Ministry of Agriculture
and Forestry of Finland

Action Plan to Reduce Ammonia Emissions from Agriculture in Finland for the years 2021–2027

PUBLICATIONS OF THE MINISTRY OF AGRICULTURE AND FORESTRY **2021:20**

Publications of the Ministry of Agriculture and Forestry 2021:20

Action Plan to Reduce Ammonia Emissions from Agriculture in Finland for the years 2021–2027

Ministry of Agriculture and Forestry Helsinki 2021

Julkaisujen jakelu
Distribution av publikationer

Valtioneuvoston julkaisuarkisto Valto

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arkivet Valto

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Julkaisumyynti
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julkaisut.valtioneuvosto.fi

Ministry of Agriculture and Forestry

ISBN pdf: 978-952-366-192-9
ISSN pdf: 1797-397X

Layout: Government Administration Department, Publications

Helsinki 2021

Description sheet
25 October 2021

Action Plan to Reduce Ammonia Emissions from Agriculture in Finland for the years 2021–2027

Publications of the Ministry of Agriculture and Forestry 2021:20

Publisher	Ministry of Agriculture and Forestry		
Group author	The action plan was prepared in cooperation between the Ministry of Agriculture and Forestry, the Ministry of the Environment and relevant stakeholders		
Language	English	**Pages**	38

Abstract

International treaties and EU legislation oblige Finland to reduce its ammonia emissions into the air. The emission reduction targets were determined in the Gothenburg Protocol of the Convention on Long Range Transboundary Air Pollution and the corresponding National Emission Ceilings Directive.

According to the Gothenburg Protocol, from 2020 onwards, Finland's ammonia emissions must be at least 20% lower than the level of emissions in 2005. The commitments of the Protocol were enforced in the EU with the National Emission Ceilings Directive (2016/2284).

Approximately 90% of Finland's ammonia emissions originate from agricultural sources, which is why most of the actions to reduce the level of emissions are targeted to agriculture. In agriculture, ammonia is released from livestock manure in livestock buildings and during the storage and application of manure. Organic and inorganic fertilizers containing nitrogen also release ammonia.

The most effective measures to reduce ammonia emissions from agriculture involve manure, its storage, and its application. Ammonia emissions can also be reduced by measures involving the feeding of domestic animals, but these measures are more difficult to regulate and to assess their impact than measures relating to the management of manure.

This action plan and the measures therein aim to reduce the ammonia emissions from agriculture to the required level.

The action plan was prepared in cooperation between the Ministry of Agriculture and Forestry and the Ministry of the Environment, the Finnish Environment Institute, Natural Resources Institute Finland, the Finnish Association for Nature Conservation, and the Central Union of Agricultural Producers and Forest Owners (MTK). The thematic group on agriculture has done most of the preparation work during the implementation of the National Air Pollution Control Programme 2030.

Keywords	agriculture, ammonia, air quality, emissions		
ISBN PDF	978-952-366-192-9	**ISSN PDF**	1797-397X
URN address	http://urn.fi/URN:ISBN:978-952-366-192-9		

Kuvailulehti
25.10.2021

Toimintaohjelma maatalouden ammoniakkipäästöjen vähentämiseksi Suomessa vuosille 2021–2027

Maa- ja metsätalousministeriön julkaisuja 2021:20

Julkaisija	Maa- ja metsätalousministeriö		
Yhteisötekijä	Toimintaohjelma on valmisteltu yhteistyössä maa- ja metsätalousministeriön, ympäristöministeriön ja sidosryhmien kanssa		
Kieli	englanti	**Sivumäärä**	38

Tiivistelmä

Kansainväliset sopimukset ja EU:n lainsäädäntö edellyttävät, että Suomi vähentää ammoniakkipäästöjä ilmaan. Päästövähennysvelvoitteista päätettiin kaukokulkeutumissopimuksen Göteborgin pöytäkirjassa ja sitä vastaavassa EU:n päästökattodirektiivissä.

Göteborgin pöytäkirjan mukaan Suomen ammoniakkipäästöjen tulee olla vuodesta 2020 alkaen vähintään 20 prosenttia pienemmät kuin vuoden 2005 päästöt. Pöytäkirjan velvoitteet pantiin EU:ssa täytäntöön päästökattodirektiivillä (2016/2284).

Suomen ammoniakkipäästöistä noin 90 prosenttia on peräisin maataloudesta, joten myös pääosa vähennystoimista kohdistuu maatalouteen. Maataloudessa ammoniakkia haihtuu kotieläinten lannasta eläinsuojissa sekä lannan varastoinnin ja levityksen yhteydessä. Ammoniakkia haihtuu myös typpeä sisältävistä muista orgaanisista ja epäorgaanisista lannoitteista.

Tehokkaimmat toimenpiteet maatalouden ammoniakkipäästöjen vähentämiseksi liittyvät lantaan, sen varastointiin ja levitykseen. Ammoniakkipäästöihin on mahdollista vaikuttaa myös kotieläinten ruokintaan liittyvillä toimilla, mutta niiden hallinta ja vaikutusten arviointi on lantaan liittyviä toimia hankalampaa.

Tällä toimintaohjelmalla ja siihen sisällytetyillä toimilla pyritään maataloudesta peräisin olevien ammoniakkipäästöjen vähentämiseen niin, että maatalouden ammoniakkipäästöt olisivat velvoitteiden mukaiset.

Tämä toimintaohjelma on valmisteltu maa- ja metsätalousministeriön, ympäristöministeriön, Suomen ympäristökeskuksen, Luonnonvarakeskuksen, Suomen luonnonsuojeluliiton ja Maa- ja metsätaloustuottajain Keskusliitto MTK:n yhteistyönä. Valmistelutyön on pääasiassa tehnyt Kansallisen ilmansuojeluohjelman 2030 toimeenpanon Maatalous-teemaryhmä.

Asiasanat	maatalous, ammoniakki, ilmanlaatu, päästöt		
ISBN PDF	978-952-366-192-9	**ISSN PDF**	1797-397X
Julkaisun osoite	http://urn.fi/URN:ISBN:978-952-366-192-9		

Presentationsblad
25.10.2021

Handlingsprogram för att minska ammoniakutsläpp från jordbruket i Finland åren 2021–2027

Jord- och skogsbruksministeriets publikationer 2021:20

Utgivare	Jord- och skogsbruksministeriet		
Utarbetad av	Operativt program bereds i samarbete med jord- och skogsbruksministeriet, miljöministeriet och intressenter		
Språk	engelska	**Sidantal**	38

Referat

Internationella fördrag och EU-lagstiftningen kräver att Finland minskar ammoniakutsläppen i luften. Utsläppsminskningsåtaganden beslutades i Göteborgsprotokollet om långväga gränsöverskridande luftföroreningar och i EU:s direktiv om nationella utsläppstak.

Enligt Göteborgsprotokollet ska Finlands utsläpp från och med 2020 vara minst 20 procent lägre jämfört med 2005. Protokollets åtaganden genomfördes i EU med direktivet om nationella utsläppstak (2016/2284).

Av Finlands ammoniakutsläpp härstammar cirka 90 procent från jordbruket, vilket betyder att även största delen av minskningsåtgärderna gäller jordbruket. Inom jordbruket avdunstar ammoniak från husdjursgödsel i djurstall och när gödsel lagras och sprids. Ammoniak avdunstar också från andra organiska och oorganiska gödselmedel som innehåller kväve.

De effektivaste åtgärderna för att minska ammoniakutsläppen från jordbruket gäller gödsel, dess lagring och spridning. Det är också möjligt att påverka ammoniakutsläppen med åtgärder som gäller utfodringen av husdjur, men det är svårare att hantera dem och att utvärdera deras effekter än åtgärderna som gäller gödseln.

Genom detta handlingsprogram och dess åtgärder eftersträvar man att minska de jordbruksbaserade ammoniakutsläppen så att de ska uppfylla de krav som fastställts för ammoniakutsläpp från jordbruket.

Detta handlingsprogram har färdigställts i samarbete mellan jord- och skogsbruksministeriet, miljöministeriet, Finlands miljöcentral, Naturresursinstitutet, Finlands naturskyddsförbund och Centralförbundet för lant- och skogsbruksproducenter MTK. Beredningsarbetet har framförallt genomförts av temagruppen för jordbruk inom det nationella luftvårdsprogrammet 2030.

Nyckelord	jordbruk, ammoniak, luftkvalitet, utsläpp		
ISBN PDF	978-952-366-192-9	**ISSN PDF**	1797-397X
URN-adress	http://urn.fi/URN:ISBN:978-952-366-192-9		

Table of Contents

PREFACE

International treaties and EU legislation oblige Finland to reduce its ammonia emissions into the air. The measures to be realised in agriculture in order to meet these requirements are presented in this action plan, which has now been updated for the 2021–2027 period.

This action plan was prepared in cooperation between the Ministry of Agriculture and Forestry, the Ministry of the Environment, the Finnish Environment Institute, Natural Resources Institute Finland, the Finnish Association for Nature Conservation, and the Central Union of Agricultural Producers and Forest Owners. The thematic group on agriculture has done most of the preparation work during the implementation of the National Air Pollution Control Programme 2030.

The previous Action Plan to Reduce Ammonia Emissions from Agriculture in Finland was completed on 8 March 2018 (MMM 2018). The action plan covered the years 2018–2020. The first corresponding action plan was prepared in 1994 (Vesi- ja ympäristöhallitus 1994).

1 Reduction commitments

The ammonia emission reduction commitments in Finland are based on the following:

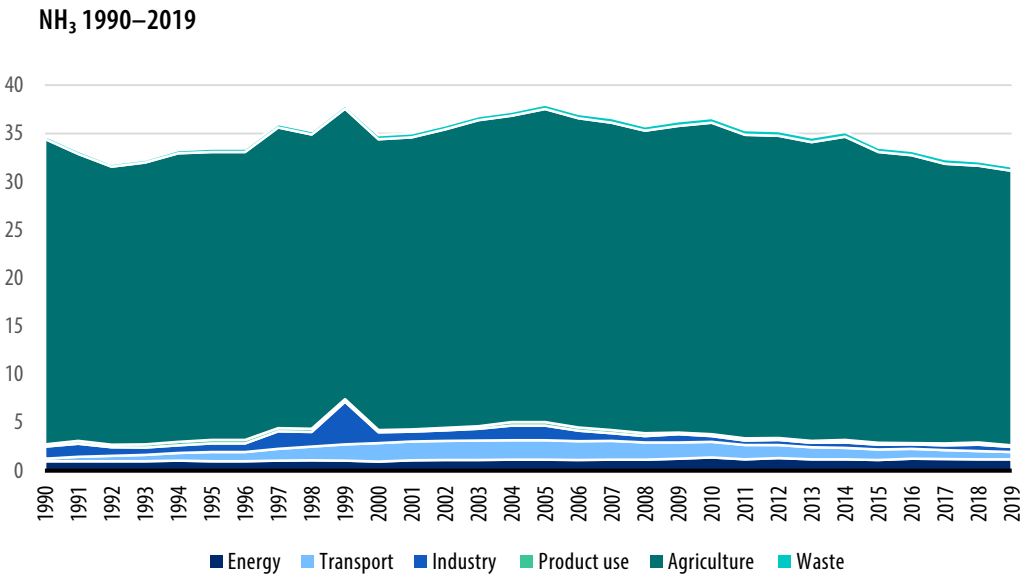
- Gothenburg Protocol of the UNECE (United Nations Economic Commission for Europe) Convention on Long Range Transboundary Air Pollution and Directive 2001/81/EC of the European Parliament and of the Council with which the commitments of the Protocol were enforced in the EU: **the ammonia emission ceiling for Finland in 2010–2019 was 31 kt/year.**
- 2012 amendment to the Gothenburg Protocol (UNECE) and Directive 2016/2284 of the European Parliament and of the Council with which the amended Protocol was enforced in the EU (the National Emission Ceilings Directive, NECD): **the ammonia emission reduction commitment starting from 2020 is 20% of the level of emissions in 2005 (38 kt).** Hence, ammonia emissions should be no more than 30 kt starting from 2020.

It should be noted that it is the reduction commitment measured as a percentage that is the binding commitment starting from 2020. The national emission inventories are annually specified. As the emission calculations are specified, the emissions are also recalculated retroactively. Hence, the above-mentioned 2005 emissions in metric tons and the annual emissions starting from 2020 are approximate, and the actual figures in metric tons may change in the future.

The development of ammonia emissions in Finland is presented in Figure 1. In addition to agriculture, other sources of ammonia emissions include transport, product use, industry and energy production.

The Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM) includes the goal of protecting the Baltic Sea from all sources of pollution in the soil, air and sea. HELCOM contains detailed procedures, measures and provisions with which the member states aim to reach the ecological goals confirmed by the Convention. In terms of agriculture, HELCOM contains a commitment to reduce ammonia emissions from livestock husbandry.

Figure 1. Annual ammonia emissions in Finland (kt) 1990–2019 (Finnish Environment Institute 2021)



2 Ammonia emissions from agriculture

In 2019, ammonia emissions in Finland amounted to 31.6 kt. Before the emissions were compared to the emission ceiling, so called flexibility (see Chapter 9) could be subtracted from the total emissions. Flexibility was valid until the reporting of the 2019 emissions. The ammonia emissions to be compared to the emission ceiling in Finland were 30.2 kt, of which some 94% (28.5 kt) originated from agriculture, which in this connection also includes fur farming (Table 1).

In agriculture, ammonia is released from livestock manure in livestock buildings and during the storage and application of manure. In addition, organic and inorganic fertilizers containing nitrogen release ammonia. In 2019, 26.2 kt (92%) of the ammonia emissions from agriculture originated from manure, 2.1 kt (7%) from inorganic nitrogen fertilisers, 0.07 kt from sewage sludge used in agriculture, and 0.07 kt from the burning of agricultural biomass on arable land (Table 2). (Finnish Environment Institute 2021)

The amount of ammonia potentially released from manure is the higher the more nitrogen there is in the manure. The amount of nitrogen is dependent on the amount and quality of protein in the animals' feed and the animals' ability to utilise the protein.

In 2019, approximately 58% of emissions from agriculture originated from cattle, 13% from pigs, 5% from poultry, 10% from fur animals and 6% from other animals. Approximately 8% originated from inorganic nitrogen fertilisers and other agriculture-based sources.

Emissions originating from manure decreased by some 13% between 2005 and 2019 (Table 3). The changes in emissions originating from different animal species depend on changes in the number of animals, the amount of nitrogen released from the manure and the manner in which the manure is processed. Changes in the number of animals are the largest stand-alone reason for the changes in emissions.

Table 1. Total ammonia emissions, ammonia emissions from agriculture and ammonia emissions compared to the emission ceiling in 1990, 2005, 2010 and 2015–2019. In 2010–2019, so called flexibility could be subtracted from the total emissions before comparing to the emission ceiling. (see Chapter 9). (Finnish Environment Institute 2021)

Year	Total emissions (kt)	Agricultural emissions (kt)	Flexibility (kt)	Emissions compared to emission ceiling (kt)
1990	34.7	31.7	–	34.7
2005	38.0	32.5	–	38.0
2010	36.6	32.3	-2.4	34.2
2015	33.5	30.2	-1.7	31.8
2016	33.2	29.9	-1.7	31.5
2017	32.4	29.0	-1.6	30.8
2018	32.1	28.7	-1.5	30.6
2019	31.6	28.5	-1.4	30.2

Table 2. Ammonia emissions from agriculture in Finland by source of emission in 1990, 2005, 2010 and 2015–2019. (Finnish Environment Institute 2021)

Year	Agricultural emissions total (kt)	Livestock manure (kt)	Inorganic nitrogen fertilisers (kt)	Municipal sewage sludge (kt)	Burning of agricultural waste (kt)
1990	31.7	27.8	3.7	0.043	0.109
2005	32.5	30.1	2.3	0.019	0.080
2010	32.3	30.0	2.2	0.034	0.050
2015	30.2	28.2	1.9	0.056	0.066
2016	29.9	27.9	1.9	0.070	0.063
2017	29.0	27.0	1.9	0.075	0.067
2018	28.7	26.6	2.1	0.066	0.049
2019	28.5	26.2	2.1	0.066	0.072

Table 3. Ammonia emissions originating from livestock manure in 2005 and 2019 (kt) by livestock category (Finnish Environment Institute, 2021)

Animal	2005 (kt)	2019 (kt)	Change 2005–2019 (%)
Dairy cows	10.57	8.75	-17 %
Suckler cows	0.48	0.75	57 %
Heifers	1.94	1.90	-2 %
Bulls	2.07	2.10	1 %
Calves	3.51	3.06	-13 %
Sows with piglets	1.77	0.98	-45 %
Boars	0.03	0.01	-71 %
Fattening pigs	3.09	2.20	-29 %
Weaned pigs	0.73	0.56	-23 %
Laying hens	0.55	0.63	15 %
Cocks	0.00	0.00	0 %
Broilers	0.38	0.70	87 %
Broiler mothers	0.07	0.07	-8 %
Chickens	0.09	0.05	-41 %
Turkeys	0.12	0.07	-43 %
Other poultry	0.00	0.00	0 %
Horses and ponies	1.10	1.29	17 %
Sheep	0.11	0.22	94 %
Goats	0.01	0.01	-23 %
Foxes and raccoon dogs	2.52	2.31	-8 %
American minks and European polecats	0.76	0.42	-44 %
Reindeer	0.18	0.16	-9 %

3 Steering instruments and related measures to reduce ammonia emissions in Finland

The currently available steering instruments to reduce ammonia emissions from agriculture are:

- Ministry of the Environment: Government Decree on Limiting Certain Emissions from Agriculture and Horticulture (the "Nitrates Decree"), environmental permits and notification decisions for livestock facilities, as well as river basin management plan measures
- Ministry of Agriculture and Forestry: Rural Development Programme for Mainland Finland 2014–2020 (environmental payments, agricultural investment aid, animal welfare payment and payment to farm advisory services)

Another factor that influences ammonia emissions from agriculture is an ongoing structural change in agriculture.

The most effective measures to reduce ammonia emissions from agriculture involve manure, its storage, and its application. Ammonia emissions can also be reduced by measures involving the feeding of domestic animals, but these measures are more difficult to regulate and assess than measures relating to the management of manure. (Grönroos 2014)

The implementation of the ammonia emission reduction measures can be promoted either by legislative means (the Nitrates Decree, the environmental permits and notification decisions required by the Environmental Protection Act) or by means that are voluntary to the operators, such as the environmental payments scheme.

3.1 Legislative means

3.1.1 Nitrates Decree

The Nitrates Decree (Government Decree on Limiting Certain Emissions from Agriculture and Horticulture, 1250/2014) requires that all new storage spaces for slurry and dry manure must be covered. A floating cover may also be used in slurry storages. The requirement also applies to storage spaces for organic side fractions and organic fertilisers.

There are several acceptable covering methods and materials ranging from tight and floating covers to surface crust on cattle slurry. As a general rule, naturally forming surface crust is used in large slurry storages at cattle farms. It is not the most efficient way of reducing ammonia emissions, however. As cattle slurry accounts for more than 70% of the total slurry volume, the impact of the covering requirement on the reduction of ammonia emissions is assessed to remain modest. On pig farms, slurry tanks are usually covered with a floating cover.

Manure must be incorporated within 24 hours of application with the exception of application by means of trailing hose spreading or broadcast application to standing crops. The application of slurry, urine and liquid organic fertiliser products by any other means than injection is always prohibited in sections of field parcels where the gradient is at least 15 per cent. Other types of manure and organic fertiliser products to be applied in sloping sections of arable parcels must be incorporated within 12 hours of application.

The impact of the manure incorporation requirement according to the decree on total ammonia emissions from agriculture was estimated to be approximately -1%, but this took place immediately after the entry into force of the decree. The modest impact was due to the fact that a significant part of the manure – more than one-third in the case of slurry – was being applied onto crops at the time when the decree entered into force, which meant that further incorporation was not possible. In addition, already before the amendment of the decree, a significant part of the manure applied on fields with no vegetation or fields covered with stubble was incorporated within 24 hours.

A farm that receives and stores manure from other farms must have a manure storage that is dimensioned according to the amount of manure received annually. A farm that receives and stores organic fertiliser products must have a water-tight storage space that is dimensioned according to the amount of fertiliser received. Organic fertiliser or dry manure with a dry matter content of at least 30 per cent may also be kept in a field heap.

The operator must conduct a manure analysis every five years to determine the soluble nitrogen, total nitrogen, and total phosphorus content of the manure. Fertilisation must be planned either based on the manure analysis or the values in the table presented in

the decree. The operator must retain the data from the manure analysis and the product specifications of organic fertiliser products and present them to the supervisory authority on request. The Nitrates Decree governs that the amount of total nitrogen in applied manure must not exceed 170 kg per hectare per year. The maximum amounts of soluble nitrogen per hectare for different plant and soil types are also determined. Maximum amounts of soluble nitrogen include the soluble nitrogen contained in inorganic fertilisers, livestock manure and organic fertiliser products.

In autumn, from the beginning of September, the amount of soluble nitrogen in livestock manure and organic fertiliser products must not exceed 35 kg/ha. The entire amount of soluble nitrogen applied in autumn must be considered as part of the total fertilisation of the following crop.

Pursuant to the Nitrates Decree, the operator must keep annual records of fertilisation and, on request, submit the information to the supervisory authority. The records must include the following: 1) the amount of manure, organic fertiliser products and nitrogen fertilisers used for adding nutrients to the field, and the concentrations of soluble nitrogen and total nitrogen contained in these; 2) the crop yield; and 3) the times when manure or organic fertiliser has been applied to the field.

3.1.2 Environmental permit or notification decision for a livestock building

According to the Environmental Protection Act (527/2014), an environmental permit or a notification decision must be obtained for activities posing a risk of pollution, or the activities must be registered. The permit or notification requirement for a livestock building is based on the keeping of animals in a production building. The keeping of animals also covers the livestock building's exercise and grazing area, as well as the storage, processing and utilisation of the manure, urine and wastewater generated in the building. The environmental permit or notification decision may include regulations on the limiting of ammonia emissions. Provisions on ammonia emissions are necessary to reduce the hazard to health and the environment caused by odours and airborne emissions, and to ensure compliance with international commitments (the Gothenburg Protocol and the National Emission Ceilings Directive). The environmental permit or notification decision may also include provisions stricter than those of the Nitrates Decree on matters such as quicker incorporation of manure (e.g., within four hours) and the covering of manure storages (including existing ones). Furthermore, the permit and notification decision may stipulate that the application of slurry is only allowed by means of injection or that application during windy conditions must be avoided.

The provisions in the permit or notification decision must be based on the best available technology, but the permit cannot demand that any specific technology be used. The goal when using best available technology is to prevent the release of emissions from the livestock building into the environment as much as possible by using the most environmentally efficient, economically feasible technical solutions and operating methods. A national report on best available technologies in livestock husbandry (Mikkola et al. 2002) has been used as one of the sources in this matter, but the report needs to be updated.

Pig and poultry production units included in the scope of the application of the Industrial Emissions Directive (IED) apply BAT conclusions concerning their industries that also include requirements on ammonia emissions. Environmental permit decisions for such "directive-size" livestock buildings specify emission limit values per animal place in such a manner that the target levels presented in the BAT conclusions will not be exceeded during the regular operating conditions of the building. The operators must also annually report their actual emissions. In Finland, IED units (large pig farms and poultry units) generate approximately 10% of all the ammonia emissions from livestock farming.

Measure T1:

Promoting the inclusion of provisions to reduce ammonia emissions in environmental permits and notification decisions.

Measure T2:

Updating the report *Paras käytettävissä oleva tekniikka kotieläintaloudessa* ("Best available technology in livestock farming in Finland"; Mikkola et al. 2002).

3.2 Rural Development Programme for Mainland Finland

The Rural Development Programme for Mainland Finland was prepared for 2014–2020. The validity period of the measures included in the programme was extended to 2021 and 2022, but allocations for the EU funding period 2021–2027 have been in use since 2021.

The measures in the ammonia action plan comply with the measures for the 2014–2020 programme period, and the plan is to also continue their implementation in the CAP strategy plan that will be prepared for 2023–2027.

3.2.1 Environmental payment measure on the injection of slurry into the soil

The most effective measure to reduce ammonia emissions in the Rural Development Programme for Mainland Finland is a parcel-specific measure concerning the injection of slurry into the soil, which is included in the scope of the environmental payment scheme. The measure has been applied in Mainland Finland since 2009 (Table 4). About 90% of farms that have applied for agricultural support have made the environmental commitment.

Table 4. Number of farms that implemented the measure of injecting slurry in fields in 2009–2020 and the area covered.

Year	Number of farms	Acreage where slurry was injected, ha
2009	1 482	50 330
2010	2 046	73 810
2011	2 566	94 231
2012	2 897	112 749
2013	2 919	119 410
2014	2 919	119 410
2015	5 300	217 000
2016	5 150	186 000
2017	5 031	188 468
2018	5 016	196 704
2019	4 862	199 027
2020	4 629	206 029

In this five-year commitment, the farmer is paid compensation to apply slurry and urine by means of injection. Payment of the compensation requires the application of at least 20 m^3 per hectare each year.

During the spring 2015 subsidy application period, some 12,500 farms (approximately 400,000 ha) selected this measure. Of these farms, 4,629 utilised the measure on 206,029 hectares in 2020. This means that a minimum of approximately 4.1 million cubic metres (20 m^3/ha x 206,029 ha) of slurry was applied by means of injection as a result of the injection of slurry into fields measure, which is almost half of the total slurry volume

(9.5 million cubic metres; Luostarinen et al. 2017). The actual volume is even higher, as some farms that apply slurry did not join the environmental payments scheme or did not choose the measure in question. Furthermore, the volume applied per hectare is most likely higher than the minimum volume of 20 m^3/ha specified in the conditions. In addition, application to an area that clearly exceeds the maximum acreage for the subsidy (60/80%) is not declared in the report of the application area. Annual fluctuation in the volume of injected slurry is caused by, for example, weather conditions and the crops currently in rotation.

In 2015–2020, farmers were paid compensation for the injecting of slurry for a maximum of 60% of the eligible arable area. The maximum percentage was increased to 80% for 2021 and 2022, which is expected to increase interest in this measure.

Measure T3:

Continuing with the support for application by means of injection as part of the agricultural support scheme in 2021–2027. Preparation of the CAP strategy plan for 2023–2027 is ongoing.

3.2.2 Agricultural investment aid

Investments improving the state of the environment

The building of manure storages and the cooling of manure channels are supported under the agricultural investment aid scheme. During the 2014–2020 programme period, aid could also be granted for other investments improving the state of the environment (Government Decree on Allocation of Farm Investment Aid, Valtioneuvoston asetus maatilan investointituen kohdentamisesta 241/2015, section 18). This included, among others, aid for the acquisition of manure separation and treatment equipment and equipment for the injecting of slurry. In 2016–2019, aid was granted for the acquisition of 61 pieces of slurry injection equipment and for the acquisition of 21 pieces of manure separation equipment. The cooling of manure channels is usually taken into account during a pig farm renovation project, but such renovations are also supported as separate projects. The support rate for investments improving the state of the environment is 35% and the support rate for the acquisition of slurry injection equipment is 40%.

Between 2000 and 2020, approximately 7,400 manure storages were built with the help of the investment aid (Table 5), of which 2,370 were covered. The total manure volume of these storages was approximately 10.4 million m^3, and the total space covered with a

concrete cover was 790,000 m^2. The total manure storage volume of non-covered manure storages for which investment aid has been granted was 7.7 million cubic metres and the volume of manure storages covered with a concrete cover was approximately 2.7 million m^3 (Table 6). When interpreting the tables, one should note that the statistics for slurry and urine tanks only include those covered with a concrete cover.

Table 5. Number of manure storages and urine tanks for which agricultural investment aid was granted in 2000–2020. Covered slurry and urine tanks only include those covered with a concrete cover.

Year	Storages for solid manure, pcs	Of which covered, pcs	Slurry tanks, pcs	Of which covered, pcs	Urine tanks, pcs	Of which covered, pcs
2000–2001	548	237	490	100	127	36
2002	311	119	330	73	60	15
2003	258	99	301	86	44	11
2004	195	87	188	35	27	6
2005	296	129	310	72	61	18
2006	229	92	279	56	37	15
2007	236	100	337	50	37	14
2008	96	57	162	30	7	2
2009	102	55	214	34	13	8
2010	70	28	176	33	12	3
2011	58	31	146	24	4	0
2012	52	32	116	20	2	2
2013	80	33	140	27	8	8
2014	43	24	89	6	2	1
2015	68	38	52	1	2	1
2016	108	85	109	5	3	0
2017	88	60	96	5	4	1
2018	113	90	121	5	3	1
2019	101	88	142	8	1	0
2020	75	67	92	7	1	1
total	3 127	1 551	3 890	677	455	143
share %		49.6		17. 4		31.4

Table 6. Total volume of manure storages and urine tanks for which agricultural investment aid was granted in 2000–2020. Covered slurry and urine tanks only include those covered with a concrete cover.

Year	Storages for solid manure, m^3	Of which covered, m^3	Slurry tanks, m^3	Of which covered, m^3	Urine tanks, m^3	Of which covered, m^3
2000–2001	264 941	114 582	506 602	103 388	46 170	13 088
2002	205 365	78 580	422 202	93 396	24 670	6 168
2003	151 221	58 027	446 776	127 650	13 138	3 285
2004	159 003	70 940	280 974	52 309	9 433	2 096
2005	204 697	89 209	465 727	108 169	21 524	6 351
2006	186 158	74 788	525 832	105 543	12 215	4 952
2007	273 474	115 879	683 215	101 367	11 824	4 474
2008	121 074	71 888	323 103	59 834	4 150	1 186
2009	90 285	48 683	510 746	81 147	4 160	2 560
2010	74 111	29 644	435 448	81 647	4 953	1 238
2011	98 376	52 580	334 275	54 949	990	0
2012	55 247	33 998	346 795	59 792	715	715
2013	75 354	31 084	331 832	63 996	2 585	2 585
2014	44 681	24 938	229 420	15 467	912	456
2015	130 286	65 506	116 665	2 500	4 448	2 114
2016	122 709	98 786	258 469	7 103	756	0
2017	90 708	69 506	261 408	5 879	1 644	500
2018	148 268	124 088	334 315	12 341	1 042	105
2019	117 939	106 524	451 084	21 276	516	0
2020	89 061	86 713	241 421	14 826	150	150
total.	2 702 958	1 445 956	6 459 502	1 160 238	163 309	52 023
share %		53.5		18.0		31.9

The volume of manure stored in covered storage spaces will increase as a result of the stipulations of the Nitrates Decree (1250/2014), but the change will be slow, which is why no changes are reflected in the currently available statistics. The covering of storages will become more common once the updated BAT conclusions for the Intensive Rearing of Pigs and Poultry (IRPP) entered into force on 21 February 2021.

New materials to cover manure storages are also being sought. Experiments with the use of biochar as a floating cover were carried out in a project called PYSTI. It proved to be a promising method of mitigating ammonia emissions. Buoyancy of the tested biochar types was good, and they decreased the nitrogen loss as efficiently as lightweight expanded clay aggregate. However, longer testing periods at farms and testing of the application technology are still required before the use of biochar as a cover material can be recommended (Hagner et al. 2020).

Measure T4:

Continuing the granting of investment aid to cover manure storages, cooling of manure channels and acquire manure treatment equipment, as well as to implement other investments that will reduce emissions.

Measure T5:

Promoting research on new manure storage cover materials. Investigating the practical performance of the new cover materials that have performed well in studies.

3.3 Other measures to reduce ammonia emissions

Measures with minor effects that are difficult to measure but that will still reduce the volume of ammonia emissions are presented below.

3.3.1 Environmental payments

Balanced use of nutrients

The balanced use of nutrients is a farm-specific measure included in the environment payment scheme of the Rural Development Programme for Mainland Finland. Its implementation will be continued during the 2021–2022 transition period. It includes maximum amounts for nitrogen and phosphorus used and more specific requirements

on cattle manure. The measure requires that the farmer accurately records all measures implemented in their fields using parcel-specific notes. The conditions must be complied with in all arable lands owned by a farmer who has given the five-year environmental commitment.

Nitrogen fertilisers can be used on a crop-specific basis and based on the circumstances of the parcel, but only by an amount per hectare that remains below the amount permitted by current legislation (legislation on fertiliser products and the Nitrates Decree). All nutrients included in livestock manure are taken into account in fertilisation.

Approximately 41,500 farms have opted for this environmental commitment. The commitment covers 2.05 million hectares of arable land, which is almost 90% of the total field area of the farms that have applied for direct aid.

Measure T6:

Continuing to support the balanced use of nutrients in 2021 and 2022. Preparation of the CAP strategy plan for 2023–2027 is ongoing.

3.3.2 Payment to farm advisory services

The measure concerning advisory services under the Rural Development Programme contributes to the reduction of excessive protein feeding by means of monitoring the feeding nutrient balance (the utilisation of nitrogen). Advice is also provided on the impact of feeding and the output levels on ammonia emissions. The payment to farm advisory services scheme includes environmental advice efforts to influence the nutrient balances of livestock farms. To achieve this, action is required regarding supplementary training for advisers and the materials used in the training. Advice is also necessary in the case of crop farms which use manure and organic fertiliser products as a source of nutrients for plants.

In collaboration with the Ministry of the Environment and appropriate stakeholders, the Ministry of Agriculture and Forestry has prepared a guide for farmers on the reduction of ammonia emissions from agriculture (Ministry of Agriculture and Forestry 2020). The guide aims to assist farmers who are considering which approach to the reduction of ammonia emissions would be best suited for their farm. The guide presents measures that can be used to reduce the ammonia emissions of a farm. It also includes information on the available incentives and practical tips from experts on how to reduce ammonia emissions.

Measure T7:

Handling through advice the importance of reducing excessive protein feeding to reduce ammonia emissions, as well as the optimal processing, storage and application of manure and organic fertiliser products, and the manner in which the nutrients in manure must be considered when fertilising plants. In investment-related advice, emphasising the significance of the covering of manure storages and the injecting of slurry in the reduction of ammonia emissions.

3.3.3 Animal welfare payment

The animal welfare payment scheme includes measures that contribute to the reduction of ammonia emissions, at least indirectly.

The feeding and care measures for cattle, pigs, sheep, and poultry must include a written feeding plan based on calculations for each group of animals which takes into account the growth of the animals, the output level and the production stage. A feed analysis must be prepared for roughage in the case of cattle and sheep. In the case of dairy cows and goats, the amount of milk must be measured. The grain used to feed poultry must be analysed for protein. An analysis must be prepared when changing the feeding plan if the batch of grain changes. If industrially produced feed is used, in which case the manufacturer has already analysed the grain, there is no need for any re-analysis. The results of the protein analysis must be included as part of the feeding plan. A total of 5,353 farms chose the feeding and care measure in 2020.

The animal feeding and care measure will be included as such in the new animal welfare plan in 2022. The change will be implemented with recovery funds. When the new CAP period starts in 2023, the welfare plans will probably remain as measures in the new animal welfare payment scheme.

For egg producing farms, there is a measure to improve the air quality of laying hen units, which requires the removal of manure from the premises three times per week. as well as recording the ammonia content in the air of the premises once a week. A limit value for the ammonia content has been specified. A total of 76 farms selected this measure in 2020.

In addition, there is a measure on the grazing and exercise of cattle, sheep and goats which provides aid for the grazing of animals during the pasture season (60 days) and

exercise outside the pasture season, as well as grazing for a longer period during the pasture season (90 days). Records of the grazing and exercise must be kept. A total of 1,912 farms were involved in these measures in 2020.

In addition to the farms included in the animal welfare payment scheme, approximately 1,000 farms receiving an organic livestock compensation grazed their animals in 2020.

The animal welfare payment scheme also includes conditions that require more abundant use of bedding in the pens.

Measure T8:

Continuing with the animal welfare payment scheme in 2021 and 2022. Preparation of the CAP strategy plan for 2023–2027 is ongoing.

3.3.4 Acid treatment of manure

In future, the introduction of new technologies may reduce ammonia emissions from agriculture. Acid treatment of manure is used in Denmark, and it has been studied in Finland. The acid treatment may take place in the livestock building, in a slurry storage tank or during the application of the manure on arable land. The acidification may reduce ammonia emissions by 20–80%, depending on the stage of the manure treatment process at which the acid is added, among other factors (Salo et al. 2015).

The possibility to use pyrolysis fluid to reduce ammonia emissions from slurry has also been studied in Finland. The fluid proved as effective as sulphuric acid: emissions were reduced by up to 99%. Disadvantages when compared to sulphuric acid include the multiple amount of chemical required (a significant increase in slurry volume), more foaming of the slurry, phytotoxic effects of organic compounds and a reduction in the usability of nitrogen due to the decomposition of compounds. Benefits include fewer flies in the slurry and a reduction of the distinctive smell of the slurry. Furthermore, the handling of pyrolysis fluid is safer than the handling of sulphuric acid (Hagner et al. 2020).

Measure T9:

Continuing with the studies on the suitability of various acids, the application techniques, and the effects on the ammonia emissions from manure under the Finnish conditions.

3.3.5 Feeding of livestock

The first step and first opportunity to influence the nutrient content of manure and thus the ammonia emissions released from the manure is the feeding of animals. The amount of protein in the feed, the quality of the feed and the capability of the animals to utilise the protein influence how much protein will remain unused and end up in the manure. The evaporation potential of ammonia increases as the nitrogen content in the manure increases. Feed should be analysed frequently to ensure that the composition of the animals' feed is known at all times. The feeding plan should be updated frequently enough to correspond to the animals' needs and the currently used feed. Furthermore, the portions should be measured or weighed, unless an automatic feed dispenser is used. This is also beneficial from the viewpoint of the farm's finances. Young cattle should be grouped in a manner which ensures that each group will receive the correct amount of protein to suit their needs. In the case of cows, the urea concentration of milk is an indication of how much crude protein there is in the feed. Urea is produced in the liver, mainly from excess ammonia absorbed from the rumen.

4 Structural change in agriculture

Agricultural production has experienced a major structural change since Finland joined the EU. In 1995, there were 95,562 agricultural and horticultural businesses in Finland, compared to 45,630 in 2020. The number of farms fell by more than 52% since 1995 and by around 1,200 farms since 2019. As the number of farms decreased, the average size of farms increased, from 22.8 hectares of field in 1995 to 50 hectares in 2020.

In recent years, the change in the production structure of agriculture has been characterised by a decrease in the number and share of livestock farms and an increase in the number and share of crop farms. For example, the number of dairy farms decreased from 31,000 in 1995 to 5,361 in 2020. During the same period, the number of dairy cows decreased from 398,500 to 259,600. The number of dairy cows decreased by almost one-fifth between 2005 (319,000 dairy cows) and 2020. During the same period, the ammonia emissions from dairy cows decreased by approximately the same amount, regardless of the fact that the amount of nitrogen released by a single animal increased by 15% due to an increase of the output level. This means that the measures to reduce emissions implemented during the same period compensated for the additional emissions caused by the increased nitrogen excretion.

The fast structural change in livestock farming and the increase of the unit size are still ongoing. The number of farms has decreased by 2.5% per year on average since 2000, or in the case of animal husbandry, by more than 7% per year. Should the decrease in livestock farms continue at this speed until 2027, the number of farms will drop to approximately 7,000, compared to more than 18,000 livestock farms in 2010. The number of farms specialising in dairy production will decrease to less than 4,000 by 2027, compared to almost 11,000 in 2010 (Huuskonen et al. 2020).

Those farms to be closed down are the smallest, which are the least profitable. Such farms are likely to have uncovered manure storages, which means that the number of uncovered storages will experience a considerable decrease as farms are closed down. Meanwhile, those farms that expand their operations will have to cover their new storage spaces, and they may also be required to cover the existing ones during the permit or notification procedure. The size of the remaining livestock units will increase and their operating methods will be more resource-efficient. Many operations that require special machinery or major investments in machinery are outsourced to private entrepreneurs. Farmers may

also sell contracting services to other farmers. This means that many of the operations involving the handling of manure will be more efficient and more professional, which will reduce the level of emissions, including ammonia emissions.

The large financial risks involved in the expansion of production units force farmers to work more professionally in order to minimise resource losses and optimise financial results. This also means that the optimisation of feeding will become more common. The change in operating culture associated with the larger unit size and the outsourcing of operations will contribute to the reduction of nitrogen losses.

The structural changes include changes in the number of animals and the size of livestock production units, which will lead to slurry systems and the covering of slurry tanks becoming more common, and the development of slurry application methods in a manner which will lead to reduced ammonia releases. Combined with legislative changes, the targeting of the environmental payments scheme measures, investment aids, advisory services and training, research projects and cooperation projects, the above-mentioned structural changes will make a significant contribution to the reduction of ammonia emissions. In this respect, the emission reduction analyses have taken into account assessments on the development of the number of animals and changes in manure processing by 2027 (see Section 7).

5 Fur farming

5.1 Production

Fur farming is highly concentrated in specific parts of Finland, mostly in the region of Ostrobothnia. There are also areas where fur farming is more common within this region. The number of fur farms has steadily decreased but the average farm size has increased, and thus the total production volume has remained more or less the same. At the end of 2020, the Finnish Fur Breeders' Association had 632 members, and those members had some 700 fur farms. In addition, there are a few dozen businesses (estimated number 20–30) that produce fur but are not members of the association. Most of the fur farms need an environmental permit due to their size. Approximately 10% of the ammonia emissions from agriculture originate from fur farms.

Most fur farms do not have any arable land of their own. Manure is utilised by means of agreements with other farms, i.e. another farm accepts the manure and uses it as fertiliser. Another option is delivering the manure to a composting plant to be forwarded to end users, such as farms, or to be refined for horticultural use and into substrate suitable for private customers. There are also joint fur farming areas in Finland utilising shared composting plants for fur animal manure. There are only a few composting plants or other facilities that process manure, however. Even though the manure from fur animals represents a fairly small proportion of the total livestock manure volume in Finland, its nutrient contribution is significant, as the manure is rich in nutrients. Furthermore, it is generated in areas with other livestock production activities.

In Finland, fur animals are bred mostly in open-sided animal sheds. The floors of many open-sided animal sheds are no longer concrete but made from another water-tight material. Some mink farms have started to breed their animals in hall buildings. Hall breeding has not become more common, however, as hall buildings are expensive to build. Some open-sided animal sheds with an earthen floor are also still in use. Intensified environmental protection measures are specified for these in the environmental permits.

The runoff water treatment processes and water-tight foundations for manure at fur farms utilise the best available technology, and are a prerequisite for the granting of an environmental permit. It has been estimated that more than half of fur farms currently have water-tight foundations in their shelter and hall buildings. There are runoff water treatment systems at an estimated 80% of farms. A water-tight floor is always installed when facilities are renovated or new ones are built. However, the manure is removed from the foundation rather infrequently, which means that the ammonia emissions are higher

than in the case of manure stored in a manure storage. The ammonia emissions released from manure under open-sided animal sheds can be reduced by removing manure frequently enough, by preventing rainwater from entering the manure storage and by using a sufficient amount of bedding.

The nutrient content of fur animal manure can be affected by modifying the animals' feeding. The more protein there is in the fur animal feed, the more nitrogen there will be in their manure. Excessive protein feeding can be monitored via the feeding nutrient balance. Optimising the feeding of each animal would reduce excessive excretion of nutrients into the manure and ensure a sufficient supply of nutrients.

5.2 Steering instruments and related measures to reduce ammonia emissions

5.2.1 Legislative means

Environmental permit

The environmental permit for a fur farm includes provisions on matters such as the removal and storage of manure. In the case of fox farms, the manure must be removed once or twice per year and in the case of mink farms, three to four times per year. All fur farms have an environmental permit requirement to use a sufficient amount of bedding, either shredded straw or peat, under open-sided animal sheds. The manure removal technology and related equipment design in the industry is still rather crude.

Nitrates Decree

The Nitrates Decree (1250/2014) governs the storage requirements for fur animal manure. Manure must be stored in a manure storage, and the capacity of the manure storage must be sufficient for manure collected over the course of 12 months. Pursuant to the Nitrates Decree, all new manure storages must be covered. The regulations on the application of manure in the Nitrates Decree also apply to the manure of fur animals.

Environmental protection guide

In 2018, the Ministry of the Environment published an environmental protection guide for fur farms (Ministry of the Environment 2018), which promotes the implementation of environmental protection measures at fur farms and provides instructions on how to reduce ammonia emissions from the processing and storage of manure. The guide is also used as an aid in advice activities.

Measure T10:

Promoting the implementation of measures in the environmental protection guide for fur farms.

In addition, Measure T2 covers the reduction of emissions from fur farming, as the report Paras käytettävissä oleva tekniikka kotieläintaloudessa ("Best available technologies in livestock farming in Finland"), which is currently being updated, also applies to fur farms.

5.2.2 Other measures

Payment to farm advisory services

The measure concerning advisory services in the Rural Development Programme may also influence ammonia emissions from fur farms. Knowledge on the climate impacts of fur farming should be enhanced by providing further training and teaching materials for advisers.

Measure T11:

Providing more advice on air pollution control in fur production. The provided advice emphasises the means of reducing ammonia emissions during the processing and storage of manure.

Research

More research on the environmental impact of fur farming (incl. ammonia emissions), the means of mitigating disadvantages and related costs, as well as the utilisation of fur animal manure is required.

Nutrient recycling pilot programme 2020–2022

Recycling of nutrients in fur animal manure

A development project on the environmental footprint and nutrient cycle of fur farming (TASSUNJÄLKI) for 2021 and 2022 has been launched as part of the pilot programme. A key goal of the project is to efficiently put into practice existing environmental research data regarding fur farming, the nutrient cycle and the environmental impact of fur animal manure, in particular. The project utilises criteria for the environmental footprint of furs that was completed in the spring of 2021 and an environmental footprint calculator developed on the basis of the criteria.

6 Measures and their effectiveness

This action plan applies to the reduction of ammonia emissions from agriculture. The ammonia emission reduction commitments in Finland are based on international commitments on the reduction of emissions into the air (see Chapter 1). The ammonia emissions from Finland can be a maximum of 31 kt/year until 2019 and a maximum of 30 kt/year starting from 2020 (the emission ceiling). In 2019, the ammonia emissions to be compared to the emission ceiling were 30.2 kt, of which agriculture accounted for 28.5 kt.

Both the total ammonia emissions and emissions from agriculture continued to decrease throughout the 2010s, with the exception of 2014 (Table 1). The emission reduction commitment changed from absolute to relative starting from 2020. The ammonia emission reduction commitment for Finland is 20% compared to emissions in 2005.

The action plan utilises the agricultural emission calculation model (Grönroos et al. 2017).

The agricultural ammonia emission reduction measures T1–T11 for 2021–2027 are:

- T1: Promoting the inclusion of provisions to reduce ammonia emissions in environmental permits and notification decisions.
- T2: Updating the report Paras käytettävissä oleva tekniikka kotieläintaloudessa (“Best available technology in livestock farming in Finland”; Mikkola et al. 2002).
- T3: Continuing with the support for application by means of injection as part of the agricultural support scheme in 2021–2027. Preparation of the CAP strategy plan for 2023–2027 is ongoing.
- T4: Continuing the granting of investment aid to cover manure storages, cooling of manure channels and acquire manure treatment equipment, as well as to implement other investments that will reduce emissions.
- T5: Promoting research on new manure storage cover materials. Investigating the practical performance of the new cover materials that have performed well in studies.

- T6: Continuing to support the balanced use of nutrients in 2021 and 2022. Preparation of the CAP strategy plan for 2023–2027 is ongoing.
- T7: Handling through advice the importance of reducing excessive protein feeding to reduce ammonia emissions, as well as the optimal processing, storage and application of manure and organic fertiliser products, and the manner in which the nutrients in manure must be considered when fertilising plants. In investment-related advice, emphasising the significance of the covering of manure storages and the injecting of slurry in the reduction of ammonia emissions.
- T8: Continuing with the animal welfare payment scheme in 2021 and 2022. Preparation of the CAP strategy plan for 2023–2027 is ongoing.
- T9: Continuing with the studies on the suitability of various acids, the application techniques and the effects on the ammonia emissions from manure under the Finnish conditions.
- T10: Promoting the implementation of measures in the environmental protection guide for fur farms.
- T11: Providing more advice on air pollution control in fur production. The provided advice emphasises the means of reducing ammonia emissions during the processing and storage of manure.

The measures are presented in more detail in Chapters 3–5 of this plan.

Compared to broadcast application and assuming that the manure is not incorporated after application, the injecting of slurry reduces the amount of released ammonia by 80% on average (injecting close to the surface less than this and injecting deeper into the soil more than this). Similarly, application with a trailing hose spreader reduces emissions by approximately 30–35% (the effect is greater in the case of application onto crops).

According to national legislation (Nitrates Decree 1250/2014), manure applied on land surface must be incorporated within a period of 24 hours, except in the case of application of manure onto growing crops. Hence, part of the manure applied by means of trailing hose spreading or broadcasting will be incorporated after application with a plough or harrow. The emission reduction effect of incorporation varies between 15% and 90%, depending on the incorporation method and how fast after the application of the manure the incorporation takes place.

It has been estimated that the proposed measures will increase the injecting of slurry and speed up the incorporation of manure applied on land between 2021 and 2027. The share

of injecting has been estimated to increase to 70% by 2025 (estimate for 2019: 62%) and to remain at this level. The incorporation of manure applied on land is expected to occur within 12 hours by 2030 (the share in 2019 was approximately 70–80%).

- By 2027, the increased use of injection into the soil is expected to reduce ammonia emissions from agriculture by approximately 1 kt from the 2019 level.

It has also been estimated that the covering of manure storages will become more common as storages are renovated.

- By 2027, the covering of manure storage is expected to reduce ammonia emissions from agriculture by approximately 0.2 kt from the 2019 level.

The number of cattle and pigs is expected to decrease by approximately 10% between 2019 and 2027. No major changes are expected in the numbers of other animals.

- As a result of the changes in the numbers of animals, ammonia emissions from agriculture will be reduced by approximately 1.8 kt by 2027.

The amount of nitrogen excreted by livestock into their manure (kg N per animal place per year) is expected to remain at roughly the current level, except for dairy cows, in the case of which the increase in the nitrogen level is expected to continue.

- The changes in nitrogen excretion will increase ammonia emissions from agriculture by approximately 0.1 kt by 2027.

All the above-mentioned factors combined will reduce ammonia emissions from agriculture by approximately 3 kt (11%) from the 2019 level by 2027. According to this estimate, ammonia emissions from agriculture would be approximately 25.5 kt in 2027.

In addition to the above-mentioned factors, the use of inorganic nitrogen fertilisers and the use of organic fertilisers other than manure will have an impact on ammonia emissions from agriculture. Of these, the use of inorganic nitrogen fertilisers is expected to remain at roughly the 2019 level in 2027, which means that there will be no major change in the emissions, unless the shares of urea fertilisers and surface-applied fertilisers increase. No major changes in the use of other organic fertilisers are to be expected. Emissions from the burning of straw and stubble in fields have practically come to an end as the result of a ban on burning as of the beginning of 2021. Stubble burning was allowed in the CAP cross compliance standards until the end of 2020 if it was necessary for sowing or to control weeds, crop diseases or pests. This exception no longer applies.

7 Monitoring of the action plan

Both agricultural and environmental authorities annually monitor the achievement of the emission reduction targets. Farms committed to the environmental payment measure on the injection of slurry into the soil, must annually report to the agricultural authority the amount of manure they have applied using the injection method. The agricultural investment aids are used to, for instance, guide farmers towards investing in solutions that will reduce emissions. Investments in the covering of manure storages are monitored, and annual statistics are prepared based on both the size and volume of the storages.

The ex-post evaluation of the Rural Development Programme 2014–2020 will assess how much the measures included in the programme reduced ammonia emissions (a sample study). The evaluation will take place in 2025–2026. Implementation of the projects included in the programme will continue until the end of 2022. The planning and scheduling of evaluations for the new CAP period that will start in 2023 is currently ongoing.

To ensure the achievement of the emission reduction targets, agricultural entrepreneurs will be informed of changes in the operating environment, new research results and measures that will reduce emissions, and they will be encouraged to utilise these. Advice for agricultural entrepreneurs plays a major role here, and the advisory operations will be optimised and targeted in a manner that will reduce the ammonia emissions. At present, most of the environmental measures, such as the injecting of slurry, are voluntary. If the targets are not reached, however, other options to reduce the level of emissions must be considered.

The agricultural thematic group of the National Air Pollution Control Programme 2030 annually monitors the achievement of measures T1–T11.

8 Compliance with emission reduction commitments

In 2019, ammonia emissions comparable to the emission ceiling were 30.2 kt, of which agriculture accounted for 28.5 kt. Ammonia emissions from Finland must not exceed 31 kt/year until 2019 and a maximum of 30 kt/year starting from 2020.

The measures presented in Chapter 6 will reduce emissions from agriculture by approximately 3 kt between 2019 and 2027. Hence, Finland's ammonia emissions in 2027 are estimated at 28.5 kt. The measures would therefore be sufficiently effective, and according to the calculations, the emissions (28.5 kt) would remain below the emission ceiling (30 kt) in 2027. Flexibility (Chapter 9) would not be required. Agriculture would account for 25.5 kt of the 2027 ammonia emissions.

Finland's ammonia emissions are annually reported in compliance with the National Emission Ceilings Directive to the Commission and in compliance with the UN Convention on Long Range Transboundary Air Pollution to the Secretariat of the Convention. As part of these processes, the maintenance of Finland's ammonia emissions below the emission ceilings is also annually monitored.

9 Emission inventory flexibilities

One of the aspects that is taken into account when verifying compliance with the emission reduction commitments is flexibility. Member states can apply for flexibility from the European Commission in compliance with Article 5 of the National Emission Ceilings Directive. Flexibility is available on the following basis, for example:

- Calculation methods or emission factors have changed from the previous ones due to scientific developments, and the emission reduction commitments have been exceeded as a result of this
- An exceptionally cold winter or an exceptionally dry summer
- If a reduction commitment has been set at a more stringent level than the cost-effective reduction and the member state has implemented all cost-effective measures, the member state may replace the missing reduction commitment with a corresponding commitment for another type of emission

Changes in activity are not an entitlement to any inventory flexibilities.

Up until 2019, Finland had approved flexibility regarding ammonia emissions from small-scale wood burning and road traffic but not from agriculture. For example, the flexibility for 2018 was -1.5 kt and for 2019 -1.4 kt.

The flexibility application criteria have changed, and Finland must reapply for this flexibility for 2020 by the end of 2021, if necessary. In August, at the time of the writing of these instructions, the preparation of this matter and the required background assessments were still unfinished. The preliminary estimate is that Finland will most likely require inventory flexibility during the first years of the 2020–2027 period.

About the terms: flexibility, adaptation or adjustment?

The previous Action plan to reduce ammonia emissions from agriculture in Finland (Ministry of Agriculture and Forestry 1/2018) used the term *mukautus* ("adaptation").

Existing EU legislation covers for the flexibility of emission inventories in Article 5 of the National Emission Ceilings Directive (2016/2284). The heading of the Article is "Flexibilities" in English and "Joustomahdollisuus" in Finnish. There are further regulations on the matter in Annex IV Part 4 of the Directive, where the English version uses the term "adjustment" and the Finnish version "sopeutus".

There were no regulations on flexibilities in the previous National Emission Ceilings Directive (2001/81/EC). At that time, adjustments were applied from the executive body of the Gothenburg Protocol of the UNECE Convention on Long Range Transboundary Air Pollution.

The National Emission Ceilings Directive was enforced in Finnish national legislation by amending the Environmental Protection Act on 18 January 2019. Section 149b of the Environmental Protection Act regulates the flexibilities. As the Environmental Protection Act uses the term "jousto" (flexibility), the same term is used in this action plan.

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Ministry of Agriculture and Forestry

Hallituskatu 3 A , Helsinki
FI-00023 Government, Finland

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ISBN: 978-952-366-192-9 PDF

ISSN: 1797-397X PDF