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Methodology for use in relation to EU SAIO Nutrient Balances

Technical Report from DCE – Danish Centre for Environment and Energy No. 395 2026

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Data sheet

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Abstract: This report describes methods used for deriving input to the nutrient balances for nitrogen (N) and phosphorus (P) under the EU SAIO framework for Gross Nutrient Balances (GNB). The methodology integrates multiple data sources, including agricultural statistics, monitoring programmes, atmospheric modelling and the Danish normative system for livestock excretion. Nutrient inputs and outputs are quantified using standardised coefficients for crops, residues, biological nitrogen fixation, atmospheric deposition, seeds and manure flows. Emphasis is placed on the consistent accounting of livestock-derived nutrients and the complex handling of manure transfers and processing. Overall, the methods applied ensure harmonised nutrient accounting aligned with EU reporting requirements.

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Contents

Preface

According to the SAIO implementing regulation on nutrient balances (EU 2024), Eurostat must compile annual nutrient balances (for nitrogen, N and phosphorus, P) for the agricultural sector in each Member State from 2030. From 2029, Member States must therefore regularly provide Eurostat with the required production data and nutrient coefficients.

Statistics Denmark already provides Eurostat with data on livestock production, crop yields and cultivated area. In the future, these data must be supplemented with new data types, including coefficients for N and P content. Statistics Denmark has asked AU to prepare documentation of methods and data sources for calculating nutrient coefficients and to provide nutrient coefficients for the years 2022-2024, and for selected data types in 2025 for delivery to Eurostat.

This report describes the methods for obtaining nutrient coefficients related to the following elements in the nutrient balances:

- N and P content in harvested main crop
- N and P content in harvested crop residues
- N deposition from air
- N fixated by leguminous crops
- N and P contents in seeds for sowing (only for cereals and potatoes)
- N and P contents in produced manure (from animals)
- N and P contents in manure imported and exported to/from external sources, e.g. biogas plants.

In addition to the documentation of methods, nutrient coefficients representing the reference years 2022, 2023 and 2024 and – for selected data types – 2025, are presented.

Sammenfatning

EU's rammer for opgørelse af næringsstofbalancer for landbrugssektoren blev etableret af den Europæiske Statistiske Komité (ESSC) i 2017 og implementeret gennem SAIO-forordningen (EU 2022) samt den tilhørende gennemførelsesforordning for næringsstoffer (EU 2024). EU's medlemsstater er forpligtet til at indrapportere deres første harmoniserede datasæt i 2029, som dækker årene 2026-2028.

SAIO-næringsstofbalancerne omfatter et bredt spektrum af input, såsom husdyrgødning, mineralsk og organisk gødning, biologisk kvælstoffiksering, atmosfærisk deposition samt næringsstoffer i såsæd. Fraførsler omfatter høstede afgrøder, afgrøderester fjernet ved høst samt eksport af husdyrgødning. SAIO- næringsstofbalancerne er kendetegn ved at systemet tager udgangspunkt i næringsstofproduktionen fra husdyr på stald, hvilket gør det mere omfattende end traditionelle markbalancer, som tager udgangspunkt i husdyrgødning tilført til marken.

I Danmark bygger metoderne til estimering af næringsstofkoefficienter på etablerede nationale datasæt, herunder data fra Danmarks Statistik og data indsamlet fra landmænd gennem de årlige gødningsregnskaber. Næringsstofkoefficienter for afgrøder stammer fra måleprogrammer, fodertabeller og fødevaredatabaser, mens værdier for afgrøderester baseres på målte næringsstofindhold og produktionsdata. Biologisk kvælstoffiksering estimeres ved hjælp af en empirisk model, der tager højde for plantebiomasse, kvælstofindhold og en række korrektionsfaktorer, herunder processer under jorden. Atmosfærisk kvælstofdeposition modelleres ved hjælp af en danske langtransportmodel (the Danish Eulerian Hemispheric Model, DEHM), som giver rumligt detaljerede og årligt opdaterede estimater.

Næringsstofkoefficienter for udskillelse af N og P fra husdyrene beregnes ved hjælp af det danske normsystem, som anvender massebalanceprincipper baseret på foderindtag, produktion og næringsstofretention. Disse koefficienter er i overensstemmelse med UNFCCC-rapportering, men tilpasset de mere detaljerede SAIO-husdyrkategorier. Selvom den nationale samlede næringsstofudskillelse er robust, indebærer fordelingen mellem underkategorier antagelser på grund af forskelle mellem produktionsbaserede data og statistikker over dyrebestande.

Strømme af husdyrgødning ind og ud af bruttobalancens systemgrænser udgør en kompleks komponent. Næringsstoffer fra husdyrgødning kan fjernes fra landbruget (fx til biogasproduktion eller eksport) og senere returneres som forarbejdede gødningsprodukter. De danske gødningsregnskaber giver samlede mængder af N og P, men mangler oplysninger om mængderne af husdyrgødning (ton gødning) og deres næringsstofindhold, hvilket kræver supplerende omregninger baseret på standardkoefficienter.

Det er vigtigt at bemærke, at SAIO's bruttobalancer for næringsstoffer adskiller sig fra de danske markbalancer beregnet i forbindelse med Landovervågningsprogrammet under NOVANA, som kun medtager næringsstoffer tilført markerne og dermed ikke indeholder ammoniakemissioner fra husdyrgødning i stald og lager. De to tilgange er derfor ikke direkte sammenlignelige.

Summary

The EU framework for gross nutrient balances (GNB) was established by the European Statistical System Committee (ESSC) in 2017 and implemented through the SAIO Regulation (EU 2022) and its nutrients implementing regulation (EU 2024). EU Member States are required to deliver their first harmonised datasets in 2029, covering the years 2026–2028, using multi-year averages. Within SAIO, nutrient balances are defined at the land level, capturing all nitrogen (N) and phosphorus (P) inputs to and outputs from agricultural land.

The SAIO nutrient balance includes a comprehensive set of inputs—such as livestock excretion, mineral and organic fertilisers, biological nitrogen fixation, atmospheric deposition and input from seeds. Outputs include harvested crops, crop residues removed from fields and manure exports. A key feature of the system is its integration of livestock-derived nutrient production, making it broader in scope than traditional field balances.

In Denmark, methods build on established national datasets covering data from Statistics Denmark and data collected from farmers in the annual fertiliser accounts. Crop nutrient coefficients are derived from monitoring programmes, feed tables and food composition databases, while crop residue values are based on measured nutrient contents and production data. Biological N fixation is estimated using an empirical model that accounts for plant biomass, N content and several correction factors, including below-ground processes. Atmospheric N deposition is modelled using the Danish Eulerian Hemispheric Model (DEHM), providing spatially detailed and annually updated estimates.

Livestock excretion coefficients (NEC and PEC) are calculated using the Danish normative system, which applies mass balance principles based on feed intake, production and nutrient retention. These coefficients are aligned with UNFCCC reporting but adapted to detailed SAIO livestock categories. While the overall national nutrient excretion is robust, allocation across sub-categories involves assumptions due to differences between production-based data and animal population statistics.

Manure flows in and out of the boundaries of the gross balance represent a complex component. Nutrients from manure may be removed from agriculture (e.g. for biogas production or export) and later returned as processed fertilisers. Danish fertiliser accounts provide total N and P flows but lack information on manure quantities and nutrient concentrations, requiring additional conversion methods based on standard coefficients.

Importantly, SAIO gross nutrient balances differ fundamentally from Danish field balances published under the national monitoring NOVANA, which only consider nutrients applied to fields and exclude livestock production and storage losses. As a result, the two approaches are not directly comparable.

Overall, the Danish implementation of SAIO nutrient balances combines detailed national data, modelling approaches and standardised coefficients to ensure consistent national nutrient accounting, while acknowledging uncertainties in data integration, manure flows and parameter estimates.

1 Nutrient balances for N and P under SAIO

In 2017, the European Statistical System Committee (ESSC) approved an agreement regarding gross nutrient balances (EUROSTAT 2017). The ambitions of this agreement were implemented in a new version of the Statistics on Agricultural Input and Output (SAIO) Regulation (EU 2022) and are defined in detail in the SAIO Nutrients Implementing Regulation (EU 2024). EU Member States are required to provide the first dataset under this regulation in 2029 covering data from the reference years 2026, 2027 and 2028. Data should be provided as 3- or 5-year running averages, depending on the type of data.

Nutrient balances for agriculture can differ based on the system boundaries they refer to, such as farm, soil/field or land. The nutrient balances that will be estimated by EUROSTAT under SAIO can be categorised as land balances or Gross Nutrient Balances (GNB). An overview of the inputs and outputs in the SAIO nutrient balances is shown in figure 1.1.

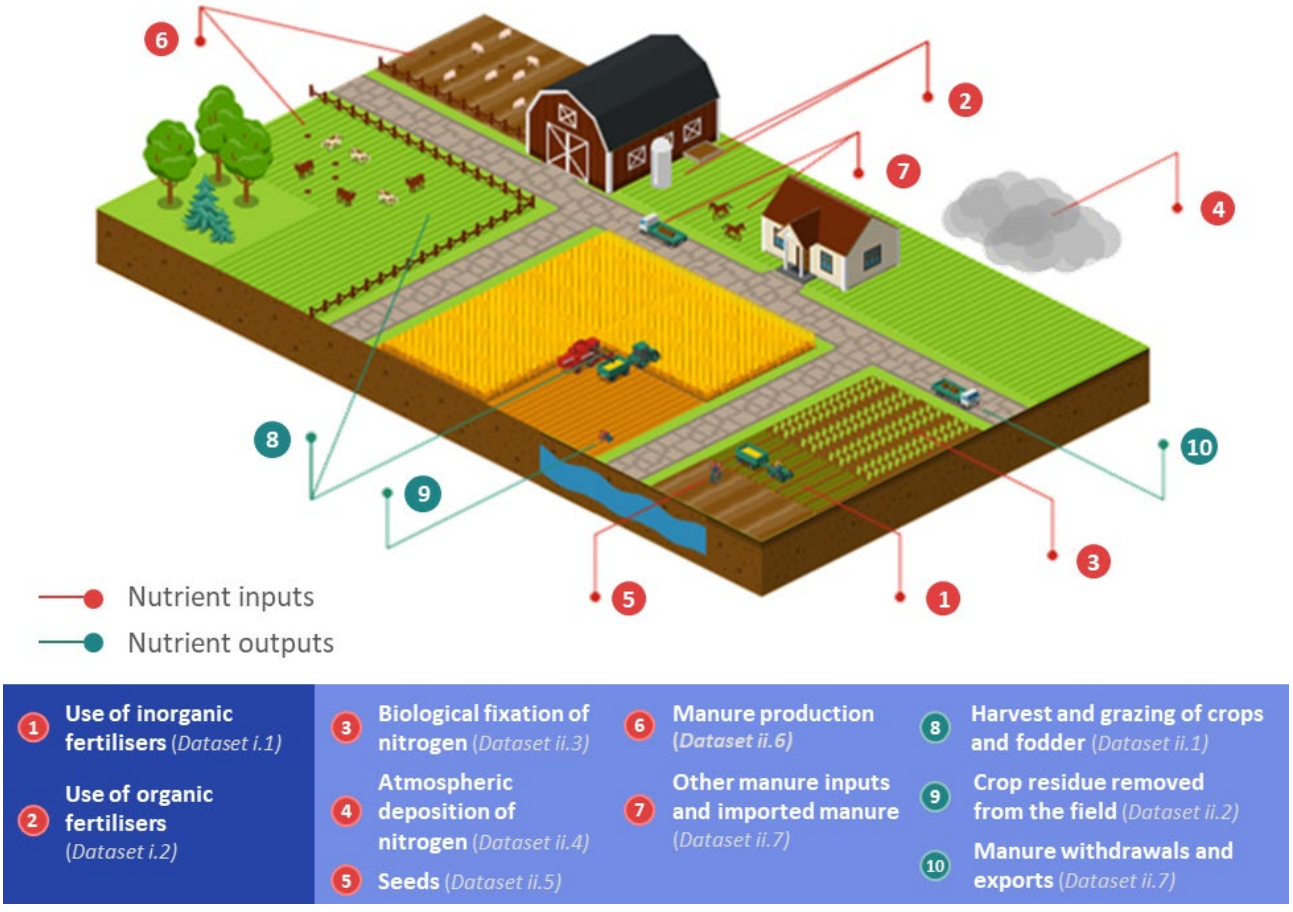

Figure 1.1. Schematic overview of elements of the gross nutrient balances for N and P under SAIO (EUROSTAT, 2026).

1. The use of inorganic fertilisers is directly reported to EUROSTAT by Statistics Denmark under SAIO. This data type is therefore not included in this report.
2. The use of organic fertilisers covers organic fertilisers, except raw animal manure, which is included under item 6. This includes sewage sludge, organo-mineral fertilisers and other organic fertilisers (e.g. processed manure from biogas plants). The quantities of N and P covered by these data

types will be provided by the Agency for Green Transition and Aquatic Environment (SGAV) based on national data collected when farmers report their fertiliser accounts. The total quantities of N and P have to be supplemented with estimates the total quantities in tonnes of dry matter (Q) and the corresponding N and P coefficients (kg N or P per tonne of dry matter). The estimation method is described in section 2.6 of this report.

3. Biological fixation of N by leguminous crops in the fields should be provided as kg N per tonne harvested dry matter. The estimation method used in Denmark is described in section 2.2.
4. Atmospheric deposition of N should be provided in kg N/ha of agricultural soil. The estimation method used in Denmark is described in section 2.3.
5. Nutrient input from seeds when sowing. This only covers seeds from cereals and potatoes. The estimation method used in Denmark is described in section 2.4.
6. Total nutrient input from manure production (livestock excretion) should be determined for a list of livestock categories and given in kg N or P per head. The estimation method used in Denmark is described in section 2.5.
7. Other manure inputs (e.g. from livestock categories not included in item 6) or manure imported from other countries. The quantities of N and P covered by these data types will be provided by SGAV based on national data collected when farmers report their fertiliser-accounts. The total quantities of N and P must be supplemented with estimates of the total quantity in tonnes of dry matter (Q) and the corresponding N and P coefficients (kg N or P per tonne of dry matter). The estimation method is described in section 2.6 of this report.
8. The harvest of dry matter from different crops and fodder types is directly reported to EUROSTAT by Statistics Denmark under SAIO. To estimate the harvested quantities of N and P, this dataset will be supplemented with nutrient coefficients for each crop category. The estimation method is described in section 2.1.1 of this report.
9. The harvest of dry matter in crop residues removed from the fields (mainly straw) is directly reported to EUROSTAT by Statistics Denmark under SAIO. To estimate the harvested quantities of N and P, this dataset will be supplemented with nutrient coefficients for each residue category. The estimation method is described in section 2.1.2 of this report.
10. Manure that is not used directly as fertiliser but is instead removed for use in other sectors (e.g. for energy production) or exported to other countries. The quantity of N and P covered by these data types will be provided by SGAV based on national data collected when farmers report their fertiliser-accounts. The total N and P quantities must be supplemented with an estimate of the total quantity in tonnes of dry matter (Q) and the corresponding N and P coefficients (kg N or P per tonne of dry matter). The estimation method is described in section 2.6 of this report.

1.1 Relation to Danish field balances estimated in NOVANA LOOP

As part of the annual reporting of data collected under the Danish monitoring programme for small agricultural-dominated catchments (LOOP), Aarhus University estimates field balances of N and P, which are published in an annual report (Thorsen et al., 2025). The approach used focuses on the field as the boundary, considering only the nutrient inputs to the fields (such as manure and mineral fertiliser application and nitrogen fixation) and the nutrient

outputs from it (harvested crops). The main difference from the SAIO gross balances is that it only addresses the quantity of nutrients in manure applied to the fields (N from storage) and not the quantity of nutrients produced by the livestock (N from animals). The loss of N by volatilization or denitrification occurring in the stables or in the manure storage facilities is not included in the field balance.

The SAIO gross balances can therefore not be directly compared with the national field balances for Denmark.

2 Nutrient coefficients for Danish agriculture

2.1 Harvested N and P

Gitte Blicher-Mathiesen, Department of Ecoscience

Crop and forage nutrient content coefficients (Annex ii, dataset 1)

Data on the produced quantities of crop products will be provided by Statistics Denmark under the SAIO domain for Crop Statistics.

Nitrogen (N) and phosphorus (P) coefficients for harvested grain products are presented in table 2.1. Grain samples used for determining N and P contents were collected as part of the annual Danish grain monitoring programme conducted by SEGES Innovation (SEGES, 2025). Sampling was carried out in collaboration with commercial feed companies across seven geographically distributed regions in Denmark, ensuring broad coverage of national production conditions. The results were calibrated using reference samples and standardised to a moisture content of 15%.

For grain maize and corn cob mix, data were obtained from the feed table (Møller et al., 2005). The code C1990 for "other cereals" includes mixtures of cereals and pulses, where pulses constitute less than 50%. Nutrient contents for these mixtures are also derived from the feed table (Møller et al., 2005).

Table 2.1. Nitrogen and phosphorus coefficients for cereals, grain maize and other cereals for the period 2022-2025.

Code				Nitrogen coefficient (kg N/tonne harvested product)				Phosphorus coefficient (kg P/tonne harvested product)			
EU	FK code	Danish crop name	English crop name	2022	2023	2024	2025	2022	2023	2024	2025
C1111	SEGES	Vinterhvede	Common winter wheat and spelt	15.84	14.4	15.04	14.4	2.5	2.3	2.6	2.5
C1112	SEGES	Vårhvede	Common spring wheat and spelt	13.92	13.1	16.8	13.44	2.5	2.3	2.6	2.5
C1210	SEGES	Rug	Rye	12.8	11.5	12.32	11.68	2.5	2.4	2.6	2.5
C1310	SEGES	Vinterbyg	Winter barley	14.56	14.2	14.72	13.92	2.6	2.4	2.7	2.6
C1320	SEGES	Vårbyg	Spring barley	13.92	13.1	16.8	13.44	2.8	2.8	3	2.8
C1410	SEGES	Havre	Oats	15.2	14.1	16.8	13.6	2.9	3	2.8	2.8
C1420	SEGES	Vårblandsæd	Spring cereal mixtures (mixed grain other than maslin)	13.92	13.1	16.8	13.44	2.8	2.8	3	2.8
C1500	204	Majs til modenhed	Grain maize and corn-cob-mix	13.44	13.4	13.44	13.44	3.2	3.2	3.2	3.2
C1600	SEGES	Triticale	Triticale	16.64	13.8	15.04	14.24	2.7	2.4	2.8	2.8
C1990	2015	Andet korn	Other cereals n.e.c.	24.99	25	24.99	24.99	3.2	3.2	3.2	3.2

N and P coefficients for harvested pulses, root crops and industrial crops such as oilseed rape are presented in table 2.2. The table also includes data on dry matter and N and P contents for each product, along with their corresponding product codes from the feed table (Møller et al., 2005).

For the two potato classes Potatoes (including seed potatoes) and Potatoes for processing, the same contents of dry matter, N and P were used, even though we expect a slightly smaller dry matter content in Potatoes (including seed potatoes). The production of Potatoes for processing covers 81-84% of the total potato production for the period 2022-2024 (Statistics Denmark, 2026).

The N and P contents and coefficients for fodder crops, such as temporary grasses and grazing, green maize and other cereals harvested green, are presented in table 2.3. Reference data for nutrient content and product codes are from Møller et al. (2005).

Nutrient contents for fresh vegetables (including melons) and strawberries were obtained from the Danish food composition database (DTU Food Institute, 2024), which provides standardised values for dry matter, protein and P contents of foods available on the Danish market (table 2.4). The P content reported in mg P per 100 g fresh weight was converted to kg P per tonne of product by multiplying by 0.01.

Table 2.2. Nitrogen and phosphorus content and coefficients for dry pulses, root crops, industrial crops and seedlings. Reference for values with the product code from (Møller et al., 2005).

Code EU	Danish crop name	EU crop name	Reference	Dry matter	Nitrogen content	Phosphorus content	Nitrogen coefficient	Phosphorus coefficient
			Code no.	(%)	(Dry matter %)		(kg N/tonne harvested product)	(kg P/tonne harvested product)
Dry pulses and protein crops for the production of grain								
P1100	Markærter	Field peas	216	85	3.84	0.46	32.6	3.9
P1200	Hestebønner	Broad and field beans	211	86	4.98	0.68	42.8	5.8
P1300	Sødlupin	Sweet lupins	215	91.5	6.70	0.47	61.3	4.3
Root crops								
R1000	Kartofler	Potatoes	395	24	1.47	0.05	3.5	0.5
R2000	Sukkerroer til fabrik	Sugar beet (excluding seed)	361	22	0.94	0.04	2.1	0.4
Industrial crops								
I1111	Vinterraps	Winter rape and turnip rape seeds	213	92.5	3.1	0.70	28.7	7.0
I1112	Vårraps	Spring rape and turnip rape seeds	213	92.5	3.1	0.70	28.7	7.0
Grass for seeds and seedlings								
E0000	Frø til udsæd	Seeds and seedlings	1014	87	2.4	0.4	20.9	3.5

Table 2.3. Nitrogen and phosphorus contents and coefficients for fodder crops, such as temporary grasses and grazing, green maize and other cereals harvested green. Reference data for nutrient content and product codes are from Møller et al. (2005).

			Refer-ence	Dry matter	Conver-sion factor	Nitrogen content	Phos-phorus content	Nitrogen coefficient	Phosphorus coefficient
			Code no.	(% pr unit)	DM/unit	(% per unit)		(kg N/tonne harvested product)	(kg P/tonne harvested product)
Temporary grasses and grazing									
G1000	Græs i omdrift	Temporary grasses and grazing	565	1.28	0.1700	2.43	0.39	5.3	0.85
G2000	Bælgplanter, helsæd	Leguminous plants harvested green	599	1.26	0.279	2.736	0.33	9.6	1.16
G2100	Lucerne	Lucerne	501	1.38	0.131	3.36	0.28	6.1	0.51
G2920	Blandinger af bælgsæd og græs	Legume grass mixtures	598	1.29	0.279	2.112	0.3	7.6	0.54
G3000	Majs, helsæd	Green maize	593	1.14	0.265	1.264	0.24	3.8	0.72
G9100	Korn, helsæd (undtagen majs)	Other cereals harvested green (excluding green maize)	583	1.35	0.279	1.66	0.3	6.2	1.13
Permanent grass									
J1000	Græsmarker og engarealer uden for omdrift, undtagen magre græsningsarealer	Permanent pastures and meadows, excluding rough grazing	458	1.16	0.159	3.2	0.4	5.9	0.7
J2000	Magre græsningsarealer uden for omdrift	Permanent rough grazing	458	1.16	0.159	3.2	0.4	5.9	0.7
J3000E	Græsarealer uden for omdrift, som ikke længere anvendes til produktionsformål, og som er tilskudsberettigede	Permanent grassland no longer used for production purposes and eligible for the payment of subsidies	458	1.16	0.159	3.2	0.4	5.9	0.7

Table 2.4. Nitrogen and phosphorus coefficients for fresh vegetables, fruit and nuts obtained from the Danish food composition database (DTU Food Institute, 2024).

			Nitrogen coefficient (kg N/tonne harvested product)	Phosphorus coefficient (kg P/tonne harvested product)
V1000	Kål	Brassicas	2.08	0.42
V2000	Blad- og stængelgrøntsager	Leafy and stalked vegetables (excluding brassicas)		
V2100	Porrer	Leeks	2.4	0.38
V2300	Salat	Lettuces	1.6	0.28
V3000	Frugtgrøntsager (herunder meloner)	Vegetables cultivated for fruit (including melons)	32.6	3.91
V4000	Rod-, knold- og løggrøntsager	Root, tuber and bulb vegetables		
V4100	Gulerødder	Carrots	1.44	0.32
V4200	Løg (kepa) og skalotteløg	Onions and shallots	1.76	0.29
V4300	Rødbeder	Beetroot	2.56	0.43
V4400	Knoldselleri	Celeriac	2.4	0.4
V5000	Bælgfrugter, friske til konsum	Fresh pulses for human consumption		
V5100	Ærter, friske til konsum	Fresh peas	8.64	1.08
V5900	Andre bælgfrugter, friske til konsum	Other fresh pulses n.e.c.		
S0000_FRI	Jordbær	Strawberries, outdoor	1.12	0.24
F1000	Frugt, bær og nødder (undtagen jordbær)	Fruits from temperate climate zones		
F1200	Stenfrugt	Stone fruits	6.25	1.13
F1240	Kirsebær	Cherries	0	0
F1241	Sødkirsebær	Sour cherries	1.76	0.27
F1242	Surkirsebær	Sweet cherries	1.44	0.25
F1250	Blommer	Plums	1.12	0.2
F3000	Bær (undtagen jordbær)	Berries (excluding strawberries)		
F3110	Solbær	Blackcurrants	2.24	0.55
F3120	Ribs	Red currants	1.44	0.27
F4000	Nødder	Nuts	32	5
W1000	Druer	Grapes	0.96	0.2

Crop residue volumes and nutrient content coefficients (Annex ii, dataset 2)

The residues are included in Annex ii, dataset 2 and those data cover residues removed from the agricultural sector in the form of

- head leaves and stems
- straw
- other crop residues.

Statistics Denmark collect data on straw from cereals, rape and legumes that are harvested and used for, for example, fodder, bedding and energy. For the SAIO nutrient balances, only the quantities used for energy-production are

included, as the quantities used for fodder or bedding are not removed from the sector.

The measured N and P contents in straw from cereals are derived from Knudsen (2022) and the dry matter content is 85% for cereals and 83% for rape (table 2.5). For cereals, weighted averages for the N and P contents were calculated based on the different cereals and the produced quantity of straw used for energy from Statistics Denmark (table 2.6). Calculation data are found in Appendix 1.

Table 2.5. Percentage of dry matter, nitrogen and phosphorus contents as percentages of dry matter in straw with a weighted content for cereals and a measured value for rape (Knudsen, 2022).

	Dry matter (%)	N content of dry matter (%)	P content of dry matter (%)
Straw from cereals	85	0.57	0.09
Straw from rape	83	0.85	0.08

Table 2.6. Harvested quantity of crop residue removed from agricultural sector for energy production and calculated nitrogen and phosphorus coefficients for individual crops for the period 2022-2025.

Coefficients for SAIO	2022	2023	2024	2025
Harvested quantity (1,000 tonnes)[1]	1733	1340	1675	2093
Straw from cereals (1,000 tonnes)	1644	1256	1565	1984
Straw from rape (1,000 tonnes)	87	83	108	108
Nitrogen coefficient (kg N/tonne fresh weight)				
Straw from cereals	4.9	4.9	4.9	4.9
Straw from rape	7.1	7.1	7.1	7.2
Phosphorus coefficient (kg P/tonne fresh weight))				
Straw from cereals	0.77	0.77	0.77	0.77
Straw from rape	0.66	0.66	0.66	0.66

[1] values from Statistics Denmark, dataset HALM1 (2022-2024) and HALM2 (2025)

In table 2.7, aggregated quantities of harvested straw removed from the agricultural sector for energy production are shown together with calculated N and P coefficients for dataset ii2 for SAIO nutrient balances 2022-2025.

Table 2.7. Data for dataset ii2. Aggregated quantities of harvested straw removed from the agricultural sector for energy production and calculated N and P coefficients for SAIO nutrient balances 2022-2025.

Coefficients for SAIO	2022	2023	2024	2025
Q (1000 tonnes)[1]	1733	1340	1675	2093
Nitrogen coefficient (kg N/tonne fresh weight)	5.0	5.0	5.0	5.0
Phosphorus coefficient (kg P/tonne fresh weight)	0.76	0.76	0.76	0.76

[1] Values from Statistics Denmark, dataset HALM1 (2022-2024) and HALM2 (2025)

2.2 Biological nitrogen fixation coefficients (Annex ii, dataset 3)

Mette Thorsen and Gitte Blicher-Mathiesen, Department of Ecoscience

Plant-associated N fixation is a mechanism in which atmospheric N is fixed through the symbiotic relationship between leguminous plants and bacteria that reside in their root nodules. Leguminous crops using this mechanism contribute with a portion of the N input in agricultural systems.

N fixation coefficients required for the data collection under SAIO should be reported as kilograms of N per tonne of harvested crop for relevant crops provided for the EUROSTAT crop production statistics. The crops and crop groups included in the SAIO data collection for N fixation are listed in Annex ii, dataset 3 of the implementing regulation (EU, 2024) and shown in table 2.8.

Table 2.8. Legume crops included in the SAIO data collection and the corresponding Danish crops used to calculate N fixation coefficients for the SAIO groups. NS= non-significant in Denmark (EU Commission, 2024).

Crop groups	
SAIO	**DK**
Dry pulses and protein crops for the production of grain (including seed and mixtures of cereals and pulses)	**Tørrede bælgfrugter og proteinafgrøder til produktion af fuldmodent korn (inkl. såsæd og blandinger af kornafgrøder og bælgsæd)**
Field peas	Markærter
Broad and field beans	Bønner og hestebønner
Sweet lupins	Sødlupin
Lentils	NS
Vetches	NS
Cickpeas	NS
Other dry pulses and protein crops	NS
Soya	NS
Temporary grasses and grazing/ Plants harvested green from arable land	**Græs i omdrift/ Græs og helsæd i omdrift**
Leguminous plants harvested green	Bælgplanter, helsæd
Lucerne	Lucerne
Legume grass mixtures	Blandinger af bælgsæd og græs (fx kløvergræs)
Other leguminous plants harvested green n.e.c.	NS
Fresh pulses	Bælgfrugter, friske til konsum
Fresh peas	Ærter, friske til konsum
Fresh beans	Bønner, friske til konsum
Other fresh pulses n.e.c	NS
Permanent grasslands Permanent pasture and meadow, excluding rough grazing	**Græs uden for omdrift Græsmarker og engarealer uden for omdrift, undtagen magre græsningsarealer**
Permanent rough grazing	Magre græsningsarealer uden for omdrift

Data sources and methods

In the Danish field balances for nitrogen, N fixation is calculated using dry matter yield and N content in the biomass, as well as the proportion of fixed N both in harvested yield, in stubble and roots based on an empirical model

that has been parameterised for different crops and purposes since 1998. The method is based on the original publications of Høgh-Jensen et al. (1998, 2003 and 2004) and adjusted for use at the national scale by Kyllingsbæk (2000). This model is used for the calculation of nitrogen fixation coefficients for the SAIO data collection.

The model estimates the part of fixed N_2 in the shoot mass of a legume corrected relatively for

(i) the quantities of fixed N_2 found below defoliation height at the end of the growing season or at maturity

(ii) the fixed N_2 transferred to other species in the mixture via the soil or via grazing animals

(iii) the fixed N_2 immobilised in the soil in partly decomposed organic matter.

The equation for symbiotic N fixation (SNF) is:

SNF = DMlegume x N% x Pfix x (1 + Proot+stubble + Ptranssoil + Ptransanimal + Pimmobile)

where

DMlegume = accumulated quantity of legume shoot dry matter above normal defoliation height

N% = concentration of N in the dry matter of the legume (kg/kg)

Pfix = fixed N_2 as proportion of total N in the shoot dry matter of the legume

Proot+stubble = fixed N_2 in the root and stubble as proportion of totally fixed shoot N at the end of the growing period

Ptranssoil = below-ground transfer of fixed legume N_2 located in the grass in mixtures as proportion of total fixed shoot N at the end of the growing period

Ptransanimal = above-ground transfer (by grazing animals) of fixed legume N_2 located in the grass in mixtures as proportion of total fixed shoot N at the end of the growing period

Pimmobile = fixed N_2 immobilised in an organic soil pool at the end of the growing period as proportion of fixed shoot N at the end of the growing period.

For legume crops (field peas, broad and field beans and sweet lupins) and temporary grasses and grazing, plants harvested green from arable land (lucerne and legume grass mixtures), the parameters used for calculation of N fixation coefficients are based on the parameters used for estimating national balances in Kyllingsbæk (2000).

For grass in rotation, it is assumed that 90% of the area is covered by legume grass mixtures with an average of 30% legumes in the grass/legume mixture. For permanent pasture and meadow, excluding rough grazing, it is assumed that legume plants cover 5% of the area. The parameters used for calculation of N fixation coefficients are the same as for legume grass mixtures (Kyllingsbæk, 2000).

For fresh pulses (fresh peas and beans), the parameters used are based on the assumption, that the N fixation in crops harvested fresh is 80% of the N fixation of legume crops harvested as mature (Kyllingsbæk, 2000).

For permanent rough grazing with extensive use, the N fixation is calculated based on the assumption of an annual N fixation of 2 kg N/ha ,as permanent grasslands often have N-fixating plants such as *Trifolium agrarium*, *Trifolium pretense*, *Trifolium repens*, *Vicia* sp., *Lotus corniclatus*, *Lathyrus pratensis*, *Lotus pedunculatus* and *Lupinus polyphyllus* (Larsen & Vikstrøm, 1995).

Nitrogen fixation coefficients for SAIO

Parameters used to calculate N fixation coefficients for SAIO are shown in table 2.9, and calculated N fixation coefficients for individual crop/crop groups are shown in table 2.10. Coefficients are presented both as kg N/ton harvested dry matter, which can be related to values presented in the published references and as the SAIO N-coefficient in kg N/tonne of harvested crop. The coefficients representing individual crops are assumed to be constant between years.

The coefficients representing aggregated groups are calculated as a weighted sum based on the total harvested quantities reported to EUROSTAT by Statistics Denmark. These are shown in table 2.11 for the period 2022-2024. Harvested quantities for fodder crops and fresh legumes are not yet available.

Table 2.9. Parameters used to calculate N fixation coefficients for SAIO nutrient balances

SAIO Crop Group	Pfix (%)	Prootstubble (%)	Ptranssoil+ Pimmobile (%)	Average share of legumes in the grass/legume mixture (%)
Field peas[1]	70	40	-	-
Broad and field beans[1]	70	40	-	-
Sweet lupins[4]	70	40	-	-
Lucerne[1]	75	50		
Legume grass mixtures[2+3]	90	25	25	30
Fresh peas[3]				
Fresh beans[3]				
Permanent pasture and meadow, excluding rough grazing[3]	90	25	50	5
Permanent rough grazing[3]	90	25	50	5

[1)] Høegh Jensen et al. (1998)

[2)] Høegh Jensen et al. (2004)

[3)] Kyllingsbæk (2000)

[4)] No data available, assumed to be similar to broad and field beans.

Table 2.10. Calculated N fixation coefficients for individual crop/crop groups for the SAIO nutrient balances. Coefficients are presented both as kg N/tonne of harvested dry matter, which can be related to values presented in the published references, and as the SAIO N-coefficient in kg N/tonne of harvested crop. The coefficients representing individual crops are assumed to be constant between years. The coefficients representing aggregated groups are calculated as a weighted sum based on the total harvested quantities reported to EUROSTAT by Statistics Denmark.

SAIO Crop group	Nitrogen fixation coefficients (kg N/tonne harvested dry matter)	SAIO nitrogen fixation coefficients (kg N/tonne harvested crop)
Field peas	38.2	32.5
Broad and field beans	49.0	41.7
Sweet lupins	49.0	41.7
Lucerne	37.1	7.4
Legume grass mixtures[1]	17.3	2.2
Fresh peas	30.6	26.0
Fresh beans	30.6	26.0
Permanent pasture and meadow, excluding rough grazing	2.1	0.3
Permanent rough grazing	2.1	0.3

[1)] Aggregated value assuming that the legume grass mixture contains 30% legumes with an average N fixation coefficient of 56,7 kg N/tonne of harvested legume dry matter.

Table 2.11. Data for dataset ii3. Calculated N fixation coefficients for both individual crop/crop groups and aggregated groups for the SAIO nutrient balances. The coefficients representing individual crops are assumed to be constant between years. The coefficients representing the aggregated groups are calculated as a weighted sum based on the total harvested quantities reported to EUROSTAT by Statistics Denmark.

SAIO Crop group	SAIO Nitrogen fixation coefficients (kg N/tonne harvested crop)			
	2022	2023	2024	2025
Dry pulses and protein crops for the production of grain (including seed and mixtures of cereals and pulses)	38.2	37.7	38.5	38.9
Field peas	32.5	32.5	32.5	32.5
Broad and field beans	41.7	41.7	41.7	41.7
Sweet lupins	-	-	-	41.7
Temporary grasses and grazing[1]	2.0	2.0	2.0	2.0
Leguminous plants harvested green	2.3	2.3	2.3	2.3
Lucerne	7.4	7.4	7.4	7.4
Legume grass mixtures (30% legumes) [2]	2.2	2.2	2.2	2.2
Fresh pulses	26.0	26.0	26.0	26.0
Fresh peas	26.0	26.0	26.0	26.0
Fresh beans	26.0	26.0	26.0	26.0
Permanent grasslands[3]	0.3	0.3	0.3	Harvest data 2025 missing
Permanent pasture and meadow excluding rough grazing	0.3	0.3	0.3	0.3
Permanent rough grazing	-	-	-	0.3

[1)] Aggregated value for the group “Temporary grasses and grasslands (Græs i omdrift)” covering 90% grass-clover mixtures and 10% grass without clover.

[2)] Grass-clover mixtures are assumed to cover 90% of the group “Temporary grasses and grasslands (Græs i omdrift)”. As a consequence, aggregated N fixation coefficients are calculated assuming that 30 % of the registered production comes from legumes.

[3)] Permanent grasslands are reported as one group in 2022-2024 by Statistics Denmark. Data for 2025 are not yet available.

2.3 Atmospheric nitrogen deposition coefficients (Annex ii, dataset 4)

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Atmospheric deposition of N requested for the data collection under SAIO covers both wet deposition, such as rain, snow and fog, and dry deposition, including particulate matter, gases and aerosols. The atmospheric N deposition coefficient should be provided as kilograms of N per hectare of utilised agricultural area.

Data sources and methods

Deposition of N and other substances in Denmark is estimated annually based on a combination of monitoring stations and modelling. Monitoring of N deposition is conducted at four monitoring stations (Poulsen et al., 2024)

Monitoring data, together with activity data from different sectors in Denmark and neighbouring EU countries, are used to model the deposition on a geographical scale of 1x1 km using the Danish Eulerian Hemispheric Model (DEHM).

DEHM is a state-of-the-art, three-dimensional, atmospheric chemistry transport model (CTM) developed to study long-range transport of air pollution across the Northern Hemisphere. DEHM was originally developed in the early 1990s in order to study atmospheric transport of sulphur dioxide and sulphate into the Arctic (Christensen, 1997).

The model has been developed and applied as a part of the Danish Air Quality Monitoring Programme for more than 10 years – with focus both on chemical species important for human health (ozone, NO_2, particles, etc.) and deposition of reduced and oxidised N to marine and terrestrial eco-systems. Further technical descriptions can be found on the webpage of the Department of Environmental Sciences (DEHM Technical description).

Nitrogen deposition coefficients for SAIO

Average N deposition on the Danish terrestrial area is published in the annual NOVANA reports (Ellerman et al., 2023 and 2024; Poulsen et al., 2024). Data for the years 2022-2024 are summarised in table 2.12. Data for 2025 will be published at the end of 2026.

Table 2.122. Data for dataset ii4. Total nitrogen deposition to Danish terrestrial areas calculated using the DEHM-model. Data from 2025 will be published at the end of 2026.

Year	Dry deposition 1,000 tonnes N	Wet deposition 1,000 tonnes N	Total deposition Kg N/ha	Data source
2022	30	17	11	(Ellerman et al., 2023)
2023	27	23	12	(Ellerman et al., 2024)
2024	27	23	11	(Poulsen et al., 2025)

2.4 Seed nutrient content coefficients (Annex ii, dataset 5)

The quantity of N and P applied to the agricultural area with seeds by sowing should be provided as kilograms of nutrient per hectare of sown cereals and potatoes.

Ideally, the number of seeds applied at sowing should be calculated based on the type of cereal or potato and local factors such as soil type and time of sowing. The recommended seed application for cereals varies with between 170-200 kg per hectare for spring barley and is higher for winter wheat, at 300-340 kg per hectare. The recommended seed rate for potatoes varies between 1.8-2.8 tonnes per hectare. The N and P input for spring barley and winter wheat was calculated and used as an average input for these two cereals. The N and P content for spring barley and winter wheat are from the same dataset as used for the content in harvested grain (see section 2.1).

The N and P input by seeds for potatoes is 8.1 kg N per hectare and 1.2 kg P per hectare, with an average use of 2.3 tonnes of potatoes for planting per hectare, a dry matter content of 24% and a N content of 1.472 %N in dry matter and a P content of 0.21% in dry matter (table 2.13). The N and P, expressed as percentages of dry matter, are from crop code 395 in Fodermiddeltabellen (Møller, 2005).

Table 2.13. Calculated averages of nitrogen and phosphorous input for spring barley and winter wheat (bold numbers) based on the Danish recommended seed application rates for spring barley and winter wheat; the percentages of N and P content in fresh grain corrected to a dry matter content of 85%, for the period 2022-2025 and the average for this period.

Recommended seed input (kg per hectare)									
	Average	**Interval**	**Dry matter**	**2022**	**2023**	**2024**	**2025**	**2022-2025**	**Input by cereal seeds**
				Nitrogen content (percentage of fresh weight)					**(Kg N per ha)**
Spring barley	185	170-200	0.85	1.4	1.5	1.4	1.4	1.5	2.6
Winter wheat	320	300-340	0.85	1.3	1.7	1.3	1.3	1.4	4.2
Average				1.4	1.6	1.4	1.4	1.4	**3.4**
				Phosphorus content (percentage of fresh weight)					**(Kg P per ha)**
Spring barley	185	170-200	0.85	0.3	0.2	0.3	0.3	0.2	0.5
Winter wheat	320	300-340	0.85	0.3	0.3	0.3	0.3	0.3	0.9
Average				0.3	0.3	0.3	0.3	0.3	**0.7**
		(tonnes/ha)		**Nitrogen content (percentage of fresh weight)**					**(Kg N per ha)**
Potatoes	2.3	1.8-2.8	0,24	1.5					**8.1**
				Phosphorus content (percentage of fresh weight)					**(Kg P per ha)**
				0.21					**1.2**

2.5 Livestock nutrient excretion coefficients (Annex ii, dataset 6)

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Introduction

The aim of the current work is to calculate national balances of N and P including numbers for ex-animal excretion of N and P. Numbers for the national excretion of N are already calculated for the United Nations Framework Convention on Climate Change (UNFCCC), and the methods are described in Albrektsen and Mikkelsen (2026). In the draft for the Handbook on Statistics on Agricultural Input and Output (SAIO, Anon-, 2025), it is recommended to follow the same principles as for the reporting to UNFCCC.

The reported values for UNFCCC use, among other things, data from Statistics Denmark (https://www.dst.dk) and the normative system (https://anivet.au.dk/forskning/sektioner/husdyrernaering-og-fysiologi/normtal), and the fertilizer accounting system (https://lbst.dk/planter/goedning/goedningsregnskab).

The normative system in Denmark is developed to calculate the N, P, K and dry matter excretion from livestock production in Denmark. The numbers are updated annually if new information becomes available. Excretion of N, P, K and dry matter is calculated either for a year-animal (e.g. a cow with 365 feeding days including the dry period) or per produced animal (e.g. slaughter chickens). The primary function of the system is to calculate excretion of N and P from livestock at farm level for the fertiliser accounting system. However, the numbers are used for other purposes as well, for instance UNFCCC.

For the present inventory, the excretion of total N (NEC) and total P (PEC) per animal from all animal species is calculated per year-animal and not per produced animal, because the N og P excretion from the animals should be coupled with the number of animals counted at a defined time point each year within each livestock category. Reported data for UNFCCC are based on the same method, i.e. the excretion per year-animal is coupled with the average number of animals within each category; however, the difference between this report and UNFCCC is that the numbers reported here cover more specific livestock sub-categories. For example, in UNFCCC, cattle are reported only as either non-dairy cattle or dairy cows, whereas in the current report, cattle are reported as dairy cows, non-dairy cows and young stock divided into many sub-categories based on gender and age.

Table 2.14 shows how livestock sub-categories in the Danish normative system correspond to the SAIO sub-categories.

Table 2.14. Correspondence between livestock sub-categories in the manure normative system and SAIO sub-categories in table 2.16.

Livestock sub-category in the Danish normative system	N and P from these sub-categories are allocated to the following SAIO sub-categories
Calves[1] for slaughter, < 6 months + Calves for slaughter, > 6 months until slaughter	Bovine animals, less than 1 year, for slaughter [A2010B] Male calves, less than 1 year, not for slaughter [A2110C] Male bovine animals, 1-2 years [A2120] Male bovine animals, 2 years or over [A2130]
Replacement heifers[1], < 6 months + Replacement heifers, > 6 months until calving	Female calves, less than 1 year, not for slaughter [A2210C] Heifers, 1-2 years, for slaughter [A2220B] Heifers, 1-2 years, not for slaughter [A2220C] Heifers, 2 years or over, for slaughter [A2230B] Heifers, 2 years or over, not for slaughter [A2230C]
Dairy cows[1]	Dairy cows [2300F]
Suckler cows[2]	Non-dairy cows [2300G]
Sows with piglets until weaning[3]	Breeding boars [A3133] Covered sows [A3120K] Sows, not covered [A3120L]
Weaned piglets, from weaning until 31 kg[4]	Piglets, less than 20 kg [A3110], partly Pigs, from 20 kg to less than 50 kg [A3131], partly
Grower-finisher pigs, 31 kg – until slaughter[4]	Pigs, from 20 kg to less than 50 kg [A3131], partly Fattening pigs, from 50 kg to less than 80 kg [A3132X] Fattening pigs, from 80 kg to less than 110 kg [A3132Y] Fattening pigs, 110 kg or over [A3132Z]
Broilers[5]	Broilers [A5140]
Layers[6]	Layers [A5110O]
Ducks	Ducks
Geese	Geese

[1] For alle sub-categories of dairy cattle, norm values for Jersey and large dairy breeds are used.

[2] The normative system has three sub-categories of suckler cows.

[3] For breeding sows, the normative system has three sub-categories: conventional sows, free range conventional sows and organic sows.

[4] For growing pigs, the normative system has two sub-categories: conventional and organic pigs.

[5] For broilers, the normative system has nine sub-categories, eight sub-categories for conventional and one subgroup for organic broilers. The eight sub-categories for conventional broilers cover two different growth rates and, within each growth rate, four different slaughter weights.

[6] For layers, the normative system has four sub-categories: one organic and three sub-categories for conventional systems, covering caged hens, barn hens and free range hens.

Definitions

The following terms will be used in the text without further definition.

Large dairy breeds = Dairy breeds like Holstein, Red Danish dairy cattle and crossbred dairy cattle with less than 87.5% Jersey genes.

SAIO = Statistics on agricultural input and output.

Reporting year = The year reported in table 2.16 for SAIO in the present report.

Fertiliser accounting system = A national database in which farmers must upload their use of N and P from animal manure and fertilisers. The N and P content of manure is based on the normative values calculated annually by Aarhus University, whereas the content of fertilisers is provided by the supplier.

Normative system = Values for N, P and K ex animal and ex storage are updated annually by Aarhus University. Overall, production data and data on feed composition are used to calculate the ex-animal excretion of N, P and K. Information on bedding and emissions in barn and storage is used to calculate ex-storage values, either per year animal or per produced animal. In the current report, only ex-animal values are used. More details on cattle, pigs and poultry can be found at https://anivet.au.dk/forskning/sektioner/husdyrernaering-og-fysiologi/normtal.

Introduction to the description of the method

Overall, the total excretion of N and P for different sub-categories of the Danish livestock production is calculated according to the methods described by Albrektsen and Mikkelsen (2026). Total Danish excretion of N and P for each animal category is distributed into sub-categories based on information about the different production systems and on the number of animals in each of the sub-categories as reported by EUROSTAT.

The description below is divided into these categories of livestock.

- Dairy cows [A2300F]
- Non-dairy cows [A2300G]
- Bovine males (bulls)
    - Bovine animals, less than 1 year, for slaughter [A2010B]
    - Male calves, less than 1 year, not for slaughter [A2110C]
    - Bovine animals, 1-2 years [A2120]
    - bovine animals, 2 years or over [A2130]
- Bovine females (heifers)
    - Female calves, less than 1 year, not for slaughter [A2210C]
    - Heifers, 1-2 years, for slaughter [A2220B]
    - Heifers, 1-2 years, not for slaughter [A2220C]
    - Heifers, 2 years or over, for slaughter [A2230B]
    - Heifers, 2 years or over, not for slaughter [A2230C]
- Breeding pigs
    - Breeding boars [A3133]
    - Covered sows [A3120K]
    - Sows, not covered [A3120L]
- Growing pigs
    - Piglets, less than 20 kg [A3110]
    - Pigs, from 20 kg to less than 50 kg [A3131]
    - Fattening pigs, from 50 kg to less than 80 kg [A3132X]
    - Fattening pigs, from 80 kg to less than 110 kg [A3132Y]
    - Fattening pigs, 110 kg or over [A3132Z]
- Broilers [A5140]
- Layers [A5110O]
- Other poultry
    - Ducks [A5210]
    - Geese [A5220]

The description for each sub-category of animals covers the following:

- Data sources used in the calculations
- Method to calculate total Danish excretion of N and P
- Method to calculate NEC and PEC
- Description of methodological aspects.

Dairy cows [A2300F]

Data sources used in the calculations

- Data from the table HDYR1: Farms with livestock by area, unit and kind (www.statistikbanken.dk/HDYR1, Statistics Denmark, last accessed 21/4-2026).
- Data from the normative system for N and P excretion from dairy cows, covering Jersey cows and large dairy breeds for reporting year 2022 (data from the fertiliser accounting year 2023/24; Lund et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Lund et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; Brask et al., 2025).
- The share of Jersey cows and large dairy breeds for reporting year 2022 was obtained from SEGES Innovation (pers. comm.). For reporting years 2023 and 2024, information from the fertiliser accounting system was used.
- The dairy cow population is based on the EUROSTAT table Bovine population (https://doi.org/10.2908/APRO_MT_LSCATL). reported for the reference period November-December of the same year as the reporting year. These figures are derived from the table KVAEG5: Number of cattle by region and type (www.statistikbanken.dk/KVAEG5, Statistics Denmark, last accessed 21/4-2026), for the fourth quarter.

Method for calculating total Danish excretion of N and P

The total Danish excretion of N and P was calculated following Albrektsen and Mikkelsen (2026). Briefly, the number of cows in table HDYR1 for the same year as the reporting year was multiplied by normative values, taking the share of Jersey cows and large breeds into account.

Method for calculating NEC and PEC

NEC and PEC per dairy cow per year are determined by dividing the total Danish excretion of N or P with the number of cows from the EUROSTAT table APRO_MT_LSCATL.

Description of methodological aspects

The values for excretion of N and P in manure in the normative system for dairy cows are based on a mass balance concept (Lund et al., 2023, 2024; Brask et al., 2025). Briefly, the mass balances are based on information on feed intake and the content of N and P in the feed in both lactating and dry cows as well as information on retention in the cows in the form of milk, milk composition and retention in cows and foetuses. Feed and milk data are based on farm registrations covering approximately 70% of Danish dairy cows, whereas gain and the content of N and P in foetuses are based on literature values.

The excreted quantity of N and P covers a 365-day feeding period see (Lund et al., 2023, 2024; Brask et al., 2025) for further details.

In Denmark, Holstein cows are dominant, but Jersey cows constitute between 10-15% of dairy cows. Therefore, the Danish normative system contains values for both Jersey and large dairy breeds. Crosses between Jersey and the large diary breed are classified as Jerseys only if more than or equal to 87.5% of their genes originate from Jersey cows (Brask et al., 2025). The proportion between Jersey cows and the large dairy breeds is nearly similar from year to year.

The excretion of N and P in the normative system represents the average excretion for Danish dairy cows. The production data collected from Danish

dairy farms include data from different times of the year, different farm practices and both organic and conventional farms.

Albrektsen and Mikkelsen (2026) used data from HDYR1 in their calculations. For both the HDYR1 and KVAEG5 inventories, the data come from the Danish cattle database. which is part of the central husbandry register (CHR) under the Danish Veterinary, Food, Agriculture and Fisheries Agency. The difference is that for HDYR1, the cattle are only counted on the selected farms once per year, whereas for KVAEG5 they are counted at all farms four times annually.

The number of cows has decreased over time, but the annual variation in the number of cows is small. Data from Statistics Denmark KVAEG5 show that the number of cows in 2022-2025 varied by 1,500 to 6,500 cows between years, and the total number of dairy cows was approximately 550,000.

Non-dairy cows [A2300G]

Data sources used in the calculations

- Data from the table HDYR1: Farms with livestock by area, unit and kind (www.statistikbanken.dk/HDYR1, Statistics Denmark, last seen 21/4-2026)
- Data from the normative system for N and P excretion from non-dairy cows of three different sizes, covering non-dairy cows < 400 kg, non-dairy cows ≥400 kg and ≤ 600 kg and non-dairy cows > 600 kg) for reporting year 2022 (data from the fertilizer accounting year 2023/24; Lund et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Lund et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; Brask et al., 2025).
- The share between the different sizes of non-dairy cows was based on information from the fertiliser accounting system. For reporting years 2022, 2023 and 2024, the data correspond to accounting years 2021/22, 2022/23 and 2023/24, respectively.
- The non-dairy cow population was obtained from the EUROSTAT table Bovine population (https://doi.org/10.2908/APRO_MT_LSCATL) reported for the reference period November-December in the same year as the reporting year. These numbers are based on the table KVAEG5: Number of cattle by region and type (www.statistikbanken.dk/KVAEG5, Statistics Denmark, last seen 21/4-2026) for the fourth quarter from Statistics Denmark.

Method for calculating total Danish excretion of N and P

The total excretion of N and P was calculated following Albrektsen and Mikkelsen (2026). Briefly, the number of non-dairy cows in table HDYR1 for the same year as the reporting year was multiplied by normative values, taking the different weight categories of the non-dairy population into account.

Method for calculating NEC and PEC

NEC and PEC values are determined by dividing the total excreted quantity of N or P with the number of non-dairy cows from the EUROSTAT APRO_MT_LSCATL.

Description of methodological aspects

The values for excretion of N and P in manure in the normative system for non-dairy cows are based on a mass balance concept (Lund et al., 2023, 2024; Brask et al., 2025), taking into account only the excretion from non-dairy cows.

The excretion from suckler calves is accounted for separately based on the assumption that it has the same excretion as a calf of one of the dairy breed categories. The excreted quantity of N and P from non-dairy cows covers a 365-day feeding period see Lund et al. (2023), Lund et al. (2024) and Brask et al. (2025) for further details.

The intake of N and P used to calculate the excretion is based on theoretical requirements for cows of the three different body weights and based on the assumption that they are grazing half of the year. There is no distinction between organic and conventional cows. The retention of N and P in milk, the foetus and body weight of the cows is based on theoretical values (Lund et al., 2023, 2024; Brask et al., 2025).

The calculated excretion is not based on farm data but on theoretical values for feed intake, dietary composition, and production, as there is no systematic collection of data on feeding practices and production on non-dairy farms with suckler cows. The herds of non-dairy cows are small, as many keep non-dairy cows as a hobby. Information on farm size is reported by Statistics Denmark in HDYR1 and more than 50% of the non-dairy cows are found on farms with fewer than 30 non-dairy cows.

The number of bovine animals is counted four times a year and published in the table KVAEG5 from Statistics Denmark. The number reported for the reference period November-December in the same year as the reporting year is applied. However, there is annual variation in the number of non-dairy cows with the highest numbers in the second quarter of the year and the lowest numbers in the fourth quarter of the year.

Bovine animals less than 1 year for slaughter [A2010B] and all other males [A2010C], [A2120] and [A2130]

Data sources used in the calculations

- Data from table ANI4: Slaughtering and production of cattle by category and unit (www.statistikbanken.dk/ANI4, Statistics Denmark, last accessed 21/4-2026).
- Data from the normative system for N and P excretion from male and female slaughter calves, covering Jersey and large dairy breeds, for reporting year 2022 (data from the fertiliser accounting year 2023/24; Lund et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Lund et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; Brask et al., 2025).
- The share between Jersey slaughter calves and large dairy slaughter calves for reporting year 2022 was obtained from SEGES Innovation (personal comm.). For reporting years 2023 and 2024, registrations in the fertiliser accounting system were used. For reporting year 2023, data from the fertilizer accounting year 2022/23 were used, and for reporting 2024 data from the fertilizer accounting year 2023/24 were used.
- The population of slaughtered animals < 1 year and males over 1 year was obtained from the EUROSTAT table Bovine population (https://doi.org/10.2908/APRO_MT_LSCATL), reported for the reference period November-December in the same year as the reporting year. These numbers are based on the table KVAEG5: Number of cattle by region and type (www.statistikbanken.dk/KVAEG5, Statistics Denmark, last accessed 21/4-2026) for the fourth quarter from Statistics Denmark.

Method for calculating total Danish excretion of N and P

The total excretion of N and P was calculated following Albrektsen and Mikkelsen (2026) for bulls. Briefly, the number of slaughtered animals in table ANI4 from Statistics Denmark, taking the share of Jersey slaughter calves into account, was used.

Method for calculating NEC and PEC

NEC and PEC values are determined by dividing the total excretion of N or P with the total number of animals reported as male calves less than 1 year old not for slaughter [A2110c], bovine animals less than 1 year for slaughter [A2010C], male bovine animals 1-2 years [A2120] and male bovine animals 2 years old or over [A2130].

Description of methodological aspects

The excretion of N and P from slaughter calves is based on mass balances per produced animal. The mass balance is based on feed intake, the concentrations of N and P in the feed, and the accumulation of N and P in the body of the animals. The data for large dairy breeds are based on farm data from the production of intensively reared slaughter calves with an average slaughter age of 10 months. The contents of N and P in the live weight gain are based on values reported in the literature. For more details, see (Lund et al. (2023), Lund et al. (2024) and Brask et al. (2025). The mass balance for Jersey cows is based on a more theoretical approach, as no farm data exist for this population. A calf is classified as Jersey only if 87.5% or more of its genes originate from Jersey cattle (Brask et al., 2025). The proportion of purebred Jersey slaughter calves is small, at less than 2% according to the fertilizer accounting system.

The number of bovine animals less than 1 year for slaughter [A2010C] also covers females slaughtered before 1 year. This number has been increasing over the years, as all dairy farms often use semen from beef cattle for cows, which are not intended to produce replacement heifers for the herd. The NEC and PEC per animal are therefore underestimated, because N and P from female calves for slaughter are not included in the total Danish excretion under slaughter calves, but instead accounted for under heifers in the Danish setup (Albrektsen & Mikkelsen, 2026). However, the missing excretion of Danish N and P from slaughtered female calves is accounted for in the NEC and PEC values for heifers, as described below.

The slaughter calf production is diverse, because different farmers have different practices regarding slaughter age and feeding. According to ANI4 approximately 70% of male calves for slaughter fits into the category described in the normative system (Lund et al., 2023, 2024; Brask et al., 2025). The remaining 30% includes calves slaughtered below 8 months or older than 12 months or steers. The current method described by Albrektsen and Mikkelsen (2026) probably tend to underestimate the excretion as nearly 20% of all calves are slaughtered later than 12 months and the excretion of N and P from an older and larger calf is higher.

It was decided to use the same NEC and PEC values independent of age at slaughter. This is probably not correct, but based on the available information, it was not possible to calculate NEC and PEC values which accurately reflect the actual biological variation.

Female calves and heifers [A2210C], [A2220B], [A2220C], [A2230B] and [A2230C]

Data sources used in the calculations

- Data from the table HDYR1: Farms with livestock by area, unit and kind (www.statistikbanken.dk/HDYR1, Statistics Denmark, last accessed 21/4-2026).
- Data from the normative system for N and P excretion from heifers, covering Jersey and large dairy breeds, for reporting year 2022 (data from the fertiliser accounting year 2023/24; Lund et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Lund et al., 2024) and for reporting year 2024 (data from the fertilizer accounting year 2025/26; Brask et al., 2025).
- The share between Jersey heifers and large dairy breeds for reporting year 2022 is obtained from SEGES Innovation (personal comm.). For reporting years 2023 and 2024, registrations in the fertiliser accounting system were used. For reporting year 2023, data from the fertilizer accounting year 2022/23 were used, and for reporting year 2024 data from the fertilizer accounting year 2023/24 were used.
- The population of females < 1 year and heifers from the EUROSTAT table Bovine population (https://doi.org/10.2908/APRO_MT_LSCATL) reported for the reference period November-December in the same year as the reporting year. The numbers are based on data in table KVAEG5: Number of cattle by region and type (www.statistikbanken.dk/KVAEG5, Statistics Denmark, last accessed 21/4-2026) for the fourth quarter from Statistics Denmark.

Method for calculating total Danish excretion of N and P

The total excretion of N and P was calculated following Albrektsen and Mikkelsen (2026) for heifers. Briefly, the number of heifers from HDYR1 from the Statistics Denmark was used, taking the share of Jersey heifers into account.

Method for calculating NEC and PEC

The total excretion of N and P was divided into excretion by females below 1 year or heifers 1 year or older in the following way. In the normative system it is possible for farmers to correct the quantity of N and P excreted depending on the age of the animals (Lund et al., 2023, 2024; Brask et al., 2025). This approach was used to partition N and P excretion between female calves less than 1 year, not for slaughter [A2210C] and older heifers ([A2220B], [A2220C], [A2230B] and [A2230C]).

The NEC and PEC for female calves less than 1 year not for slaughter [A2210C] were found by dividing the N or P excreted for females less than one year by the number female calves less than 1 year not for slaughter [A2210C]. The NEC and PEC for heifers in the following sub-categories – heifers 1-2 years for slaughter [A2220B], heifers 1-2 years not for slaughter [A2220C], heifers 2 years or over for slaughter [A2230B] and heifers 2 years or over not for slaughter [A2230C] – were found by dividing the quantity of N or P excreted by older heifers by the total number of animals in the above-mentioned categories.

Description of methodological aspects

The excretion from heifers in the normative system is based on 365 feeding days. The excretion is a mass balance based on feed intake, the concentration of N and P in feed and on the accumulation of N and P in animal growth. The

numbers are based partly on theoretical values, as reliable farm data are less frequent than for dairy cows (Lund et al., 2023, 2024; Brask et al., 2025).

The difference in excretion of N and P between Jersey and large dairy breeds in Denmark is considered. The total number of heifers is assumed to be constant throughout the year according to table KVAEG5 from Statistics Denmark.

The number of females slaughtered before 1 year is included in the category "bovine animals less than 1 year for slaughter" [A2010c] in the EUROSTAT table APRO_MT_LSCATL.

In the present report, the total excretion N and P in Denmark from females slaughtered before 1 year is ascribed to the category "female calves or heifers". In principle, the N and P from these heifers slaughtered before 1 year should be allocated to "bovine animals less than 1 year for slaughter" [A2010c], but it has not been possible to determine a proper distribution between female calves for slaughter and not for slaughter.

Therefore, NEC and PEC values for the categories female calves and heifers are likely overestimated, whereas values for the sub-categories "bovine male and female calves less than 1 year for slaughter, and males over 1 year" are likely underestimated. The overall purpose is to calculate country mass balances for all N and P from livestock manure. It is concluded that all the N and P from the production systems of slaughter calves and dairy replacement heifers are accounted for, whereas the distribution between the different categories is less accurate.

For female calves and heifers, it has been considered that NEC and PEC values would be lower for younger than older animals. However, the same NEC and PEC values have been ascribed to all heifers above 1 year old and independent on whether they are raised to become a dairy cow or slaughtered. This is not correct, but information to make a more biologically realistic distribution was not available.

Breeding pigs [A3133], [A3120K] and [A3120L]

Data sources used in the calculations

- Data from table HDYR1: Farms with livestock by area, unit and kind (www.statistikbanken.dk/HDYR1, Statistics Denmark, last accessed 21/4-2026).
- Data from the normative system for N and P excretion for conventional sows, organic sows and free-ranging sows for reporting year 2022 (data from the fertiliser accounting year 2023/24; Sørensen et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Sørensen et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; Sattarova et al., 2025).
- The share of conventional, organic and free-ranging sows is based on data registered in the fertiliser accounting system. For reporting years 2022, 2023 and 2024 data from the fertiliser accounting year 2021/22, 2022/23 and 2023/24 were used.
- The pig population is obtained from the EUROSTAT table pig population (https://doi.org/10.2908/APRO_MT_LSPIG), reported for the reference period November-December in the same year as the reporting year. The population size is based on numbers in the table SVIN: Number of pigs at the first day of the quarter by type (www.statistikbanken.dk/SVIN) for the

first quarter from Statistics Denmark for years 2023, 2024 and 2025, corresponding to reporting years 2022, 2023 and 2024, respectively. The counting for the first quarter is conducted on 1 January, and it is therefore assumed to represent the number of animals in November and December of the preceding year.

Method for calculating total Danish excretion of N and P

The total excretion of N and P were calculated following Albrektsen and Mikkelsen (2026). Briefly, the number of sows from table HDYR1 counted in the same year as the reporting year were multiplied by normative values taking the share of conventional, organic and free-ranging sows into account.

Method for calculating NEC and PEC

In the normative system, there are not separate values for breeding boars [A3133], covered sows [A3120K] and not covered sows [A3120L]. The normative value for N and P excretion per animal includes data from covered (pregnant) and not covered (lactating) sows, boars and gilts. Therefore, there is no separate number for breeding boars in sow herds. However, for boars kept at breeding stations with no sow production, Sørensen et al. (2023), Sørensen et al. (2024) and Sattarova et al. (2025) reported that these boars had an excretion of N and P, equal to 63% of the excretion from a year sow. The NEC and PEC values for breeding boars [A3133] are therefore assumed to be 63% of a year sow. The NEC and PEC values for covered sows [A3120K] and not covered sows [A3120L] are obtained by first subtracting N and P excreted by boars from the total sum of N or P excreted. The remaining amount was divided by the sum of covered sows [A3120K] and not covered sows [A3120L] from the EUROSTAT table Pig population APRO_MT_LSPIG.

Description of methodological aspects

The normative values for N and P excretion per animal reported by Sørensen et al. (2023), Sørensen et al. (2024) and Sattarova et al. (2025) are based on mass balances of N and P. Feed intake and productivity of the sows are based on production data from Danish pig farms. The N and P concentrations in feed are based on surveys of the content in commercial feed mixtures for pigs provided by major Danish feed suppliers. The accumulation of N and P in suckler pigs and sows is based on literature values. Data are updated yearly for conventional sows, whereas data for organic sows and free ranging sows are updated less frequently.

The NEC and PEC values for breeding sows are overestimated as the excretion from the suckler piglets (until weaning at around 6 kg body weight) is included in the sow's excretion. Consequently, the excretion from for piglets, less than 20 kg [A3110] is underestimated (see section for piglets and fattening pigs for further details).

The number of sows from table HDYR1 is based on counts performed in May or June, whereas the numbers used to calculate NEC and PEC are based on counts on 1 January of the following year. Between 2022 and 2023, there was a major drop in the number of breeding animals due lower profitability.

The number of organic and free-ranging sows accounts in total for less than 2% of all sows in Denmark.

Piglets and fattening pigs [A3110], [A3131], [A3132X], [A3132Y] and [A3132Z]

Data sources used in the calculations

- Data from table ANI5: Slaughterings and production of pigs by category and unit (www.statistikbanken.dk/ANI5, Statistics Denmark, last accessed 21/4-2026).
- Data from the normative system for N and P excretion for piglets and fattening pigs for both conventional and organic animals for reporting year 2022 (data from the fertiliser accounting year 2023/24; Sørensen et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; Sørensen et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; Sattarova et al., 2025).
- Data on the number of dead sows are obtained from Vinther (2023), Hyttel (2024) and Hyttel (2025).
- The share between conventional and organic pigs is based on data registered in the fertiliser accounting system. For reporting years 2022, 2023 and 2024 data from the fertiliser accounting years 2021/22, 2022/23 and 2023/24 were used.
- Data on the pig population are obtained from the EUROSTAT table Pig population (https://doi.org/10.2908/APRO_MT_LSPIG), reported for the reference period November-December in the same year as the reporting year. The population size is based on numbers in the table SVIN: Number of pigs at the first day of the quarter by type (www.statistikbanken.dk/SVIN) for the first quarter from Statistics Denmark for year 2023, 2024 and 2025, corresponding to the reporting years 2022, 2023 and 2024. The counting for the first quarter is conducted on 1 January, and it is therefore assumed to represent the number of animals in November and December of the preceding year.

Method for calculating total Danish excretion of N and P

The total excretion of N and P were calculated following by Albrektsen and Mikkelsen (2026). Briefly, first the total number of produced fattening pigs is calculated, including the fattening pigs that are subsequently selected as breeding animals. The number of piglets is calculated by adding the number of exported live piglets. The total excretion from piglets and growing pigs is calculated based on the normative values and the share of conventional and organic piglets and growing pigs.

Method for calculating NEC and PEC

In the normative system, there are no separate values for piglets less than 20 kg [A3110], pigs from 20 kg to less than 50 kg [A3131], fattening pigs from 50 kg to less than 80 kg [A3132X], fattening pigs from 80 kg to less than 110 kg [A3132Y] and fattening pigs 110 kg or over [A3132Z].

Furthermore, the division of the total Danish excretion of N and P is complicated by the fact that numbers reported to EUROSTAT do not reflect the actual distribution across the different categories of fattening pigs. In Denmark pig farmers are reporting the categories Statistics Denmark: suckling piglets; weaned pigs up to 50 kg; finisher pigs above 50 kg until slaughter; and breeding boars and sows for slaughter. The distribution in this report of the total Danish excretion of N and P is based on the assumption by Statistics Denmark that:

i) piglets less than 20 kg [A3110] correspond to the sum of suckling piglets + 1/3 of weaned pigs below 50 kg.

ii) pigs from 20 kg to less than 50 kg [A3131] correspond 2/3 of weaned pigs below 50 kg.

iii) fattening pigs from 50 kg to less than 80 kg [A3132X] correspond to 4/5 of fattening pigs above 50 kg.

iv) fattening pigs from 80 kg to less than 110 kg [A3132Y] correspond to the remaining 1/5 of fattening pigs above 50 kg.

v) fattening pigs 110 kg or over [A3132Z] correspond to breeding boars and sows for slaughter (Larsen, pers. comm.).

The average live weight of slaughter pigs was in the normative system assumed to be 117 kg for the accounting year 2025/26 (Sattarova et al., 2025) and has gradually increased over the years. For example, the average live weight for slaughter pigs was assumed to be 98 kg when the numbers for excreted N and P per animals were calculated with the current setup in 1997 (Poulsen & Kristensen, 1997).

Within the fertiliser accounting system, farmers must correct reported N and P when actual weights of piglets or fattening pigs deviate from the standard start and end weights used to calculate the standard norm values for pigs of a specific weight (Sørensen et al., 2023; Sattarova et al., 2025).

The NEC and PEC per pig are calculated as follows for the different sub-categories of piglets and fattening pigs.

Piglets less than 20 kg [A3110]: The correction equations in the normative system for conventional and organic piglets (Sørensen et al., 2023, 2024; Sattarova et al., 2025) were used to calculate the proportion of N and P excretion from weaning until 20 kg per piglet as a proportion of the norm value for pigs from weaning until 31 kg. The total Danish excretion from these pigs calculated based on this proportion was divided by the number of piglets less than 20 kg from Statistics Denmark to obtain the NEC and PEC values. [A3110].

Pigs from 20 kg to less than 50 kg [A3131]: The correction equations in the normative system for conventional and organic piglets and fattening pigs were used to calculate the proportion of N and P excretion from 20 kg to 31 kg for piglets plus the excretion from 31 kg to 50 kg for slaughtering pigs. The NEC and PEC values were found by dividing the N and P from these pigs calculated with the number of pigs from 20 kg to less than 50 kg from Statistics Denmark to obtain the NEC and PEC values [A3131].

Fattening pigs 110 kg or over [A3132Z]: The NEC and PEC values for this category of animals, which represents breeding boars and sows for slaughter, were assumed to be 63% of the ex-animal value for a year sow, which represents the excretion from a breeding boar (Sørensen et al., 2023, 2024; Sattarova et al., 2025).

Fattening pigs from 50 kg to less than 80 kg [A3132X]: First the total quantity of N and P excreted by Danish fattening pigs, 110 kg or over [A3132Z] and by pigs between 31 kg and 50 kg was subtracted from the total quantity excreted by Danish fattening pigs in the fertiliser accounting system. To comply with the method for distributing pigs from 50 kg to 110 kg used by Statistics Denmark this quantity was multiplied with 4/5 meaning that 80% of the excretions in the interval from 50 kg to 110 kg was ascribed to the category 50 kg to 80 kg. To

obtain the NEC and PEC per pig this quantity was divided by the number fattening pigs from 50 kg to less than 80 kg [A3132X] reported to EUROSTAT.

Fattening pigs from 80 kg to less than 110 kg [A3132Y]: The total quantity of N and P excreted by Danish fattening pigs 110 kg or over [A3132Z] and by pigs between 31 kg and 50 kg was subtracted from the total quantity for fattening pig in the fertiliser accounting system and multiplied by 1/5, meaning that 20% of the excretions in the interval from 50 kg to 110 kg was ascribed to the category 80 kg to 110 kg. To obtain the NEC and PEC per pig, this quantity was divided by the number of fattening pigs, from 80 kg to less than 110 kg [A3132Y] reported to EUROSTAT.

Description of methodological aspects

The excretion of N and P for piglets and fattening in the normative system are given per produced pig. The values for piglets and fattening pigs are based on a mass balance. Feed intake and live weight gain for piglets and fattening pigs are based on production data from commercial farmers, and the N and P concentrations in feed are based on a survey of the content in commercial pig-feed mixtures from the Danish feed suppliers. The N and P concentrations in live weight gain are based on literature values; for more details, see Sørensen et al. (2023), Sørensen et al. (2024) and Sattarova et al. (2025).

The organic production of pigs makes up less than 2% of the total production. The excretion of N and P ex-animal is higher for organic than conventional production. This has been considered by including the specific normative values for organic pigs.

The number of animals in the different sub-categories of piglets and fattening pigs does not fit with the current production practices, where the slaughter weight of fattening pig is 117 kg (Sattarova et al., 2025). Therefore, it was decided to allocate the N and P as described above. Statistics Denmark plans to update the equations for allocation of the counted number of pigs from the table SVIN (www.statistikbanken.dk/SVIN) to the EUROSTAT table Pig population (https://doi.org/10.2908/APRO_MT_LSPIG). When a new model is in place, the above-described method should be reviewed.

The number for piglets less than 20 kg [A3110] is underestimated because the excretion from suckling piglets in the normative system is included as part of the excretion from sows. However, the principle used in the present report is to distribute the contributions to each weight group of pigs in a manner that ensures that the total national excretion of N and P from pig production is equal to the excretion reported by Albrektsen and Mikkelsen (2026) to UNFCCC.

Broilers [A5140]

Data sources used in the calculations

- Data from table ANI6: Slaughterings and production of poultry by category and unit (www.statistikbanken.dk/ANI6, Statistics Denmark, last accessed 21/4-2026).
- Information directly from Statistics Denmark on animals slaughtered on farm and exported animals for slaughter.
- Data from the normative system for N and P excretion for conventional broilers of different production lengths and breeds and for organic broilers for reporting year 2022 (data from the fertiliser accounting year 2023/24;

van der Heide et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; van der Heide et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; van der Heide et al., 2025).
- The share of the different types of conventional and organic broilers is based on data registered in the fertiliser accounting system. For reporting years 2022, 2023 and 2024, data from the fertiliser accounting years 2021/22, 2022/23 and 2023/24 were used.
- The number of broilers reported to EUROSTAT is unknown.

Method for calculating total Danish excretion of N and P

The total excretion N and P was calculated in following Albrektsen and Mikkelsen (2026). Briefly, the total sum of excretions from broilers slaughtered at Danish slaughterhouses, broilers slaughtered on farms and broilers exported for slaughter was summed to obtain total excretion. The share of the different sub-categories of conventional and organic broilers was calculated from the information in the fertilizer accounting system.

Method for calculating NEC and PEC

Statistics Denmark will not report numbers of broilers to SAIO until 2026. It is therefore not possible to describe how the NEC and PEC values are calculated, as Statistics Denmark has not reported these numbers to EUROSTAT.

Description of methodological aspects

The normative values for broilers are given per produced animal and are updated on a yearly basis, except for organic broilers. The normative value for N and P excretion ex-animal for conventional broilers is divided into different sub-categories, taking different breeds and slaughter weights into account. There is only one normative value for organic broilers irrespective of slaughter weight. The organic share of the total production is below 2%. The normative values are calculated as mass balances with input of farm-based data on slaughter weight, slaughter age and feed efficiency. Feed composition is based on a survey among the major Danish feed companies. The content of N and P in weight gain are based on slaughter studies; for further details, see van der Heide et al. (2023, 2024, 2025).

The production of broilers is rather uniform and can be divided into three major sub-categories: conventional fast growing broilers based on only one breed, slower growing conventional broilers, also based on only one breed, and organic broilers, which probably are more diverse than the first two groups.

The information about feed composition from the feed companies takes changes in the feed composition over the growth period of the broilers into account.

Layers [A5110O]

Data sources used in the calculations

- ANI8: Production of eggs and types of production by unit (www.statistikbanken.dk/ANI6, Statistics Denmark, last accessed 21/4/2026).
- Data from the normative system for N and P excretion for conventional layers of different production lengths and breeds and for organic layers for reporting year 2022 (data from the fertiliser accounting year 2023/24; van der Heide et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; van der Heide et al., 2024) and for reporting year

2024 (data from the fertiliser accounting year 2025/26; van der Heide et al., 2025).
- Number of hens reported to EU is unknown.

Method for calculating total Danish excretion of N and P

The total excretion of N and P was calculated following Albrektsen and Mikkelsen (2026). Briefly, Statistics Denmark reports million kgs of eggs produced by caged layers, free-range layers, layers on deep litter, organic layers and eggs sold directly to consumers. The number of year hens is calculated for each sub-category by dividing the produced quantity of eggs per layer category by the egg production per hen within each sub-category (van der Heide et al., 2023, 2024, 2025). The number of year hens in each sub-category is multiplied by the excretion of N and P ex-animal from each sub-category (van der Heide et al., 2023, 2024, 2025). Finally, all excretions for each subcategory are summed to obtain the total Danish excretion.

Method for calculating NEC and PEC

Statistics Denmark will not report numbers of layers to SAIO before 2026; therefore, no data are currently available.

Description of methodological aspects

The normative values for N and P ex animal from layers [A5110O] are based on a mass balance approach and are calculated per animal per year. Information on productivity and feed consumption is available for the different sub-categories of layers each year. The composition of feed for layers is based on a survey among leading feed companies. Live weight gain of hens is based on the most common breeds used in Denmark. The content of N and P in eggs and live weight gain is based on literature values.

A year-hen only includes only the output from the layers during the laying period. In Denmark, the production of pullets has separate ex-animal normative values for N and P. The excretion of N and P for pullets is not included in the excretion for hens.

Ducks [A5210] and geese [A5220]

Data sources used in the calculations

- Data from table ANI6: Slaughterings and production of poultry by category and unit (www.statistikbanken.dk/ANI6, Statistics Denmark, last accessed 21/4-2026).
- Information obtained directly from Statistics Denmark on animals slaughtered on farms and animals exported for slaughter
- Data from the normative system for N and P excretion for conventional layers of different production lengths and breeds and for organic layers for reporting year 2022 (data from the fertiliser accounting year 2023/24; van der Heide et al., 2023), for reporting year 2023 (data from the fertiliser accounting year 2024/25; van der Heide et al., 2024) and for reporting year 2024 (data from the fertiliser accounting year 2025/26; van der Heide et al., 2025).
- The number of ducks and geese reported to the EU is unknown.

Method for calculating total Danish excretion of N and P

The total excretion of N and P was calculated in the same way as described by Albrektsen and Mikkelsen (2026). Briefly, the total sum of ducks or geese slaughtered at slaughterhouses, on farms or exported ducks or geese for slaughter was summed and multiplied by the normative values for N and P ex-animal from the normative system (van der Heide et al., 2023, 2024, 2025).

Method for calculating NEC and PEC

Statistics Denmark reports data on ducks and geese only for years ending in 3, 6 and 0 and currently no data are available.

Description of methodological aspects

The normative value in Denmark is defined per produced animal. The value is based on a mass balance for live weight gain, feed intake, feed composition and the gain of N and P in live weight (van der Heide et al., 2023, 2024, 2025). The productions of ducks and geese is small in Denmark compared to, for example, broilers. According to Statistics Denmark, the total number of ducks slaughtered at slaughterhouses k, on farms or exported was between 40,000 and 100,000 during 2022-2024. For geese, the numbers were below 5,000 in the same period.

Comments on the methods used to estimate NEC and PEC

As described in the introduction of this section, NEC and PEC are based on values for total Danish ex-animal excretion divided by the number of animals reported by Statistics Denmark to EUROSTAT. The total Danish ex-animal excretion of N and P will only be correct if the NEC and PEC per animal for each sub-category are combined with the correct number of animals in each sub-category.

Deviations in the NEC and PEC values from year to year do not directly reflect changes in the Danish production. The total excretion within each sub-category of animals is based on the number of produced animals and the excretion per produced animal. However, this total excretion is divided by the number of animals in the specific sub-category counted on a certain day. For example, the excretion from growing pigs is calculated based on the number of slaughtered and exported pigs within a certain year. This excretion is then divided by the number of pigs counted on the first day (1 January -20xx) of the following year. If the number of pigs decreases during the year, each pig counted on that date represents more animals than if the population had remained stable.

Comparison of NEC and PEC numbers between countries should be done with care as methods to calculate the NEC and PEC values might differ. For example, values for breeding sows might be higher in Denmark than in comparable countries because the N and P from suckling piglets are included in the values for breeding sows in Denmark, whereas other countries may allocate this excretion to the sub-category piglets less than 20 kg [A3110]. On the other hand, Danish NEC and PEC values for the sub-category piglets < 20 kg [A3110] are likely lower than in other countries.

It was recommended by SAIO to follow the same principles as those used for reporting to UNFCCC. The method developed by Albrektsen and Mikkelsen (2026) uses normative values as its starting point for calculating different sub-categories within the Danish normative system. However, these do not align with the sub-categories from EUROSTAT. The NEC and PEC estimates are therefore not accurate for all sub-categories, but the total Danish ex-animal

excretion of N and P remains accurate, as N and P surpluses and deficits across sub-categories cancel each other out.

Data for any reporting year in table 2.16 are based on data with different timestamps as explained in table 2.15. For example, data for reporting year 2022 are based on data from Statistics Denmark from year 2022. Ex-animal values for N and P are from the normative values for year 2023/24. Information on different groups of animals, e.g. organic production systems, come from the fertiliser accounting system from year 2021/22. The reason for this discrepancy is that the normative values are based on data from 1-2 years prior to the year in which they are applied. For example, normative values for 2023/24 data are based on production data from 2021 or 2022. In contrast, data from the fertiliser accounting system 2021/22 align with reporting year 2022, because most of the manure applied in 2021/22 (1 August to 31 July) is spread on fields during spring and summer 2022.

Table 2.15. Comparison of reporting year 2022 for SAIO across different data sources used for the calculations, as an example.

Timeline	**2021**	**2022**	**2023**	**2024**
Reporting year SAIO		2022		
Data sources used to calculate the normative values:				
Farm data used to calculate the mass balance values in the normative system[1)]	2021-2022			
Data source used to calculate the total Danish excretion of N and P:				
Allocation of animals from Statistics Denmark into different sub-categories reported in the fertiliser accounting system[2)]		2021/22		
Statistics Denmark – number of animals		2022		
N and P ex-animal normative values from the normative system[3)]			2023/24	
Data sources used to calculate NEC and PEC values:				
EUROSTAT		2022		

[1)] There are differences between sub-groups, e.g. dairy cows feed intake data are from 2022 for the normative year 2023/24, whereas for pigs the feed intake data are from 2021. For some species, the time span for data collection might even be longer to ensure sufficient data. More detailed information on the single years can be found at https://anivet.au.dk/forskning/sektioner/husdyrernaering-og-fysiologi/normtal.

[2)] Data reported by the farmers for the fertiliser accounting year starting 1/8-2021 until 31/7-2022.

[3)] The normative values are used by the farmer in the fertiliser accounting year 1/8-2023 to 31/7-2024.

Table 2.16. Data for dataset ii6: Livestock nutrient excretion coefficients. NEC: Nitrogen excretion coefficients (kg nitrogen per

	2022		2023		2024	
	NEC	**PEC**	**NEC**	**PEC**	**NEC**	**PEC**
Bovine animals, less than 1 year [A2010]	-	-	-	-	-	-
Bovine animals, less than 1 year, for slaughter [A2010B]	22.7	3.47	20.4	2.47	19.4	2.32
Male calves, less than 1 year, not for slaughter [A2110C]	22.7	3.47	20.4	2.47	19.4	2.32
Female calves, less than 1 year, not for slaughter [A2210C]	31.4	3.82	33.9	3.82	35.2	3.82
Bovine animals, 1-2 years [A2020]	-	-	-	-	-	-
Male bovine animals, 1-2 years [A2120]	22.7	3.47	20.4	2.47	19.4	2.32
Heifers, 1-2 years [A2220]	-	-	-	-	-	-
Heifers, 1-2 years, for slaughter [A2220B]	61.5	7.98	60.5	7.86	60.4	7.83
Heifers, 1-2 years, not for slaughter [A2220C]	61.5	7.98	60.5	7.86	60.4	7.83
Bovine animals, 2 years or over [A2030]	-	-	-	-	-	-
Male bovine animals, 2 years or over [A2130]	22.7	3.47	20.4	2.47	19.4	2.32
Heifers, 2 years or over [A2230]	-	-	-	-	-	-
Heifers, 2 years or over, for slaughter [A2230B]	61.5	7.98	60.5	7.86	60.4	7.83
Heifers, 2 years or over, not for slaughter [A2230C]	61.5	7.98	60.5	7.86	60.4	7.83
Cows [A2300]	-	-	-	-	-	-
Dairy cows [A2300F]	157	25.2	156	25.2	159	25.9
Non dairy cows [A2300G]	72.2	6.89	69.7	6.65	68.0	6.48
Live swine, domestic species [A3100]	-	-	-	-	-	-
Piglets, less than 20 kg [A3110]	1.50	0.408	1.30	0.387	1.32	0.371
Pigs, from 20 kg to less than 50 kg [A3131]	4.02	0.879	3.34	0.755	3.31	0.722
Fattening pigs, 50 kg or over [A3132]	-	-	-	-	-	-
Fattening pigs, from 50 kg to less than 80 kg [A3132X]	15.4	2.51	13.0	2.01	13.9	2.10
Fattening pigs, from 80 kg to less than 110 kg [A3132Y]	15.4	2.51	13.0	2.01	13.9	2.10
Fattening pigs, 110 kg or over [A3132Z]	14.6	3.01	14.5	3.01	13.8	3.03
Breeding pigs [A3120 and3133]	-	-	-	-	-	-
Breeding boars [A3133]	16.8	3.40	14.9	3.11	12.0	2.60
Covered sows [A3120K]	20.1	4.08	18.4	3.85	17.2	3.74
Sows, not covered [A3120L]	20.1	4.08	18.3	3.83	18.1	3.95
Live sheep and goats [A4000]	-	-	-	-	-	-
Milk ewes and ewe-lambs put to the ram [A4110KC]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Non milk ewes and ewe-lambs put to the ram [A4110KD]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other sheep [A4120]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Live goats [A4200]	-	-	-	-	-	-
Goats mated and having already kidded [A4210K]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other goats [A4220]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total poultry [A5000]	-	-	-	-	-	-
Chickens [A5100]	-	-	-	-	-	-
Broilers [A5140]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Layers [A5110O]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other Poultry [A5000X5100]	-	-	-	-	-	-
Ducks [A5210]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Geese [A5220]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Turkeys [A5230]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ostriches [A5410]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other poultry [A5900]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Fur animals [A6010]	-	-	-	-	-	-
Foxes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Racoon dogs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mink	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Chinchillas	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other fur animals	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rabbits [A6110]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a.: Data not available. Either animal numbers are declared non-significant / non-existing by Statistics Denmark, or the numbers have not been reported to Eurostat for the mentioned calendar years.

2.6 Livestock manure and organic fertiliser import/export

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Livestock manure in its raw form produced on farms can be either applied directly to the fields or used outside the agricultural sector, e.g. for energy production (biogas). Some nutrients from the removed manure can eventually be returned to the agricultural fields as organic fertilisers. This process complicates the tracking of manure flows in nutrient balances and increases the risk of double-counting nutrients.

The management of manure flow in the SAIO nutrient balance is primarily based on three datasets:

- Dataset i.2 - Organic fertilisers for agriculture
- Dataset ii.6 - Livestock nutrient excretion coefficients
- Dataset ii.7 - Livestock manure withdrawal volumes and nutrient content coefficients

The following steps should be considered when accounting for nutrients from manure in the nutrient balances (EUROSTAT, 2026):

1. Estimating total nutrients from raw manure: The calculation of nutrients from raw manure is based on excretion coefficients reported in Dataset ii.6.
2. Deducting manure removed: Not all nutrients from the raw manure recorded in Step 1 are applied directly to the soil. A proportion of manure is removed for purposes such as:
    - Exporting to other countries
    - Producing energy (e.g., biogas)
    - Processing into fertilisers or components of compound fertilisers
    - Disposal

All manure removed, regardless of the purpose of the removal, should be reported in dataset ii.7 "Other manure withdrawals" – except for manure exports to other countries, which should be reported in "Exported livestock manure".

3. Nutrients from the removed manure (step 2) can eventually return to the fields as organic fertilisers, for instance as degassed byproducts of energy production. The nutrient content of manure may change during these processing stages, affecting its final nutrient contribution when reapplied. These nutrients should be reported in Dataset i.2, and can fall under two categories:

a. Organic fertilisers, when the resulting materials (e.g. digestate or processed manure) are applied without mixing with inorganic components, or organo-mineral fertilisers when the resulting material is used to produce a compound fertiliser of both organic and inorganic components.

Figure 2.1 shows how the manure flows within the SAIO nutrient balances should be reported.

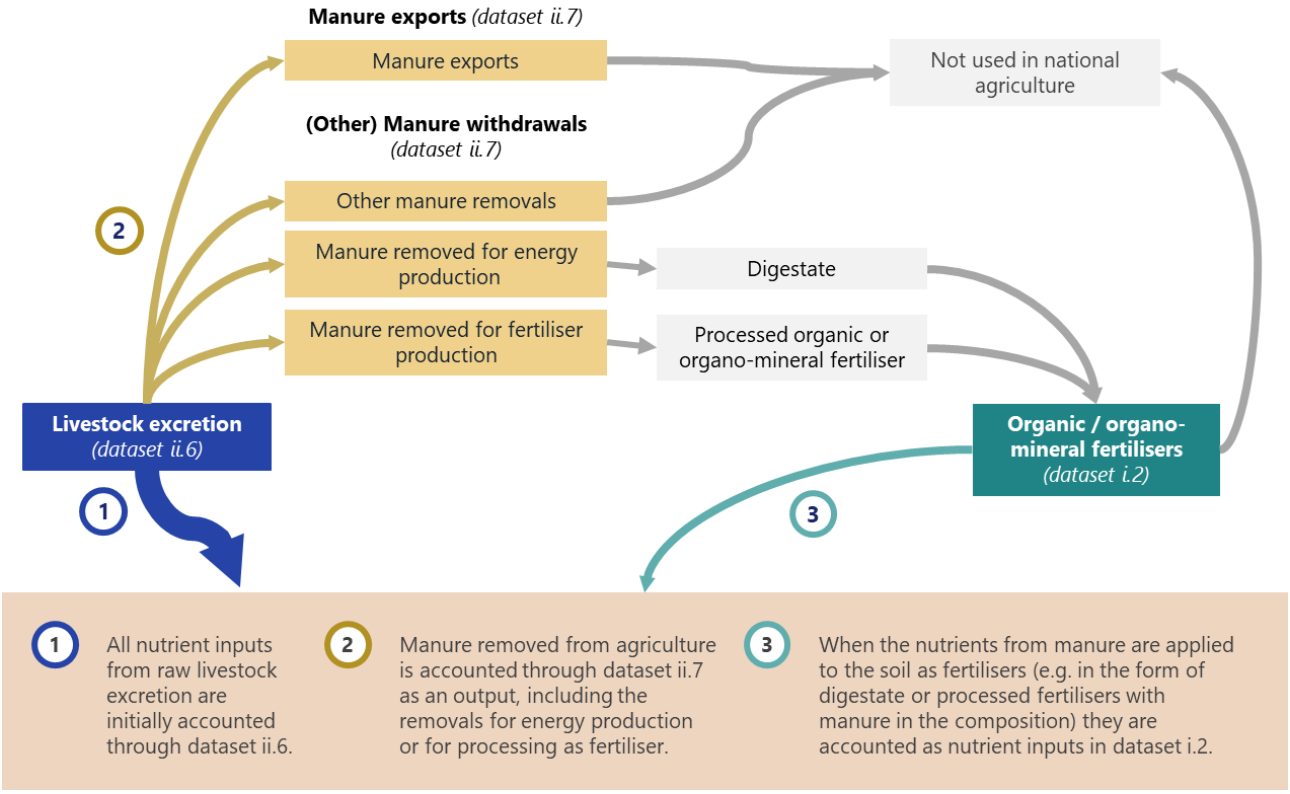

Figure 2.1. Diagram showing how manure flows should be reported within the SAIO nutrient balances (EUROSTAT, 2026).

Data sources and methods

In Denmark, farmers are required to report their production and use of fertilisers (both mineral and organic) as fertiliser accounts to a national authority.

Data from the fertiliser accounts include the quantity of N and P in livestock manure that is exported from one farm to other farms, to energy production facilities (i.e. biogas plants) or out of the country. In addition, the fertiliser accounts include manure or other organic fertilisers (e.g. degassed products from external biogas plants) received by the farms.

The quantity of nutrients in livestock manure removed from the farms that is not used directly as fertilisers within the agricultural sector will be included in dataset ii.7.

The quantity of nutrients in processed livestock manure received by the farms will be included in dataset i.2.

However, the national reporting from farmers only contains the total quantities of N and P removed from or received by the farmers. The total quantity of manure dry matter (Q) is not reported, neither are the N and P coefficients (N and P per tonne of dry matter).

Therefore, a technical conversion of the data is applied in order to estimate the quantity of Q and the N and P coefficients from the total quantities of N and P. The conversion method is based on registered types and quantities of livestock manure and other organic fertilisers received by or delivered from external facilities, such as biogas plants, other processing plants handling animal manure, or suppliers of other types of organic fertilisers (SGAV, 2024).

The dry matter content is estimated from literature (Børsting & Hellwing, 2024; SEGES, 2018a,b; Hansen, 2022).

In table 2.17, the types of products included for the calculation of average NC and PC for the data type "Other organic fertilisers" in dataset 2 are shown. The data cover products delivered to the following types of companies: biogas plants (registration codes "IBAB"), other processing plants/"forarbejdningsanlæg" (registration codes "IFAF"), suppliers of other organic fertilisers/"Leverandør af anden org. gødning" (registration code "IAAA") and suppliers of processed animal manure/"Leverandør af forarbejdet husdyrgødning" (registration code "IGAF").

It is assumed that the distribution of fertiliser types delivered from the different suppliers will not vary much between the years 2022-2025, and that the N- og P coefficients therefore can represent the average values in all four years.

Table 2.17. Types of products included in "Other organic fertilisers" in dataset 2. The calculated average nitrogen content (NC) and phosphorus content (PC), marked with grey fill, will be used for estimating Q based on total quantities of N and P provided by SGAV.

Type of organic fertiliser	Share of total quantity of N	Manure quantity (1,000 tonnes wet weight)	Nitrogen quantity (tonnes)	Phosphorus quantity (tonnes)	Dry matter content[1] (%)	Manure quantity (1,000 tonnes DM)	kg N /tonnes DM	kg P /tonnes DM
Degassed biomass	93%	18,488	85,482	15,353	6	1,109	77	14
Other organic fertiliser with documentation	0.2%	63	220	57	30	19	12	3
Other types of organic fertiliser	1.4%	495	1,306	556	30	149	9	4
Fiber fraction after processing animal manure	0.6%	100	584	207	30	30	19	7
Grønsaft/green waste	0.02%	76	20	7	3	2	9	3
Garden and park waste	0.01%	16	11	17	60	9	1	2
Kartoffelfrugtsaft/Potato juice	2%	151	1,881	396	30	45	41	9
Compost (not from animal manure)	0.3%	28	241	97	50	14	17	7
Composted household waste	0.03%	6	32	3	16	1	36	4
Meat and bone meal, blood meal and fish meal/fish waste	1%	29	938	118	30	9	109	14
Vinasse	0.03%	1	28	0	30	0	107	0
Liquid fraction after processing animal manure	1.8%	367	1,660	290	3	11	151	26
Sum	**100%**	**19,819**	**92,401**	**17,102**	**7**	**1,399**	**66**	**12**

[1] Based on information in registered data combined with published sources (SGAV, 2024; SEGES, 2018a,b)

In table 2.18, average N and P coefficients for "Other organic fertilisers" (and sewage sludge) are shown.

Table 2.18. Data for dataset i2. Organic fertilisers for agriculture (other than raw animal manure).

Type of fertiliser	Q (1,000 ton dry matter)	NC (kg N/tonnes DM)	PC (kg P/tonnes DM)
Sewage sludge	To be calculated based on the total quantity of N provided by SGAV for the years 2022-2025	38	20
Other organic fertilisers	To be calculated based on the total quantity of N provided by SGAV for the years 2022-2025	66	12
Organo-mineral fertilisers	Provided by SGAV	Provided by SGAV	Provided by SGAV

Table 2.19, the types of products included for the calculation of average NC and PC values for the data type "Other organic fertilisers" in dataset 2 are shown. The data cover raw animal manure delivered to the following types of producers: biogas plants (registration codes "IBMA" and "IBMH") and other processing plants/"forarbejdningsanlæg" (registration codes "IFMA" and "IFMH").

Table 2.19. Types of products included in "Other manure withdrawals" in dataset 7. The calculated average nitrogen content (NC) and phosphorus content (PC), marked with grey fill, will be used for estimating Q based on total the quantities of N and P provided by SGAV.

Type of organic fertiliser	Share of total quantity of N	Manure quantity (1,000 tonnes wet weight)	Nitrogen quantity (tonnes)	Phosphorus quantity (tonnes)	Dry matter content[1] %	Manure quantity (1,000 tonnes DM)	kg N /tonnes DM	kg P /tonnes DM
Liquid manure	0.005%	4	3	1	3	0	27	4
Other animal manure (not poultry) and deep litter manure (not cattle, pig or poultry)	0.03%	15	23	5	20	3	8	2
Mixed animal manure	10.0%	1,400	7,320	1,367	20	280	26	5
Deep litter manure (poultry) and other animal manure (poultry)	5.4%	167	3,910	1,253	55	92	42	14
Deep litter manure (not cattle, pig or poultry) og other manure types	0.8%	92	572	115	30	27	21	4
Deep litter manure (Cattle and pig)	18.1%	1,554	13,237	2,028	30	466	28	4
Farmyard manure	0.06%	6	47	16	25	1	34	12
Slurry from meat eating fur animals	0.00%	0	2	0	10	0	46	10
Cattle slurry	42.9%	7,595	31,356	5,344	10	760	41	7
Pig slurry	22.8%	4,509	16,641	3,596	5	225	74	16
Sum	**100%**	**15,343**	**73,111**	**13,726**	**12**	**1,855**	**39**	**7**

[1] Based on information in the fertiliser accounts combined with published sources (Børsting and Hellwing, 2024).

It is assumed that the average N and P contents for raw animal manure exported out of the country (if any) can also be represented by the values in table 2.19.

Average N and P coefficients for the data types "Other manure withdrawals" and "Exported livestock manure" are provided in table 2.20.

Table 2.20. Data for dataset ii7. Livestock manure withdrawals.

Type of fertiliser	Q (1,000 tonnes dry matter)	NC (kg N/tonnes DM)	PC (kg P/tonnes DM)
Exported manure and other manure withdrawals	-	-	-
Exported livestock manure	To be calculated based on the total quantity of N provided by SGAV for the years 2022-2025	39	7
Other manure withdrawals	To be calculated based on the total quantity of N provided by SGAV for the years 2022-2025	39	7
Imported manure and other manure inputs	-	-	-
Imported livestock manure	NS	NS	NS
Other manure inputs	Provided by SGAV based on fertiliser accounts		

3 References

Albrektsen, R. & Mikkelsen, M.H. 2026. Danish Emission Inventories for Agriculture. Inventories 1985 - 2023. Aarhus University, DCE – Danish Centre for Environment and Energy, 265 pp. Scientific Report No. 696. Scientific report no. 696

ANI4. Slaughterings and production of cattle by category and unit (www.statistikbanken.dk/ANI4, Statistics Denmark, last seen 21/4-2026

ANI5. Slaughterings and production of pigs by category and unit (www.statistikbanken.dk/ANI5, Statistics Denmark, last seen 21/4-2026

Brask, M.J., Hellwing, A.L.H., Børsting, C.F., Lund, P., Kjeldsen, A.M.H. & Martinussen, H. 2025. Kapitel 3 Næringsstofudskillelse fra kvæg, ab dyr – Normtal for husdyrgødning 2025/2026 - Aarhus Universitet

Børsting C.F. & Hellwing, A.L.F. 2024. Normtal for husdyrgødning – 2024/25. Rådgivningsrapport fra DCA – Nationalt Center for Fødevarer og Jordbrug, Aarhus Universitet. 45 sider. Kan findes på https://anis.au.dk/forskning/sektioner/husdyrernaering-og-fysiologi/normtal/

Danmarks Statistik. Ingen årstal. Vejledning ved indhentning af udbytter for korn, raps og bælgsæd. https://www.dst.dk/Site/Dst/SingleFiles/GetArchiveFile.aspx?fi=fode&fo=hoest_vejled&ext={2}

Danmarks Statistik. 2026. Høstresultat efter enhed, område, afgrøde og tid HST77. https://www.statistikbanken.dk/statbank5a/default.asp?w=2560

Ellermann, T., Bossi, R., Sørensen, M.O.B., Christensen, J., Lansø, A. S. & Poulsen, M.B. 2024: Atmosfærisk deposition 2022. NOVANA. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 85s. – Videnskabelig rapport fra DCE – Nationalt Center for Miljø og Energi nr. 588. SR588.pdf

Ellermann, T., Bossi, R., Sørensen, M.O.B., Christensen, J., Lansø, A.S., Monies, C. & Poulsen, M.B. 2024: Atmosfærisk deposition 2023. NOVANA. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 68 s. – Videnskabelig rapport fra DCE – Nationalt Center for Miljø og Energi nr. 626. SR626.pdf

EUROSTAT. 2017. Gross Nutrient Balances – ESS agreement. 71 p. d8d6b0f8-c15a-4a2a-af7e-7756d4b39ef4

EU. 2022. Regulations on statistics on agricultural input and output, amending Commission Regulation (EC) No 617/2008 and repealing Regulations (EC) No 1165/2008, (EC) No 543/2009 and (EC) No 1185/2009 of the European Parliament and of the Council and Council Directive 96/16/EC. Publications Office

EU. 2024. Commission Implementing Regulation (EU) 2024/2212 of 3 September 2024 laying down rules for the application of Regulation (EU) 2022/2379 of the European Parliament and of the Council as regards statistics on nutrients.

EUROSTAT. 2026. SAIO handbook of nutrient statistics (in preparation)

DTU Food Institute (National Food Institute). 2024. *FRIDA – Danish Food Composition Database.* Technical University of Denmark. Available at: https://frida.fooddata.dk/

Hansen, M.N. 2022. Gødningsværdi af afgasset biomasse til vinterhvede. Foreløbige resultater af markforsøg 2022. Præsentation ved temadag om afgasset biomasse 10. november 2022. pm_22_4588_AP4_Resultater_fra_markforsoeg_med_afgasset_biomasse.pdf

HDYR1. Farms with livestock by area, unit and kind (www.statistikbanken.dk/HDYR1, Statistics Denmark, last seen 21/4-2026)

Hyttel, H.L. 2024. Landsgennemsnit for produktivitet i produktionen af grise i 2023. SEGES Innovation P/S.

Hyttel, H.L. 2025. Landsgennemsnit for produktivitet i produktionen af grise i 2024. SEGES Innovation P/S.

Høgh-Jensen, H., Loges, R., Jørgensen, F.V., Vinther, F.P. & Jensen E.S. 2003. Empirical model for quantification of symbiotic nitrogen fixation in leguminous crops. Agricultural Systems, 1-31. (Unpublished).

Høgh-Jensen, H., Loges, R., Jørgensen, F.V., Vinther, F.P. & Jensen E.S. 2004. An empirical model for quantification of symbiotic nitrogen fixation in grass-clover mixtures. Agricultural Systems 82, 181-194. https://www.sciencedirect.com/science/article/pii/S0308521X04000113

Høgh-Jensen, H., Loges, R., Jensen E.S., Jørgensen, F.V. & Vinther, F.P. 1998. Empirisk model for kvantificering af symbiotisk kvælstoffiksering. In: Kristensen, E. S. and Olesen, J.E. (Eds). Kvælstofudvaskning i konventionelle og økologiske produktionssystemer. Forskningscenter for Økologisk Jordbrug. 27 s. (in Danish)

Knudsen, L. 2022. Værdi af næringsstoffer i halm. LandsbrugsInfo, 1 side.

KVAEG5: Number of cattle by region and type (www.statistikbanken.dk/KVAEG5, Statistics Denmark, last seen 21/4-2026)

Kyllingsbæk, A. 2000. Kvælstofbalancer og kvælstofoverskud i dansk landbrug 1979-1999. DJF report Markbrug nr. 36. 48 pages. (in Danish)

Larsen, S.N. & Vikstrøm, T. (eds). 1995. Ferske enge – en beskyttet naturtype. Miljø og Energiministeriet, Skov og naturstyrelsen. 184 pages. (in Danish).

Lund, P., Hellwing, A.L.H., Børsting, C.F., Lund, P., Kjeldsen, A.M.H. & Martinussen, H. 2023. Kapitel 3 Næringsstofudskillelse fra kvæg, ab dyr – Normtal for husdyrgødning 2024/2025 - Aarhus Universitet

Lund, P., Hellwing, A.L.H., Børsting, C.F., Lund, P., Kjeldsen, A.M.H. & Martinussen, H. 2024. Kapitel 3 Næringsstofudskillelse fra kvæg, ab dyr – Normtal for husdyrgødning 2024/2025 - Aarhus Universitet

Møller, J., Thøgersen, R., Helleshøj, M.E., Weisbjerg, M.R., Søegaard, K. & Hvelplund, T. 2005. *Fodermiddeltabel - Sammensætning og foderværdi af fodermidler til kvæg*.

Poulsen, H.D. & Kristensen, V.F. 1997. Normtal for husdyrgødning – En revurdering af danske normtal for husdyrgødningens indhold af kvælstof, fosfor og kalium. Danmarks JordbrugsForskning. Beretning nr. 736, 165 sider. https://dcapub.au.dk/pub/sh_beretning_736.pdf

Poulsen, M.B., Ellermann, T., Bossi, R., Sørensen, M.O.B., Christensen, J., Lansø, A.S. & Monies, C., 2024: Atmosfærisk deposition 2024. NOVANA. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 59 s. Videnskabelig rapport nr. 678. In Danish. SR678.pdf

Sattarova, E., Sørensen, M.T., Hellwing, A.L.F., Tybirk, P., Grove, S.S. & Børsting, C.F. 2025. *Kapitel 2 Næringsstofudskillelse fra grise, ab dyr – Normtal for husdyrgødning 2025/2026,* Nr. 2024-0647366, 2025-0914500, 32 s., dec. 15, 2025. Rådgivningsnotat fra DCA - Nationalt Center for Fødevarer og Jordbrug.

SEGES. 2018a. Dyrkningsvejledning. Anvendelse af spildevandsslam. September 2018. dv_18_2439_3177_Spildevandsslam_V6.pdf

SEGES. 2018b. Anvendelse af restprodukter som gødnings- og jordforbedringsmiddel. Landbrugsinfo september 2018. pm_22_8621_Anvendelse_af_restprodukter_som_goednings_og_jordforbedringsmiddel.pdf

SEGES. 2025. Nærringsindhold i korn fra høsten 2025. Notat fra SEGES Innovation 13 sider. https://www.landbrugsinfo.dk/-/media/landbrugsinfo/public/c/d/c/notat_naringsindhold_korn_2025_endelige_resultater.pdf

SEGES. 2024. Nærringsindhold i korn fra høsten 2024. Notat fra SEGES Innovation 13 sider. https://www.landbrugsinfo.dk/-/media/landbrugsinfo/public/6/e/7/notat_naringsindhold_korn_2024_endelige_resultater.pdf

SEGES. 2023. Nærringsindhold i korn fra høsten 2023. Notat fra SEGES Innovation 13 sider. https://www.landbrugsinfo.dk/-/media/landbrugsinfo/public/c/8/e/naringsindhold_korn_host_2023.pdf

SEGES. 2022. Nærringsindhold i korn fra høsten 2022. Notat fra SEGES Innovation 19 sider. https://www.landbrugsinfo.dk/-/media/landbrugsinfo/public/7/d/d/notat_naringsindhold_korn_host_2022_endelige_resultater.pdf

SGAV (Agency for Green Transition and Aquatic Environment). 2024. Register for Gødningsregnskab (In Danish) https://lbst.dk/planter/goedning/goedningsregnskab/register-for-goedningsregnskab (datasæt fra leverandørregisteret (LGCompanyA+B))

SVIN: Number of pigs at the first day of the quarter by type (www.statistikbanken.dk/SVIN, Statistics Denmark, last seen 21/4-2026)

Sørensen, M.T., Tybirk, P., Krogh, U.P., Hellwing, A.L.F. & Børsting, C.F. 2023. Kapitel 2 Næringsstofudskillelse fra svin, ab dyr – Normtal for husdyrgødning 2023/2024

Thorsen, M., Blicher-Mathiesen, G., Wienke, J., Petersen, J., Andersen, H.E., Frederiksen, R.F., Jensen, P.G., Hansen, B. & Thorling, L. 2025. Landovervågningsoplande 2024. NOVANA. Aarhus Universitet, DCE - Nationalt Center for Miljø og Energi, 316 s. - Videnskabelig rapport nr. 680

Appendixes

Appendix 1 Weighted nutrient contents in straw from cereals used for energy

Tabel A1. Data used to calculate weighted nitrogen and phosphorus contents in straw used for energy; the bold values in the first line represent the weighted contents. Data on dry matter, nitrogen and phosphorus as % of dry weight are from Knudsen (2022). Data on the production of straw from cereals and rape used for energy are derived from Statistic Denmark. Averages for the period 2022-2025 are used to calculate the weighted average for cereals.

	Dry matter	**Nitrogen content**	**Phosphorus content**	**Straw production for energy consumption (1,000 tonnes)**				
	(%)	**(% of dry weight) (%)**		**2022**	**2023**	**2024**	**2025**	**2022-2025**
All cereals	85	**0.57**	**0.09**	1644	1256	1565	1984	1612
Winter wheat	85	0.53	0.09	857	787	847	1022	878
Spring wheat	85	0.53	0.09	6.6	3	4,5	6.4	5
R	85	0.61	0.09	199	151	198	253	200
Triticale				8.9	9	8.5	16.3	11
Winter barley	85	0.64	0.08	81	80	80,9	119	90
Spring barley	85	0.64	0.09	457	208	387	493	386
Oat	85	0.59	0.14	34	18	37,8	70	40
Rape	83	0.85	0.08	88	83	108	108	97

NUTRIENT COEFFICIENTS FOR ESTIMATING NUTRIENT BALANCES FOR THE AGRICULTURAL SECTOR IN DENMARK

Methodology for use in relation to EU SAIO Nutrient Balances

This report describes methods used for deriving input to the nutrient balances for nitrogen (N) and phosphorus (P) under the EU SAIO framework for Gross Nutrient Balances (GNB). The methodology integrates multiple data sources, including agricultural statistics, monitoring programmes, atmospheric modelling and the Danish normative system for livestock excretion. Nutrient inputs and outputs are quantified using standardised coefficients for crops, residues, biological nitrogen fixation, atmospheric deposition, seeds and manure flows. Emphasis is placed on the consistent accounting of livestock-derived nutrients and the complex handling of manure transfers and processing. Overall, the methods applied ensure harmonised nutrient accounting aligned with EU reporting requirements.

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