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COMMISSION STAFF WORKING DOCUMENT

Accompanying the document

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2016–2019

{COM(2021) 1000 final}

Pressure from Agriculture



Denmark's utilized agricultural area amounts to 2.6 Mha, representing 62.5% of the total land area and has remained stable since 2013. The major outputs of the agricultural industry excluding services and secondary activities include in a decreasing order pigs (26.9%), milk (20.7%), and cereals (11.4%).

Major land use statistics for Denmark

Table 1.Utilized agricultural area (abbreviated as UAA)

Denmark	2005	2007	2010	2013	2016
Utilised agricultural area UAA (1000 ha)	NA	2694	2676	2628	2625
arable land (1000 ha)	NA	2451	2446	2406	2372
permanent grass (1000 ha)	NA	233	217	196	226
permanent crops (1000 ha)	NA	10	7	27	28
kitchen gardens (1000 ha)	NA	0	0	0	NA

Note:
Eurostat (FSS)

Denmark's arable land has decreased by 2.6% since 2007. The permanent grass land area has increased by 15.3% since 2013.

Animal distribution in Denmark

All Denmark's livestock have decreased since 2013. The livestock density index has remained stable since the last reporting period and is significantly higher than the EU average of 0.8.

Table 2. Livestock statistics

Denmark	2005	2007	2010	2013	2016
Livestock index	1.69	1.72	1.86	1.58	1.58
dairy cows (10^6 heads)	0.56	0.55	0.57	0.57	0.56
live bovines (10^6 heads)	1.57	1.54	1.63	1.58	1.55
live pigs (10^6 heads)	12.60	13.17	12.29	12.40	12.28
live poultry (10^6 heads)	NA	NA	18.74	19.43	18.51

Note:
Eurostat (FSS)

Nitrogen and phosphorus fertilizers and surplus (kg/ha UAA)

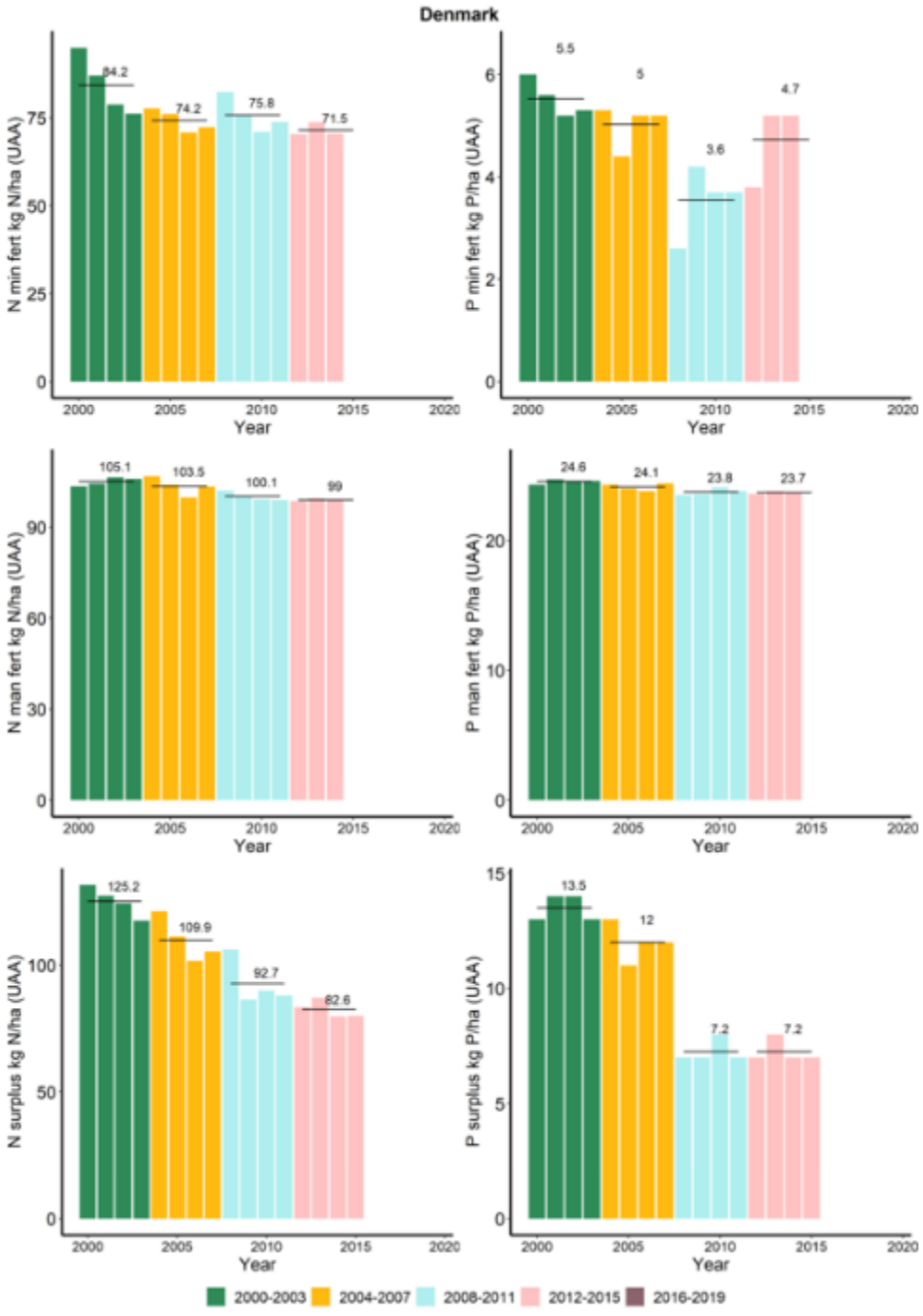


Figure 1. N and P fertilizers and gross surplus (kg/ha)

The gross nitrogen and phosphorus surpluses originate form EUROSTAT data for the years 2000-2015. No data for the period 2016-2019 is available. In the plots: N/P min and N/P man are respectively the N/P mineral fertilizers and N/P manure.

Livestock unit - LSU /ha

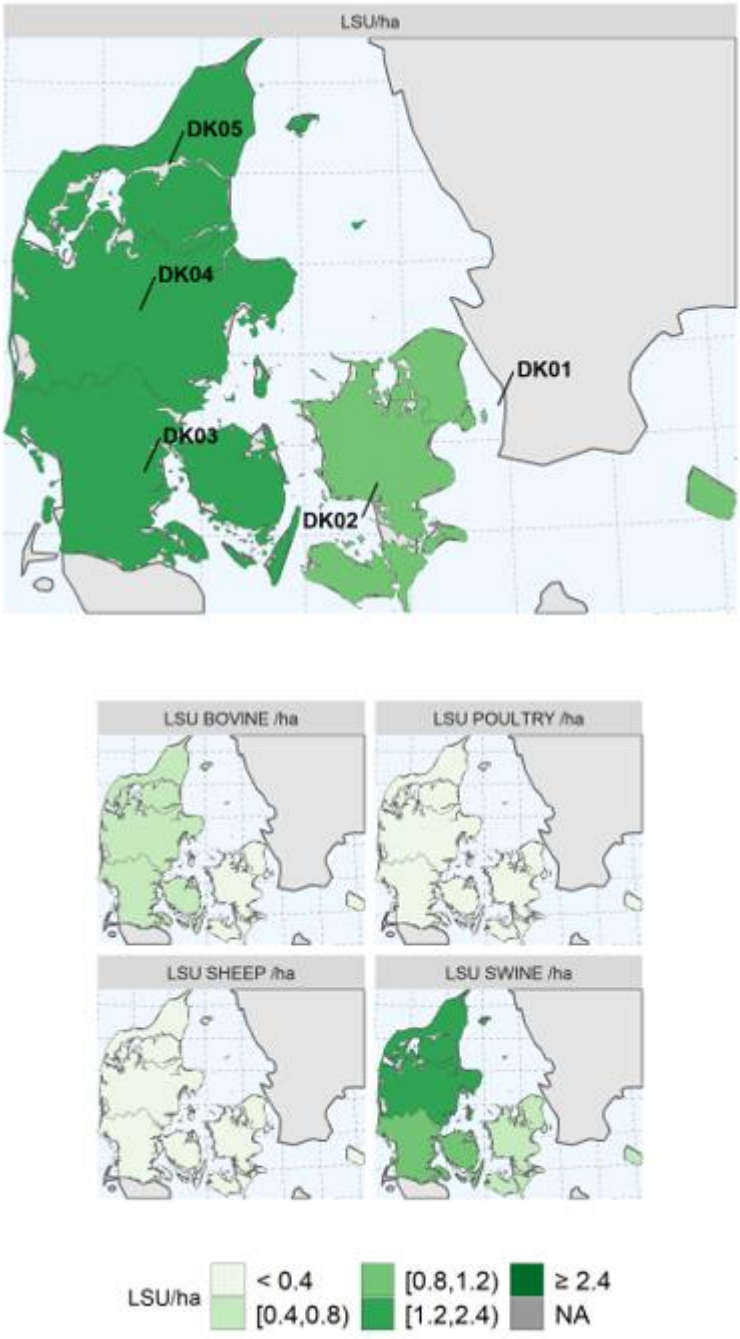


Figure 2. Map of livestock unit distribution, year 2016 (Source: Eurostat, February 2021)

Animal production is concentrated in the western part of the Denmark (total LSU and LSU by animal type were retrieved individually from EUROSTAT).

In this document, the NUTS-2013 version is used. (https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts)

Water Quality Monitoring

The groundwater monitoring network used for meeting the monitoring requirements of the Nitrates Directive, ND, also serves to assess groundwater quality according to the Water Framework Directive, WFD. Implementation of the WFD has required large adjustments of the groundwater-monitoring network. The major adjustments took place in the period 2010-17, and involved establishment of new monitoring wells, as well as closure of existing monitoring wells.

Watercourses are dominated by numerous small streams and only very few larger rivers, which still – on a European scale – have relatively short distance between source and outlet. Therefore, Danish streams are generally not liable to eutrophication, and nitrate constitutes a major part of total nitrogen during all seasons. The lakes included are a selection of Danish lakes > 5 hectares covered by the Water Framework Directive.

For groundwater measurements, some stations have same coordinates due to different depths. In this case, the average values cover different measurements in time, but also location. In maps providing the spatial distribution of monitoring points, it is not possible to distinguish stations with the same coordinates: for NO3 concentration, the average value is shown; for trends and trophic status the worst case was considered.

It is noteworthy that in some cases in the bar charts the total value can differ from 100% due to rounding errors.

Groundwater quality monitoring network

Table 3. Number of GW stations with measurements and trends per type

		Number of stations with measurements			Number of stations with Trends		
Station Type	Description	2008-2011	2012-2015	2016-2019	2008-2011	2012-2015	2016-2019
0	Phreatic groundwater (shallow): 0-5 m	33	73	77	33	69	68
1a	Phreatic groundwater (deep) 5-15 m	129	362	392	129	321	338
1b	Phreatic groundwater (deep) 15-30 m	118	438	462	118	389	412
1c	Phreatic groundwater (deep) >30 m	56	328	344	56	222	287
2	Captive groundwater	258	0	0	252	0	0
3	Karstic groundwater	0	0	0	0	0	0
9	Not specified	1	0	0	1	0	0
	Total	**595**	**1201**	**1275**	**589**	**1001**	**1105**

Surface water quality monitoring network

Table 4. Number of SW stations with measurements, trends and trophic status per type

		Number of stations with measurements			Number of stations with Trends			Number of stations with Trophic status		
Station Type	Description	2008-2011	2012-2015	2016-2019	2008-2011	2012-2015	2016-2019	2008-2011	2012-2015	2016-2019
4	River water	111	111	425	111	111	209	0	0	391
5	Lake/reservoir water	50	66	20	14	27	20	200	0	403
6	Transitional water	0	0	0	0	0	0	0	0	0
7	Coastal water	36	27	48	0	27	43	0	0	48
8	Marine water	34	17	18	0	17	13	0	0	7
9	Not specified	0	0	0	0	0	0	0	0	0
	Total	**231**	**221**	**511**	**125**	**182**	**285**	**200**	**0**	**849**

Groundwater Quality

Groundwater average annual nitrate concentration

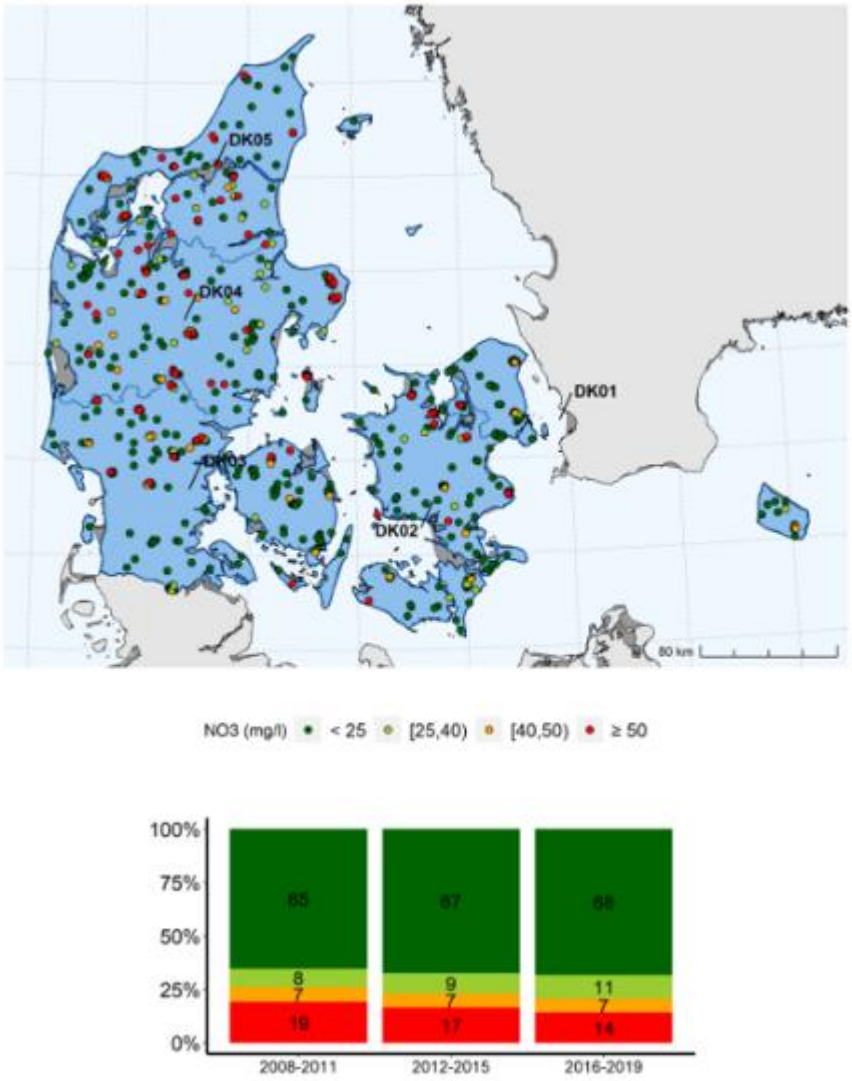


Figure 3. Spatial distribution of average NO3 annual concentration (map) and corresponding percentage of monitoring points per classes of concentration by reporting period (x axis).

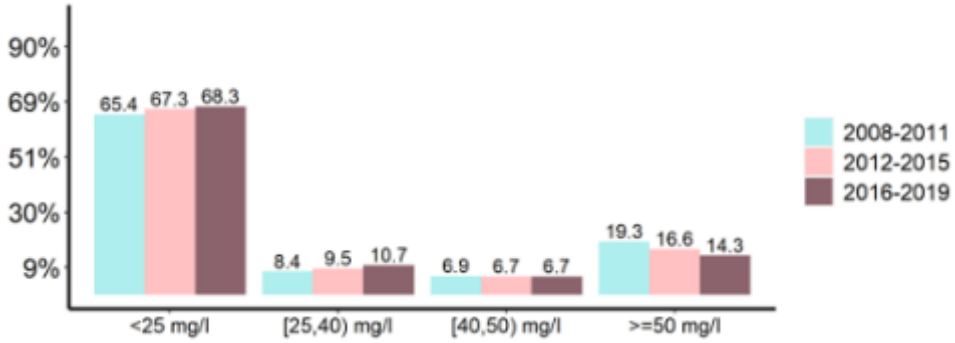


Figure 4. Comparison of percentage of monitoring points in the three reporting periods by classes of average NO3 annual concentration (x axis)

Groundwater average annual nitrate concentration trend

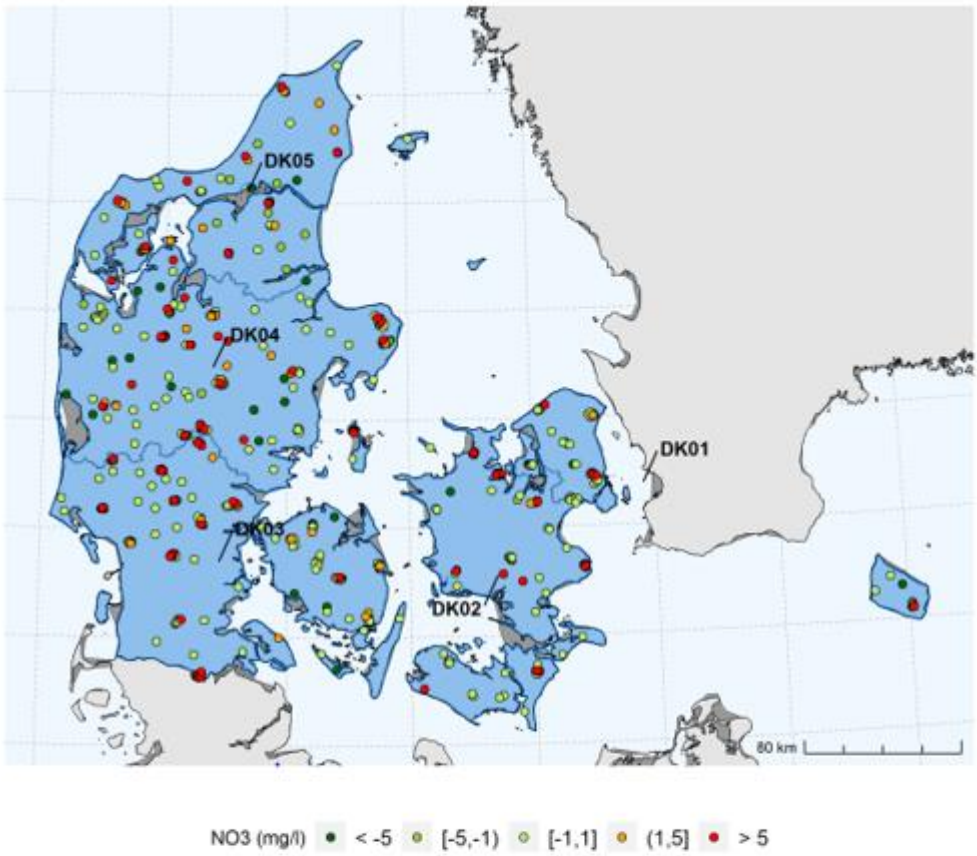


Figure 5. Spatial distribution of average NO3 annual trends (map) and corresponding percentage of monitoring points per classes of trends by reporting period (x axis).

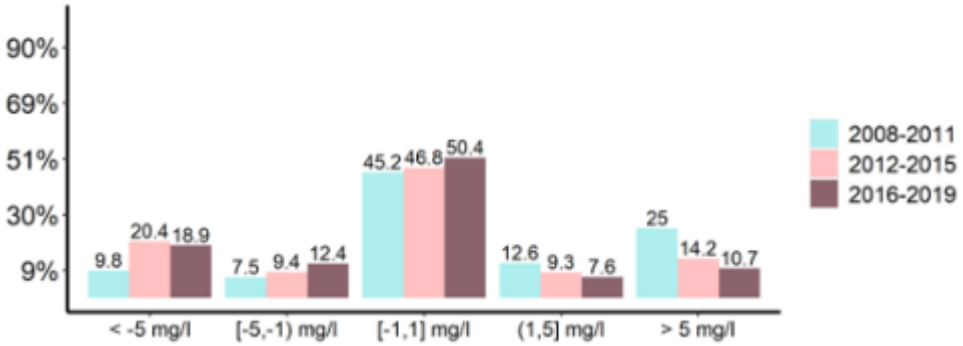
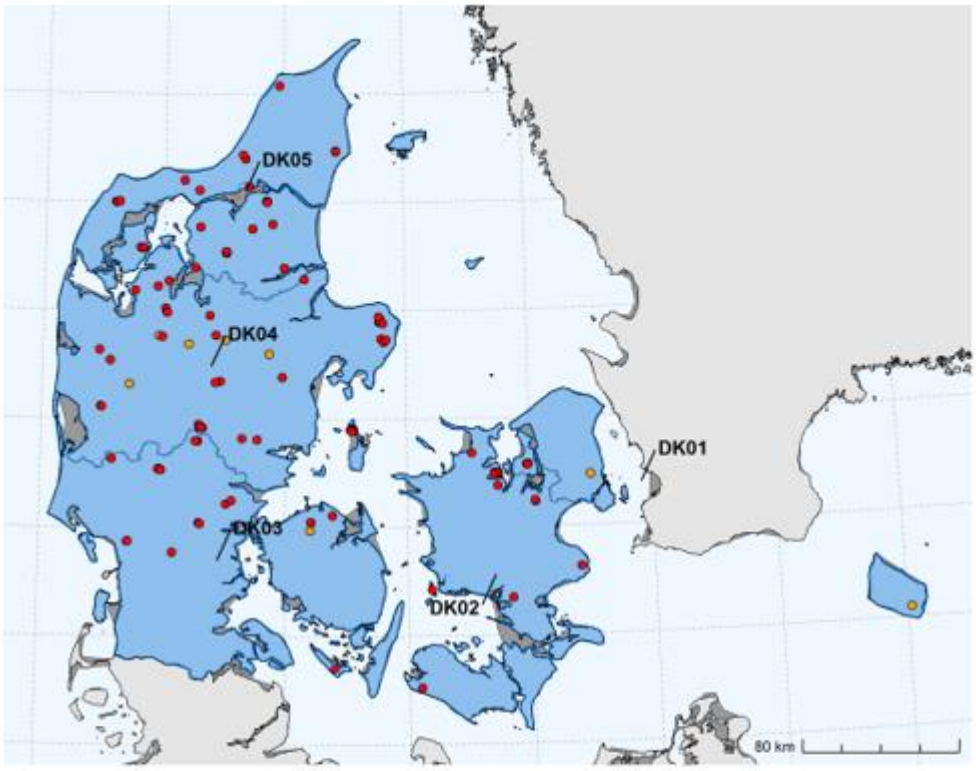


Figure 6. Comparison of percentage of monitoring points in the three reporting periods by classes of average NO3 annual trends (x axis)

Groundwater hotspot

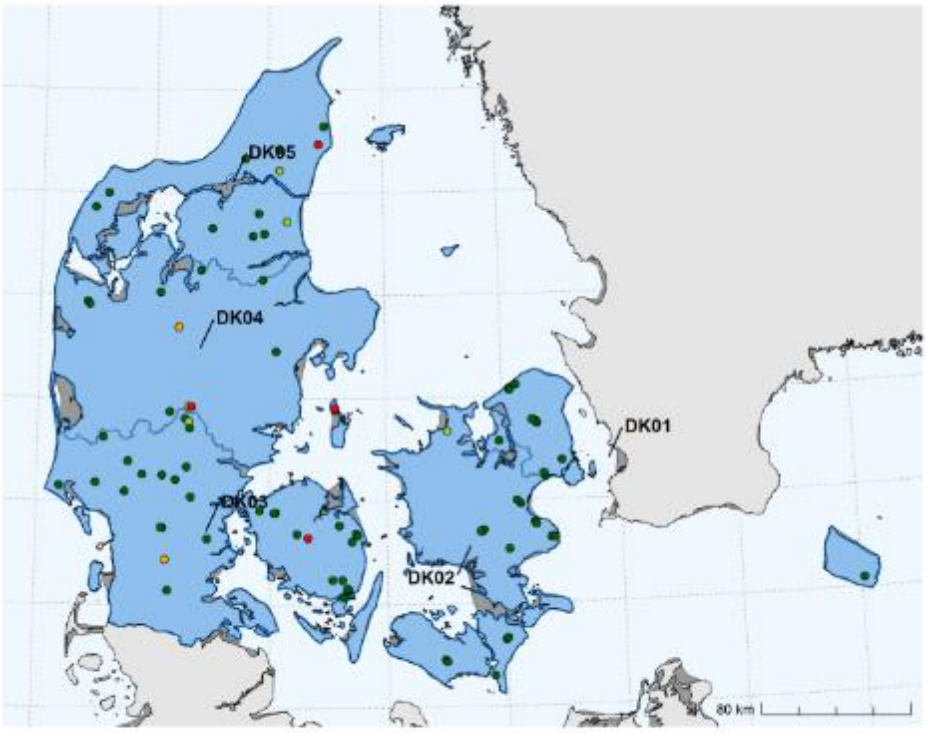


NUTS ID	NUTS NAME	>=40 and < 50 mg/l incr.trend	>=50 mg/l
DK01	Hovedstaden	1	7
DK02	Sjælland	2	24
DK03	Syddanmark	6	32
DK04	Midtjylland	20	67
DK05	Nordjylland	3	52
	Total	**32**	**182**

Figure 7. GW hotspot analysis map (top graph) and distribution by NUTS2 (lower graph) of average NO3 annual concentration greater than 40 mg/l.

The hotspot analysis identifies all the GW monitoring stations that have NO3 concentration in the range of 40-50 mg/l with increasing trends and above 50 mg/l. The map shows the spatial distribution of these points, and the table reports the number of stations by NUTS inside and outside NVZ.
Only the NUTS of interest are reported.

Groundwater stations removed



Station Type	Description	Number of removed stations		
		total removed	with measurements	with trends
0	Phreatic groundwater (shallow): 0-5 m	5	5	4
1a	Phreatic groundwater (deep) 5-15 m	24	24	20
1b	Phreatic groundwater (deep) 15-30 m	26	26	22
1c	Phreatic groundwater (deep) >30 m	47	47	26
2	Captive groundwater	0	0	0
3	Karstic groundwater	0	0	0
9	Not specified	0	0	0
	Total	**102**	**102**	**72**

Figure 8. GW removed stations map (top graph) and distribution by groundwater type (lower graph). In the map in blue the NVZ.

The removed stations analysis identifies all the GW monitoring stations that were removed in the current reporting period. The map shows the spatial distribution of these points with the concentrations of the previous reporting period, and the table reports the number of stations with measurements and trends per type.

Surface Water Quality

Surface water average annual nitrate concentration

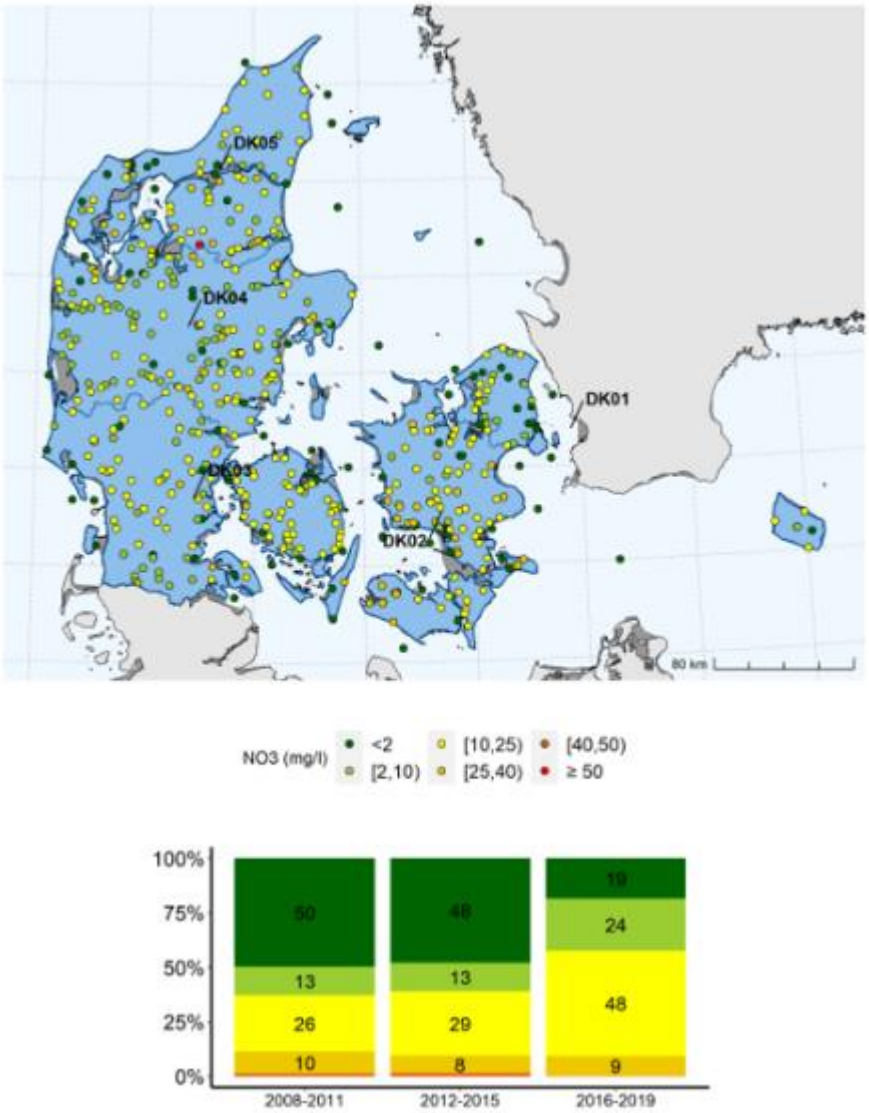


Figure 9. Spatial distribution of average NO3 annual concentration (map) and corresponding percentage of monitoring points per classes of concentration by reporting period (x axis). The percentages below 5% are not labelled, see the next plot for more information.

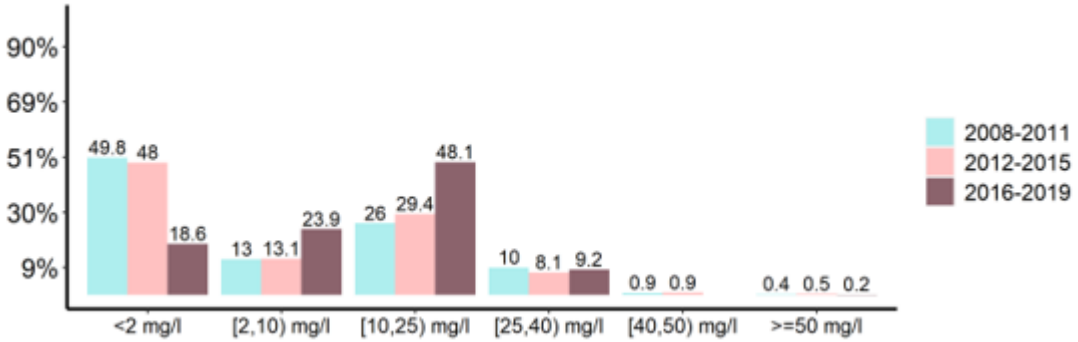


Figure 10. Comparison of percentage of monitoring points in the three reporting periods by classes of average NO3 annual concentration (x axis)

Surface water average annual nitrate concentration trend

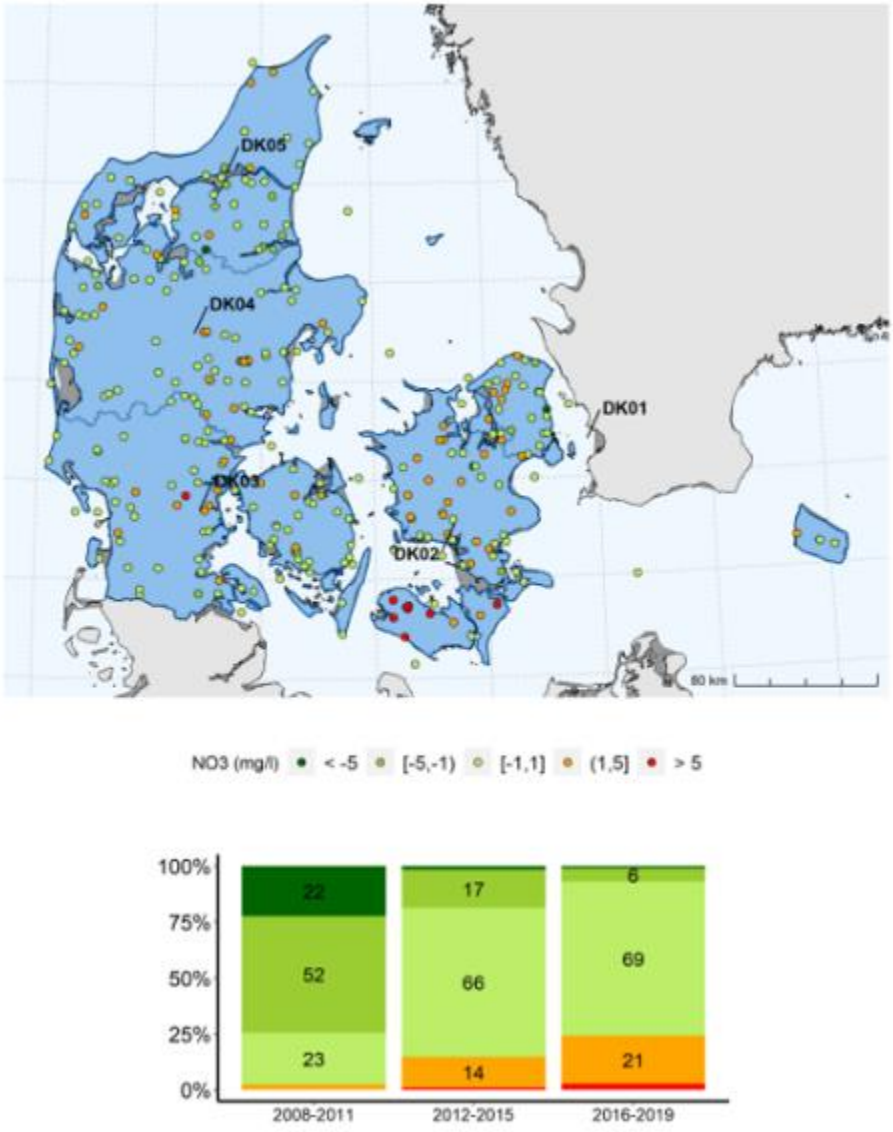


Figure 11. Spatial distribution of average NO3 annual trends (map) and corresponding percentage of monitoring points per classes of trends by reporting period (x axis). The percentages below 5% are not labelled, see the next plot for more information.

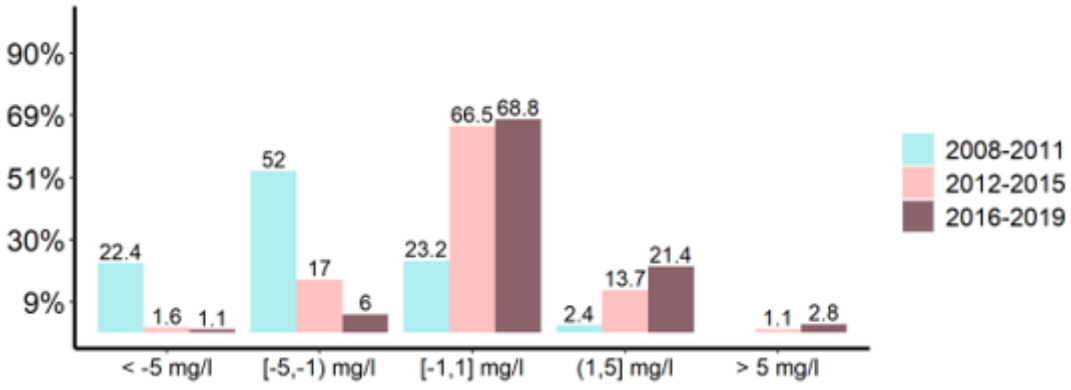


Figure 12. Comparison of percentage of monitoring points in the three reporting periods by classes of average NO3 annual trends (x axis)

Surface Water Eutrophication

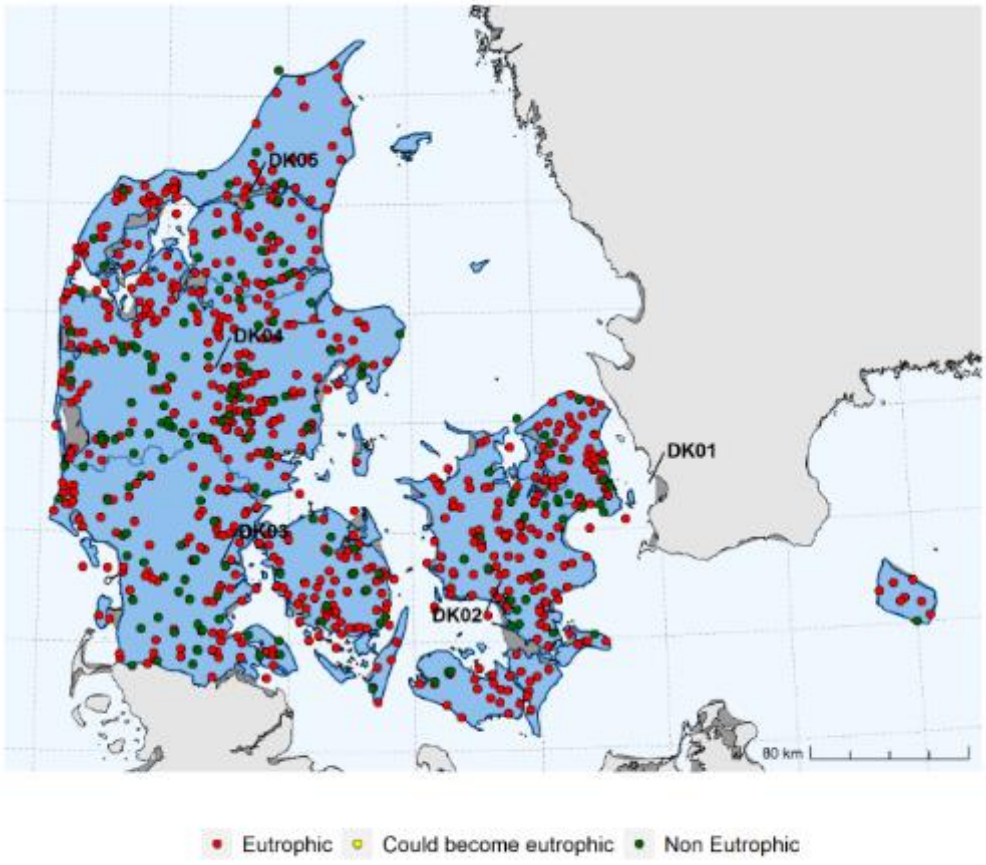


Figure 13. Spatial distribution of eutrophic status (map) and corresponding percentage of monitoring points per classes of status by reporting period (x axis).

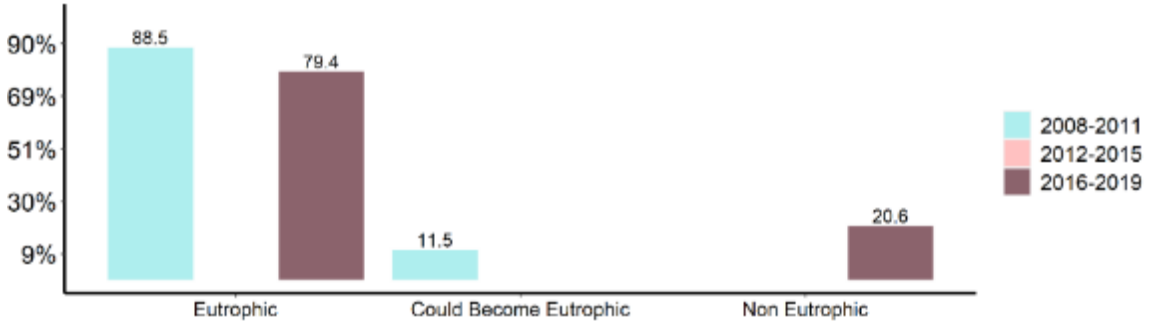
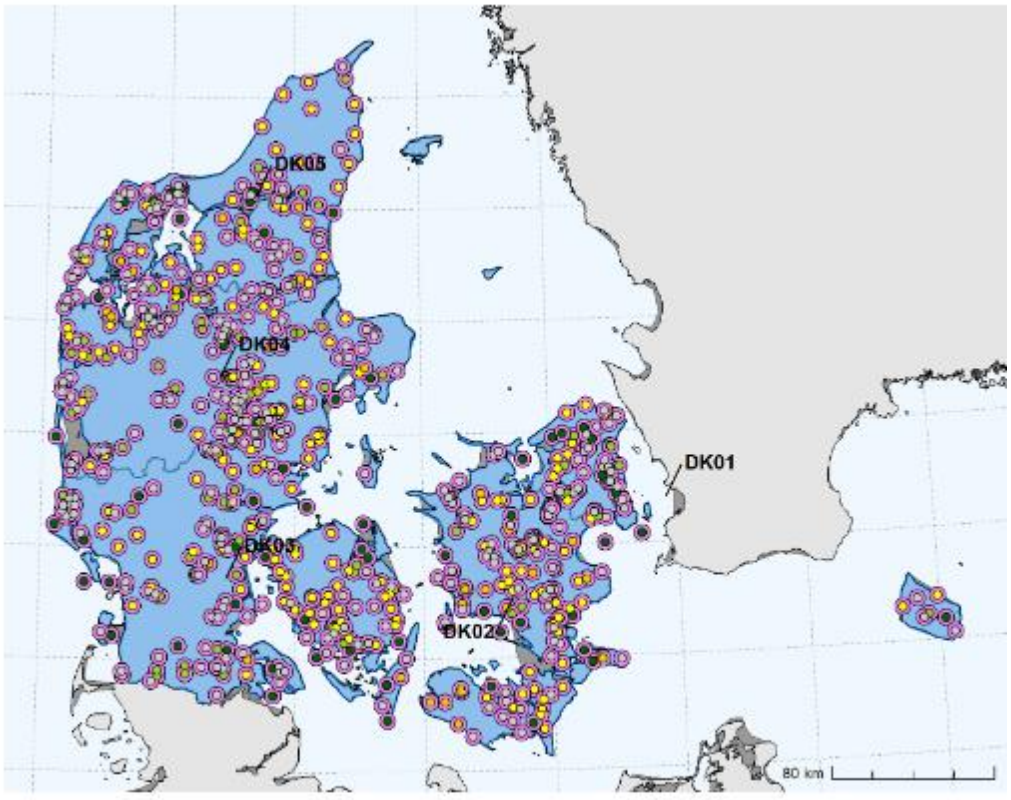


Figure 14. Comparison of percentage of monitoring points in the three reporting periods by classes of status (x axis)

The Eutrophic status vs average NO3 annual concentration



			Number of stations by classes of concentration						
NUTS ID	NUTS NAME	High trophic status	<2 mg/l	[2,10) mg/l	[10,25) mg/l	[25,40) mg/l	[40,50) mg/l	>=50 mg/l	Unclassified
DK01	Hovedstaden	55	8	7	11	0	0	0	29
DK02	Sjælland	123	1	5	41	16	0	0	60
DK03	Syddanmark	148	5	19	46	3	0	0	75
DK04	Midtjylland	192	6	31	43	8	0	0	104
DK05	Nordjylland	104	6	8	33	5	0	0	52
NO_NUTS	SALINE	52	43	9	0	0	0	0	0
	Total	**674**	**69**	**79**	**174**	**32**	**0**	**0**	**320**

Figure 15. The SW monitoring stations with eutrophic status versus the average NO3 annual concentration. In the map in blue the NVZ

The analysis shows all the SW monitoring stations with the higher trophic status and the corresponding value of NO3 concentration. The map shows the spatial distribution of these points, and the table reports the number of stations with measurements with highest trophic status and the corresponding stations by classes of NO3 concentration. Only the NUTS of interest are reported.

Eutrophication caused by excess amounts of nutrients is mainly a problem in lakes and marine waters, and large or slowly flowing rivers. In Danish streams, the residence time is too short for planktonic algae to become a problem. Thus, monitoring of eutrophication indicators such as chlorophyll-a concentration is only relevant in lakes, coastal waters and large rivers. Dissolved nutrients may have an effect on benthic algae and macrophytes in streams, but Denmark has not yet established a classification scheme for this kind of nutrient enrichment effects in watercourses.

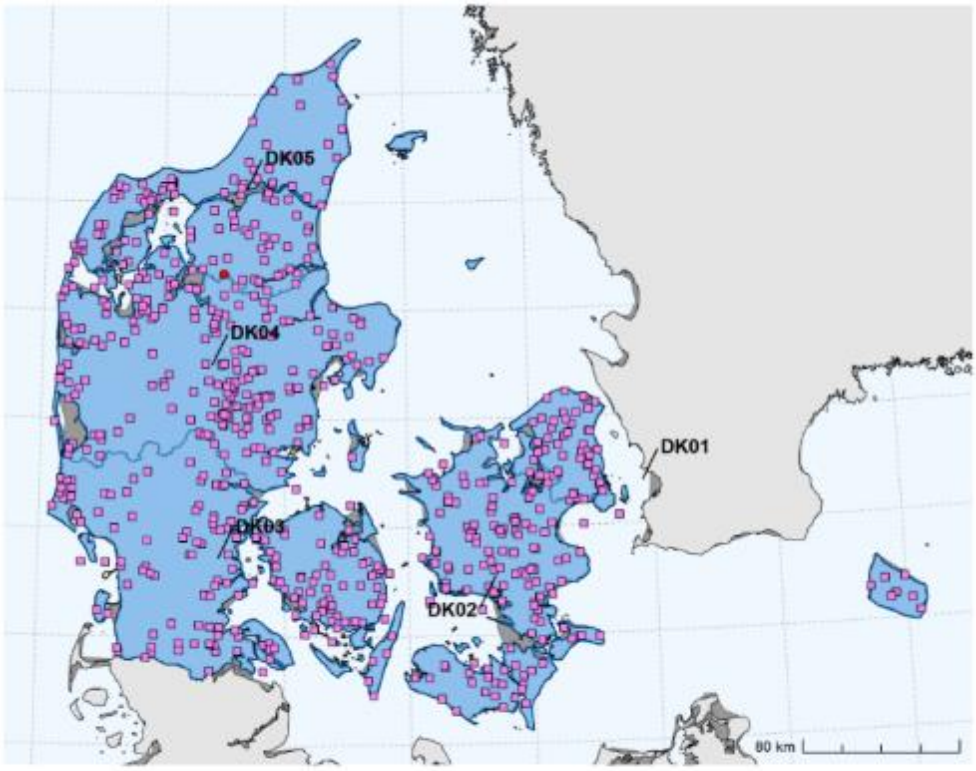
The classification of ecological state are based on data from the third River Basement Management Plans (RBMP) in line with the Guidelines. The same approach for classification of ecological state are used for watercourses, lakes and Estuarine, coastal and marine waters.

The classification of the ecological state of lakes is based on monitoring data sampled during the period 2014-2019. If there are no data from this period, data dating back until 2008 may have been used.

Table 5. Summary of SW stations by classes of trophic status and type.

		Number of stations with Trophic status		
Station Type	Description	Eutrophic	Could become eutrophic	Non Eutrophic
4	River water	283	0	108
5	Lake/reservoir water	339	0	64
6	Transitional water	0	0	0
7	Coastal water	46	0	2
8	Marine water	6	0	1
9	Not specified	0	0	0
	Total	**674**	**0**	**175**

Surface Water quality hotspot

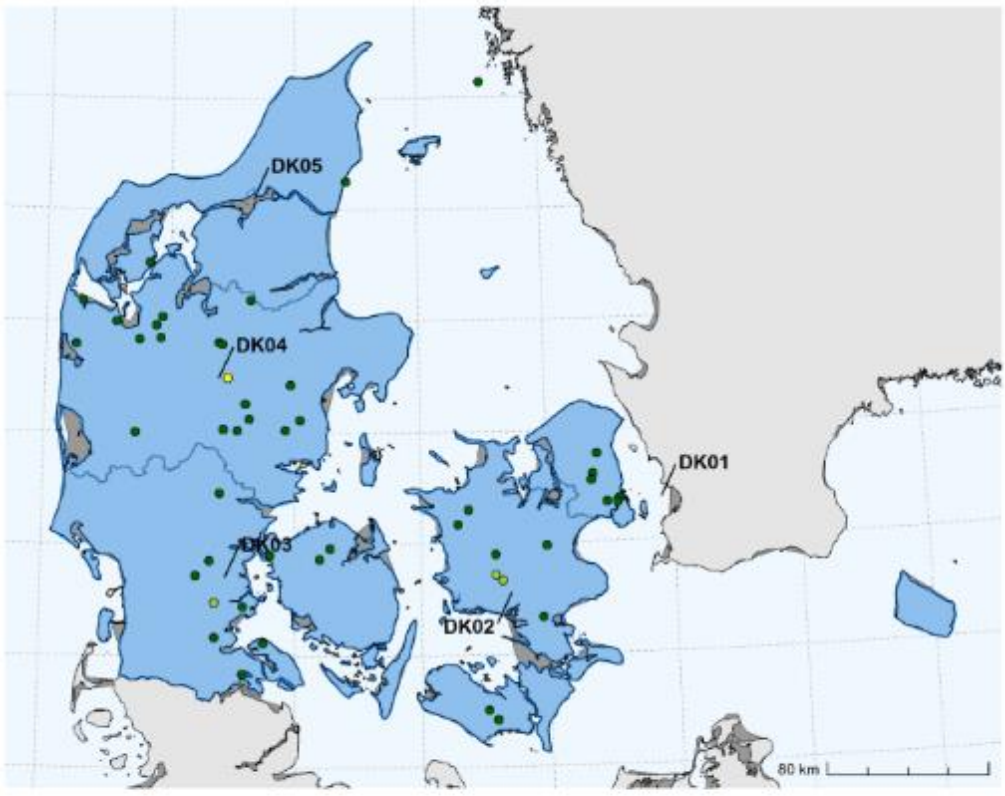


NUTS ID	NUTS NAME	High trophic status	>=40 and < 50 mg/l incr.trend	>=50 mg/l
DK01	Hovedstaden	55	0	0
DK02	Sjælland	123	0	0
DK03	Syddanmark	148	0	0
DK04	Midtjylland	192	0	1
DK05	Nordjylland	104	0	0
NO_NUTS	SALINE	52	0	0
	Total	**674**	**0**	**1**

Figure 16. SW hotspot analysis map (top graph) and distribution by NUTS2 (lower graph) of average NO3 annual concentration greater than 40 mg/l and trophic status.

The hotspot analysis identifies all the SW monitoring stations that have high trophic status, NO3 concentration in the range of 40-50 mg/l with increasing trends and above 50 mg/l. The map shows the spatial distribution of these points, and the table reports the number of stations by NUTS inside and outside NVZ.
Only the NUTS of interest are reported.

Surface Water Stations Removed



Station Type	Description	Number of removed stations			
		total removed	with measurements	with trends	with trophic status
4	River water	1	1	1	0
5	Lake/reservoir water	46	46	8	0
6	Transitional water	0	0	0	0
7	Coastal water	0	0	0	0
8	Marine water	2	2	2	0
9	Not specified	0	0	0	0
	Total	**49**	**49**	**11**	**0**

Figure 17. SW removed stations map (top graph) and distribution by surface water type (lower graph). In the map NVZ in blue.

The removed stations analysis identifies all the SW monitoring stations that were removed in the current reporting period. The map shows the spatial distribution of these points with the concentrations of the previous reporting period, and the table reports the number of stations with measurements and trends per type.

Measures in the Action Programme

According to article 3 (5) in the Nitrates Directive the Danish Nitrates Action Programme applies to the whole national territory. Measures according to code of good practice pursuant to the Nitrates Directive, are included in the Nitrate Action Programme as mandatory measures equivalent to the measures included in the programme pursuant to the directive.

The cost effectiveness shows that the higher N-quota has increased income and N-losses, but in both cases less than expected. The increased income is likely to be around 400-600 million DKK. The increased use of nitrogen has been around 30-35.000 tones N.

The period from 2015 to 2019 has seen a transition towards more targeted measures and this has insured that the implementation has become more flexible and cheaper to implement. At the same time, it has only been a first step towards targeting as the variation in the measures efficiency across soils and the nitrogen retention map has not been fully used in the targeting. The increased flexibility was a process that already started before 2016 allowing farmers to replace catch crops with other measures if the measures had the same environmental effect. The targets regarding collective measures have been ambitious and especially the creation of mini wet lands, which in 2015 was a new measure. It is not uncommon that new measures are faced with implementation challenges, which also happened in this case despite a large effort to get farmers on board

Table 6. Details of Action Programme

Measure	General details in Action Programme (*)
Period of prohibition of fertiliser application	• In the period from harvest, though no later than 1. October, to 1. February, liquid manure or digestate from vegetable biomass may not be applied – with exemptions (§ 28 of EO No 760)
Restrictions for application on sloped soils	• Manure, degassed plant biomass, and mineral fertilizer must not be applied on sloping areas (§ 29 (6) (7) of EO No 760)
Restrictions for application on soaked, frozen, or snow-covered soils	• Manure, digestate from plant biomass, silage effluent, residual water and mineral fertilizer must not be applied in a manner with risk of run-off, including water-saturated, flooded, frozen or snow-covered soil (§ 29 (5) of EO No 760)
Restrictions for application near watercourses (buffer strips)	• Manure, digestate, silage effluent, residual water and mineral fertilizer must not be applied 2 m from watercourses (§ 29 (5) (8) of EO No 760)
Effluent storage works	§ 8-9,11-16,18-19, 22-26 of Order No 1318
	• Stables, stalls, etc. shall be designed in such a way that ground-water and surface water is not polluted.
	• Silage must be stored in a silage storage facility or wrapped in waterproof material. Silage effluent must be discharged through purpose-designed drainage.
	• Storage vessels for liquid manure, silage effluent, digestate and residual water must be constructed of materials which are re-sistant, impermeable to moisture. The vessels must be dimen-sioned in relation to capacity, so that they can withstand the in-fluence, including from stirring, covering and emptying. Drains from stables/stalls, manure yards, silage stocks, cesspools, and pump wells shall be run through impermeable closed pipes and shall lead to liquid manure containers.
Capacity of manure storage	§ 8-9,11-16,18-19, 22-26 of Order No 1318
	• Solid manure must be stored in accordance with the correct provisions. When storing manure it must be ensured that surface water from the surrounding areas cannot seap into the manure storage. Compost with a dry matter content of at least 30% may be stored in the field, if complying with certain requirements.
	• Manure stored in the field, deep litter and processed manure, compost with a dry matter percentage greater than or equal to 12 must be covered with waterproof material.
	• Capacity of storage facilities for manure must be adequate (specified). Adequate storage capacity may be satisfied by storage on other property or delivery to the biogas plant, manure treatment plant or manure storage facility.
Rational fertilisation (e.g., splitting fertilisation, limitations)	• In each plan period, farms subject to registration in the Fertilizer Register pursuant to the Act must not apply more nitrogen for fertilizer purposes than the fertilizer quota calculated for the farm. For each plan period, a farm's total fertilizer quota for nitrogen must be calculated as the sum of the quotas for each farm field. For each field the quota must be calculated on basis of the size of the field, the crop, the pre-crop and the nitrogen standard of the crop (§ 12 of Act No. 338)
	• Application of liquid manure and digestate may only be carried out by means of trailing hoses, trailing foot/shoe applicators or by injection (§ 27 (2) , 29 (1) of EO No 760)
Crop rotation, permanent crop enhancement	• Agricultural enterprises with crop or livestock or combinations thereof with a certain annual turnover from crops or livestock, or combinations thereof and a total area of 10 hectares or more, shall establish a minimum amount of catch crops (§ 38 of Act No 338)
Vegetation cover in rainy periods, winter	• Not specified
Fertilisation plans, spreading records	• Requirement to prepare a fertilizer plan and a fertilizer account for each holding (§ 11, 12, 14 of EO No. 762)
	• Farms subject to registration in the Fertilizer Register pursuant to the Fertilizers Act must report a fertilizer plan in a dedicated template showing all cultivated and uncultivated areas, a field map and the field crops. The farms must do this no later than 10 September after the end of the planning period. The farms must submit the plan electronically using a self-service IT facility on the Danish Agricultural Agency website (§ 11, 12, 14 of EO No. 762)
	• By the end of March each year, farmers are obliged to submit their farm fertilization account containing information on the pre-vious cropping season (planning period August-July) to the Dan-ish Agricultural Agency for registration and control (§ 11, 12, 14 of EO No. 762)
Other measures	• Agricultural enterprises with crop or livestock or combinations thereof with a certain annual turnover from crops or livestock, or combinations thereof and a total area of 10 hectares or more, shall establish a minimum amount of catch crops (§ 38 in Act No 338)
Date for application limit of 170 kg N/ha/year:	• The planning period is from 1st of August to 31st of July. The compliance with the limit in the planning period is calculated, when the fertilizer account for the planning period is submitted latest April 1, the year after the planning period.

(*) Executive Order (EO) No 760 of 30 June 2019 on Environmental Regulation of Animal Husbandry and the Storage and Use of Fertilisers, "Bekendtgørelse om miljøregulering af dyrehold og om opbevaring og anvendelse af gødning"

Executive Order (EO) No 762 of 29 July 2019 on Agricultural Use of Fertilisers in the planning period 2019/2020, "Bekendtgørelse om jordbrugets anvendelse af gødning i planperioden 2019/2020".

Order No. 1318 on commercial keeping of livestock, manure, silage, of /06/2015.

Act No. 338 of 2. April 2019 on agricultural use of fertilizer and plant cover. "Lov nr. 338 af 2. april 2019 om jordbrugets an-vendelse af gødning og om næringsstofreducerende tiltag"

Controls

In the period2016/2017, the Danish Agricultural Agency carried out 121 inspections on the spot, 1.7 % were reported to the police for severe violations and 0.8 % receives an administrative fine for a severe violation of the provisions on rational fertilizer use. This share illustrates a decrease in farms with severe violations, compared to the previous data from 2014 (9.6 %).

586 Danish farmers over the 35.866, which were obliged to submit a fertilizer account in the period 2016/2017, were controlled for fertilization accounts and for the amount of livestock manure applied to land each year.

In 2019, a total of 235 on-site inspections on catch crops was carried out involving three national schemes on catch crops: Mandatory catch crops, livestock catch crops and the targeted nitrogen regulation (targeted catch crops).

Designation of NVZ

Denmark applies a whole territory approach (43,908 km^2).

Forecast of Water Quality

In the 2nd River Basin Management Plans (RBMPs) for 2015-2021 it was estimated that land-based Danish nitrogen losses to Danish coastal waters should be reduced to approximately 44,700 tons N/year (target load) to support the coastal waters to meet good ecological status. In the model calculations it is assumed that other member states reduce their load correspondingly to a level that supports the achievement of the targets (burden-sharing).

As regard to the environmental objectives in groundwater, it was presupposed in the 2nd RBMP that on a long term basis, the new targeted regulation along with the baseline 2021 and the existing general regulation will meet the need of measures for groundwater bodies as proposed in the draft river basin management plans 2015-2021. Thus, groundwater bodies in poor chemical status in general are expected to reach good chemical status after 2021.

Summary

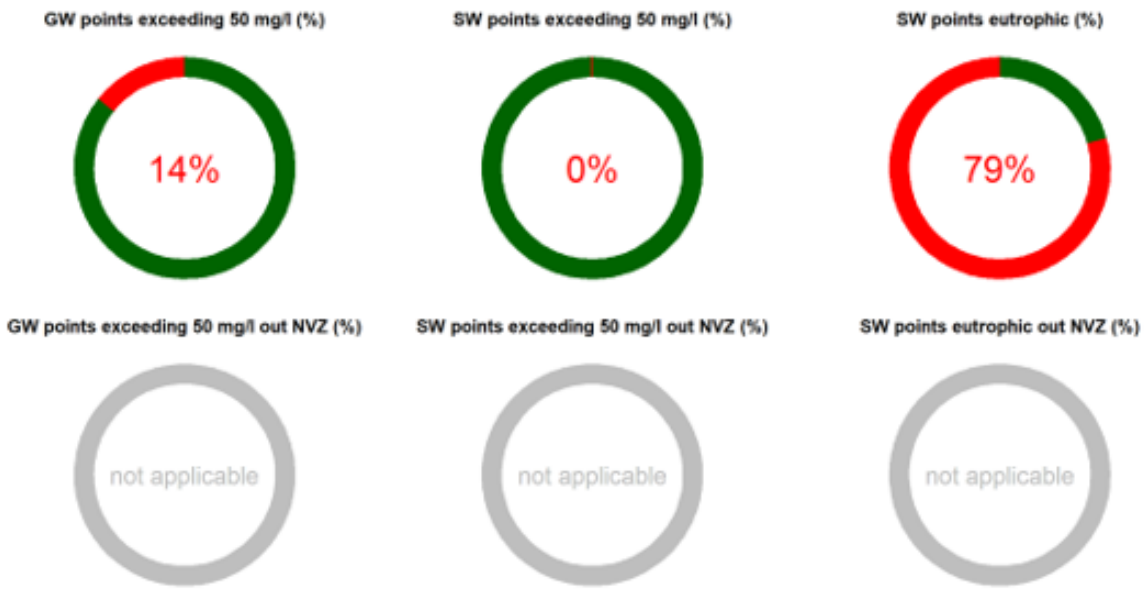


Figure 18. The summary plot for the period 2016-2019

This plot provides in the first row the percentage of stations exceeding 50 mg/l with respect to the total stations with measures and the percentage of eutrophic SW stations with respect to the total for which the trophic status is reported. In the second row, the percentage of stations exceeding 50 mg/l that are outside NVZ with respect to the total of stations exceeding 50 mg/l, and the percentage of SW eutrophic stations that are outside NVZ with respect to the total that are eutrophic.

Long term analysis

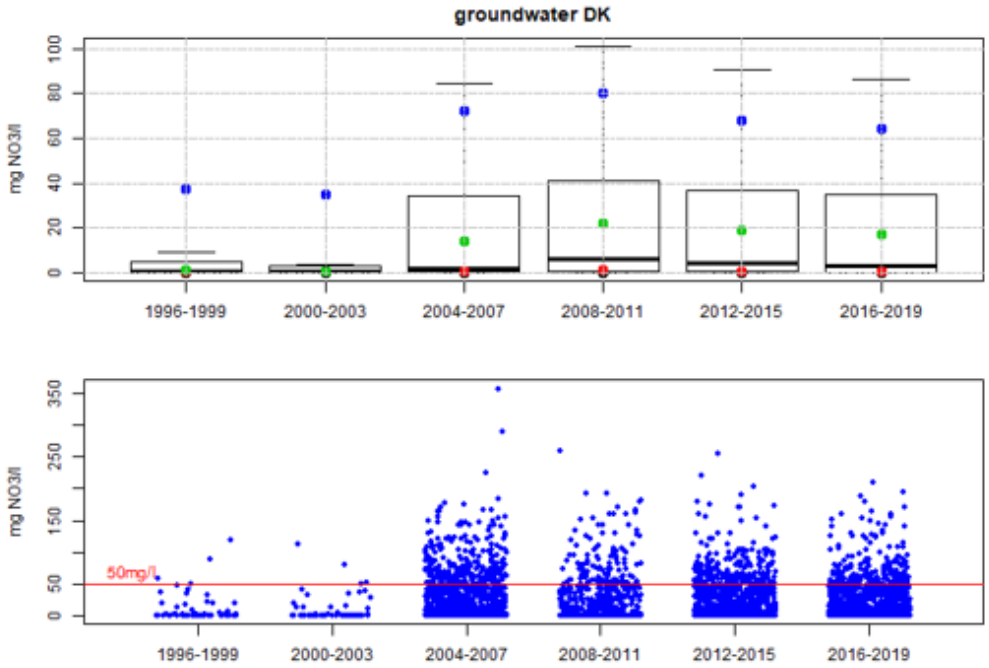


Figure 19. Time series of box whisker plots along with the distribution of the average NO3 annual concentrations for each reporting period for groundwater stations. RPs represent the reporting periods, RP7 being the last period (2016-2019). The blue, red, green and black dots represent the mean of the fourth third, second and first quartiles, respectively.

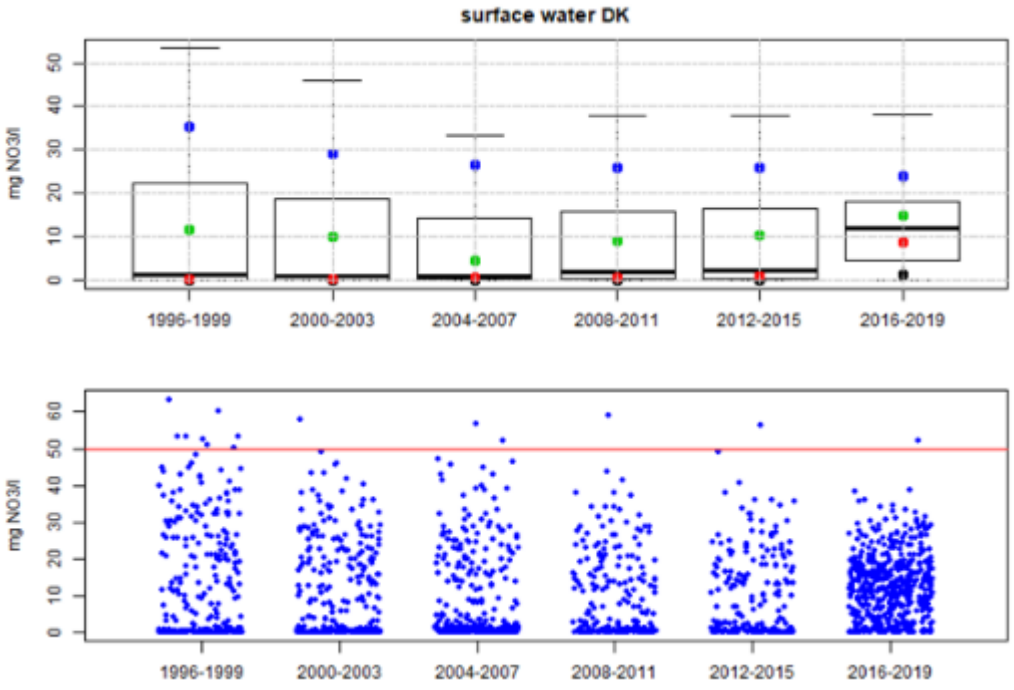


Figure 20. Time series of box whisker plots along with the distribution of the average NO3 annual concentrations for each reporting period for surface water stations. RPs represent the reporting periods, RP7 being the last period (2016-2019). The blue, red, green and black dots represent the mean of the fourth third, second and first quartiles, respectively. « Note that all types of surface waters are pooled. For the last period (2016-2019), considerable more water courses were monitored compared to previous periods. This might have biased the average towards higher NO3 concentration"

Conclusions and recommendations

Denmark has a high livestock pressure and the nitrogen surplus is about the average for the EU.

There is a very well elaborated network of monitoring stations. The groundwater quality is generally good. However, there are a high number of groundwater monitoring points with increasing trend. A very high number of the surface waters are found to be eutrophic.

The action programme was revised in 2020.

The Commission recommends Denmark to further reinforce its action programme to tackle the eutrophication of both inland and marine waters where the agricultural pressure is significant.