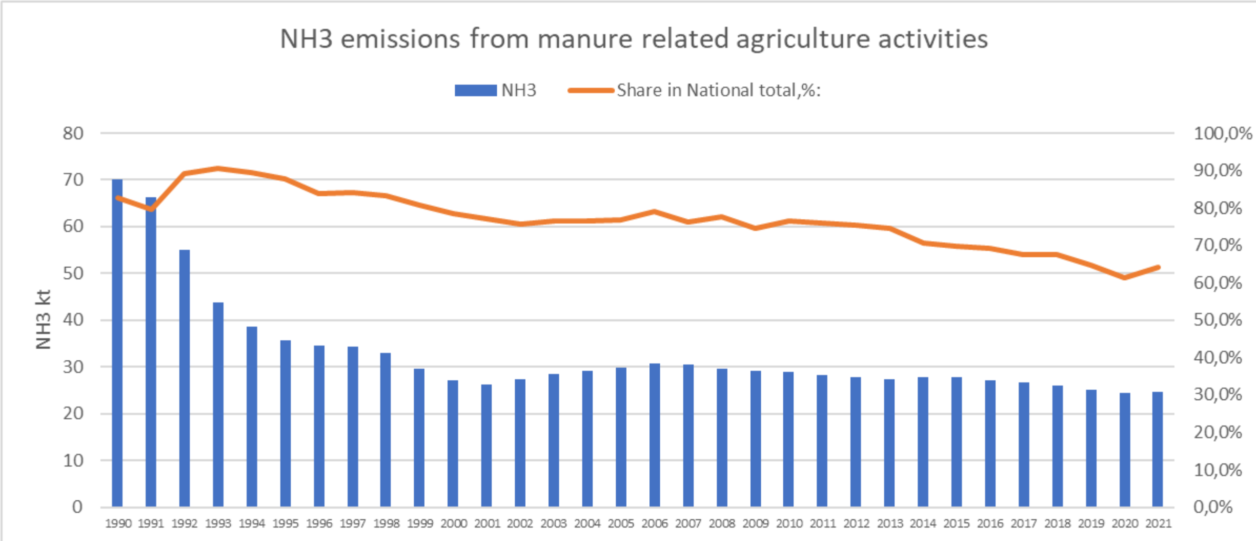


Figure 1. Ammonia emissions from manure related activities

NH3 emissions in this group of agriculture activities in 2021 decreased by 17,8% as compared with 2005.

1.1. Manure management - Dairy cattle (3.B. 1.a)

1.1.1. Parameters

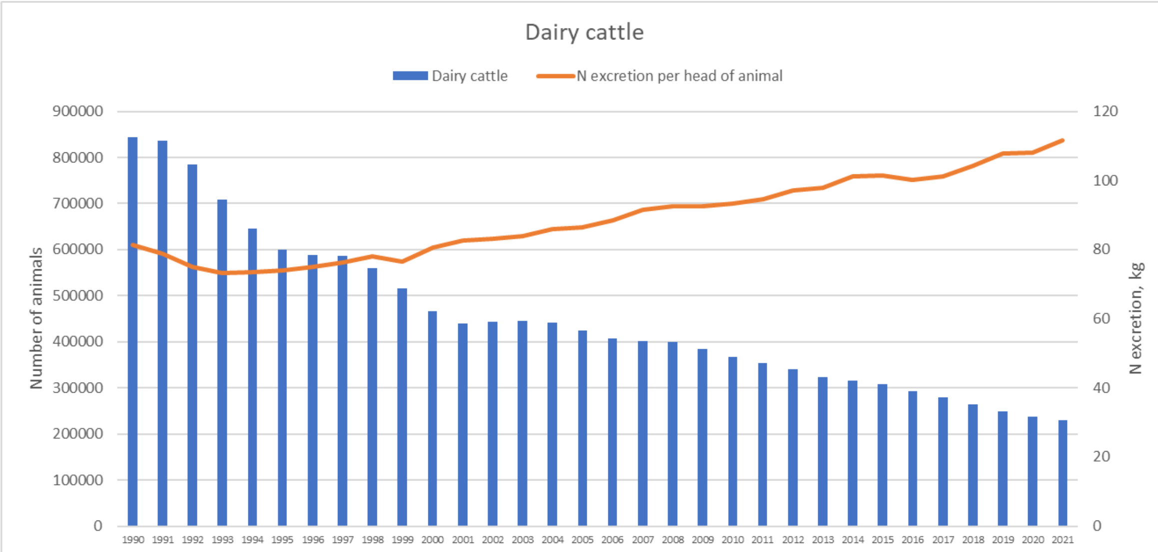


Figure 2. Dairy cattle: number of livestock and N excretion per head of animal

Number of dairy cattle in 2021 dropped by 72,9% in comparison with 1990 and by 46,1% in comparison with 2005, but amount of N excretion per head of animal in 2021 as compared with 1990 and 2005 increased by 37,5% and 29,2% correspondingly.

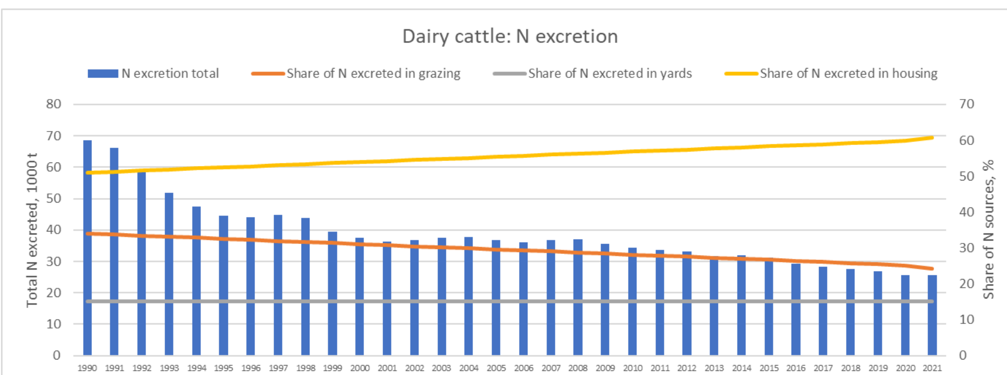


Figure 3. Dairy cattle: N excretion

Share of N excreted in housing was increasing during period 1990-2021. The length of housing (days/yr) was increasing too: from 219 in 1990 to 238 in 2005 and to 261 in 2021.

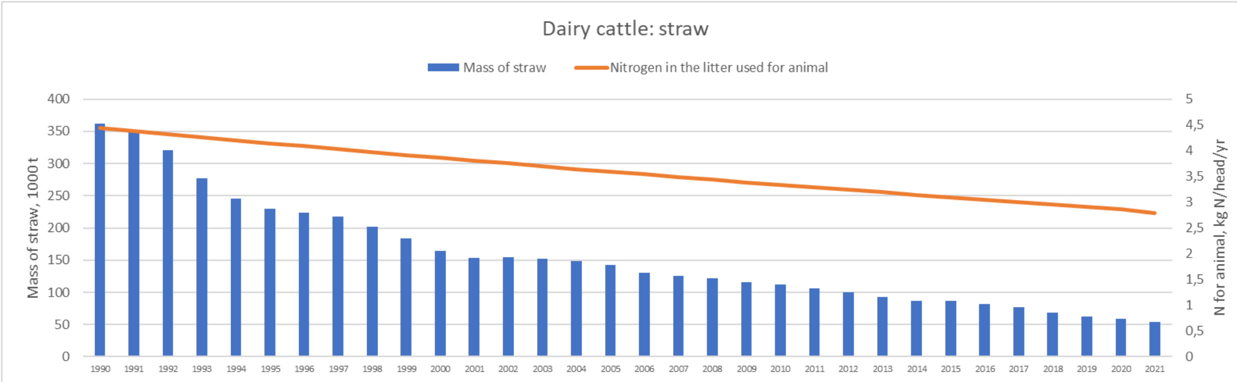


Figure 4. Dairy cattle: straw

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Proportion_tied_housing_Dairy cattle		0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Source:		LT national agriculture surveys											
Proportion_with_natural_crust_Dairy cattle		0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
Proportion_without_natural_crust_Dairy cattle		0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Source:		LEPA Expert judgement											

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	219	225	232	238	244	250	252	253	254	256	257	261
Source:		GHG inventory data											
Proportion of N excreted as TAN	Fraction	0,6	0,6	0,6	0,63	0,63	0,63	0,63	0,63	0,63	0,63	0,63	0,63
Source:		Default			LT national EF research 2018-2019								
Fraction of TAN deposited in housing as slurry	Fraction	0,12	0,16	0,19	0,23	0,27	0,30	0,31	0,32	0,33	0,33	0,34	0,36
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											

Figure 5. Other parameters used for dairy cattle emission calculation

Dairy cattle manure was not used for biogas production.

Emissions

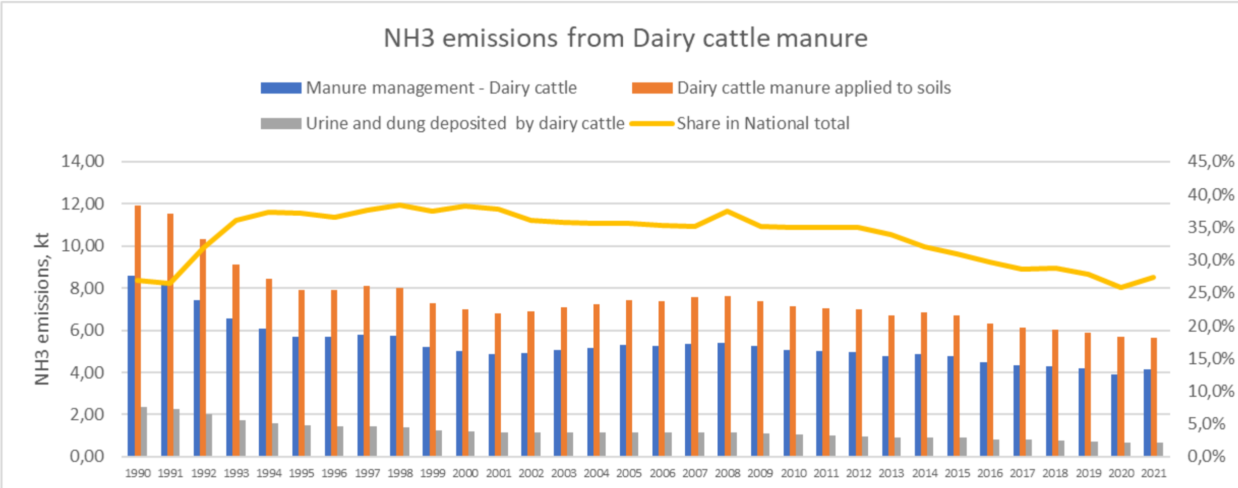


Figure 6. NH3 emissions from Dairy cattle manure

From NH3 emissions in 3B1a calculated by N-flow tool, effect of the measures foreseen in the National Air Pollution Control Plan (version 2019) was subtracted: 137 tonnes in 2020, 142 tonnes in 2021. This effect was evaluated by the method provided by the producer of the Plan. NH3 emissions from dairy cattle manure amounted to 10,46 kt (27,3% of national ammonia emissions), 24,7% decrease since 2005.

Pollutant	*Pollution source*	*Unit*	*1990*	*1995*	*2000*	*2005*	*2010*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2021 vs 2005,%*	*2021 vs 1990,%*
NH3	3B1a (Manure management - Dairy cattle)	Gg	8,565	5,700	4,993	5,289	5,083	4,753	4,507	4,358	4,286	4,191	3,892	4,138	-21,8%	-51,7%
NH3	Dairy cattle manure applied to soils	Gg	11,943	7,935	6,989	7,429	7,151	6,690	6,337	6,126	6,032	5,903	5,670	5,653	-23,9%	-52,7%
NH3	Urine and dung deposited by dairy cattle	Gg	2,381	1,475	1,192	1,166	1,033	0,890	0,830	0,790	0,763	0,733	0,688	0,664	-43,1%	-72,1%
NO2	3B1a	Gg	0,240	0,153	0,130	0,134	0,124	0,111	0,104	0,100	0,098	0,095	0,090	0,090	-32,7%	-62,4%
NMVOC	3B1a	Gg	11,812	8,497	6,679	6,163	5,384	4,558	4,358	4,162	3,950	3,720	3,558	3,463	-43,8%	-70,7%
TSP	3B1a	Gg	0,700	0,511	0,408	0,382	0,339	0,291	0,279	0,267	0,254	0,240	0,228	0,224	-41,5%	-68,0%
PM10	3B1a	Gg	0,319	0,233	0,186	0,175	0,155	0,133	0,127	0,122	0,116	0,110	0,104	0,102	-41,5%	-68,0%
PM2.5	3B1a	Gg	0,208	0,152	0,121	0,114	0,101	0,086	0,083	0,079	0,076	0,071	0,068	0,066	-41,5%	-68,0%

Figure 7. Trend of all pollutants in 3B1a

PM2.5 emission were evaluated taking into account effect of the measures foreseen in the National Air Pollution Control Plan (version 2019): 0,685 tonne in 2020; 0,671 in 2021.

1.2. Manure management – Non-dairy cattle (3.B. 1.b)

Parameters

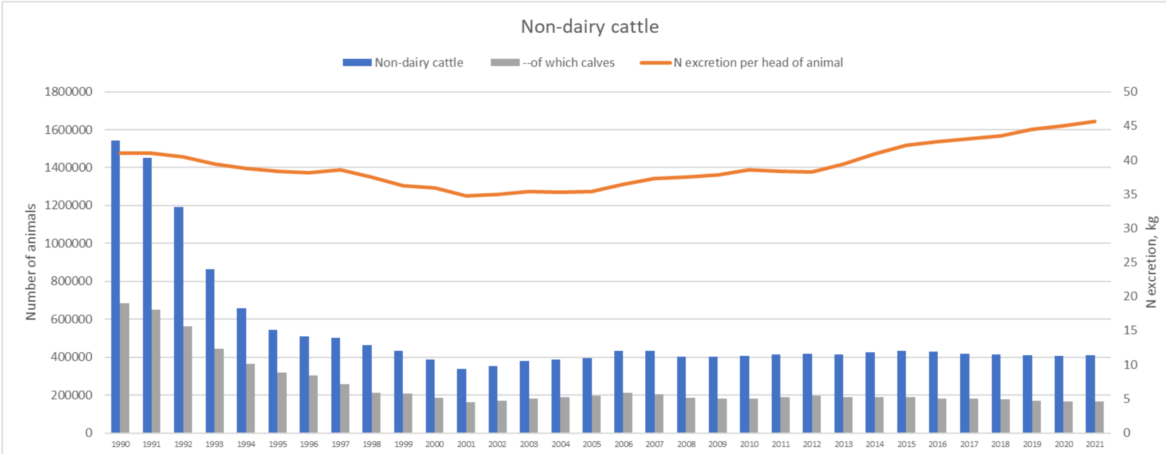


Figure 8. Non-dairy cattle: number of livestock and N excretion per head of animal

Number of non -dairy cattle in 2021 dropped by 73% in comparison with 1990 but increased by 4% in comparison with 2005. Amount of N excretion per head of animal in 2021 as compared with 1990 and 2005 increased by 11% and 29% correspondingly.

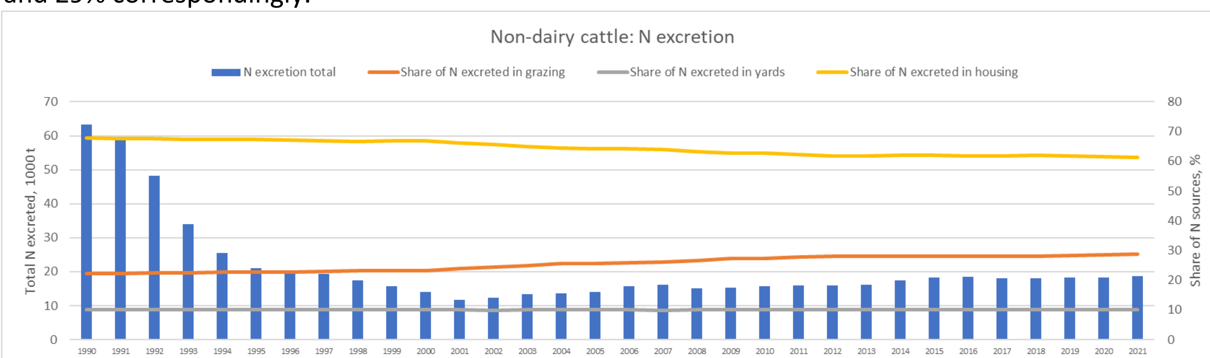


Figure 9. Non-dairy cattle: N excretion

Share of N excreted in grazing was increasing during period 1990-2021. The length of housing (days/yr) was declining: from 275 in 1990 to 261 in 2005 and to 248 in 2021.

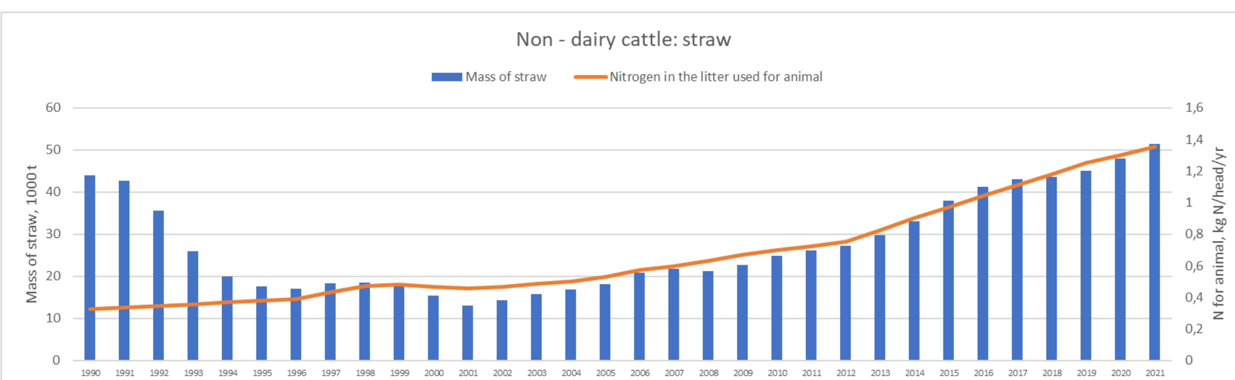


Figure 10. Non-dairy cattle: straw

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	275	273	271	261	254	251	251	251	251	250	249	248
Source:		GHG inventory data											
Proportion of N excreted as TAN		0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
Source:		Default											
Fraction of TAN deposited in housing as slurry		0,20	0,23	0,25	0,28	0,30	0,31	0,31	0,31	0,31	0,31	0,32	0,32
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											
Proportion_with_natural_crust_non dairy cattle		0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
Proportion_without_natural_crust_non dairy cat		0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
Source:		LT Expert judgement											

Figure 11. Other parameters used for non-dairy cattle emission calculation

Non-dairy cattle manure was not used for biogas production.

Emissions

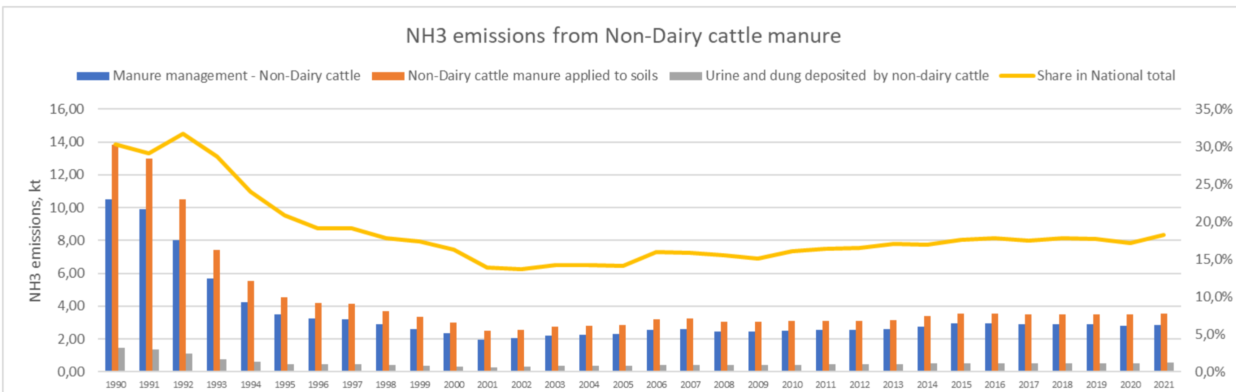


Figure 12. NH3 emissions from Non-dairy cattle manure

From NH3 emissions in 3B1b calculated by N-flow tool, effect of the measures foreseen in the National Air Pollution Control Plan (version 2019) was subtracted: 93 tonnes in 2020, 95 tonnes in 2021. This effect was evaluated by the method provided by the producer of the Plan. NH3 emissions from non-dairy cattle manure amounted to 6,98 kt in 2021 (18,2% of national ammonia emissions), 26,6% increase since 2005.

Pollutant	*Pollution source*	*Unit*	*1990*	*1995*	*2000*	*2005*	*2010*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2021 vs 2005,%*	*2021 vs 1990,%*
NH3	3B1b (Manure management - Non-Dairy cattle)	Gg	10,500	3,490	2,327	2,286	2,525	2,924	2,930	2,882	2,876	2,889	2,815	2,868	25,5%	-72,7%
NH3	Non-Dairy cattle manure applied to soils	Gg	13,817	4,530	2,975	2,858	3,105	3,553	3,550	3,484	3,475	3,484	3,496	3,556	24,4%	-74,3%
NH3	Urine and dung deposited by non-dairy cattle	Gg	1,435	0,485	0,330	0,367	0,437	0,523	0,528	0,519	0,517	0,525	0,536	0,552	50,5%	-61,5%
NO2	3B1b	Gg	0,307	0,097	0,062	0,057	0,060	0,067	0,067	0,065	0,065	0,065	0,065	0,066	15,3%	-78,5%
NMVOC	3B1b	Gg	10,324	3,631	2,570	2,512	2,519	2,660	2,633	2,568	2,537	2,495	2,453	2,467	-1,8%	-76,1%
TSP	3B1b	Gg	0,523	0,198	0,133	0,131	0,128	0,134	0,132	0,129	0,127	0,124	0,122	0,122	-6,3%	-76,6%
PM10	3B1b	Gg	0,257	0,084	0,063	0,061	0,063	0,066	0,066	0,064	0,064	0,063	0,062	0,062	2,5%	-75,7%
PM2.5	3B1b	Gg	0,168	0,054	0,041	0,040	0,041	0,043	0,043	0,042	0,042	0,041	0,041	0,041	3,0%	-75,6%

Figure 13. Trend of all pollutants in 3B1b

PM2.5 emission were evaluated taking into account effect of the measures foreseen in the National Air Pollution Control Plan (version 2019): 0,409 tonne in 2020; 0,413 in 2021.

1.3. Manure management – Swine (3.B. 3)

Parameters

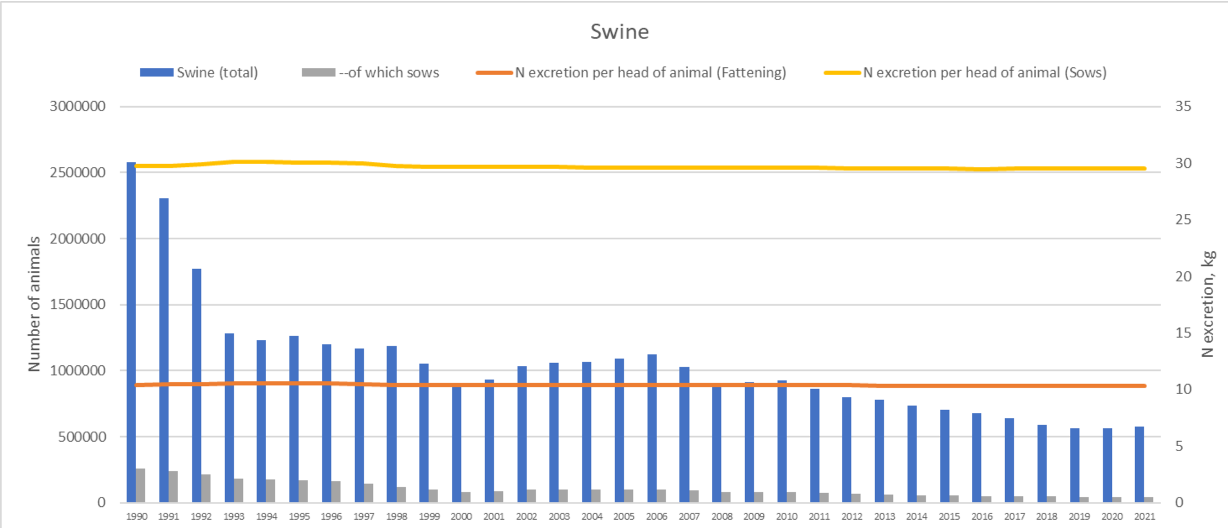


Figure 14. Swine: number of livestock and N excretion per head of animal

Number of swines in 2021 dropped by 77,6% in comparison with 1990 and by 47,2% in comparison with 2005. Amount of N excretion per head of animal was stable in the period 1990-2021.

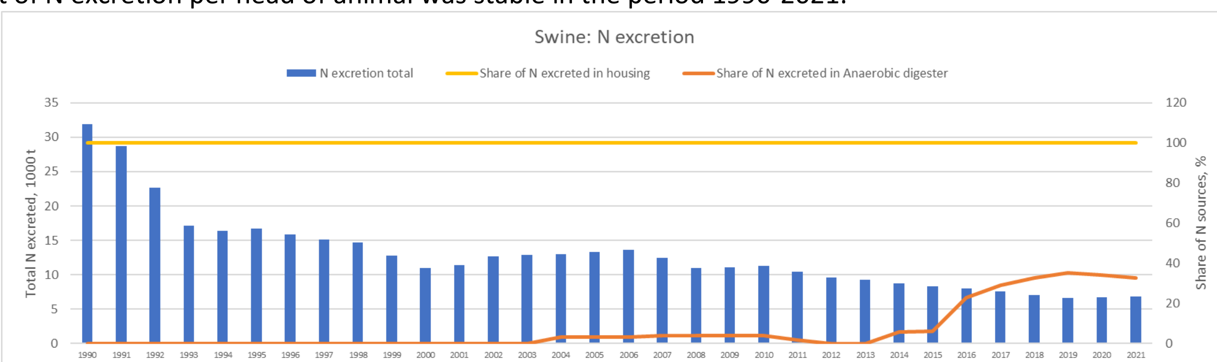


Figure 15. Swine: N excretion

All Nitrogen was excreted in housing.

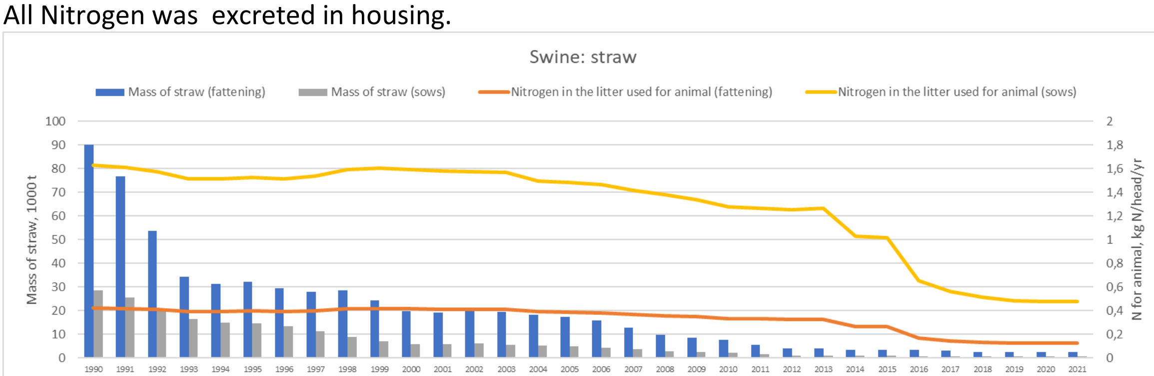


Figure 16. Swine: N in straw

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	365	365	365	365	365	365	365	365	365	365	365	365
Source:		GHG inventory data											
Proportion of N excreted as TAN		0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7
Source:		Default											
Fraction of TAN deposited in housing as slurry		0,16	0,32	0,48	0,63	0,78	0,84	0,76	0,74	0,72	0,72	0,73	0,74
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											

Figure 17. Other parameters used for swine emission calculation

Emissions

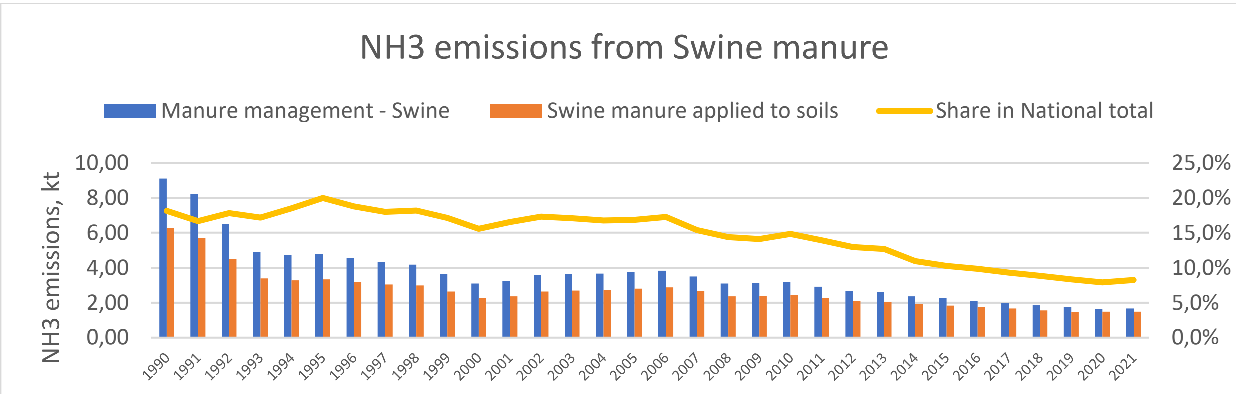


Figure 18. NH3 emissions from swine manure

From NH3 emissions in the 3B3 calculated by N-flow tool, effect of the measures foreseen in the National Air Pollution Control Plan (version 2019) was subtracted: 53 tonnes in 2020, 54 tonnes in 2021. This effect was evaluated by the method provided by the producer of the Plan. NH3 emissions from swine manure amounted to 3,15 kt in 2021 (8,2% of national ammonia emissions), 52% decrease since 2005.

Effect of biostabilizator Poliflock BTS applying in the large farms was accounted.

2014	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
73	70	130	136	134	117	175	208

Figure 19. Reduction of NH3 emissions by Poliflock BTS, tonnes

Pollutant	*Pollution source*	*Unit*	*1990*	*1995*	*2000*	*2005*	*2010*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2021 vs 2005,%*	*2021 vs 1990,%*
NH3	3B3 (Manure management - Swine)	Gg	9,107	4,793	3,105	3,752	3,173	2,260	2,110	1,988	1,850	1,760	1,660	1,667	-55,6%	-81,7%
NH3	Swine manure applied to soils	Gg	6,279	3,342	2,259	2,809	2,440	1,835	1,768	1,673	1,559	1,477	1,487	1,488	-47,0%	-76,3%
NO2	3B3	Gg	0,224	0,095	0,048	0,042	0,021	0,012	0,017	0,018	0,017	0,017	0,016	0,016	-61,7%	-92,8%
NMVOC	3B3	Gg	1,717	0,896	0,591	0,717	0,609	0,450	0,432	0,409	0,381	0,360	0,359	0,367	-48,8%	-78,6%
TSP	3B3	Gg	2,091	1,009	0,738	0,897	0,764	0,566	0,548	0,516	0,477	0,452	0,453	0,465	-48,2%	-77,8%
PM10	3B3	Gg	0,310	0,154	0,109	0,132	0,112	0,083	0,080	0,075	0,070	0,066	0,066	0,068	-48,5%	-78,1%
PM2.5	3B3	Gg	0,014	0,007	0,005	0,006	0,005	0,004	0,004	0,003	0,003	0,003	0,003	0,003	-48,8%	-78,3%

Figure 20. Emission of other pollutants from swine manure

Effect of the measures foreseen in the National Air Pollution Control Plan (version 2019) on PM2.5 emission was too small to be counted.

1.4. Manure management – Horses (3.B. 4.e)

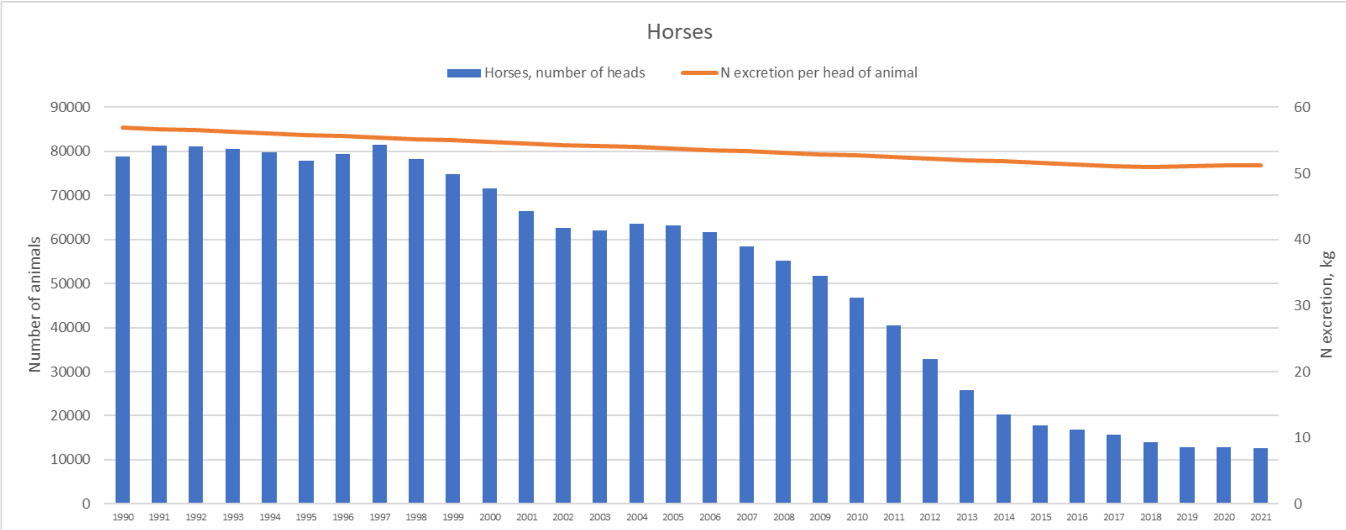
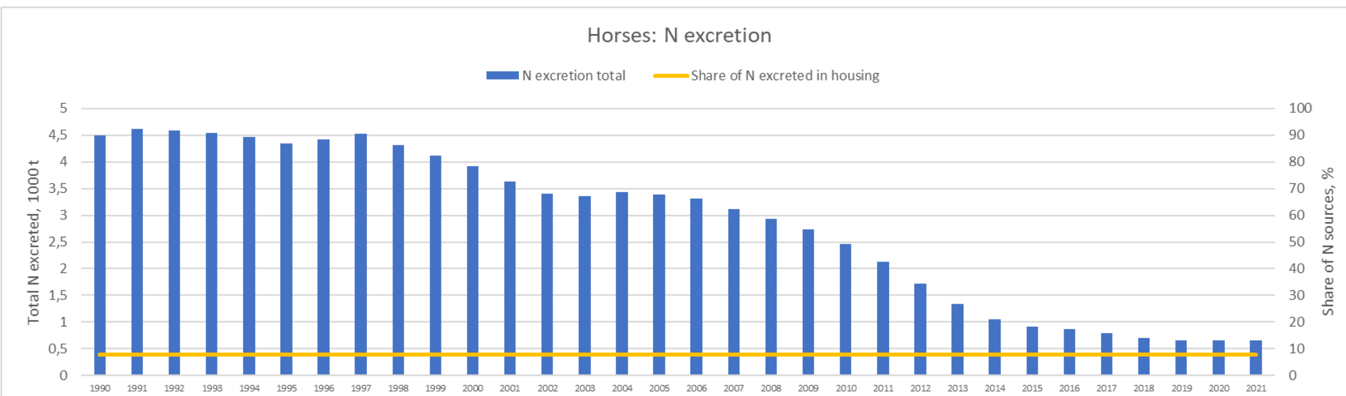


Figure 21. Horses: number of animals, N excretion per head of animal



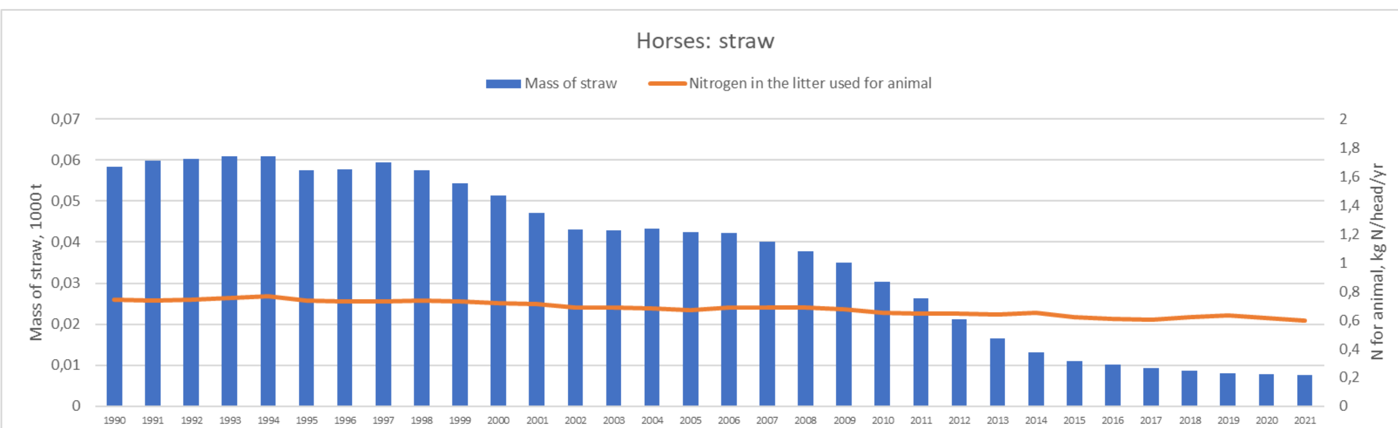


Figure 23. Horses: staw

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	29	29	29	29	29	29	29	29	29	29	29	29
Source:		GHG inventory data											
Proportion of N excreted as TAN		0,7	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
Source:		Default											
Fraction of TAN deposited in housing as slurry		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0	0	0	0	0	0	0	0	0	0	0	0
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											

Figure 24. Other parameters for emissions calculation

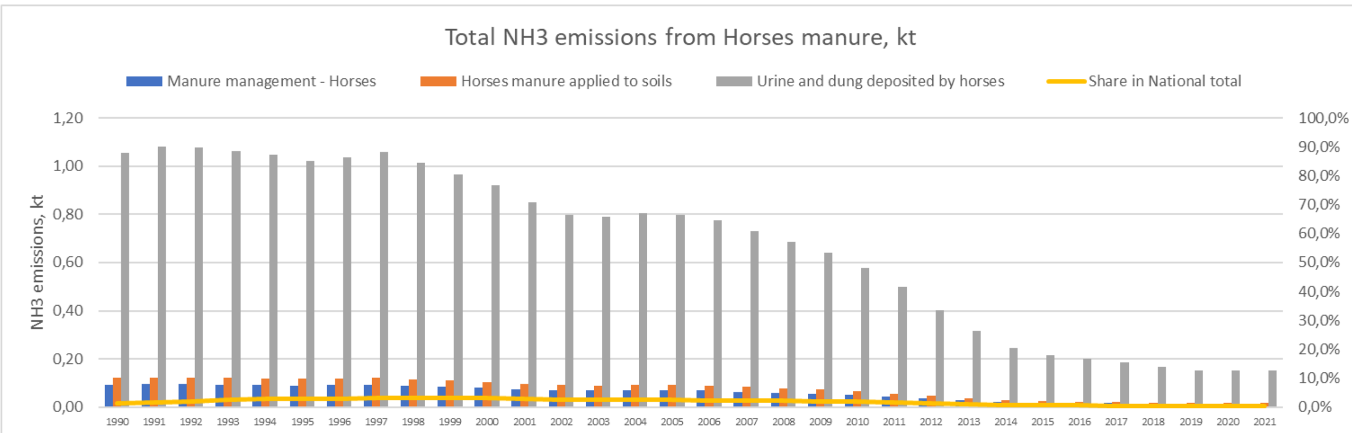


Figure 24. NH3 emissions

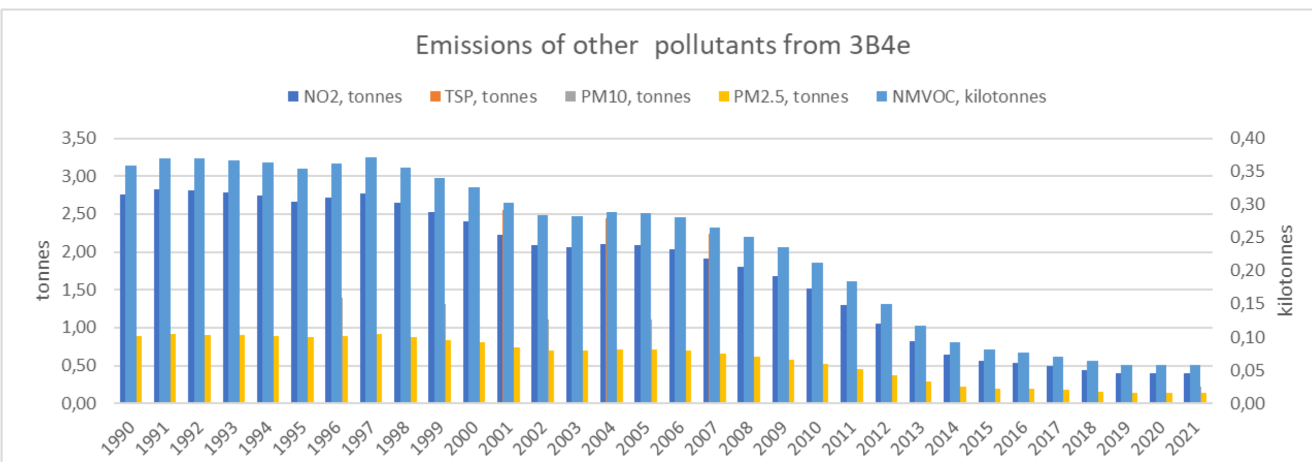


Figure 25. Emissions of other pollutants

1.5. Manure management – Sheep (3.B. 2)

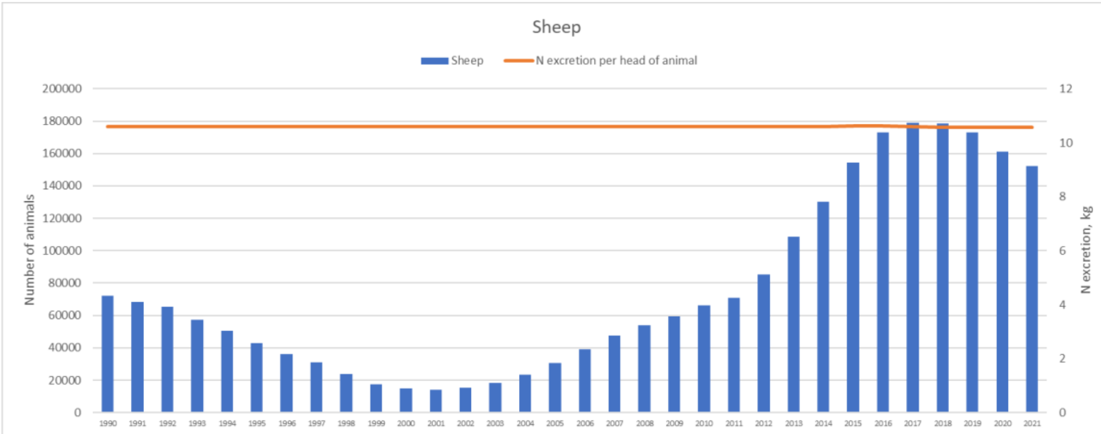
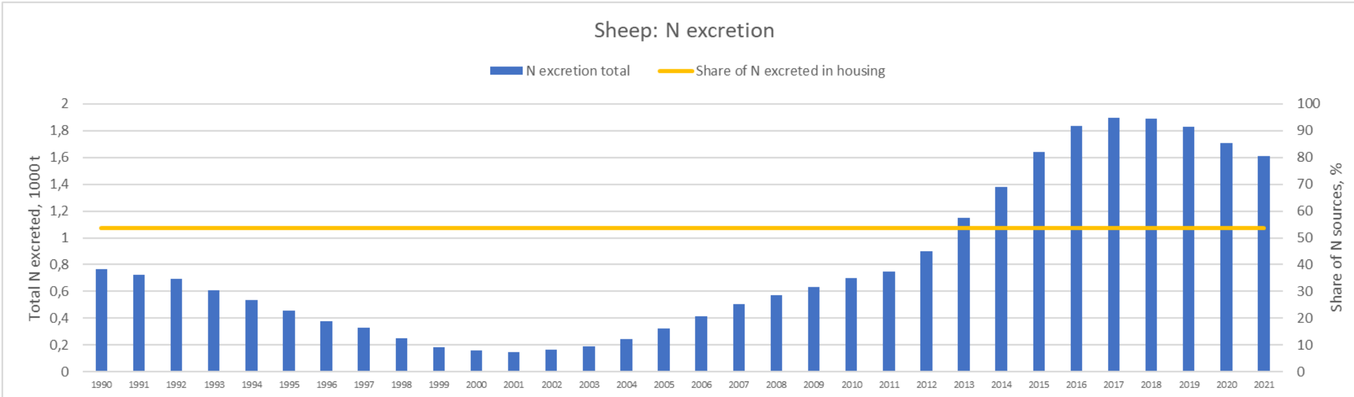


Figure 26. Sheep: number of animals, N excretion per head of animal



igure 27. Sheep: N excretion

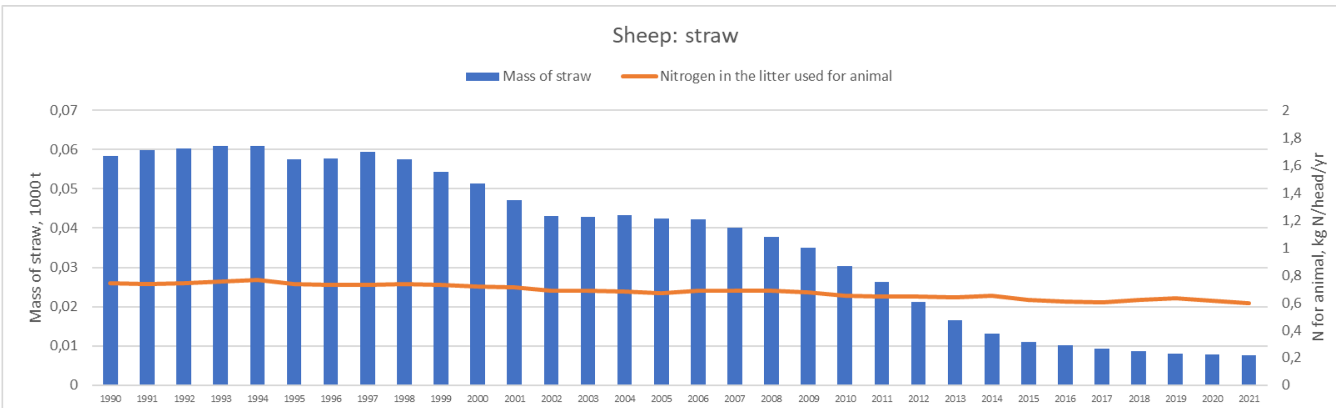


Figure 28. Sheep: straw

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	200	200	200	200	200	200	200	200	200	200	200	200
Source:		GHG inventory data											
Proportion of N excreted as TAN		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		Default											
Fraction of TAN deposited in housing as slurry		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0	0	0	0	0	0	0	0	0	0	0	0
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											

Figure 29. Sheep: other parameters

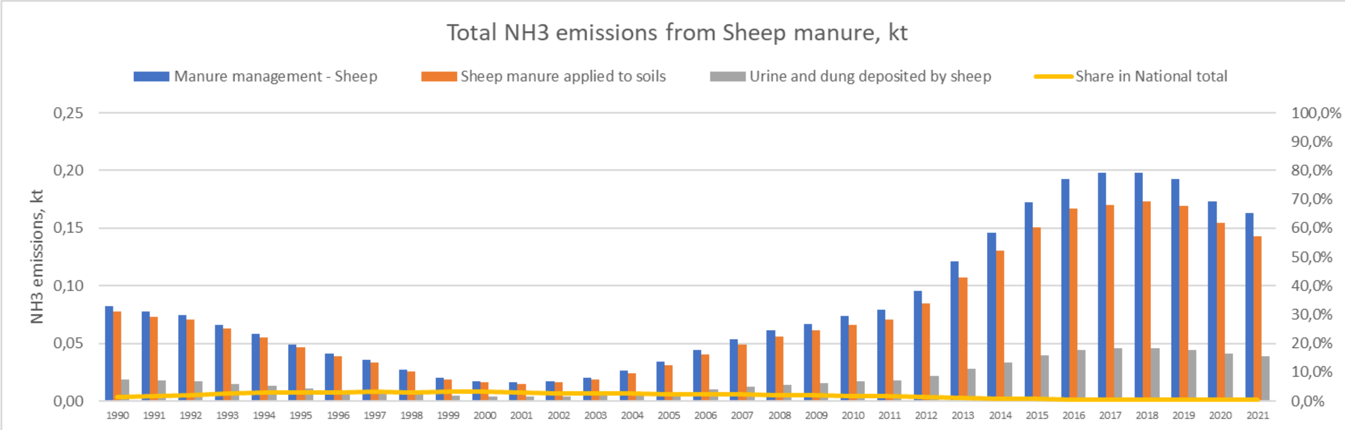


Figure 30. Sheep: NH3 emissions

1.6. Manure management – Goats (3.B. 4.d)

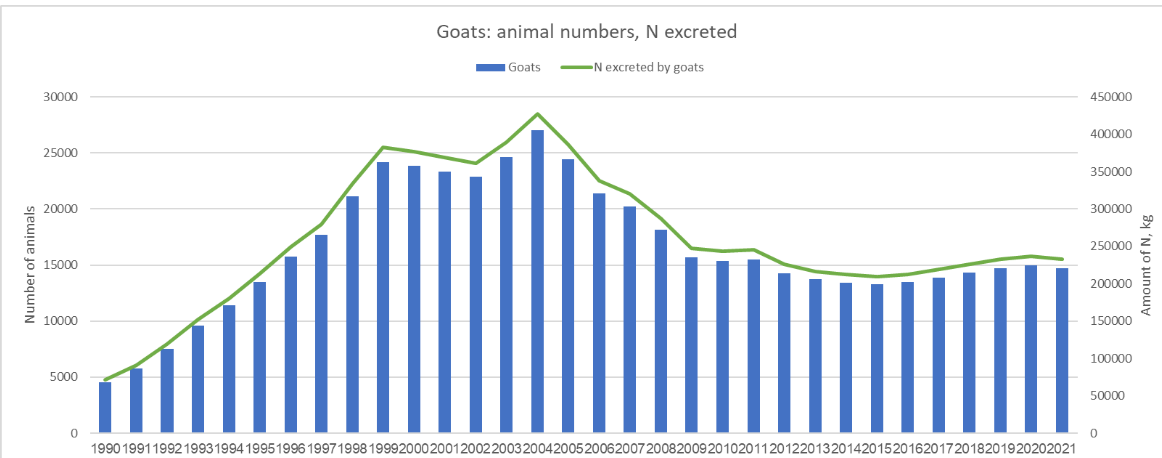


Figure 30a. Goats: number of animals

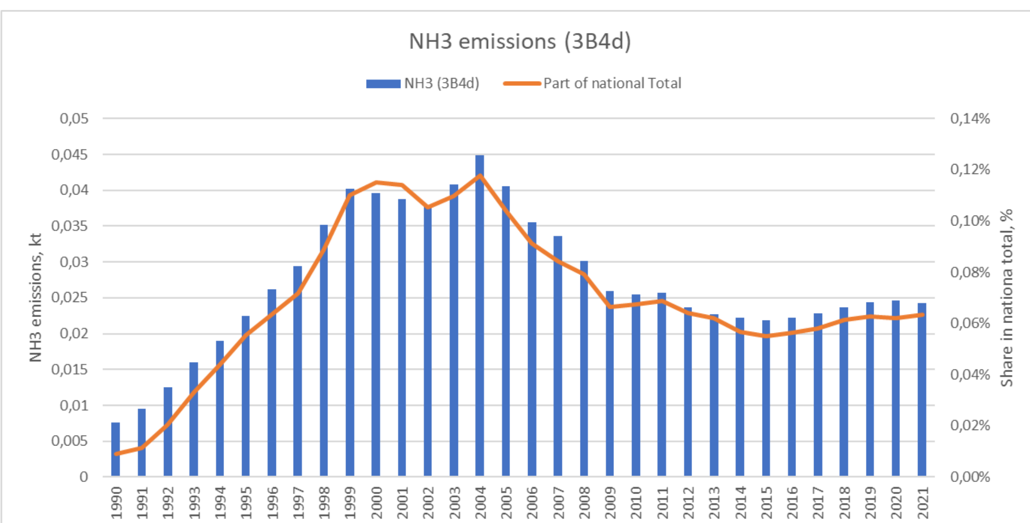


Figure 30b. Goats: NH3 emissions

1.7. Manure management – Fur animals (3.B.4.h)

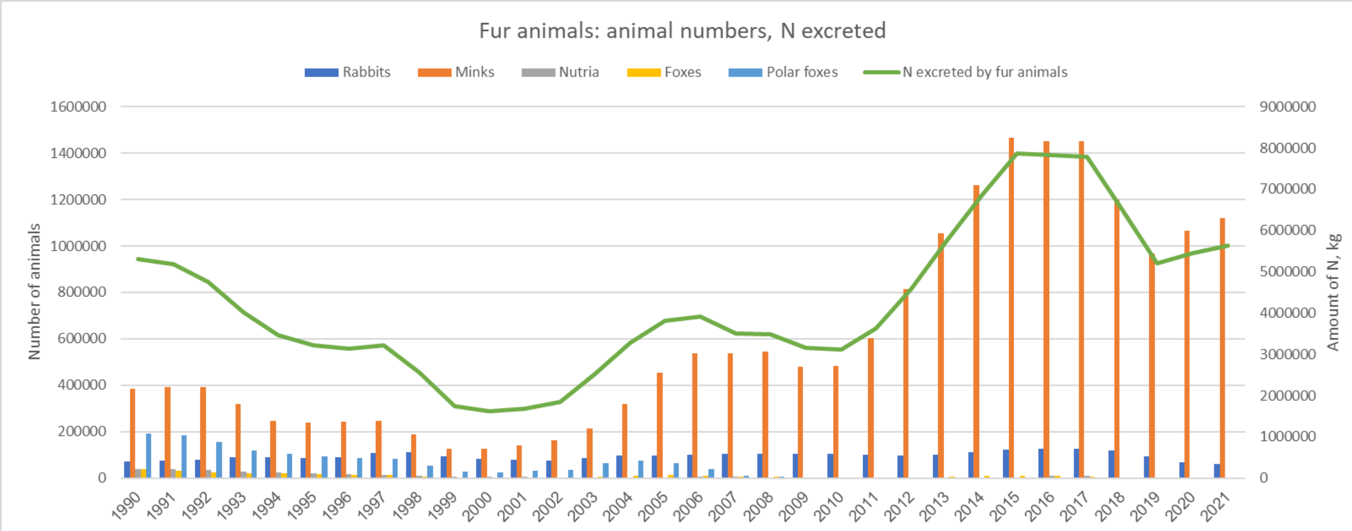


Figure 31. Fur animals

		1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Housed period	days	365	365	365	365	365	365	365	365	365	365	365	365
Source:		GHG inventory data											
Proportion of N excreted as TAN		0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
Source:		Default											
Fraction of TAN deposited in housing as slurry		0,00	0,00	0,00	0,00	0,17	0,24	0,25	0,26	0,26	0,26	0,28	0,29
Source:		GHG inventory data											
Fraction of Total-N and TAN entering storage (slurry)		0	0	0	0	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Fraction of Total-N and TAN entering storage (solid)		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Source:		LEPA Expert judgement											

Figure 32. Main parameters used in the N-flow tool

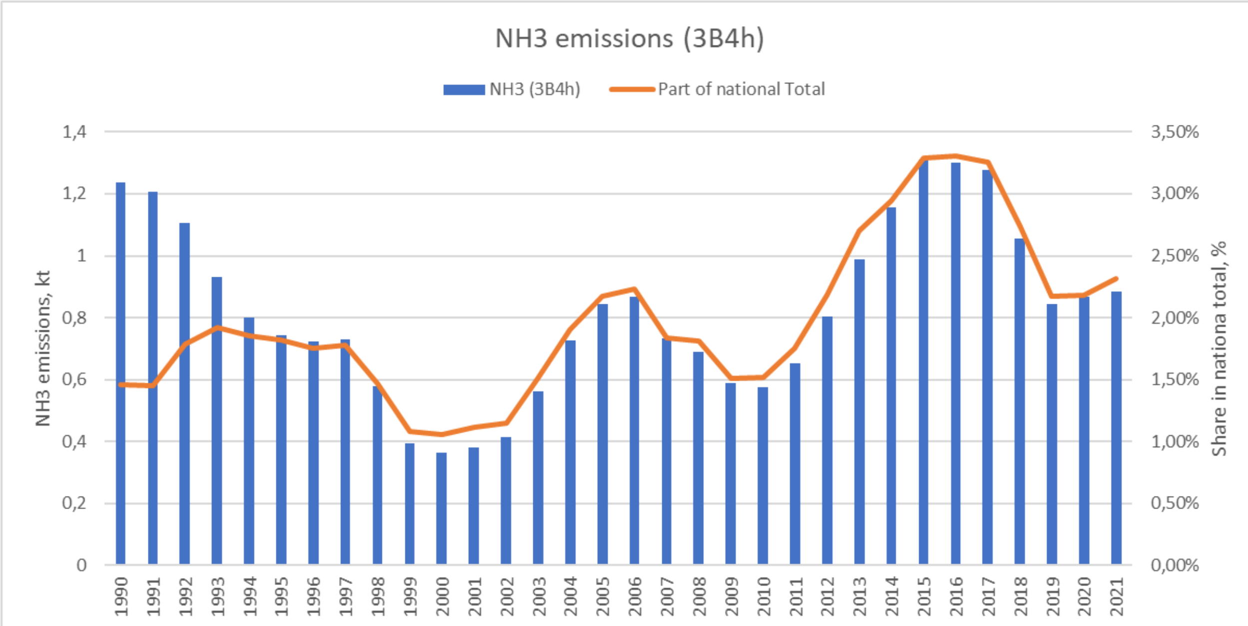


Figure 33. NH3 emissions

1.8. Manure management – Poultry (3.B.4.g)

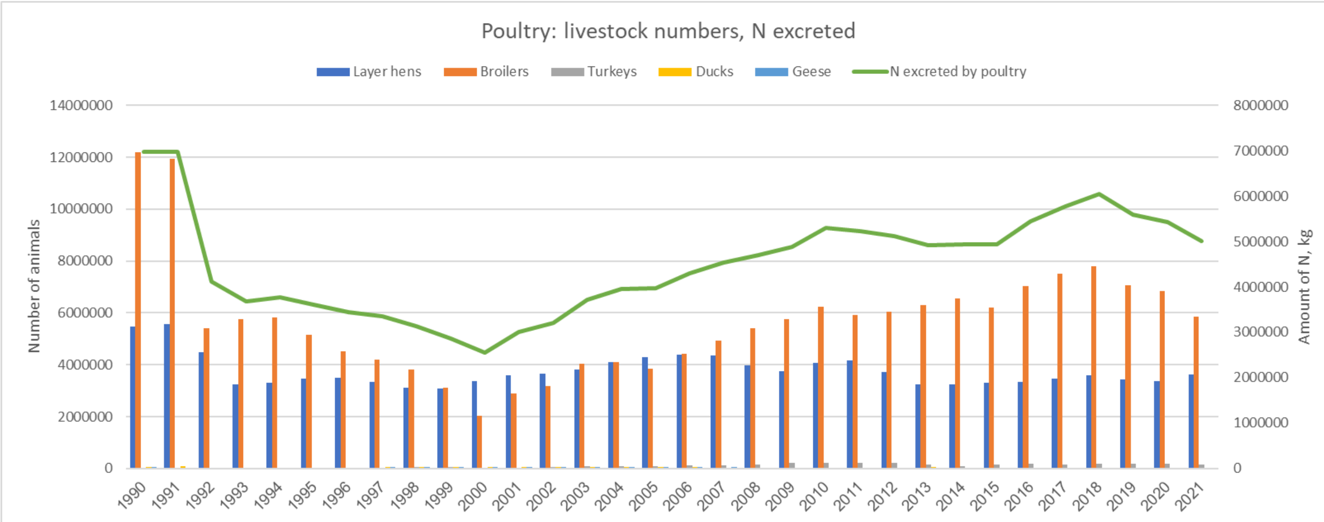


Figure 33. Poultry: livestock numbers, N excreted

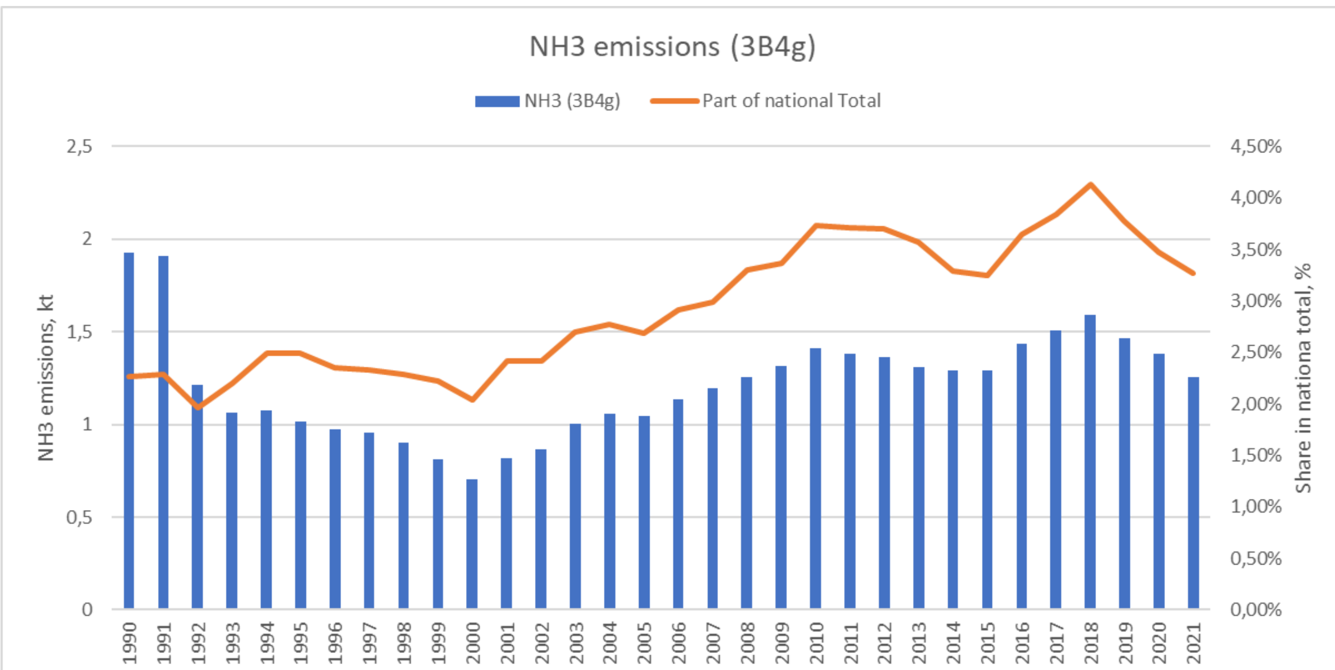


Figure 34. Poultry: NH3 emissions

1.9. Animal manure applied to soils (3.D.a.2.a)

Manure of all livestock categories (except fur animals) was applied to soils. NH3 and NO2 emissions were calculated using the EEA N-flow tool.

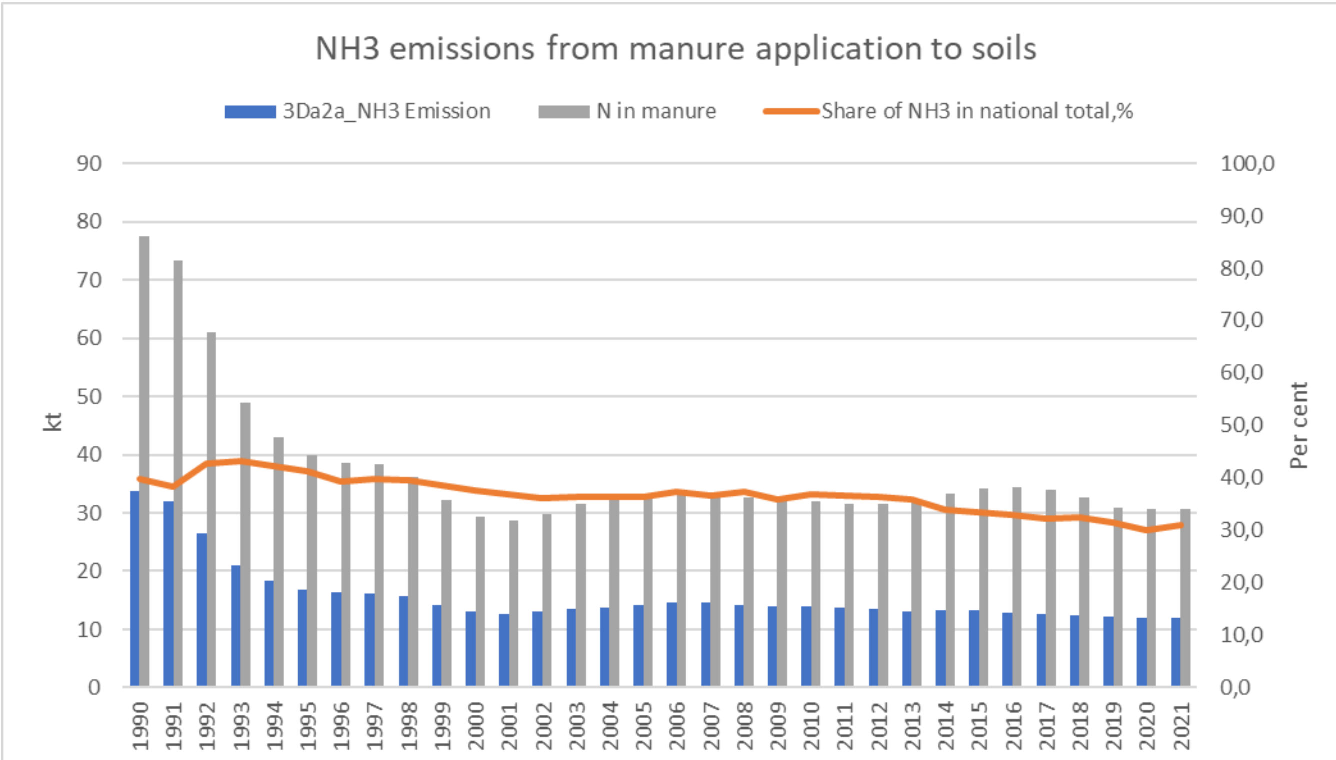


Figure 35. Manure application to soils: NH3 emissions

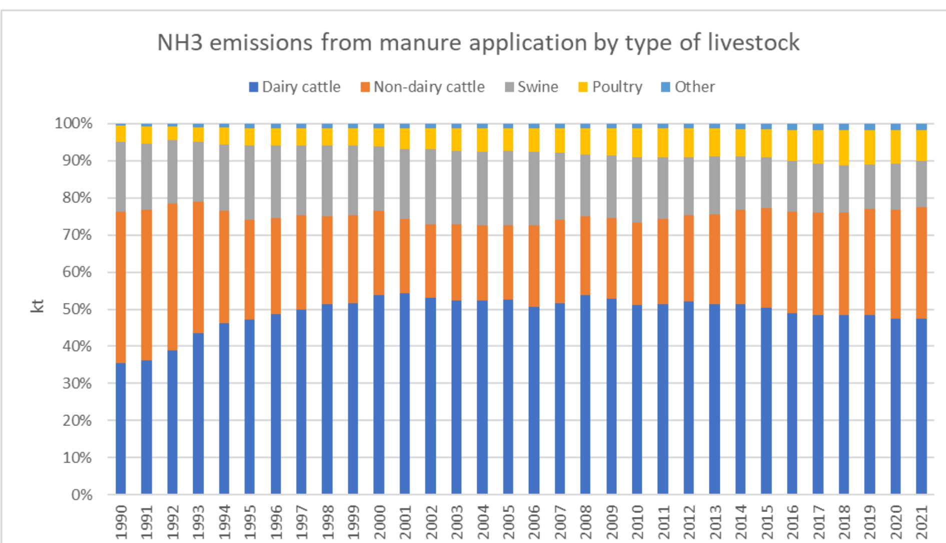
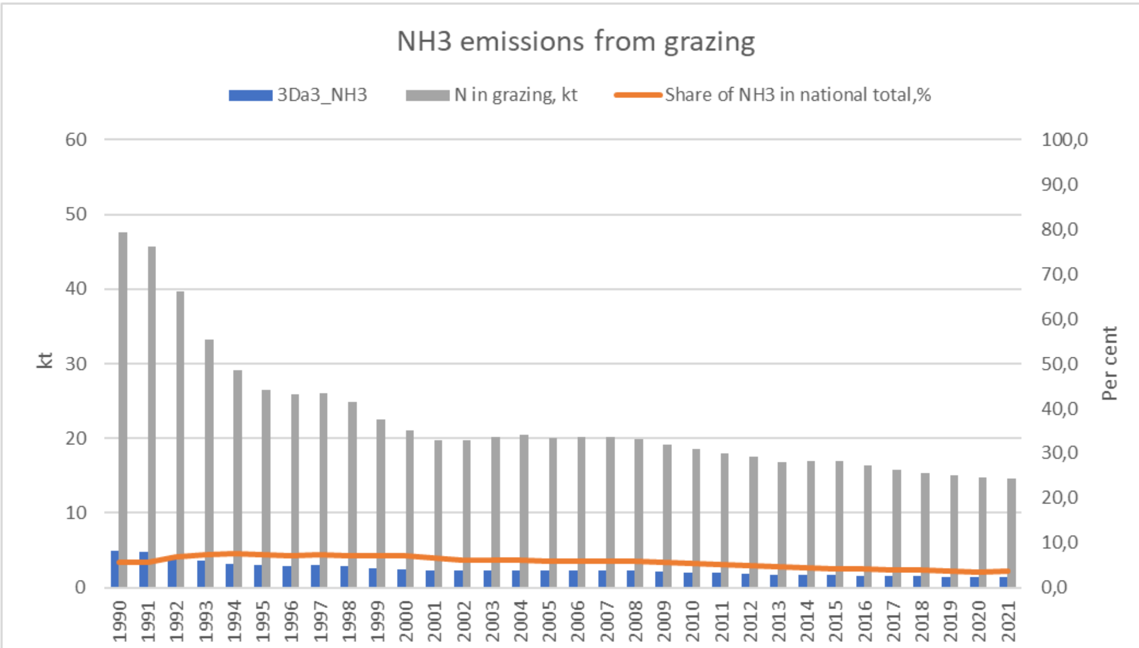
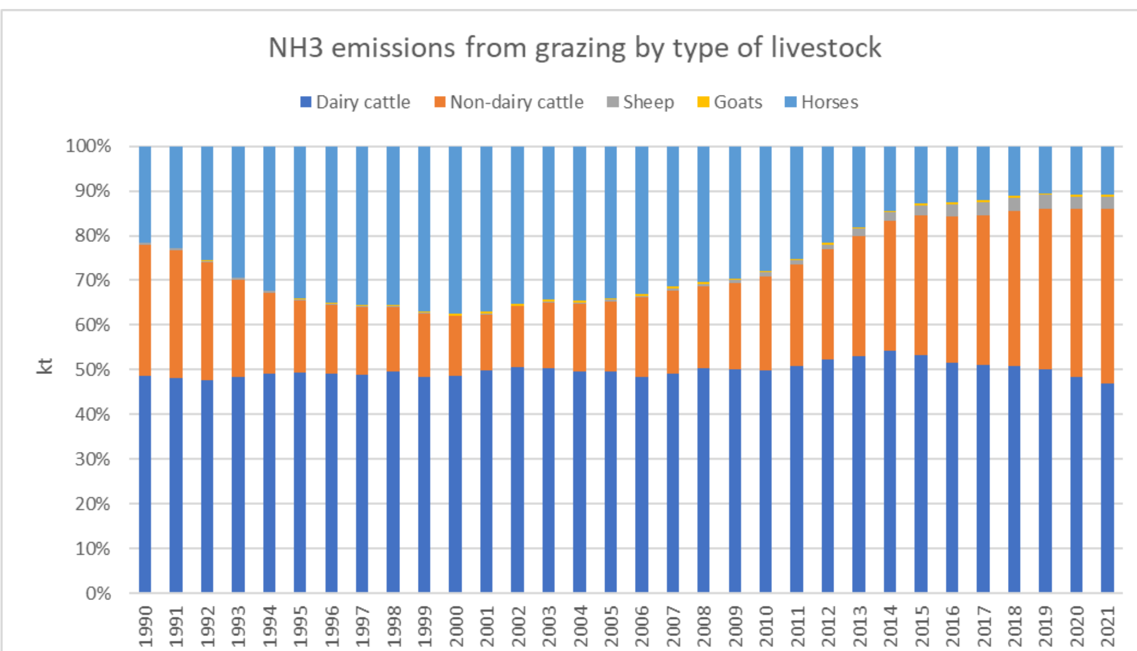


Figure 36. Manure application to soils: NH3 emissions by type of livestock

1.10. Urin and dung deposited by grazing animals (3.D.a.3)

Grazing emissions occur from cattle, sheep, goats, horses. NH3 and NOx emissions were calculated using the EEA N-flow tool. Data on pasture can be found in the Annex II.





2. Inorganic N-fertilizers (includes also urea application) (3.D.a.1)

General notes

Climate in Lithuania is cool (*source: Lithuanian GHG inventory*), soil pH is normal, soil with pH more than 7 do not occur in Lithuania (*source: Lithuania, MoE 1996, cited by: Soil Survey and available Soil Data in Lithuania, EUROPEAN SOIL BUREAU – RESEARCH REPORT NO. 9*)

IFA (International Fertilizer Association) data (N kt.)

Country	Product	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Lithuania	Ammonia dir. applic. (N)																
	Ammonium sulphate (N)				12,5	16,8	10	9	10	8	12,6	35,8	35	45,1	37,7	41	43
	Urea (N)				12,3	23	10	9	9	10	26	11,4	11,7	8,9	10,1	15	17
	Ammonium nitrate (N)				50,5	54,5	60	62	63	61	56,9	56,1	58,4	51,3	55,4	47	55
	Calc. amm. nitrate (N)				7,9	4,9	5	5	3	5	6	5,8	6,6	6,2	7,2	8	8
	Nitrogen solutions (N)				15	5,4	20,2	20	20	20	16,8	30,9	31,5	33,5	35,5	40	50
	Other N straight (N)																
	Ammonium phosphate (N)				14,1	3,9	5	10	5	5	4	3,4	2,9	3,1	3,6	2	2
	Other NP (N)				3	9,7	10	10	15	15	18,2	5,4	5,3	3,1	2,5	2	2
	N K compound (N)																
	N P K compound (N)				3	16,2	23	22	25	31	22,7	19	18,1	20,8	22,1	20	22
	Total N Straight				**98,2**	**104,6**	**105,2**	**105**	**108**	**104**	**118,3**	**139**	**143,2**	**144**	**145,9**	**151**	**173**
	Total N Compound				**20,1**	**29,8**	**38**	**42**	**42**	**51**	**44,9**	**27,8**	**26,3**	**26**	**28,2**	**24**	**26**
	Grand Total N	**119**	**122**	**127**	**118,3**	**134,4**	**143,2**	**147**	**150**	**155**	**163,2**	**167,8**	**169,5**	**171**	**174,1**	**175**	**199**

Table 3.2. 3.D Crop production and agricultural soils (GB2019)

Table 3.2 EFs for NH_3 emissions from fertilisers (in g NH_3 (kg N applied)$^{-1}$)

	Climate					
	Cool		Temperate		Warm	
	normal pH (a)	high pH (b)	normal pH (a)	high pH (b)	normal pH (a)	high pH (b)
Anhydrous ammonia (AH)	19	35	20	36	25	46
AN	15	32	16	33	20	41
Ammonium phosphate (AP) (c)	50	91	51	94	64	117
AS	90	165	92	170	115	212
CAN	8	17	8	17	10	21
NK mixtures (d)	15	32	22	33	20	41
NPK mixtures (d)	50	91	67	94	64	117
NP mixtures (d)	50	91	67	94	64	117
N solutions (e)	98	95	100	97	126	122
Other straight N compounds (f)	10	19	14	20	13	25
Urea(g)	155	164	159	168	198	210

(a) A 'normal' pH is a pH of 7.0 or below.
(b) A 'high' pH is a pH of more than 7.0 (usually calcareous soils).
(c) AP is the sum of ammonium monophosphate (MAP) and diammonium phosphate (DAP).
(d) NK mixtures are equivalent to AN, NPK and NP mixtures, which are 50 % MAP plus 50 % DAP.
(e) N solutions are equivalent to urea AN.
(f) Other straight N compounds and equivalent to calcium nitrate.
(g) Urea is an organic compound with the chemical formula $CO(NH_2)_2$.

NH3 emissions from Urea application

Urea (N) data for 1990-2007 were taken from the GHG inventory, for 2008-2020 from the IFA database, for 2021 from IFA database applying proportion in 2020 to all amount of N fertilizers in 2021. The tier 2 NH3 emission factor was taken from the Table 3.2.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Urea (N), kt	22,64	26,49	9,40	4,59	4,59	4,27	8,44	8,66	8,91	10,04	10,47	10,89	12,28	12,39	12,50

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Urea (N), kt	20,00	12,00	20,00	12,30	23,00	10,00	9,00	9,00	10,00	26,00	11,40	11,70	8,90	10,10	15,00	17,00	14,95

NH3 emissions from other N fertilizers in 1990-2004

All fertilizers (N) data for 1990-2004 were taken from IFA database.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
All N fert. (N), 1000 t	212	248	88	43	43	40	79	81,1	83,4	94	98	102	115	116	117

Tier 1 NH3 EF 0,05 (kg NH_3/ kg fertiliser N applied) was used.)

NH3 emissions from Ammonium sulphate, Ammonium nitrate, Calc. amm. Nitrate, Nitrogen solutions, Ammonium phosphate, Other NP, N P K compound from 2005

(N) data of these fertilizers for 2008-2020 were taken from the IFA database, for 2021 from IFA database applying proportion of 2020 to all amount of N fertilizers in 2021; for 2005-2007 from IFA database applying proportion of 2008 to all amount of N fertilizers in 2005-2007. The corresponding EF from Table 3.2 were used.

Amount of N-fertilizers by type used in Lithuania, N 1000 t

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Urea	20,0	12,0	20,0	12,3	23,0	10,0	9,0	9,0	10,0	26,0	11,4	11,7	8,9	10,1	15,0	17,0	14,9
Ammonium sulphate	11,7	13,0	12,6	12,5	16,8	10,0	9,0	10,0	8,0	12,6	35,8	35,0	45,1	37,7	41,0	43,0	37,8
Ammonium nitrate	47,2	52,4	51,0	50,5	54,5	60,0	62,0	63,0	61,0	56,9	56,1	58,4	51,3	55,4	47,0	55,0	48,4
Calc. amm. nitrate	7,4	8,2	8,0	7,9	4,9	5,0	5,0	3,0	5,0	6,0	5,8	6,6	6,2	7,2	8,0	8,0	7,0
Nitrogen solutions	14,0	15,6	15,1	15,0	5,4	20,2	20,0	20,0	20,0	16,8	30,9	31,5	33,5	35,5	40,0	50,0	44,0
Ammonium phosphate	13,2	14,6	14,2	14,1	3,9	5,0	10,0	5,0	5,0	4,0	3,4	2,9	3,1	3,6	2,0	2,0	1,8
Other NP	2,8	3,1	3,0	3,0	9,7	10,0	10,0	15,0	15,0	18,2	5,4	5,3	3,1	2,5	2,0	2,0	1,8
N P K compound	2,8	3,1	3,0	3,0	16,2	23,0	22,0	25,0	31,0	22,7	19,0	18,1	20,8	22,1	20,0	22,0	19,3
All	119,0	122,0	127,0	118,3	134,4	143,2	147,0	150,0	155,0	163,2	167,8	169,5	172,0	174,1	175,0	199,0	175,0

NO2 emissions from N fertilizers in 1990-2021

Tier 1 NO2 EF 0,04 (kg NO_2 / kg N applied) was used.

3. Other organic fertilisers applied to soils (3Da2b, 3Da2c)

		1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Sewage sludge applied to soils (FCOM)	t N yr	151,2	151,2	166,4	43,6	302,9	612,1	361,4	477,8	379,2	355,4	361,1	372,5	383,9	395,3	452,6
Compost applied to soils (FSEW)	t N yr	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

		2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*
Sewage sludge applied to soils (FCOM)	t N yr	465,4	289,0	372,7	983,5	841,1	584,3	646,6	413,3	527,3	671,3	801,8	674,5	986,8	570,9	579,5	598,4	556,0
Compost applied to soils (FSEW)	t N yr	0,0	0,0	0,0	0,0	0,0	13,1	15,0	17,5	25,8	42,3	39,8	57,0	84,9	100,7	142,9	178,4	230,0

EFs for emisions from sludge: Tier 1 NH_3 EF 0,13 kg NH_3/ kg N applied, Tier 1 NO_2 EF = 0,13*(0,002/ 0,0068)= 0,038235294 kg NH_3/ kg N applied.

EFs for emisions from compost: Tier 1 NH_3 EF 0,08 kg NH_3/ kg N applied, Tier 1 NO_2 EF 0,04 kg NO_2 /kg waste N applied.

4. Crop residues applied to soils

No methodology is provided in GB2019 for estimating air pollutant emissions.

5. Farm-level agricultural operations including storage, handling and transport of agricultural products (3dc)

Wet climate Efs were used.

Table 3.5 Tier 2 EFs for agricultural crop operations, in kg ha^{-1} PM10, wet climate conditions

Crop	I	Soil cultivation 1	Harvesting 2	Cleaning 3	Drying 4
Wheat	1	0.25	2.7	0.19	0.56
Rye	2	0.25	2.0	0.16	0.37
Barley	3	0.25	2.3	0.16	0.43
Oat	4	0.25	3.4	0.25	0.66
Other arable	5	0.25	NC	NC	NC
Grass	6	0.25	0.25	0	0

Note: grass includes hay making only.

Table 3.7 Tier 2 EFs for agricultural crop operations, in kg ha^{-1} $PM_{2.5}$, wet climate conditions

Crop	I	Soil cultivation 1	Harvesting 2	Cleaning 3	Drying 4
Wheat	1	0.015	0.02	0.009	0.168
Rye	2	0.015	0.015	0.008	0.111
Barley	3	0.015	0.016	0.008	0.129
Oat	4	0.015	0.025	0.0125	0.198
Other arable	5	0.015	NC	NC	NC
Grass	6	0.015	0.01	0	0

Note: grass includes hay making only.

Source: EMEP/EEA air pollutant emission inventory guidebook 2019, 3.D Crop production and agricultural soils

As activity data for estimating emissions from soil cultivation, following data were used:

	Sown area of agricultural crops | thousand ha																
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Grain crops	991,9	1005,9	1044	1058,7	1151,2	1096,6	1121,2	1212,9	1261,9	1378,6	1488,9	1577,1	1528,1	1464,4	1509,5	1525,8	1529,6
Cereals	956,1	962,9	1003,3	1022	1103,5	1041,8	1075	1169,3	1217,2	1296,5	1331,5	1339	1267,3	1269,6	1361,4	1391,4	1372,2
Winter cereals	421,3	366	425,9	464,4	627,1	532,2	400,6	595,9	644,6	493,5	708,3	755	738,8	542,4	901,9	921,8	908,6
Winter wheat	298,3	252,6	276,7	290	397,2	372,9	279,6	436,9	466,5	359	573,3	630,7	634,5	465,4	743,2	755,7	791,8
Winter triticale	64,2	56,2	67,4	87,7	124,6	92	75,5	97,3	122,2	88,4	93,3	86,8	69,7	47,6	95,9	104,6	64,5
Winter rye	50,9	51,1	69,8	74,3	82,2	51,7	42,8	55,4	48,7	37,1	38,2	32,7	27,1	21	40,8	36,7	26,2
Winter barley	7,9	6,1	12	12,4	23,1	15,6	2,7	6,3	7,2	9	3,5	4,8	7,5	8,4	22	24,8	26,1
Spring cereals	534,8	596,9	577,4	557,6	476,4	509,6	674,4	573,4	572,6	803	623,2	584	528,5	727,2	459,5	469,6	463,6
Spring wheat	71,2	91,2	77,9	113,5	102,8	152,4	276,4	191,9	202	353,6	263,8	254,4	205,3	311,9	157,1	142,5	158,2
Spring barley	341,5	377,3	369,4	320,1	254,3	224,8	251,3	212,3	202,8	258,5	199	170,1	141,1	219,3	154,4	140,9	120,9
Spring triticale	11	9,1	13,1	10,5	11,5	19,8	21	22,2	23,2	33,2	29,2	15,5	11,7	10,1	9,7	11,1	11,7
Spring rye								0,6	0,9	0,9	0,6	0,4	0,2	0,5	0,4	0,4	0,2
Oats	59,6	59,3	61,7	68	63,8	62,3	63,9	71,9	74	76,2	64,3	71,1	82,9	105,5	88,7	105,4	94,3
Buckwheat	28,4	31,3	21,7	27,5	21,8	19,9	27,5	36,8	30,7	37,7	36,8	45,2	64,3	54,5	28,7	39,7	50,4
Mixed cereals	21,3	26,4	27,5	10,1	16,5	22,5	24	23,1	20,4	22,8	17,3	14	11,1	11,9	7,3	8,6	8,3
Grain maize	1,6	2	5,4	7,6	5,5	7,2	9,6	14	17,8	19,2	12	13,2	11,7	13,4	13	20,7	19,2

Source: Statistics Lithuania

As activity data for estimating emissions from harvesting, cleaning, drying following data were used:

	Harvested area of agricultural crops | thousand ha																
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Grain crops						1061,7	1110,1	1202,1	1257,8	1370,3	1486,1	1558,7	1435,7	1445,3	1490,7	1514,6	1508,6
Cereals						1012	1064,7	1159,7	1213,4	1288,8	1329,1	1326,7	1199,5	1257,2	1349,6	1382,4	1356,5
Winter cereals						521,1	393,6	594,7	643,4	488	707,6	751	719,3	539,6	897,7	917	902,1
Winter wheat						367,4	275,2	436,2	466	355	573	628,6	620,6	463,1	739,6	751,9	787,4
Winter triticale						89,4	73,8	96,9	121,7	87	92,9	85,5	65,8	47,3	95,7	104	63
Winter rye						49,5	42	55,3	48,5	37	38,2	32,2	25,7	20,8	40,7	36,6	25,9
Winter barley						14,8	2,6	6,3	7,2	9	3,5	4,7	7,2	8,4	21,7	24,5	25,8
Spring cereals						490,9	671,1	565	570	800,8	621,5	575,7	480,2	717,6	451,9	465,4	454,4
Spring wheat						150,2	275,9	190,8	201,4	353	263,2	251,9	191,3	309,7	156,2	141,7	156,7
Spring barley						217	250,1	211	202,1	258	198,9	167,8	134,4	217,5	153,1	140,3	118,9
Spring triticale						19,2	20,6	22,2	23,2	33,1	29,1	15,4	10	9,8	9,7	11	11,5
Spring rye								0,6	0,9	0,9	0,6	0,4	0,2	0,5	0,4	0,4	0,2
Oats						57,8	63,2	70,8	73,6	75,9	64,1	70,8	76	103	86,1	104,9	92,4
Buckwheat						19,2	27,2	33,9	30,5	37,4	36,7	43,6	48,5	52,7	27,6	39,1	48,6
Mixed cereals						19,7	23,8	22,2	20,3	22,6	17	13,3	9,8	10,9	5,8	7,5	7,8
Grain maize						7,1	9,6	12,9	17,2	19	11,7	12,4	9,9	13,4	12,8	20,2	17,9
Meadows, hay						209,6	201,3	166,2	183,8	181,1	273,1	385,7	348,1	366,1	261,8	227,2	300,5

Source: Statistics Lithuania

6. Cultivated crops (3de)

As activity data for estimating NMVOC emissions from cultivated crops, following data were used:

	Sown area of agricultural crops | thousand ha																
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Grain crops	991,9	1005,9	1044	1058,7	1151,2	1096,6	1121,2	1212,9	1261,9	1378,6	1488,9	1577,1	1528,1	1464,4	1509,5	1525,8	1529,6
Cereals	956,1	962,9	1003,3	1022	1103,5	1041,8	1075	1169,3	1217,2	1296,5	1331,5	1339	1267,3	1269,6	1361,4	1391,4	1372,2
Winter cereals	421,3	366	425,9	464,4	627,1	532,2	400,6	595,9	644,6	493,5	708,3	755	738,8	542,4	901,9	921,8	908,6
Winter wheat	298,3	252,6	276,7	290	397,2	372,9	279,6	436,9	466,5	359	573,3	630,7	634,5	465,4	743,2	755,7	791,8
Winter triticale	64,2	56,2	67,4	87,7	124,6	92	75,5	97,3	122,2	88,4	93,3	86,8	69,7	47,6	95,9	104,6	64,5
Winter rye	50,9	51,1	69,8	74,3	82,2	51,7	42,8	55,4	48,7	37,1	38,2	32,7	27,1	21	40,8	36,7	26,2
Winter barley	7,9	6,1	12	12,4	23,1	15,6	2,7	6,3	7,2	9	3,5	4,8	7,5	8,4	22	24,8	26,1
Spring cereals	534,8	596,9	577,4	557,6	476,4	509,6	674,4	573,4	572,6	803	623,2	584	528,5	727,2	459,5	469,6	463,6
Spring wheat	71,2	91,2	77,9	113,5	102,8	152,4	276,4	191,9	202	353,6	263,8	254,4	205,3	311,9	157,1	142,5	158,2
Spring barley	341,5	377,3	369,4	320,1	254,3	224,8	251,3	212,3	202,8	258,5	199	170,1	141,1	219,3	154,4	140,9	120,9
Spring triticale	11	9,1	13,1	10,5	11,5	19,8	21	22,2	23,2	33,2	29,2	15,5	11,7	10,1	9,7	11,1	11,7
Spring rye								0,6	0,9	0,9	0,6	0,4	0,2	0,5	0,4	0,4	0,2
Oats	59,6	59,3	61,7	68	63,8	62,3	63,9	71,9	74	76,2	64,3	71,1	82,9	105,5	88,7	105,4	94,3
Buckwheat	28,4	31,3	21,7	27,5	21,8	19,9	27,5	36,8	30,7	37,7	36,8	45,2	64,3	54,5	28,7	39,7	50,4
Mixed cereals	21,3	26,4	27,5	10,1	16,5	22,5	24	23,1	20,4	22,8	17,3	14	11,1	11,9	7,3	8,6	8,3
Grain maize	1,6	2	5,4	7,6	5,5	7,2	9,6	14	17,8	19,2	12	13,2	11,7	13,4	13	20,7	19,2

Source: Statistics Lithuania

NMVOC from standing crops Ef was 0,86 kg/ha

7. Use of pesticides (3Df)

Source category description

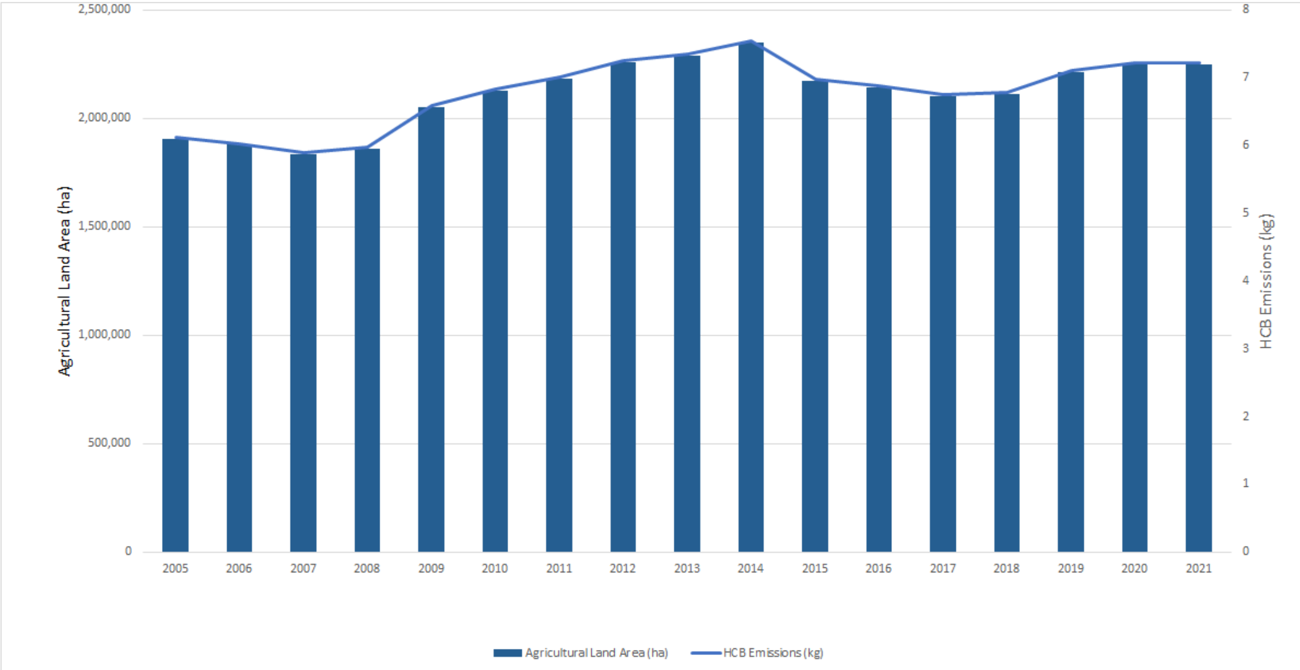
The sector of the use of pesticides (3.D.f) covers the usage of insecticides, fungicides, plant growth regulators, rodenticides, and herbicides for the agricultural purposes and their HCB emissions. The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) and Protocol to the Convention on LRTAP banned production and consumption of 11 specific POPs. In addition, there are multiple Directives concerning maximum levels of pesticide residues in fruits and vegetables (Directive 76/895/EEC), cereal products (86/362/EEC), food of animal origin (86/363/EEC), plant origin products (90/642/EEC), placing of plant products on the market (91/414/EEC), biocidal products in the market (98/8/EEC) and, maximum levels of pesticides in the animal food and feed (EC regulation No. 396/2005).

According to the latest study, most of the pesticides used in 2014 were herbicides (43%), fungicides (29%), plant growth regulators (26%) and insecticides (2%). [31] In the herbicide category, glyphosate (20.6%) and MCPA (16.8%) were the most common constituents in commercial herbicides. In the case of fungicide, the major constituent was tebuconazole (25.6%). In the case of insecticides, the major constituent was thiacloprid (45.5%), and only 5 active substances are being used in the plant growth regulators with major substance being chlormequat (84.3%).

90-95% of sugar beetroot, sweetcorn, rapes and cereal species are processed with pesticides, and in the case of other agricultural goods, only a smaller percentage of the harvest was treated with pesticides: potatoes (62%), vegetables (26%), and fruit and berries (23%). On average 1.08 kg of active ingredients were used for one hectare of agricultural land, with most of the active pesticides being used for berries and fruits (3.09 kg/ha) and least for the sweetcorn (0.38 kg/ha).

[1] https://osp.stat.gov.lt/informaciniai-pranesimai?articleId=3975263

Information on the amount of different pesticides used (i.e. insecticides, fungicides, herbicides, etc.) for the 1992-2014 period can be gathered from the Statistics Division of the Food and Agriculture Organization of UN (FAOSTAT). No national data on total or plant-specific pesticide consumption is available. In 2014 conducted study, we have shown that only HCB emissions occur from the use of pesticides (3.D.f).



Agricultural land area along with HCB emissions (kg)

Methodological issues

In 2014 we have conducted a study, where we proved that only HCB emissions occur from the use of pesticides (3.D.f). Pesticides which contain minor amounts of HCB as impurity were addressed. Only two chemicals, chlorothalonil and clopyralid, were identified to produce HCB emissions in small amounts. HCB emissions were estimated by using Yang (2006) emission factors (EMEP/EEA guidebook, 2019, 3.D.f, 3., table 3). For chlorothalonil and clopyralid the emission factors were 10 g/Mg and 2.5 g/Mg of pesticides used, respectively. The total amounts of chlorothalonil and clopyralid were obtained from statistical studies, and are equal to 5190.07 and 1359.65 kg, respectively.

Furthermore, no annual statistics in Lithuania are collected on the use of pesticides. Thus, HCB emissions from pesticide usage in 1990 were calculated based on reported HCB emissions by other countries. The average ratio of HCB emitted per agricultural land (kg of HCB per 1000 ha) was applied for agricultural area (3389 thousand ha) in Lithuania in 1992 (no data on agricultural land in 1990 is available at FAOSTAT database), and reported for 1990 on assumption that HCB emissions from this sub-sector were similar for years 1990 and 1992.

Country	Agricultural Land, 1000 ha (1990)	Reported HCB emissions from NFR 3.D.f (1990)	Ratio, kg/1000 ha
Denmark	2788	18.280	6.56E-03
Finland	2393	1.207	5.04E-04
Italy	16840	23.486	1.39E-03
Germany	18032	21.830	1.21E-03
United Kingdom	18203	116.326	6.39E-03
		Average	3.21E-03

Table **Klaida! Dokumente nėra nurodyto stiliaus teksto.**-1 Agricultural land (FEOSTAT Database), with reported HCB emissions and ratios by the country.

Activity data

As no statistics are collected on the use of pesticides, the agricultural land area was used for the HCB emission calculations. The statistics on the agricultural land area were taken from the National Lithuania Statistics database.

8. Other

3Db	Indirect emissions from managed soils	NE
3Dd	Off-farm storage, handling and transport of bulk agricultural products	NO
3F	Field burning of agricultural residues	NO