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PART 16/27

COMMISSION STAFF WORKING DOCUMENT

Member State country fiche 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 States reports for the period 2020–2023

European Commission

Italy

Country staff working document
on the implementation of the Nitrates Directive

Period: 2020-2023

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1. KEY FINDINGS AND RECOMMENDATIONS

Italy submitted its report under the Nitrates Directive for the period 2020-2023 in December 2024 ([1]) via electronic reporting on Reportnet 3 portal ([2]).

This country staff working document is presented in line with the reporting guidelines and it is based on the data reported by the Member State ([3]), Eurostat and other EU official data sources. The Italian authorities were consulted for factual correctness. There may be differences with the information presented in their national report. ([4])

The numbers presented below are indicators of the situation in the Member State but need further interpretation to draw specific conclusions. In some cases, changes in the monitoring networks and in methodology for assessing trophic status may complicate comparisons between reporting periods.

1.1. Key findings

Pressures from agriculture

In Italy, the utilised agricultural area (UAA) accounts for 42% of the country's total land area, which is higher than the EU average (38%). The livestock density is 0.7 livestock units per hectare (LSU/ha) of UAA, which is like the EU average of 0.7 LSU/ha, but there are regional variations with livestock densities above 1 LSU/ha UAA in several regions. The gross nitrogen balance is 56 kg/ha UAA, and the gross phosphorus balance is below 1 kg/ha UAA. ([5])

Monitoring network

For groundwater, the density of the monitoring network is around 15 stations per 1 000 km^2, which is higher than the EU average (8 stations). Compared to the previous reporting period, the density decreased by 1%.

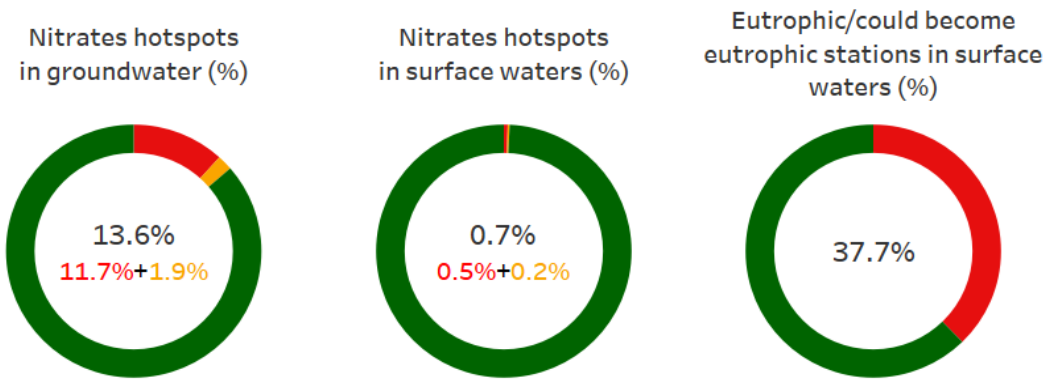
For surface freshwater, the density of the monitoring network is around 7 stations per 1 000 km^2, which is like the EU average (7 stations). Compared to the previous reporting period, the density decreased by 15%. The monitoring network includes river and lakes/water reservoirs stations.

For surface saline waters, the monitoring network includes transitional, coastal and marine water stations.

([1]) Final version was received in November 2025.
([2]) Reportnet 3 is an e-Reporting platform for reporting environmental and climate data to the European Environment Agency (EEA).
([3]) Only monitoring points electronically reported with nitrate concentration or tropic status, which were not removed from the monitoring network were considered for this assessment.
([4]) A uniform data-processing approach is applied to all Member States. In some instances, this may not fully correspond to the specific methodology used in the Member State.
([5]) The EU average is not available due to data gaps.

Water quality

Figure 1 – Share of monitoring points showing pollution in groundwater and surface waters



Note: The percentage share of **nitrate hotspots** refers to monitoring points with average annual nitrate concentrations ≥ 50 mg/l (red), or between 37.5 and 49.99 mg/l with an increasing trend (orange). This is calculated relative to the total number of points with measurements. The percentage share of monitoring points classified as **eutrophic or could become eutrophic** (red) is calculated relative to the total number of points with trophic status reported.

In **groundwater**, 88.3% of monitoring points show nitrate concentrations below 50 mg/l.

Overall, 13.6% of monitoring points fall in two categories illustrated in Figure 1, i.e. they show nitrate concentrations ≥ 50 mg/l (11.7%), or between 37.5 and 49.99 mg/l with an increasing trend (1.9%). Compared to the data reported in the previous reporting period, this represents a decrease of 0.5 percentage points (from 14.1% to 13.6%). The regions with the highest share are Umbria (32.1%), Puglia (31.6%), and Sicilia (31.5%).

Compared to the previous reporting period, nitrate concentrations decreased in 38.8% of groundwater monitoring points and increased in 26.8%. Among points with nitrate concentration ≥ 50 mg/l, increases (48.1%) were more frequent than decreases (46.8%).

In **surface water**, 99.5% of monitoring points show nitrate concentrations below 50 mg/l and 62.3% are classified as non-eutrophic.

Overall, 0.7% of monitoring points fall in two categories illustrated in Figure 1, i.e. they show nitrate concentrations ≥ 50 mg/l (0.5%), or between 37.5 and 49.99 mg/l with an increasing trend (0.2%). Compared to the data reported in the previous reporting period, this represents a decrease of 0.1 percentage points (from 0.8% to 0.7%). 18% of surface water monitoring stations show nitrate concentrations ≥ 10 mg/l, which is relevant for eutrophication.

Compared to the previous reporting period, nitrate concentrations decreased in 24.0% of surface water monitoring points and increased in 19.0%.

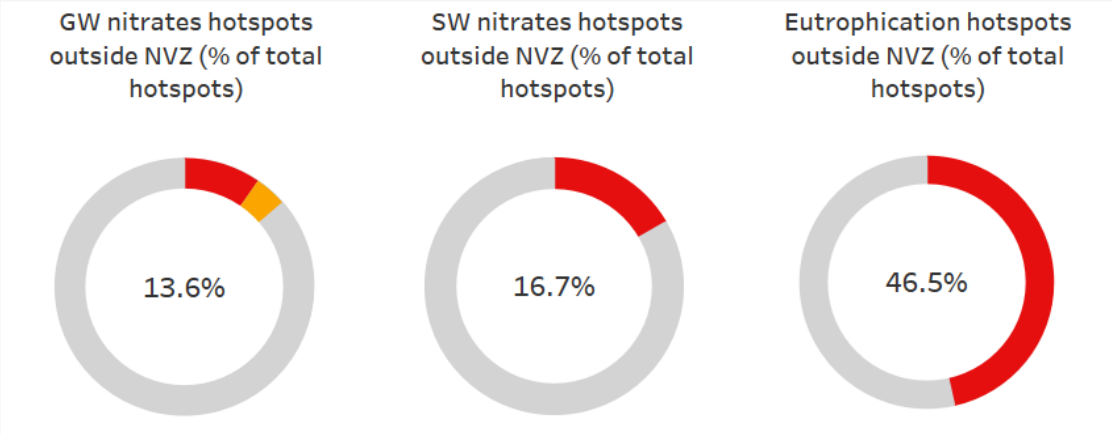
The share of monitoring points reported as eutrophic/could become eutrophic is 37.7% as illustrated in Figure 1. This represents an increase of 3.5 percentage points compared to the previous period (from 34.2% to 37.7%). The regions with the highest share are Lombardy (81.6%), Campania (59.3%) and Veneto (59.2%).

Nitrate Vulnerable Zones

Italy revised the Nitrate Vulnerable Zones (NVZ) during this reporting period. The area of NVZ increased by 16% and covers 31% of utilised agricultural area.

In Italy, some monitoring points showing pollution are located outside NVZ. Figure 2 reflects that outside NVZ, there are 13.6% of groundwater monitoring points show nitrate pollution (85 out of 625), 16.7% of surface water monitoring points show nitrate pollution (3 out of 18) and 46.5% of all the eutrophic/could become eutrophic points in surface waters were situated outside NVZ (401 out of 862) ([6]).

Figure 2 – Share of monitoring points showing pollution located outside Nitrate Vulnerable Zones (NVZ) relative to the total number of points showing pollution



Note: The percentage share of **nitrate hotspots outside NVZ** refers to monitoring points with average annual nitrate concentrations ≥ 50 mg/l (red), or between 37.5 and 49.99 mg/l with an increasing trend (orange), located outside NVZ. This is calculated relative to the total number of nitrate hotspots. The percentage share of **eutrophication hotspots outside NVZ** (red) is calculated as number of monitoring points classified as eutrophic/could become eutrophic, located outside NVZ, relative to the total number of points reported as eutrophic/could become eutrophic. Hotspots inside NVZ are shown in grey.

Action Programme

Italy did not modify its national action programme during this reporting period. However, some Italian regions modified their action programmes during the 2020-2023 reporting period.

Enforcement action

In 2018, the Commission initiated an infringement procedure and sent Italy a letter of formal notice, expressing concerns about its failure to meet various obligations under the Directive. In particular, the Commission requested the authorities to ensure the stability of the nitrates monitoring network, the review and further designate NVZ in several regions and to take additional measures or reinforced actions. After an additional letter or formal notice in December 2020, the Commission sent a reasoned opinion in February 2023 explaining that while some progresses have been made, concerns remain in some regions, where the situation in groundwater polluted by nitrates is not improving or the

([6]) 35 of these eutrophic/could become eutrophic monitoring points are located in coastal or marine waters.

problem of eutrophication in surface waters is worsening. The Commission and the Italian authorities are in contact over the resolution of this case.

1.2. Recommendations

- Review and where necessary reinforce measures to improve water quality, notably with a view to addressing:
  - high or increasing nitrate concentrations in groundwater hotspots
  - high or increasing nitrate concentrations in surface waters
- Review and where necessary update the designation of nitrate vulnerable zones to ensure that the designated zones include all areas with significant agricultural pressure that drain into:
  - nitrate pollution hotspots in groundwaters
  - waters that are eutrophic
- Improve representativeness and coverage of monitoring networks and reported data by extending the monitoring in saline waters
- When preparing the Nitrates Action Programme and designating Nitrate Vulnerable Zones:
  - take into account objectives and deadlines of the Water Framework Directive, ensuring coherence with the 4th RBMP
  - consider introducing limitations on phosphorus fertilisation, if not yet implemented
  - ensure the cooperation between competent authorities in different sectors, such as agriculture and water, and with stakeholders
  - consider where measures could be simplified without compromising on results, working with the Commission and the other member States in the light of the findings of the evaluation of the Nitrates Directive
- Promote the dissemination of best practice, scientific knowledge and innovation to:
  - improve the analysis of expected future evolution in water quality and develop gap assessments for the nutrient load reductions required to reach water quality objectives
  - accelerate preparedness and resilience of action programmes and measures in the context of climate change

2. PRESSURES FROM AGRICULTURE

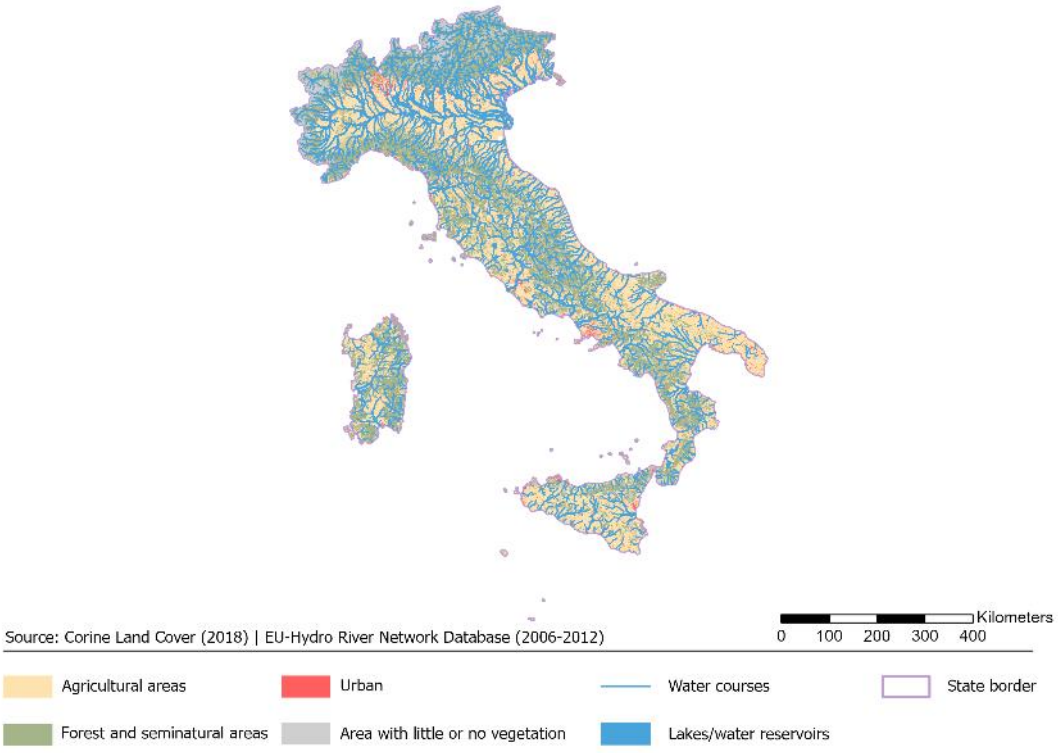
In Italy, crop production accounted for the largest portion of the agricultural sectory's total output value at 58.7% in the reporting period 2020-2023. Animal production followed with 29.7%, and other outputs made up 11.6% ([7]). The share of agricultural land used for organic farming increased from 14.8% in the reporting period 2016-2019 to 17.4% in the reporting period 2020-2023 ([8]).

The risk of diffuse pollution of waters by nutrients from agriculture is primarily dependent on the agricultural pressures in the Member State, expressed in terms of utilised agricultural area (UAA), livestock density, the use of mineral and manure fertilisers, as well as the nitrogen and phosphorus balance. This section describes the evolution of these indicators.

2.1. Land use

The map below presents the distribution of land use in Italy along with watercourses and lakes/water reservoirs.

Figure 3 – Land use distribution in Italy



([7]) Source: Eurostat (aact_eaa01)
([8]) Source: Eurostat (ef_m_org)

The utilised agricultural area (UAA) in Italy covered 12.5 million hectares in 2020, making up 42.1% of the country's total land area. Arable land accounted for 57.5% of UAA, followed by permanent grassland at 25% and permanent crops at 17.4%.

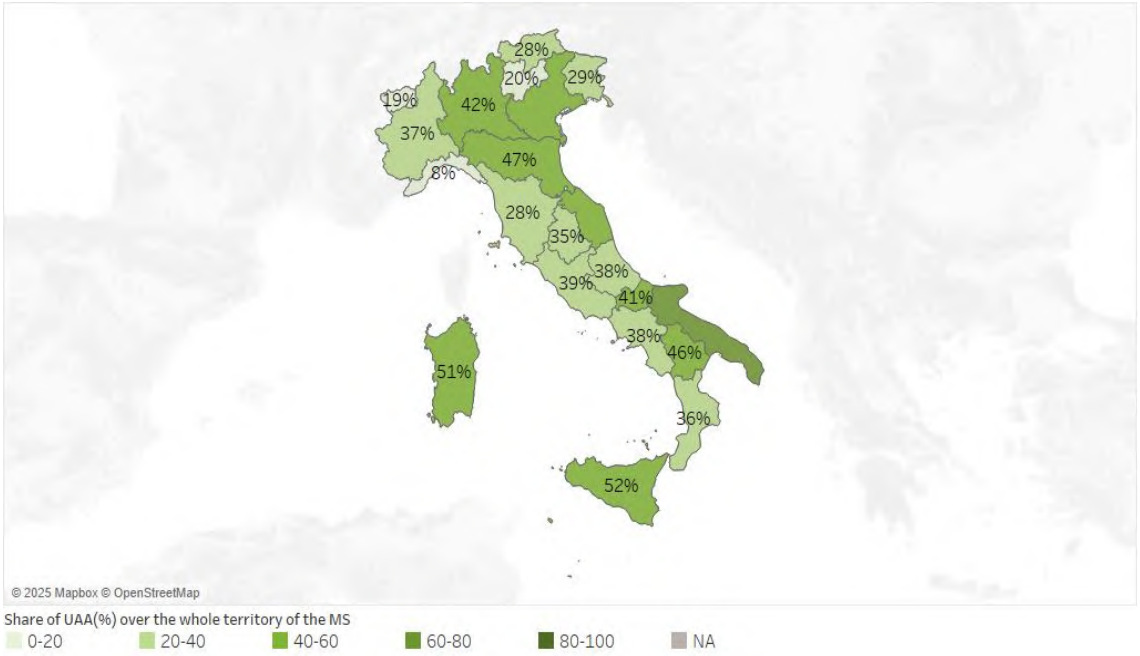
Table 1 – Evolution of the utilised agricultural area

	2010	2013	2016	2020	2023
utilised agricultural area (1000 ha)	12,856	12,099	12,598	12,524	NA
arable land (1000 ha)	7,009	6,728	7,145	7,198	NA
permanent grassland (1000 ha)	3,434	3,316	3,233	3,134	NA
permanent crops (1000 ha)	2,381	2,032	2,201	2,178	NA
kitchen gardens (1000 ha)	32	22	19	14	NA

Source: Eurostat (ef_lus_main)

In 2020, the share of the UAA ranged from 52% in Sicilia, to 8% in Liguria.

Figure 4 – Share of utilised agricultural area (UAA) at NUTS2 level in 2020 ([9])



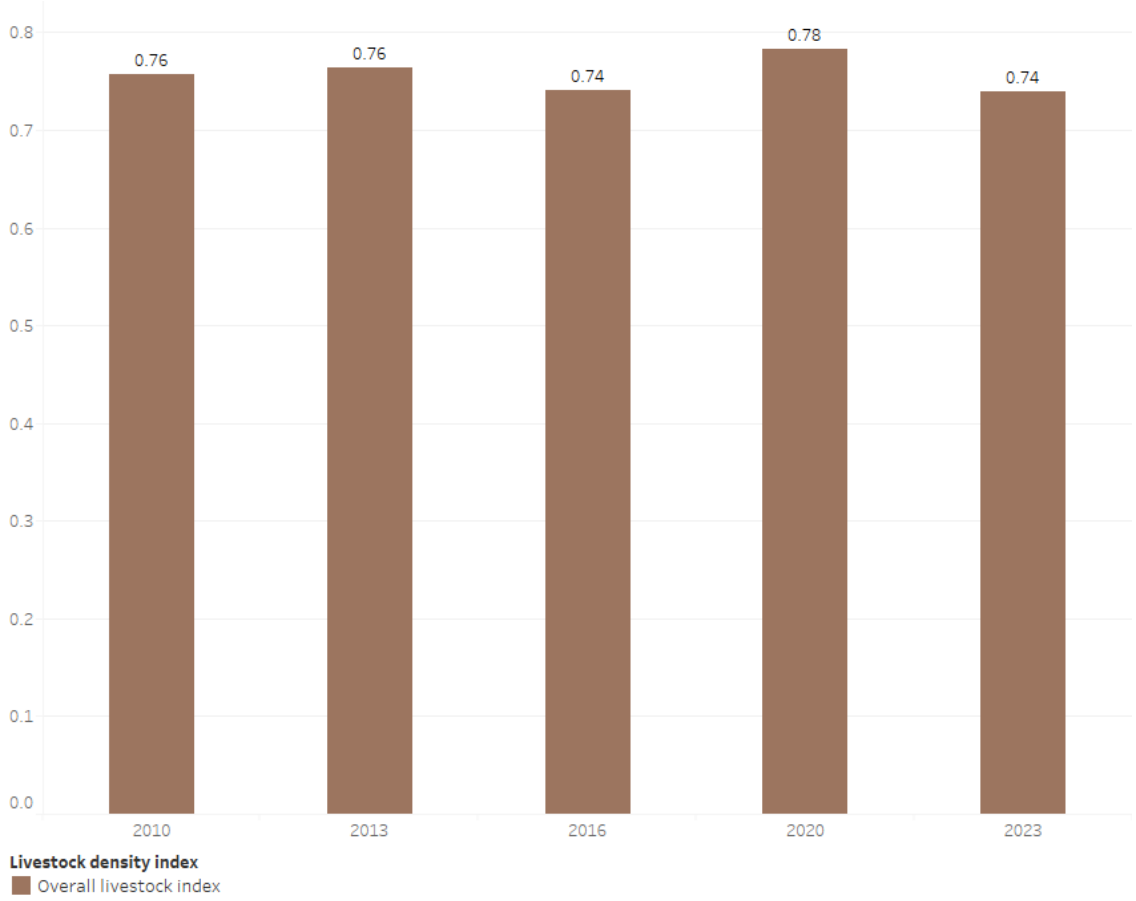
Source: Eurostat (ef_lus_main)

([9]) Latest available data.

2.2. Livestock density

In Italy the livestock density was 0.74 livestock units per hectare (LSU/ha) of UAA in 2023. The livestock density has decreased since 2010 but with a spike in 2020.

Figure 5 – Evolution of the livestock density (LSU/ha UAA)



Source: Eurostat (ef_fsi_lskds)

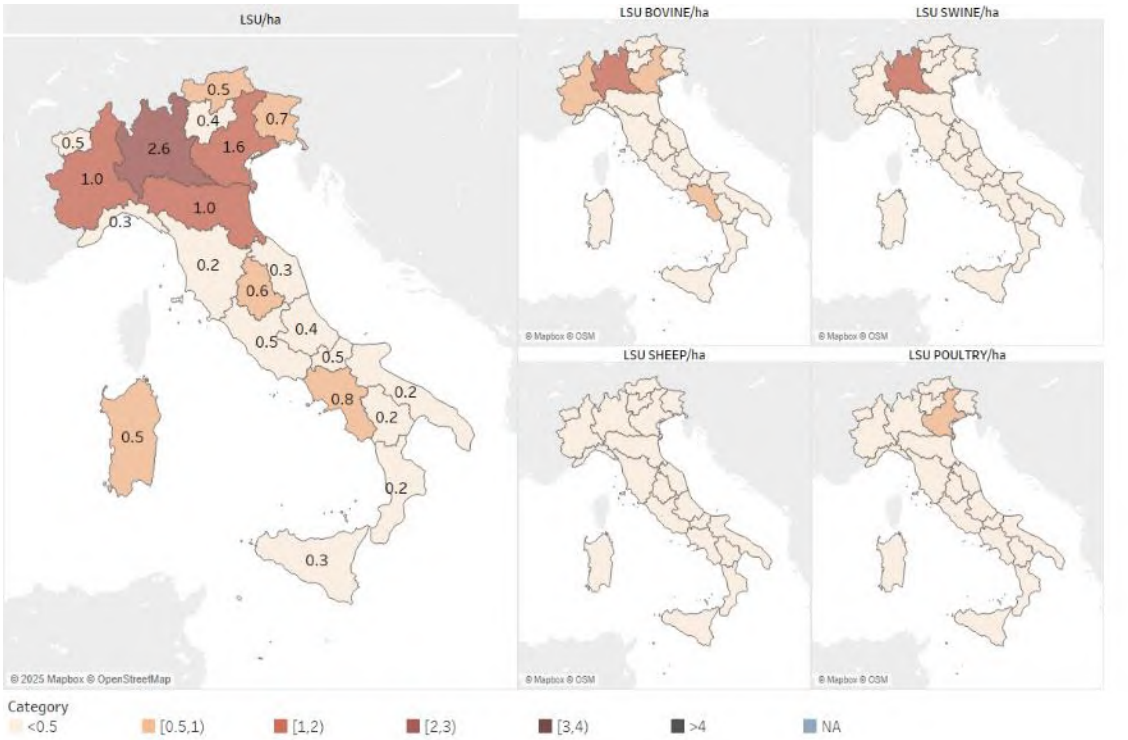
Table 2 – Evolution of the livestock numbers by animal type

	2007	2010	2013	2016	2020	2023
live bovines (Million heads)	6.58	5.83	6.25	6.31	6.40	6.00
of which dairy cows (Million heads)	1.84	1.75	2.07	2.06	1.87	1.81
live pigs (Million heads)	9.27	0.74	8.56	8.48	8.54	9.17
live poultry (Million heads)	NA	167.51	164.90	158.03	173.38	NA
live sheep (Million heads)	NA	8.01	7.18	7.28	7.03	6.50
live goats (Million heads)	0.92	0.98	0.98	1.03	1.07	0.98

Source: Eurostat, for live poultry and live sheep data complemented with FAOSTAT

There are regional variations, with livestock densities of 2.6 LSU/ha UAA in Lombardy, 1.6 in Veneto and 1.0 in Emilia-Romagna and Piemonte.

Figure 6 – Livestock density distribution by animal type (LSU/ha UAA) at NUTS2 level in 2020 ([10])



Source: Eurostat (Livestock units: ef_lsk_main; Utilised agricultural area: ef_lus_main)

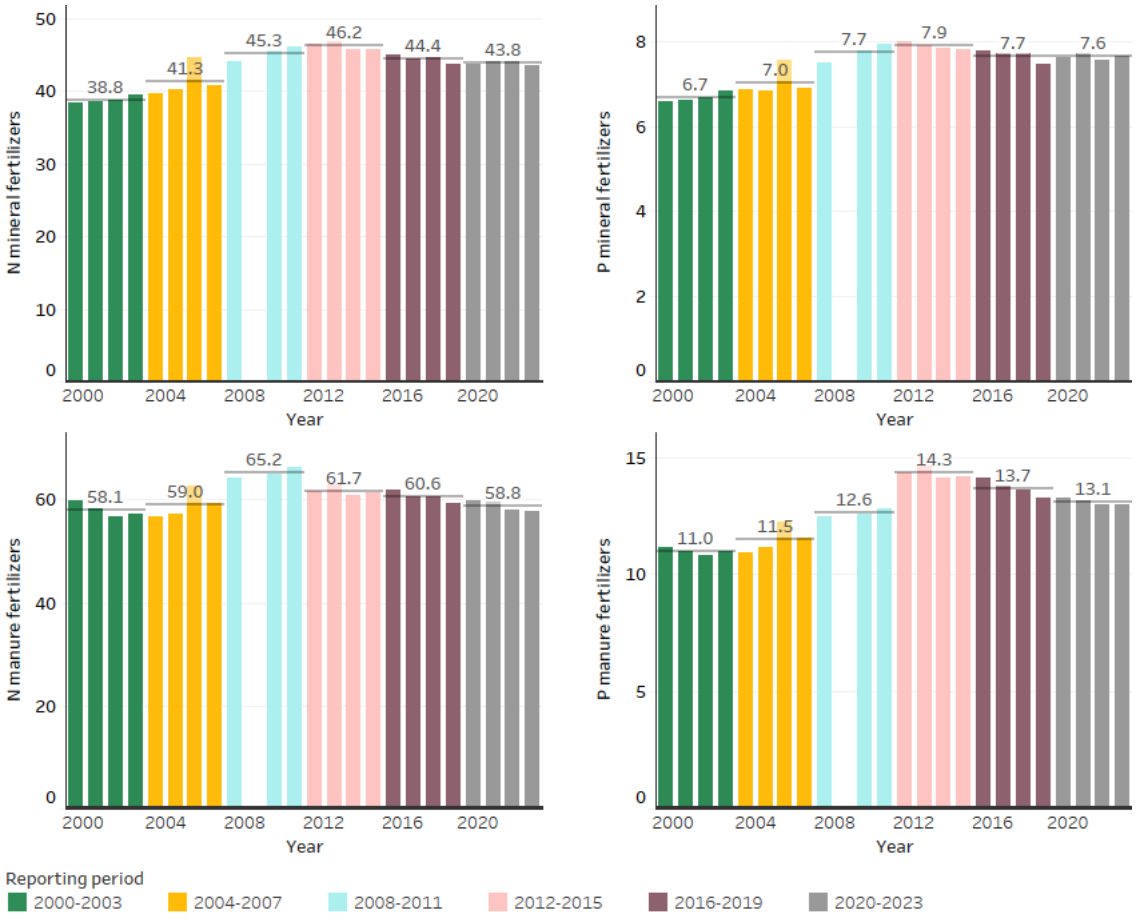
([10]) Latest available data.

2.3. Nitrogen and phosphorus fertiliser use

In Italy, the use of **nitrogen (N) fertilisers** was 43.8 kg/ha UAA for mineral fertilisers and 58.8 kg/ha UAA for manure fertilisers in 2020-2023. The use of mineral fertilisers has decreased by 0.6 kg/ha UAA, and the use of manure fertilisers has decreased by 1.8 kg/ha UAA since the last reporting period.

The use of **phosphorus (P) fertilisers** was 7.6 kg/ha UAA for mineral fertilisers and 13.1 kg/ha UAA for manure fertilisers in 2020-2023. The use of mineral fertilisers decreased by 0.1 kg/ha UAA since the last reporting period and the use of manure fertilisers decreased by 0.6 kg/ha UAA since the last reporting period.

Figure 7 – Evolution of nitrogen and phosphorus fertiliser use (kg/ha UAA)



Source: Eurostat (aei_pr_gnb)

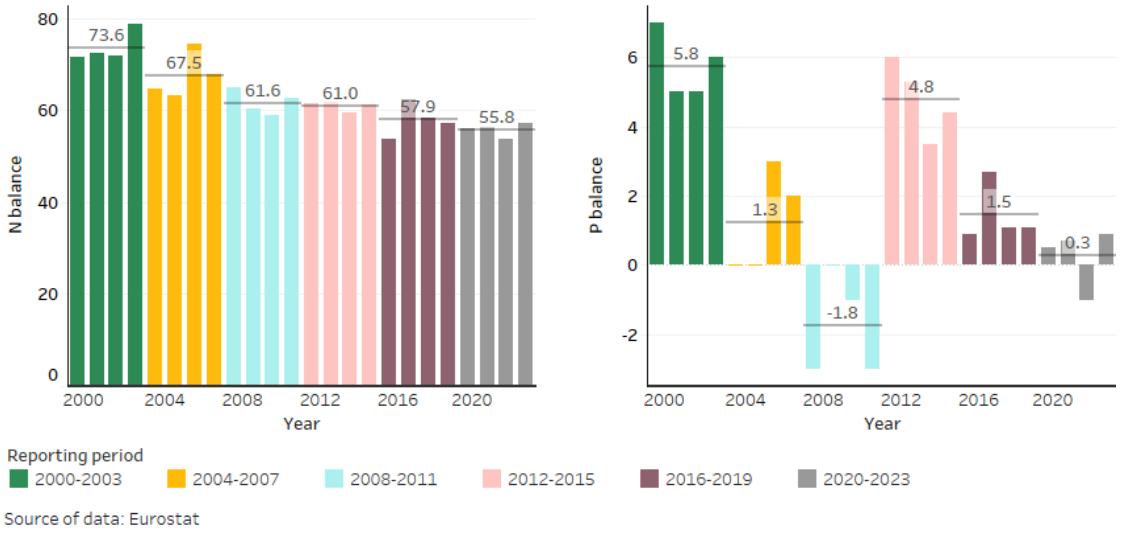
2.4. Nitrogen and phosphorus balance

The nitrogen balance ([11]) per hectare of agricultural land (kg/ha UAA) is an indicator of the success that farmers have had in implementing balanced fertilisation and of the resulting nutrient pressure from agriculture. A high surplus (positive balance) indicates a risk of emissions into water and air.

In Italy, the **gross nitrogen (N) balance** was 55.8 kg/ha UAA in 2020-2023. The nitrogen balance decreased by 2.1 kg/ha UAA since previous reporting.

The **gross phosphorus (P) balance** was 0.3 kg/ha UAA in 2020-2023. The phosphorus balance decreased by 1.2 kg/ha UAA since previous reporting.

Figure 8 – Evolution of gross nitrogen and phosphorus balance (kg/ha UAA)



Source: Eurostat (aei_pr_gnb)

2.5. Nitrogen discharge to the environment

Italy didn't provide numerical information on the nitrogen discharge from agriculture to the environment.

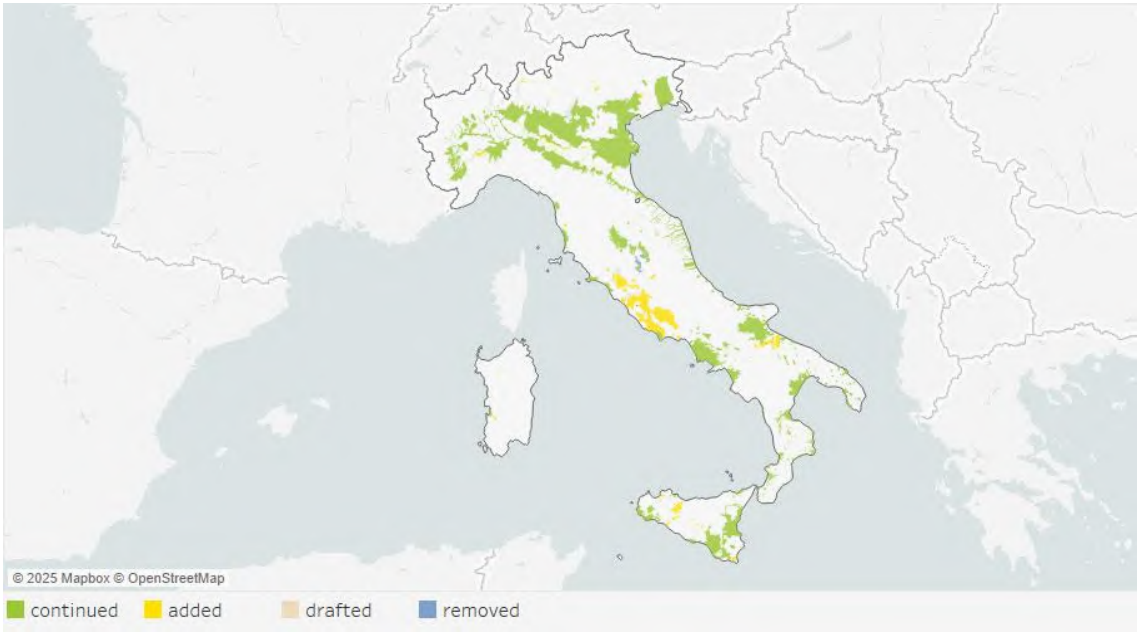
([11]) Gross nutrient balance (aei_pr_gnb)

3. NITRATE VULNERABLE ZONES

In line with 3 paragraph 2, Italy designates nitrate vulnerable zones (NVZ) as all known areas of land in its territories which drain into the waters identified as polluted or at risk of being polluted and which contribute to pollution. Action programmes with mandatory measures are implemented in NVZ to reduce and prevent water pollution. The Nitrates Directive requires that the Member State reviews and if necessary, revise or add to the designation of vulnerable zones as appropriate, and at least every four years, to consider changes and factors unforeseen at the time of the previous designation.

During the reporting period 2020-2023 Italy changed the NVZ. The last designation was done in 2021. The regions that made changes to their designation were Basilicata, Emilia-Romagna, Friuli-Venezia Giulia, Lazio, Molise, Piedmont, Umbria, and the Autonomous Province of Trento, with the latter making its first designation of NVZs. Most of the newly designated areas were in Lazio, which added 11 new NVZs in 2021 and 2023. The other Italian regions did not change their NVZs during the reporting period. Valle d'Aosta and the Autonomous Province of Bolzano have not designated any NVZs in their territories. The map below shows the current designation with the changes compared to the previous reporting period. The NVZ increased by 16.3% in comparison with NVZ reported in the previous reporting period.

Figure 9 – Changes in the designation of the Nitrates Vulnerable Zones during the reporting period 2020-2023



The map below shows the current NVZ designation relative to the agricultural area. The designated areas cover 17.8% of territory and 30.8% of UAA.

Figure 10 – Distribution of the Nitrates Vulnerable Zones (NVZ) and agricultural area

Note: Based on CORINE Land Cover data with simplified detail; some smaller agricultural areas may not appear.

4. NITRATES IN GROUNDWATER

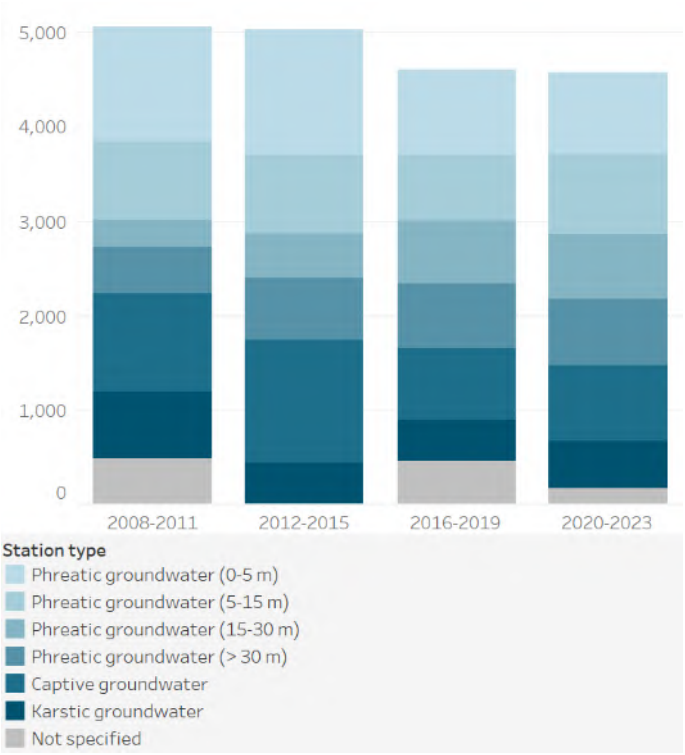
4.1. Monitoring of nitrate concentrations in groundwater

The implementation of the Nitrates Directive is responsibility of the regions and autonomous provinces. In particular, the water quality monitoring is primarily conducted by the Regional Environmental Protection Agencies (ARPA) and their regional monitoring networks and coordinated for this report by the Italian Institute for Environmental Protection and Research (ISPRA). The Italian report does not elaborate on the general sampling frequency in the monitoring network although some regions offer some information. Umbria, for example, reports between one and four samples per year for groundwater stations.

During the reporting period 2020-2023 nitrate concentrations were reported at 4 581 groundwater monitoring points. The station density was 14.7 stations per 1,000 km^2. Of these monitoring points, 47.9% of monitoring points were located within NVZ and 52.1% outside NVZ.

The overall number of monitoring points decreased by 31 (0.7%) compared to the previous reporting period. The number of stations decreased from around 5 000 in 2012-2015 to around 4500 in 2016-2019. The graph below presents the changes in the monitoring network over the last four reporting periods.

Figure 11 – Evolution of groundwater monitoring network (monitoring points with measurements of nitrates)



In this reporting period, changes in nitrate concentrations compared to the previous monitoring period (trends) were assessed for 3 824 monitoring points, accounting for 83.5% of all points with measurements. The share of monitoring points with trends increased compared to the previous reporting period, which was 74.4% in reporting period 2016-2019. The table below presents the number of monitoring points with measurements and trends in the last four reporting periods.

Table 3 – Number of groundwater monitoring points with measurements of nitrates and trends by station type ([12])

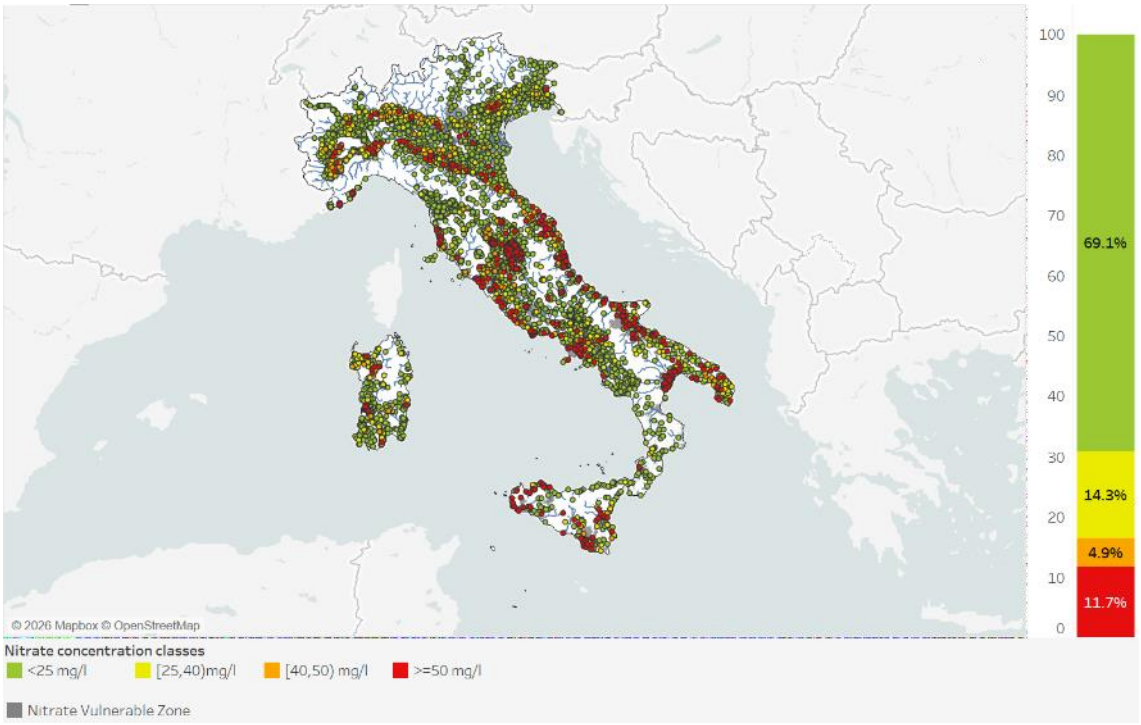
	Stations with measurements				Stations with trends			
Station type	2008-2011	2012-2015	2016-2019	2020-2023	2008-2011	2012-2015	2016-2019	2020-2023
Phreatic groundwater (0-5 m)	1,229	1,338	905	861	927	1,005	766	690
Phreatic groundwater (5-15 m)	818	823	694	856	549	707	527	765
Phreatic groundwater (15-30 m)	292	475	665	680	293	423	432	597
Phreatic groundwater (> 30 m)	493	647	682	714	510	598	530	653
Captive groundwater	1,036	1,310	773	794	969	1,080	654	583
Karstic groundwater	708	442	428	509	347	321	284	415
Not specified	494		465	167	598		238	121
Total	5,070	5,035	4,612	4,581	4,193	4,134	3,431	3,824

[12]) Italy reported that monitoring was discontinued in 1 260 monitoring points relative to the previous reporting period. Discontinuation may be due to nitrate concentrations below 25 mg/l, change in station code or type, or other specific reasons.

4.2. Nitrate concentrations in groundwater

In Italy, 11.7% of groundwater monitoring points show average nitrate concentrations equal to or above the drinking water threshold of 50 mg/l, whereas 4.9% had concentrations between 40-49.99 mg/l, 14.3% showed concentrations between 25-39.99 mg/ and 69.1% below 25 mg/l. The figure below shows a spatial distribution of the average nitrate concentrations and the shares in corresponding nitrate concentration classes.

Figure 12 – Map of average annual mean nitrate concentrations in groundwater and share of monitoring points by nitrate concentration class in the reporting period 2020-2023



Note: In the map, monitoring points with higher values are plotted on top.

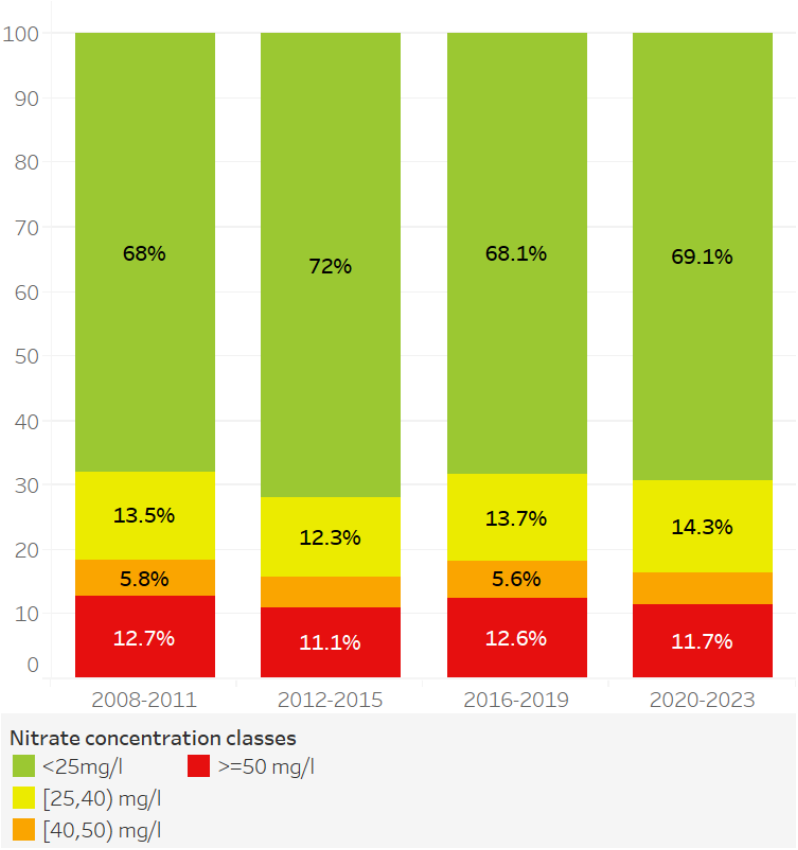
The station type category with the highest share of points with nitrate concentrations equal to or above the drinking water threshold of 50 mg/l was phreatic groundwaters at depth 15-30m with a share of 16.0%, as shown in the table below.

Table 4 – Share of groundwater monitoring points by nitrate concentration class (mg/l) in the reporting period 2020-2023, categorised by station type

	Number of stations	% of Total	<25	[25,40)	[40,50)	>=50
Phreatic groundwater (0-5 m)	861	18.8%	74.6%	11.3%	3.8%	10.3%
Phreatic groundwater (5-15 m)	856	18.7%	60.2%	16.7%	7.2%	15.9%
Phreatic groundwater (15-30 m)	680	14.8%	61.0%	16.5%	6.5%	16.0%
Phreatic groundwater (> 30 m)	714	15.6%	56.7%	22.3%	6.2%	14.8%
Captive groundwater	794	17.3%	87.9%	7.4%	3.0%	1.6%
Karstic groundwater	509	11.1%	79.8%	11.8%	2.0%	6.5%
Not specified	167	3.6%	51.5%	14.4%	4.2%	29.9%
Total	4,581	100.0%	69.1%	14.3%	4.9%	11.7%

Compared to the previous reporting period, the share of monitoring points with concentration ≥ 50 mg/l decreased from 12.6% to 11.7%. The graph below presents the share of monitoring points per classes of nitrate concentrations in the last four reporting periods.

Figure 13 – Share of monitoring points in groundwater by class of nitrate concentration ([13]) in the current and previous reporting periods



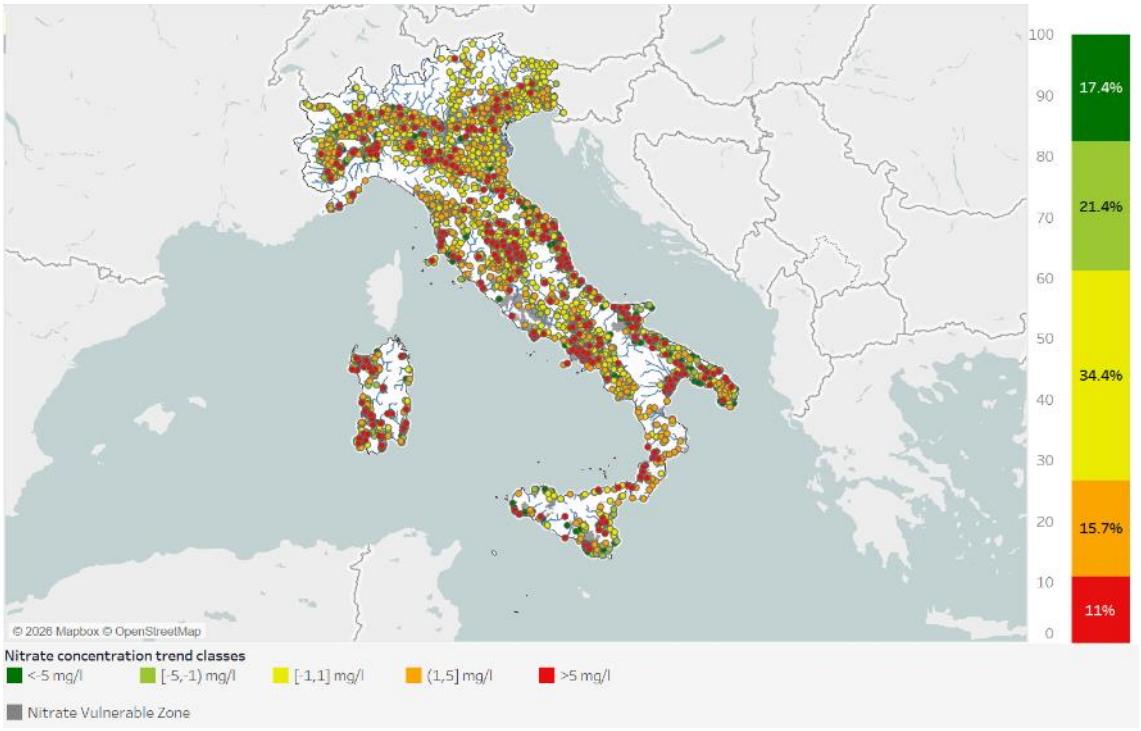
Note: The percentages below 5% are not labelled.

([13]) Average of annual mean values over the reporting period.

4.3. Trends in nitrate concentrations in groundwater

Compared to the last reporting period, there has been a decrease of nitrate concentrations in 38.8% of monitoring points and an increase in 26.8%. For the remaining 34.4% there was no significant change. The increase or decrease can be categorised as weak if it is between 1 and 5 mg/l, and as strong if it is above 5 mg/l.

Figure 14 – Map of trends in average annual mean nitrate concentrations ([14]) in groundwater between the periods 2016-2019 and 2020-2023 and share of monitoring points by trend class



Note: In the map, monitoring points with higher values are plotted on top.

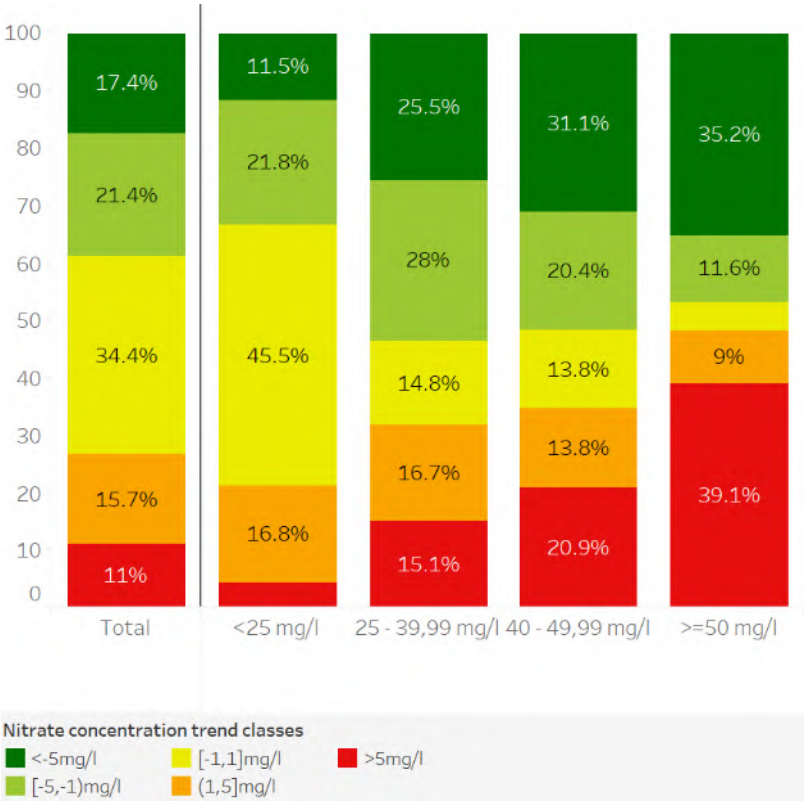
Table 5 – Share of groundwater monitoring points by trend class (mg/l) between the periods 2016-2019 and 2020-2023, categorised by station type

	Total Number of Stations	% Total Number of Stations	<-5	[-5,-1)	[-1,1]	(1,5]	>5
Phreatic groundwater (0-5 m)	690	18.0%	137	116	211	136	90
Phreatic groundwater (5-15 m)	765	20.0%	183	146	209	108	119
Phreatic groundwater (15-30 m)	597	15.6%	138	135	160	102	62
Phreatic groundwater (>30 m)	653	17.1%	91	194	201	108	59
Captive groundwater	583	15.2%	38	108	323	79	35
Karstic groundwater	415	10.9%	48	99	180	53	35
Not specified	121	3.2%	32	21	32	15	21
Total	3,824	100.0%	667	819	1,316	601	421

([14]) The average of annual mean values of nitrate concentrations over the reporting period 2020-2023 compared to the average for the reporting period 2016-2019.

When looking at the trend for waters that are polluted in the current reporting period (equal or above 50 mg/l), there has been an increase of nitrate concentration for 48.1% and a decrease for 46.8% between the previous and the current reporting periods. The graph below shows the increase (in red and orange) and decreases (in green) per nitrate concentration class.

Figure 15 – Share of groundwater monitoring points by classes of trend between the periods 2016-2019 and 2020-2023, across different nitrate concentration classes (<24.99 mg/l, 25-39.99 mg/l, 40-49.99 mg/l and ≥50mg/l) ([15])

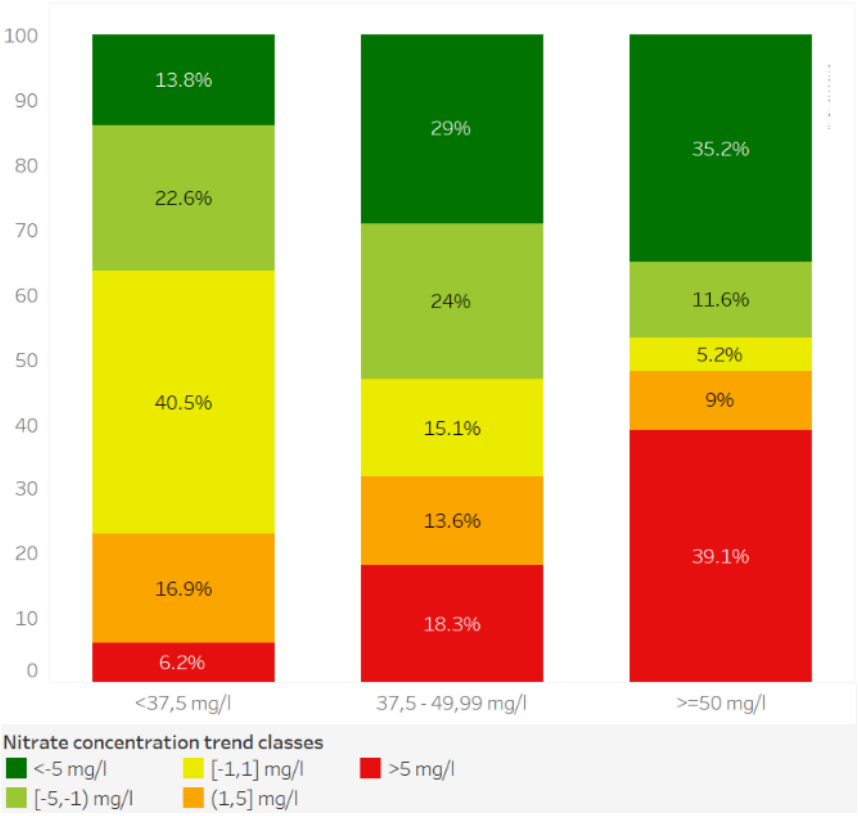


Note: The percentages below 5% are not labelled.

([15]) Nitrate concentration classes as per the Nitrates Directive report.

To better align the water quality assessment with the thresholds defined under the Groundwater Directive trends were also calculated for the water quality class with nitrate concentrations between 37.5-49.99 mg/l. When looking at the trend in this concentration category, there has been an increase of nitrate concentration for 31.9% and a decrease for 53.0% of monitoring points.

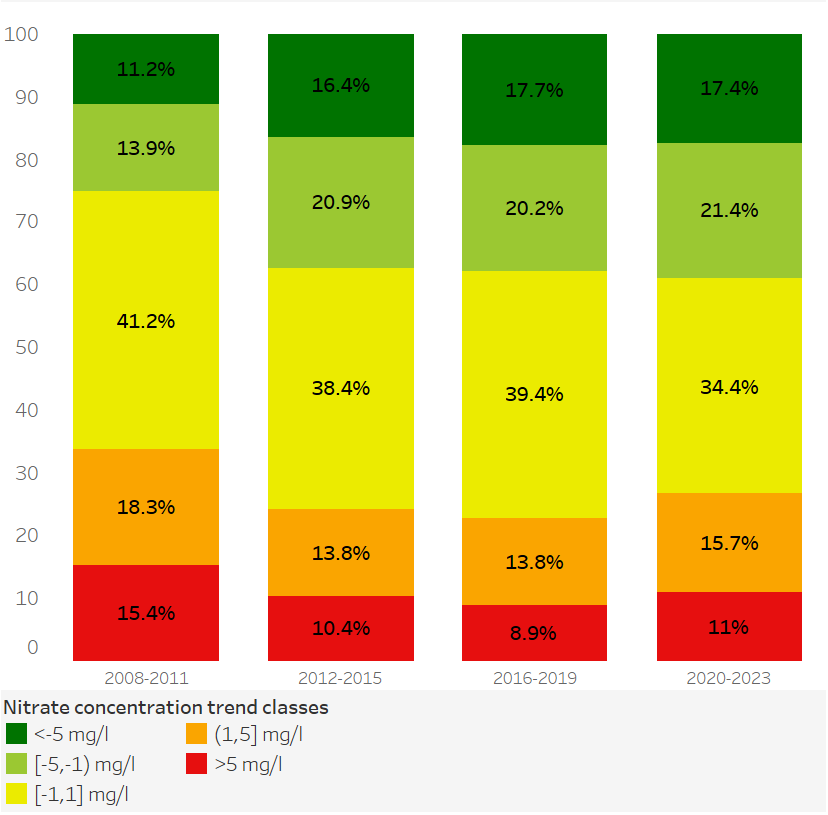
Figure 16 – Share of groundwater monitoring points by classes of trend between the periods 2016-2019 and 2020-2023, in different nitrate concentration classes (<37.5 mg/l, 37.5-49.99 mg/l and ≥50mg/l) ([16])



([16]) Nitrate concentration classes as in the Water Framework Directive guidance on GW status and trend assessment as division of nitrates quality standard (50mg/l and 75 % of this value [37.5 mg/l]).

Compared to the previous reporting period, there was a higher share of monitoring points with decreasing nitrate concentrations (38.8% in the current reporting period compared to 37.9% in the previous reporting period) but also a higher share of monitoring points with increasing nitrate concentrations (26.7% compared to 22.7%). The graph below shows the share of monitoring points with increases (in red and orange), decreases (in green) and without significant change (in yellow) in nitrate. concentrations between reporting periods.

Figure 17 – Share of groundwater monitoring points by class of nitrate concentration trend ([17]) in the current and previous reporting periods

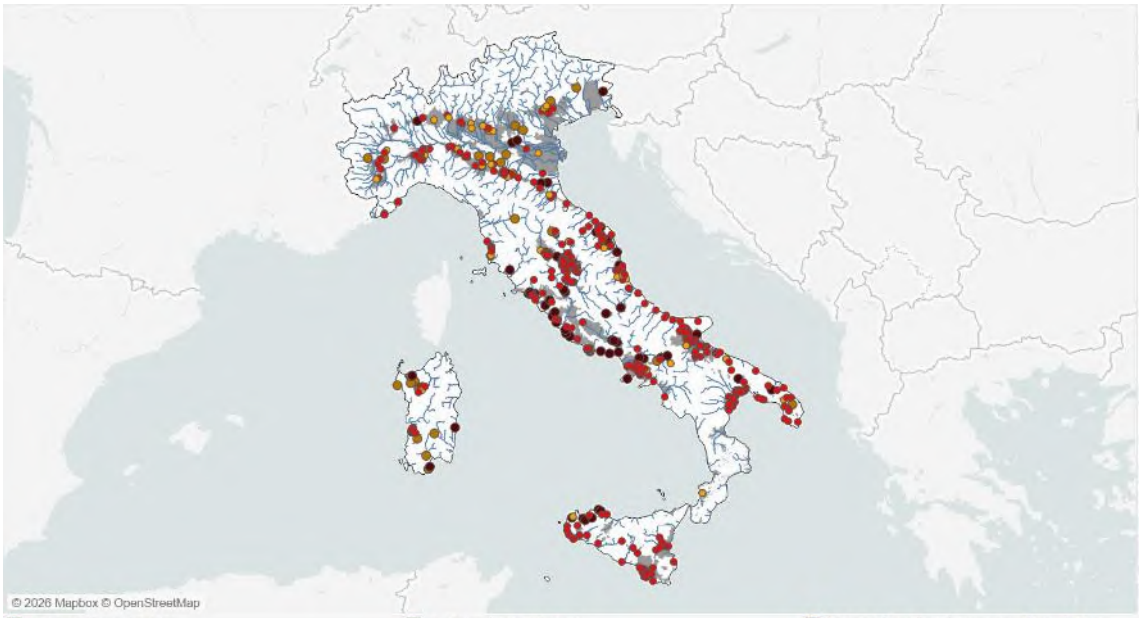


([17]) Change in average annual mean nitrate concentrations compared to the previous reporting period.

4.4. Nitrate pollution hotspots in groundwater

A nitrate pollution hotspot in groundwater is defined here as a monitoring point where the average annual nitrate concentration is either ≥ 50 mg/l or between 37.5 and 49.99 mg/l with an increasing trend. In Italy there are 625 groundwater nitrate pollution hotspots, of which 85 are outside NVZ, accounting for 13.6% of all groundwater nitrate pollution hotspots.

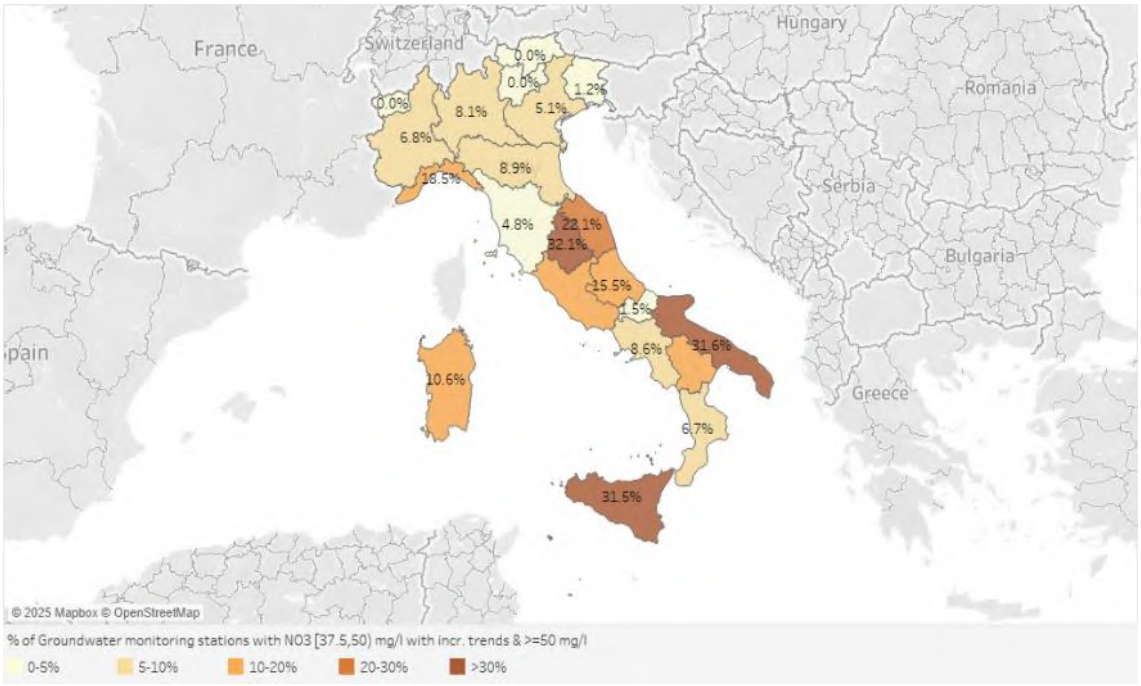
Figure 18 – Groundwater nitrate pollution hotspots (map) and their distribution inside and outside Nitrate Vulnerable Zones (table)



		inside NVZ	outside NVZ	Total
Groundwater	[37.5,50) with incr. trend	63	25	88
	>=50	432	54	486
notSpecificed	[37.5,50) with incr. trend	1		1
	>=50	44	6	50
Total		540	85	625

The regions with the highest share of hotspots were Umbria (32.1%), Puglia (31.6%), and Sicilia (31.5%).

Figure 19 – Share of groundwater nitrate pollution hotspots at NUTS2 level



5. NITRATES IN SURFACE WATERS

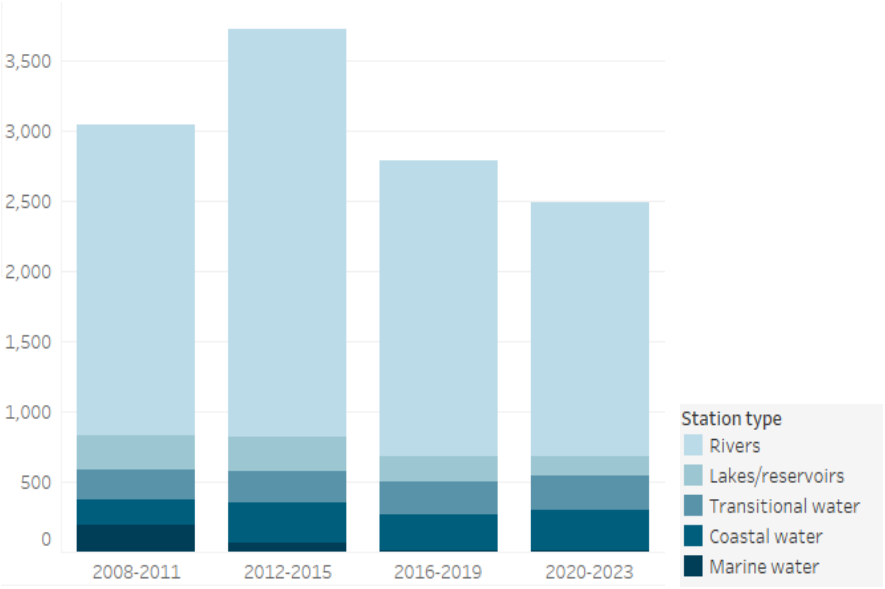
5.1. Monitoring of nitrate concentrations in surface waters

The implementation of the Nitrates Directive is responsibility of the regions and autonomous provinces. In particular, the water quality monitoring is primarily conducted by the Regional Environmental Protection Agencies (ARPA) and their regional monitoring networks and coordinated for this report by the Italian Institute for Environmental Protection and Research (ISPRA). During this monitoring period, some surface water stations were removed and not replaced with alternative stations, primarily because an analysis of pressures and impacts revealed that these stations were not monitoring pollution caused by agricultural sources. Nonetheless, it is stated that this pollution will continue to be monitored and reported under the Water Framework Directive (WFD).

During the reporting period 2020-2023 nitrate concentrations were reported at 2 488 surface water monitoring points. Among these, 72.7% were in rivers, 5.3% were in lakes or reservoirs, and 21.9% were in saline waters. The freshwater monitoring points density was 6.5 stations per 1 000 km^2. Of these monitoring points, 40.5% monitoring points were located within NVZ and 59.5% outside NVZ.

The overall number of monitoring points decreased by 303 (10.9%) compared to the previous reporting period. There has been a decrease in monitoring stations since 2012-2015. In the current reporting period, the main driver of this decrease was due to a reduction in river points and to a lesser extent points in lakes/reservoirs. The graph below presents the changes in the monitoring network over the last four reporting periods.

Figure 20 – Evolution of surface water monitoring network (monitoring points with measurements of nitrates)



In this reporting period, changes in nitrate concentrations compared to the previous monitoring period (trends) were assessed for 3 708 monitoring points, accounting for 90.1% of all points with measurements. The share of monitoring points with trends increased compared to the previous reporting period (85.7% in reporting period 2016-2019). The table below presents the number of monitoring points and the number of monitoring points with trends in the last four reporting periods.

Table 6 – Number of surface water monitoring points with measurements of nitrates and trends per type ([18])

	Stations with measurements				Stations with trends			
Station type	2008-2011	2012-2015	2016-2019	2020-2023	2008-2011	2012-2015	2016-2019	2020-2023
Rivers	2,220	2,906	2,112	1,809	1,554	1,984	1,787	1,668
Lakes/reservoirs	243	248	176	133	243	199	144	124
Transitional water	216	223	240	251	142	86	223	226
Coastal water	174	294	255	287	53	138	229	215
Marine water	194	60	8	8	224	43	8	8
Total	3,047	3,731	2,791	2,488	2,216	2,450	2,391	2,241

([18]) Italy reported that monitoring was discontinued in 530 monitoring points relative to the previous reporting period. Discontinuation may be due to nitrate concentrations below 25 mg/l, change in station code or type, or other specific reasons.

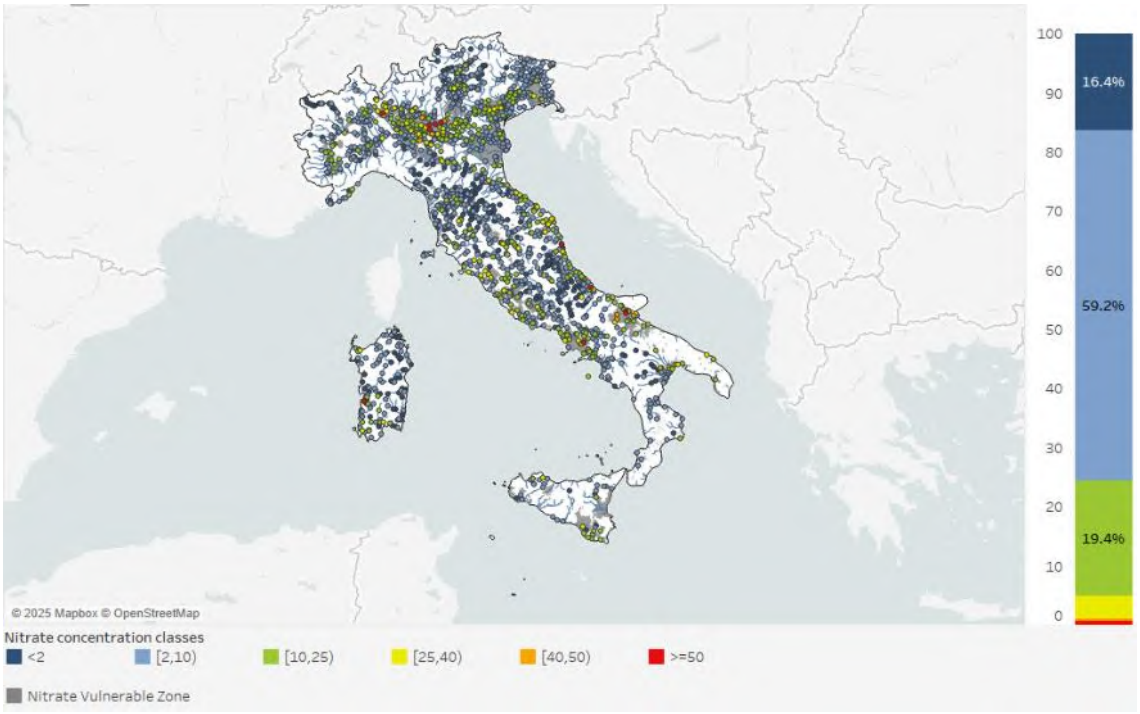
5.2. Nitrate concentrations in surface waters

Rivers

In Italy, 0.7% of monitoring points in rivers showed average nitrate concentrations equal to or above the drinking water threshold of 50 mg/l, whereas 0.5% had concentrations between 40-49.99 mg/l, 3.9% showed concentrations between 25-39.99 mg/, 19.4% in the class 10-24.99 mg/l, 52.2% in the class 2-9.99 mg/l and 16.4% below 2 mg/l.

It is relevant to look at the distribution in nitrate concentration classes below 25 mg/l for surface water as there can be a risk of eutrophication in lower concentration classes.

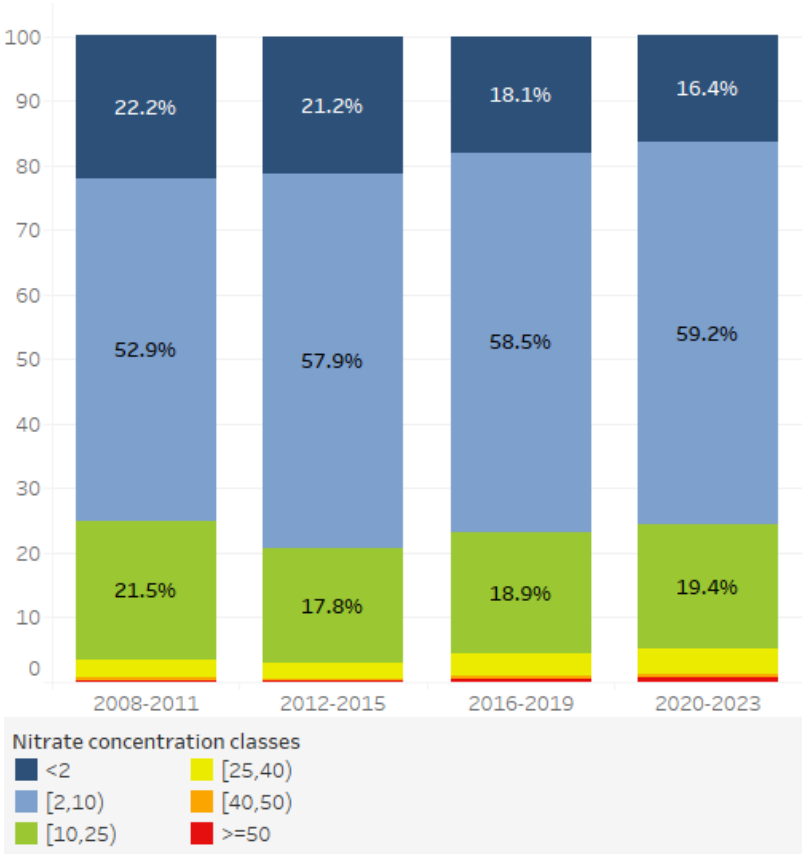
Figure 21 – Map of average annual mean nitrate concentrations in rivers and share of monitoring points by concentration class in the reporting period 2020-2023



Note: In the map, monitoring points with higher values are plotted on top. In the graph, the percentages below 5% are not labelled.

Compared to the previous reporting period, the share of monitoring points in rivers with concentrations ≥ 50 mg/l increased from 0.6% to 0.7%. The graph below presents the shares of monitoring points per classes of nitrate concentration in the last four reporting periods. In the current and past three reporting periods the shares across all concentration classes remained relatively stable. However, the share in the concentration class <2mg/l has decreased from 22.2% to 16.4% between the periods 2008-2011 and 2020-2023.

Figure 22 – Share of monitoring points in rivers by class of nitrate concentration ([19]) in the current and previous reporting periods



Note: The percentages below 5% are not labelled.

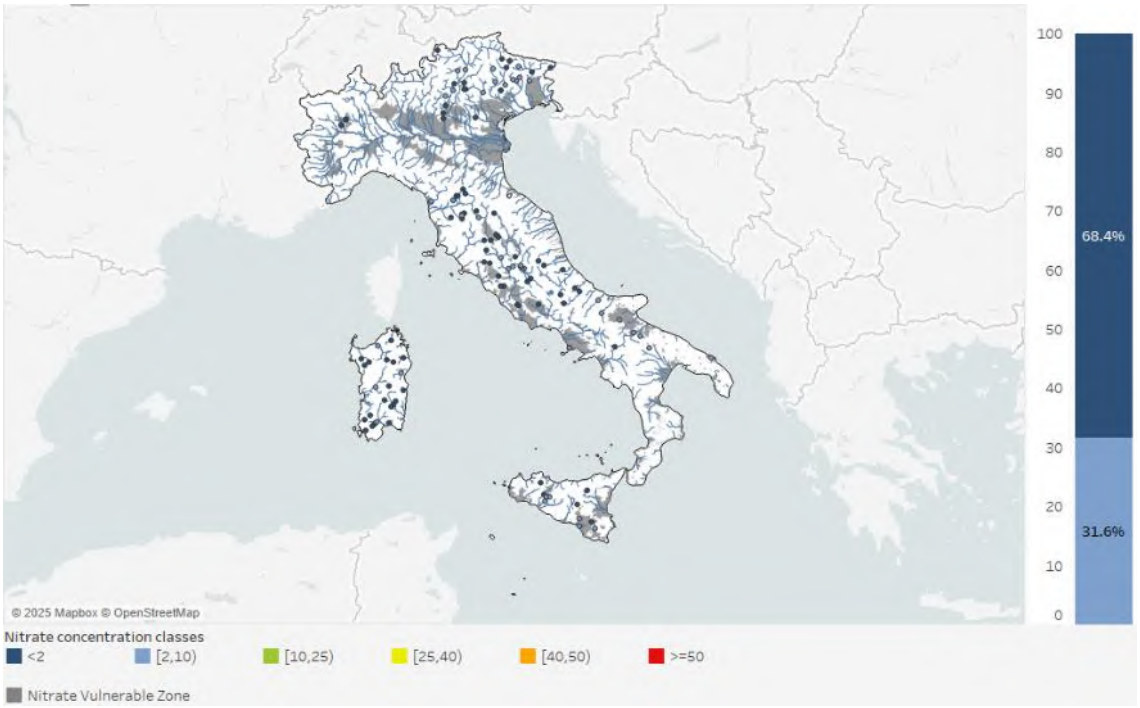
([19]) Average of annual mean values over the reporting period.

Lakes/water reservoirs

In Italy, no monitoring points in lakes/water reservoirs showed average nitrate concentrations equal to or above the drinking water threshold of 50 mg/l or even above 10 mg/l, whereas 31.6% showed concentrations in the class 2-9.99 mg/l and 68.4% below 2 mg/l.

It is relevant to look at the distribution in nitrate concentration classes below 25 mg/l for surface water as there can be a risk of eutrophication in lower concentration classes.

Figure 23 – Map of average annual mean nitrate concentrations in lakes/water reservoirs and share of monitoring points by concentration class in the reporting period 2020-2023



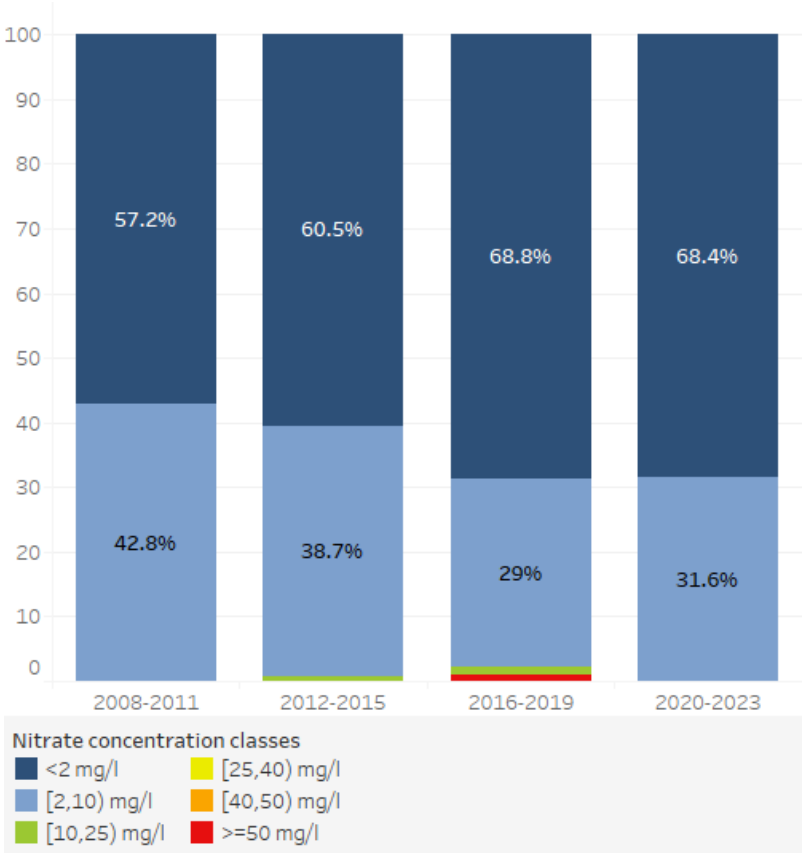
Note: In the map, monitoring points with higher values are plotted on top.

Table 7 – Share of freshwater monitoring points by nitrate concentration class (mg/l) in reporting period 2020-2023, categorised by station type

	Number of stations	% of Total	<2	[2,10)	[10,25)	[25,40)	[40,50)	>=50
Rivers	1,809	93.2%	16.4%	59.2%	19.4%	3.9%	0.5%	0.7%
Lakes/reservoirs	133	6.8%	68.4%	31.6%				
Total	1,942	100.0%	19.9%	57.3%	18.1%	3.6%	0.5%	0.6%

Compared to the previous reporting period, the share of monitoring points in lakes/water reservoirs with concentration ≥ 50 mg/l decreased from 1.1% to 0%. The graph below presents the shares of monitoring points per classes of nitrate concentration in the last four reporting periods. There has been a steady increase in the lowest concentration category <2 mg/l from 2008-2011 to 2016-2019 with only a slight decrease in 2020-2023, with an increase in the class 2-9.99 mg/l.

Figure 24 – Share of monitoring points in lakes/water reservoirs by class of nitrate concentration ([20]) in the current and previous reporting periods



Note: The percentages below 5% are not labelled.

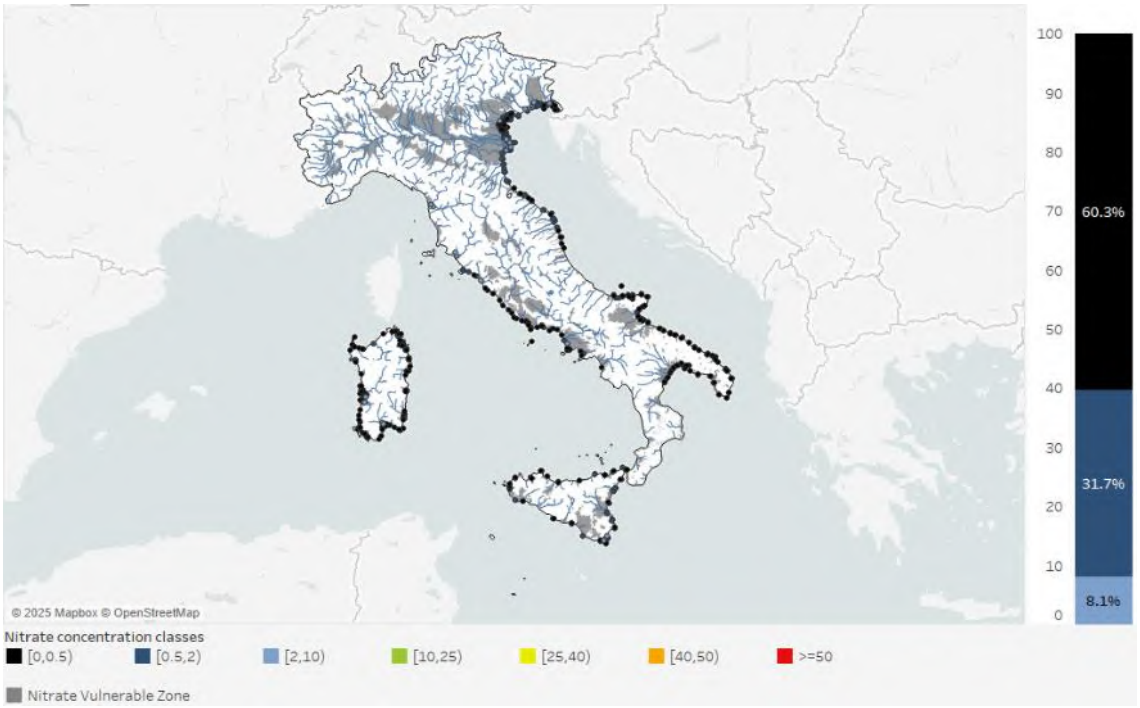
([20]) Average of annual mean values over the reporting period.

Saline waters ([21])

No points in saline waters monitoring points showed average nitrate concentrations ≥ 10 mg/l, 8.1% showed concentrations between 2-9.99 mg/l and 31.7% between 0.5-2 mg/l and 60.3% below 0.5 mg/l.

It is relevant to look in detail at very low nitrate concentrations, also below 0.5 mg/l and between 0.5 mg/l and 2 mg/l, because saline waters tend to have very low concentrations and some saline waters can become eutrophic even at concentrations below 2 mg/l.

Figure 25 – Map of average annual mean nitrate concentrations in saline waters and share of monitoring points by concentration class in reporting period 2020-2023



Note: In the map, monitoring points with higher values are plotted on top.

It is also relevant to look separately at transitional waters as they typically show higher nitrate concentrations. In Italy, 17.1% of monitoring points showed average annual mean nitrate concentrations in the class 2-9.99 mg/l, 35.5% between 0.5-2 mg/l and 47.4% below 0.5 mg/l, as shown in the table below.

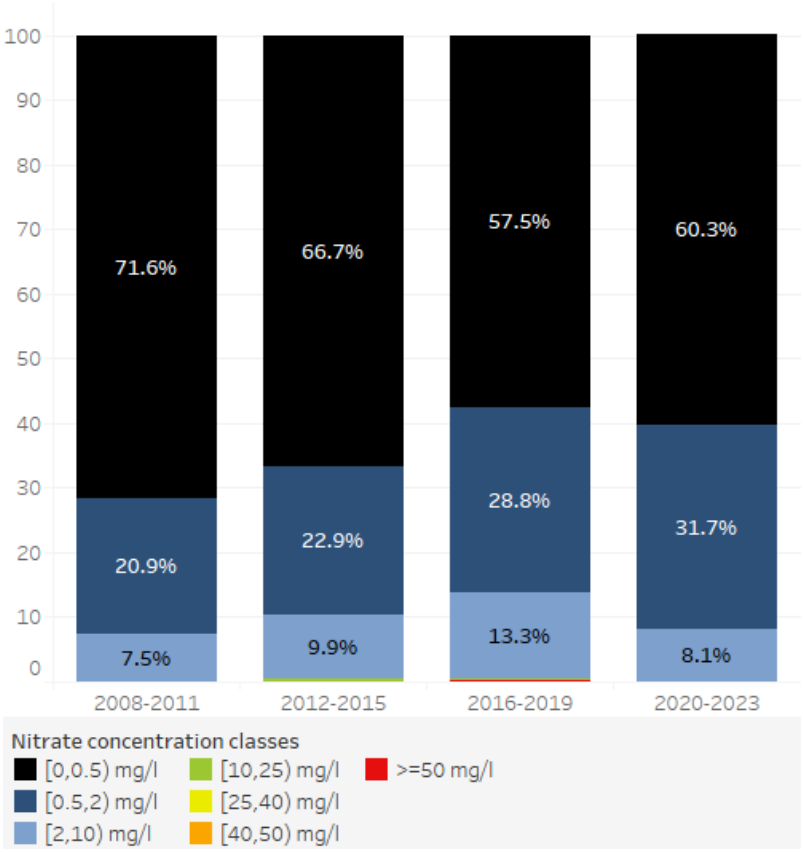
Table 8 – Share of saline water monitoring points by nitrate concentration class (mg/l) in the reporting period 2020-2023, categorised by station type

	Number of stations	% of Total	<0.5	[0.5,2)	[2,10)	[10,25)	[25,40)	[40,50)	>=50
Transitional water	251	46.0%	47.4%	35.5%	17.1%				
Coastal water	287	52.6%	72.5%	27.2%	0.3%				
Marine water	8	1.5%	25.0%	75.0%					
Total	546	100.0%	60.3%	31.7%	8.1%				

([21]) This includes coastal, marine and transitional waters.

The graph below presents the shares of monitoring points per classes of nitrate concentration in the last four reporting periods.

Figure 26 – Share of monitoring points in saline waters by class of nitrate concentration ([22]) in the current and previous reporting periods



Note: The percentages below 5% are not labelled.

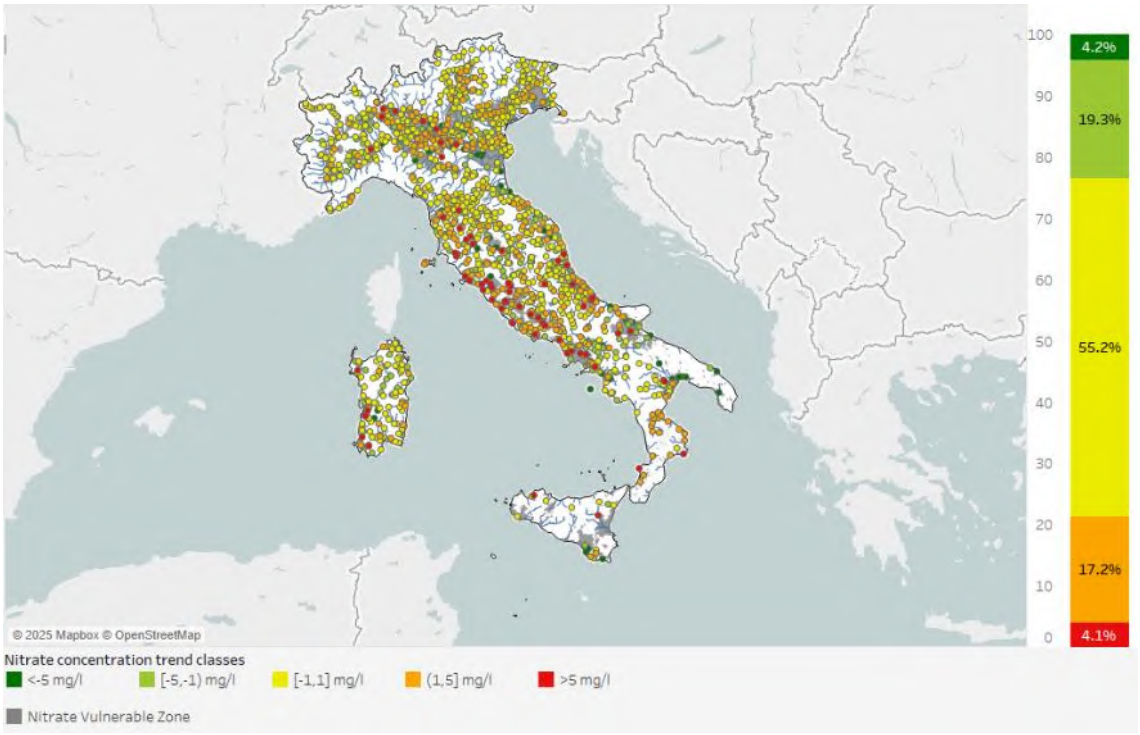
([22]) Average of annual mean values over the reporting period.

5.3. Trends in nitrate concentrations in surface waters

Rivers

Compared to the last reporting period, there has been a decrease of nitrate concentrations in 23.5% of monitoring points and an increase in 21.3%. For the remaining 55.2% there was no significant change. The increase or decrease can be categorised as weak if it is between 1 and 5 mg/l, and as strong if it is above 5 mg/l.

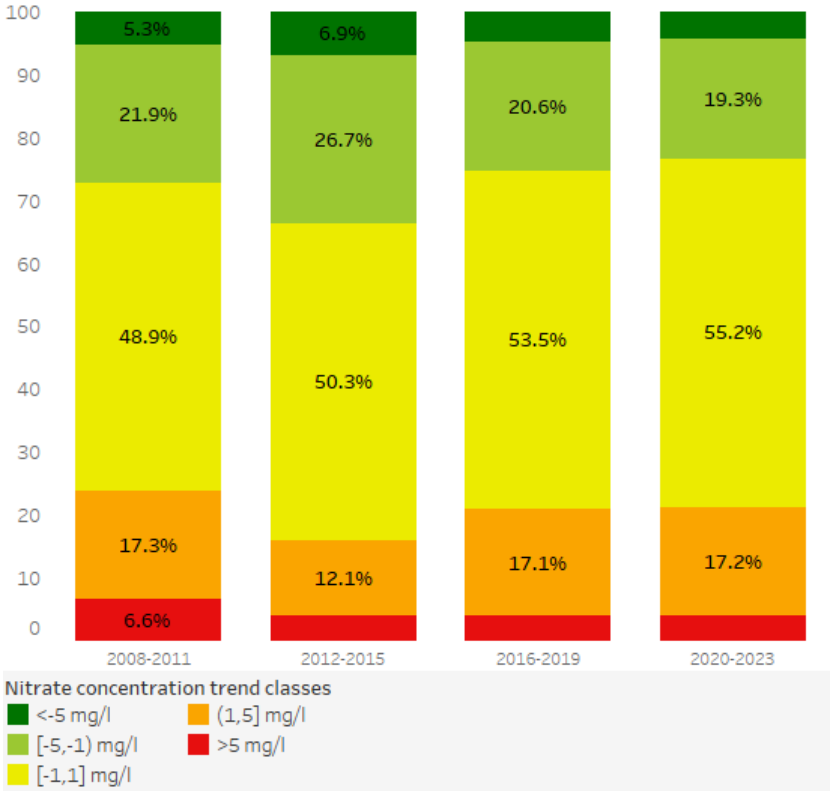
Figure 27 – Map of trends in average annual mean nitrate concentrations in rivers between the periods 2016-2019 and 2020-2023 and share of monitoring points by trend class



Note: In the map, monitoring points with higher values are plotted on top.

Compared to the previous reporting period, there was a lower share of monitoring points with decreasing nitrate concentrations (23.5% in the current reporting period compared to 25.4% in the previous reporting period compared) but a higher share of monitoring points with increasing nitrate concentrations (21.3% compared to 21.1%). The graph below shows the share of monitoring points with increases (in red and orange), decreases (in green) and without significant change (in yellow) in nitrate concentrations between reporting periods.

Figure 28 – Share of monitoring points in rivers by class of nitrate concentration trend ([23]) in the current and previous reporting periods



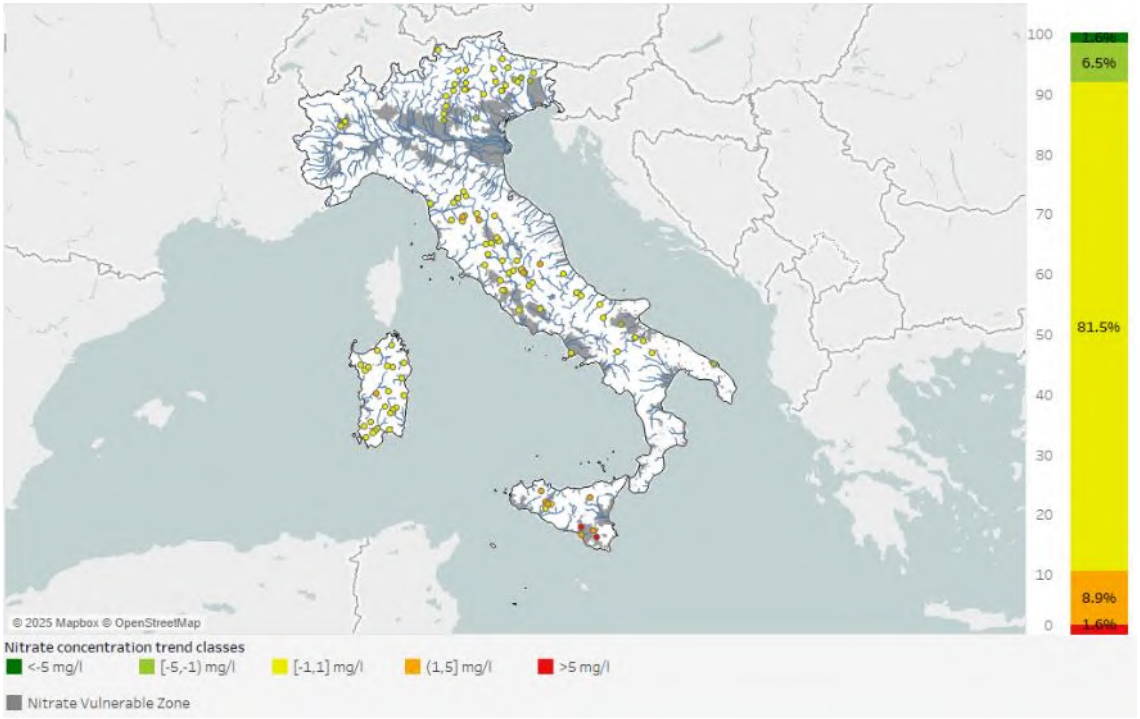
Note: The percentages below 5% are not labelled.

([23]) Change in average annual mean nitrate concentrations compared to the previous reporting period.

Lakes and water reservoirs

Compared to the last reporting period, there has been a decrease of nitrate concentrations in 8.1% of monitoring points and an increase in 10.5%. For the remaining 81.5% there was no significant change. The increase or decrease can be categorised as weak if it is between 1 and 5 mg/l, and as strong if it is above 5 mg/l.

Figure 29 – Map of trends in average annual mean nitrate concentrations in lakes/water reservoirs between the periods 2016-2019 and 2020-2023 and share of monitoring points by trend class



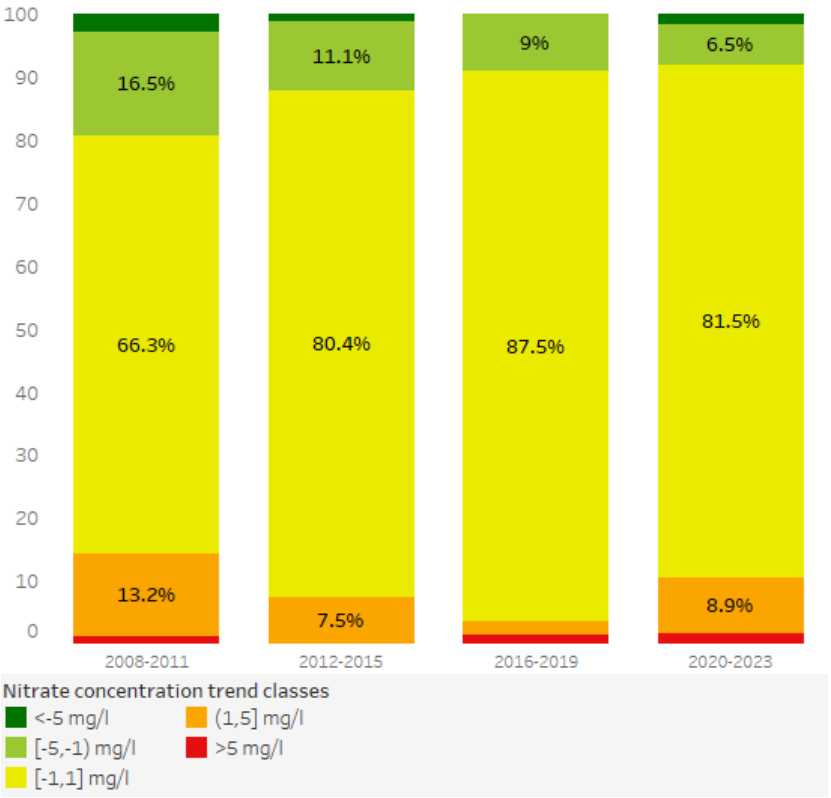
Note: In the map, monitoring points with higher values are plotted on top.

Table 9 – Share of freshwater monitoring points by trend class (mg/l), categorised by station type

	Total Number of Stations	% Total Number of Stations	<-5	[-5,-1)	[-1,1]	(1,5]	>5
River	1,668	93.1%	4.2%	19.3%	55.2%	17.2%	4.1%
Lake/Reservoir	124	6.9%	1.6%	6.5%	81.5%	8.9%	1.6%
Total	1,792	100.0%	4%	18.4%	57%	16.6%	3.9%

Compared to the previous reporting period, there is lower share of monitoring points with decreasing nitrate concentrations (8.1% in the current reporting period compared to 9.0% in the previous reporting period) but higher share of monitoring points with increasing nitrate concentrations (10.5% compared to 3.5%). The graph below shows the share of monitoring points with increases (in red and orange), decreases (in green) and without significant change (in yellow) in nitrate concentrations between reporting periods.

Figure 30 – Share of monitoring points in lakes/water reservoirs by class of nitrate concentration trend ([24]) in the current and previous reporting periods



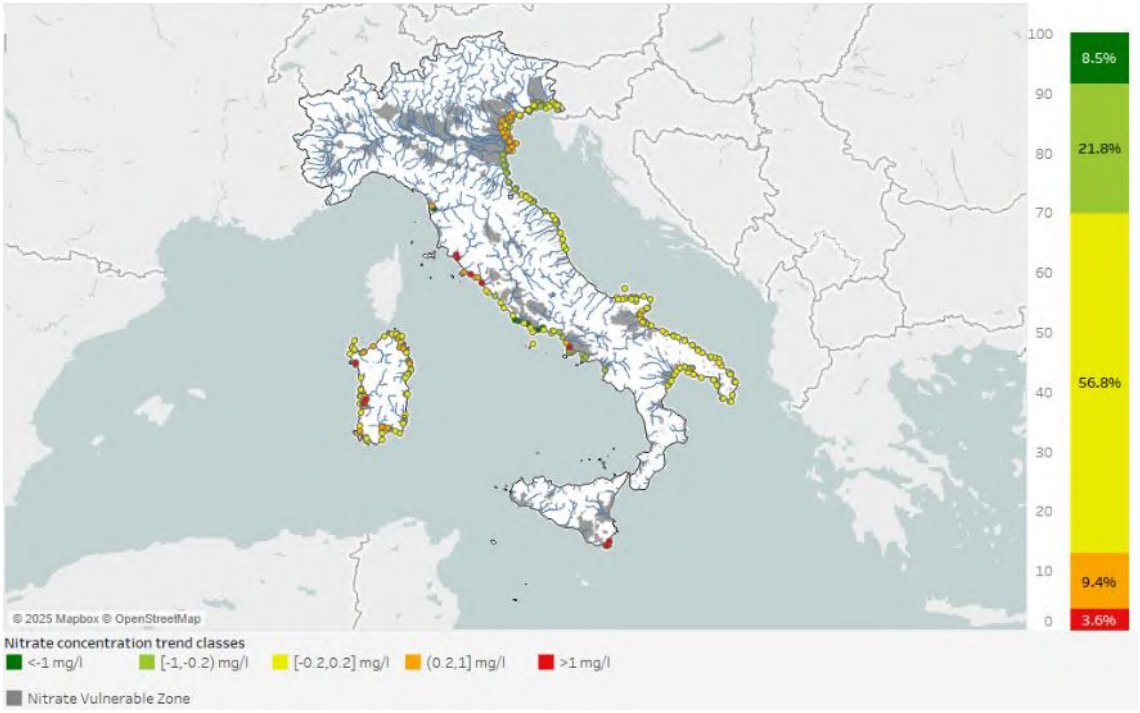
Note: The percentages below 5% are not labelled.

([24]) Change in average annual mean nitrate concentrations compared to the previous reporting period.

Saline waters

Compared to the last reporting period, there has been a decrease of nitrate concentrations in 30.3% of monitoring points and an increase in 13.0%. For the remaining 56.8% there was no significant change. The increase or decrease can be categorised as weak if it is between 0.2 and 1 mg/l, and as strong if it is above 1 mg/l.

Figure 31 – Map of trends in average annual mean nitrate concentrations in saline waters between periods 2016-2019 and 2020-2023 and share of monitoring points by trend class



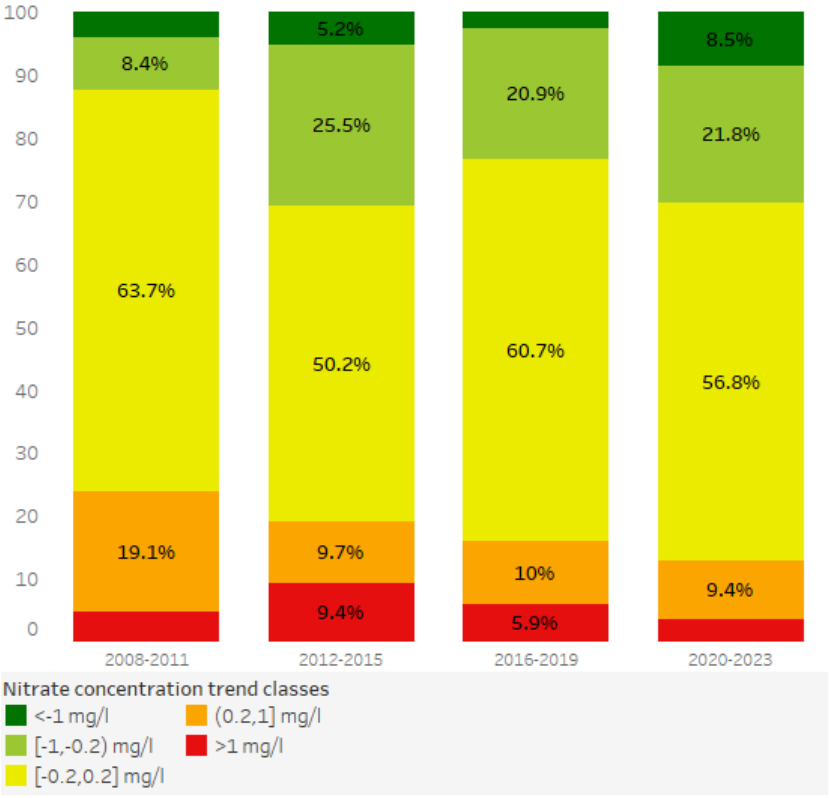
Note: In the map, monitoring points with higher values are plotted on top.

Table 10 – Share of saline water monitoring points by trend class (mg/l), categorised by station type

	Total Number of Stations	% Total Number of Stations	<-1	[-1,-0.2)	[-0.2,0.2]	(0.2,1]	>1
Transitional water	226	50.3%	15%	22.6%	40.7%	15%	6.6%
Coastal water	215	47.9%	1.9%	18.6%	75.3%	3.7%	0.5%
Marine water	8	1.8%		87.5%	12.5%		
Total	449	100.0%	8.5%	21.8%	56.8%	9.4%	3.6%

Compared to the previous reporting period, there is higher share of monitoring points with decrease of nitrate concentrations (30.3% in the current reporting period compared to 23.5% in the previous reporting period) and lower share of monitoring points with increase of nitrate concentrations (13.0% compared to 15.9%). The graph below shows the share of monitoring points with increases (in red and orange), decreases (in green) and without significant change (in yellow) in nitrate concentrations between reporting periods.

Figure 32 – Share of monitoring points in saline waters by classes of nitrate concentrations ([25]) in the current and previous reporting periods



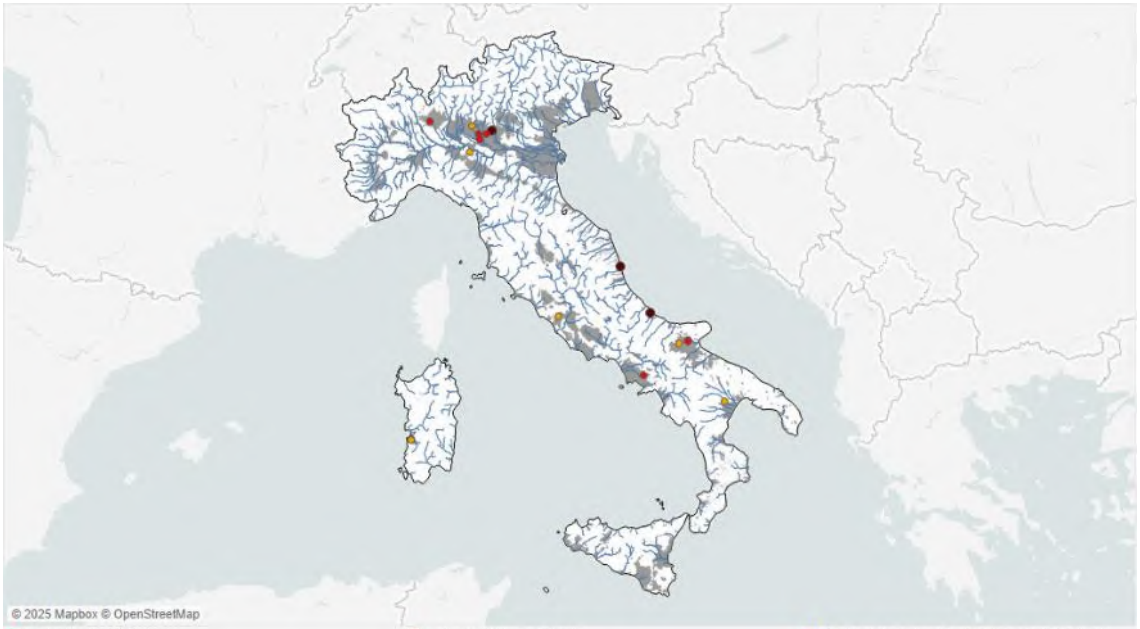
The percentages below 5% are not labelled.

([25]) Change in average annual mean nitrate concentrations compared to the previous reporting period.

5.4. Nitrate pollution hotspots in surface waters

A nitrate pollution hotspot is defined here as a monitoring point where the average annual nitrate concentration is ≥ 50 mg/l or between 37.5 and 49.99 mg/l with an increasing trend. There are 18 surface water nitrate pollution hotspots, of which 3 are outside NVZ, accounting for 16.7% of all surface water nitrate pollution hotspots in the country.

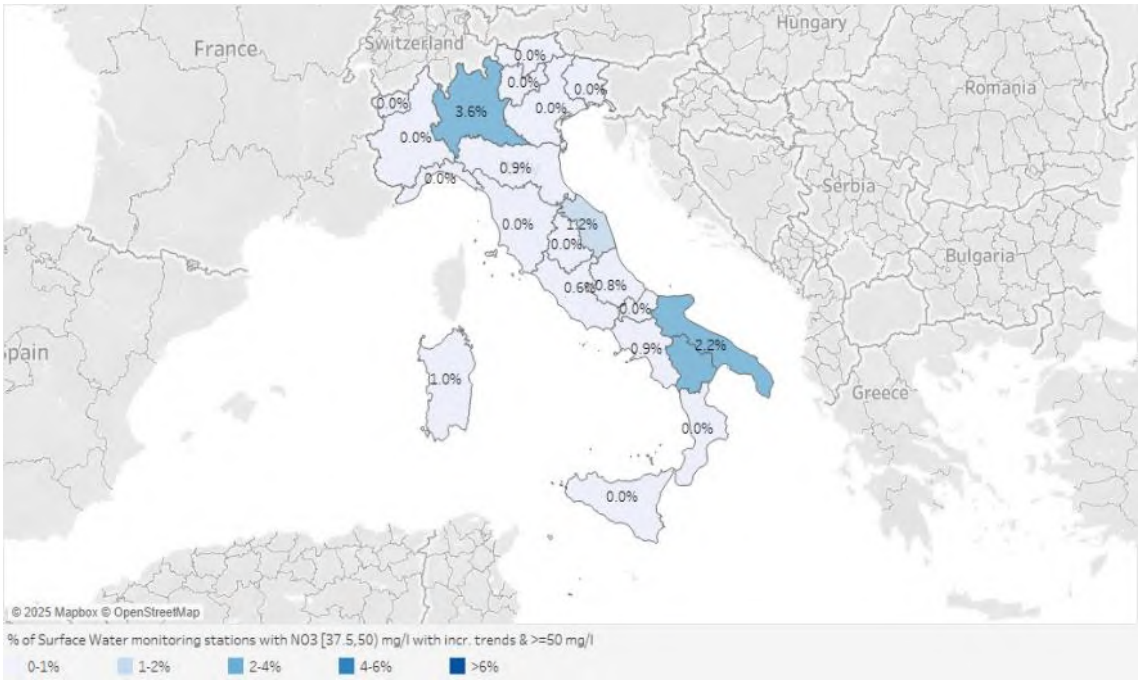
Figure 33 – Surface water nitrate pollution hotspots (map) and their distribution inside and outside Nitrates Vulnerable Zones (table)



		inside NVZ	outside NVZ	Total
Rivers	[37.5,50) with incr. trend	6		6
	>=50	9	3	12
Lakes/reservoirs	[37.5,50) with incr. trend			
	>=50			
Total		15	3	18

The regions with the highest share of hotspots are Lombardy (3.6%), Basilicata (2.9%) and Puglia (2.2%).

Figure 34 – Share of surface water nitrate pollution hotspots at NUTS2 level



6. EUTROPHICATION OF SURFACE WATERS

6.1. Monitoring of trophic status in surface waters

In Italy, the responsibility for monitoring eutrophication falls to the Italian Institute for Environmental Protection and Research (ISPRA) and regional authorities, who use the national information system for the protection of Italian waters (SINTAI) to assess the trophic status of water bodies.

During the reporting period 2020-2023 trophic status was reported at 2 284 monitoring points. Among these, 71.3% were in rivers, 4.9% were in lakes or reservoirs, and 23.8% were in saline waters. The station density of monitoring points, where trophic status was assessed equals to 5.8 stations per 1 000 km^2. Of these monitoring points, 38.1% of monitoring points were located within NVZ and 61.9% outside NVZ.

The overall number of freshwater monitoring points decreased by 514 (22.8%), and number of saline water monitoring points increased by 41 (8.2%) compared to the previous reporting period. Since 2012-2015 there has been a steady decrease in monitoring stations.

Figure 35 – Evolution in surface water monitoring network (number of points with trophic status reported)

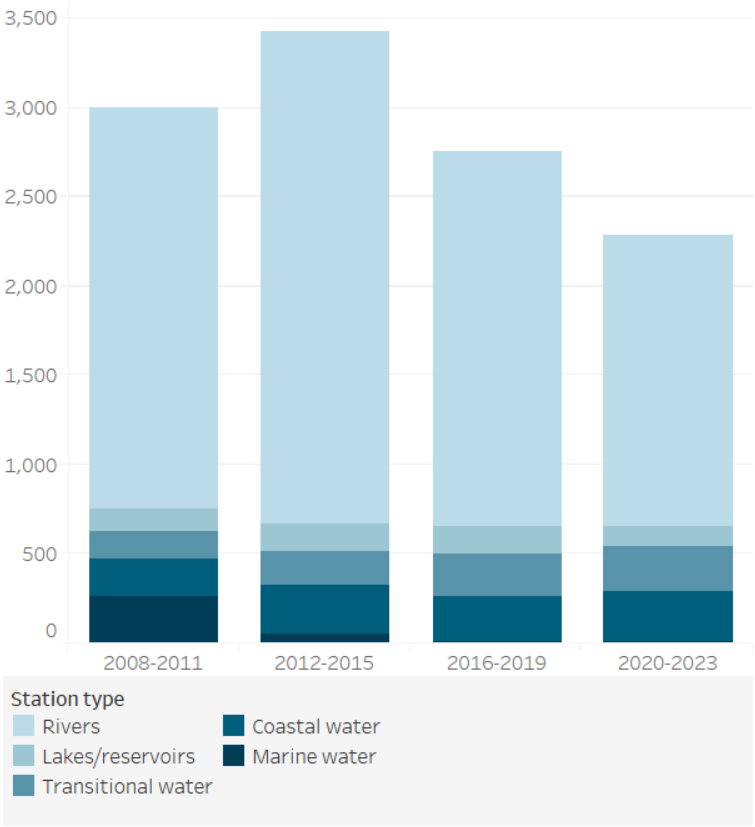


Table 11 – Number of monitoring points reporting trophic status by station type ([26])

Station type	Stations With Trophic Status			
	2008-2011	2012-2015	2016-2019	2020-2023
Rivers	2,238	2,753	2,099	1,628
Lakes/reservoirs	123	157	155	112
Transitional water	163	183	240	249
Coastal water	212	281	255	287
Marine water	259	49	8	8
Total	2,995	3,423	2,757	2,284

6.2. Methodology for the assessment of trophic status

The classification and assessment system for the trophic status of water bodies has been developed in accordance with the "Guideline document on eutrophication assessment in the context of European water policies" (Guideline CIS document no. 23). In this context, the Ministry of Ecological Transition (MiTE) has published the document "Criteri per la valutazione dell'Eutrofizzazione nei corpi idrici superficiali," available on the SINTAI network (System National Fact Sheet for the Italian Water Market).

The methodology involves evaluating the trophic state using aquatic flora and physical-chemical quality elements to support biological elements. In some regional contexts, not all biological elements required for the method's application were available for the current reporting period. In such cases, a transitional methodology was used during the reporting period 2016-2019. This method is primarily based on the use of chemical-physical elements and implements the TRIX index to define the trophic state of the water. During the reporting period 2020-2023, more stations than in the previous period were monitored using the national methodology.

Italy reported that the parameters and limit values used in the eutrophication assessment for the Nitrates Directive align with those of the Water Framework Directive.

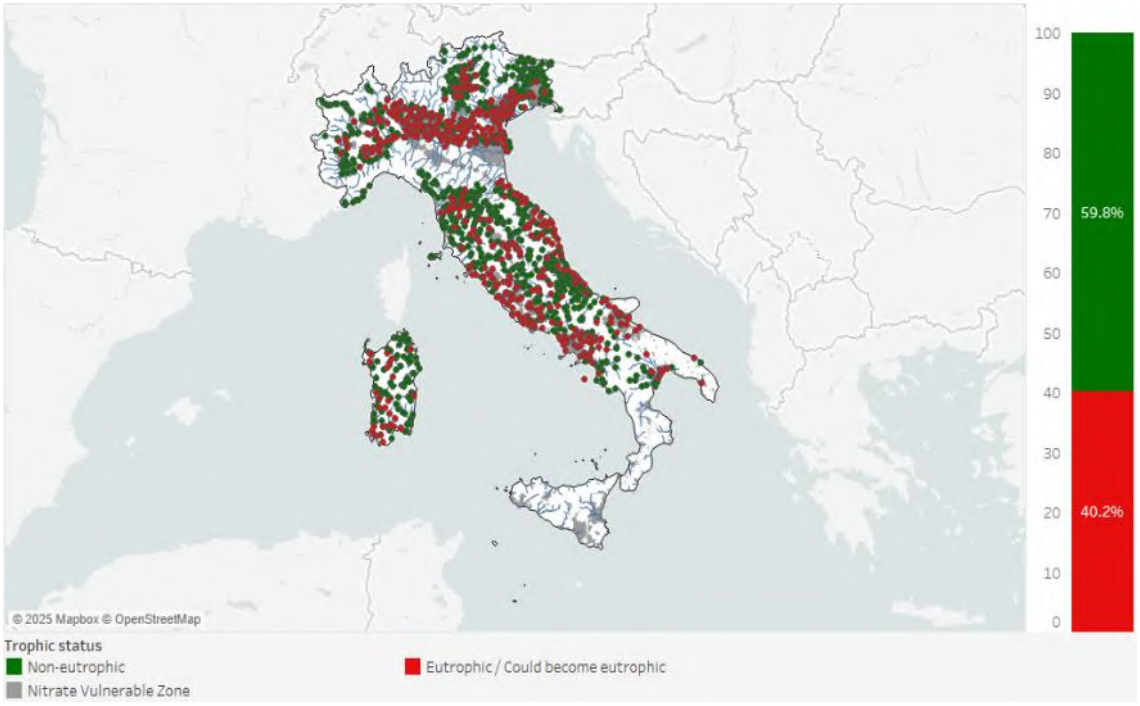
([26]) Italy reported that monitoring was discontinued in 523 monitoring points relative to the previous reporting period. Discontinuation may be due to nitrate concentrations below 25 mg/l, change in station code or type, or other specific reasons.

6.3. Eutrophication of surface waters

Rivers

40.2% of monitoring points in rivers were eutrophic/could become eutrophic. The figure below shows the shares in respective classes in a graph and spatial distribution in the map.

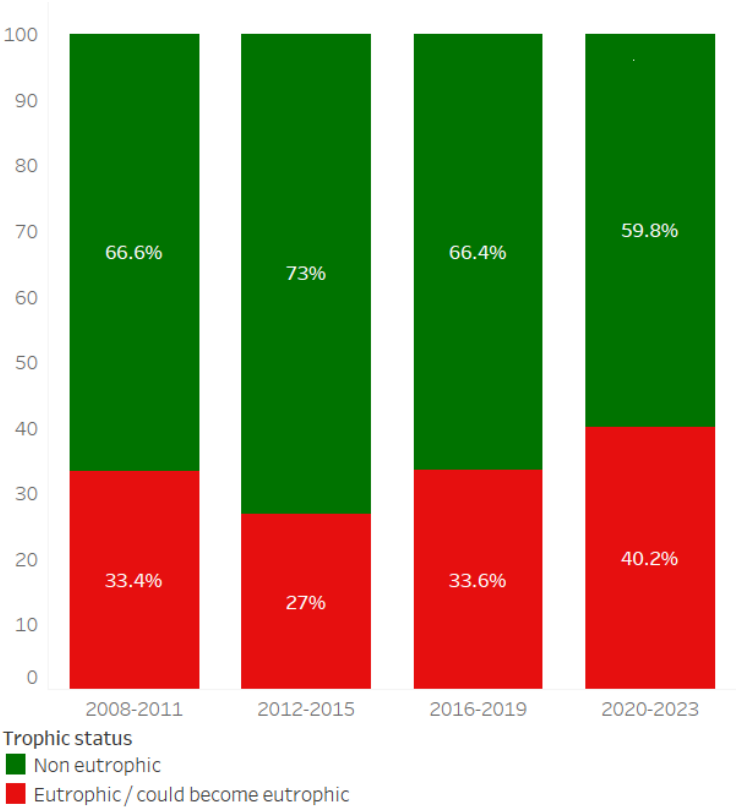
Figure 36 – Map of trophic status in rivers and share of monitoring points by trophic class in the reporting period 2020-2023



Note: In the map, eutrophic/could become eutrophic monitoring points are plotted on top.

Compared to the previous reporting period, the share of eutrophic/could become eutrophic monitoring points increased from 33.6% to 40.2%. The graph below presents the shares of monitoring points according to their trophic status in the last four reporting periods. From 2008-2011 to the current reporting period the share in stations with eutrophic/could become eutrophic status has increased from 33.4% to 40.2% with a decrease in 2012-2015 to 27.0%.

Figure 37 – Share of monitoring points in rivers by class of trophic status in the current and previous reporting periods



Lakes and water reservoirs

54.5% of monitoring points in lakes/water reservoirs were eutrophic/could become eutrophic. The figure below shows the shares in respective classes in a graph and spatial distribution in the map.

Figure 38 – Map of trophic status in lakes/water reservoirs and share of monitoring points by trophic class in the reporting period 2020-2023

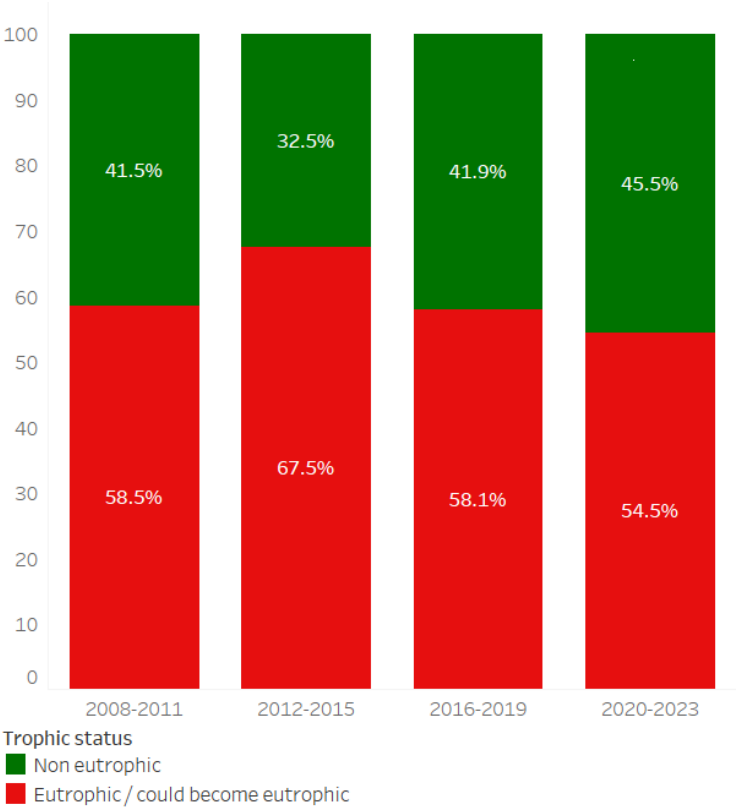
Note: In the map, eutrophic/could become eutrophic monitoring points are plotted on top.

Table 12 – Share of freshwater monitoring points by class of trophic status, categorised by station type

Station type	Number of Stations	% of Total	Non-eutrophic	Eutrophic/could become eutrophic
Rivers	1,628	93.6%	59.8%	40.2%
Lakes/reservoirs	112	6.4%	45.5%	54.5%
Total	1,740	100.0%	58.9%	41.1%

Compared to the previous reporting period, the share of eutrophic/could become eutrophic monitoring points decreased from 58.1% to 54.5%. The graph below presents the shares of monitoring points according to their trophic status in the last four reporting periods. Across the current and the past three reporting periods the share of stations with eutrophic/could become eutrophic status has remained relatively stable decreasing only slightly from 2008-2011.

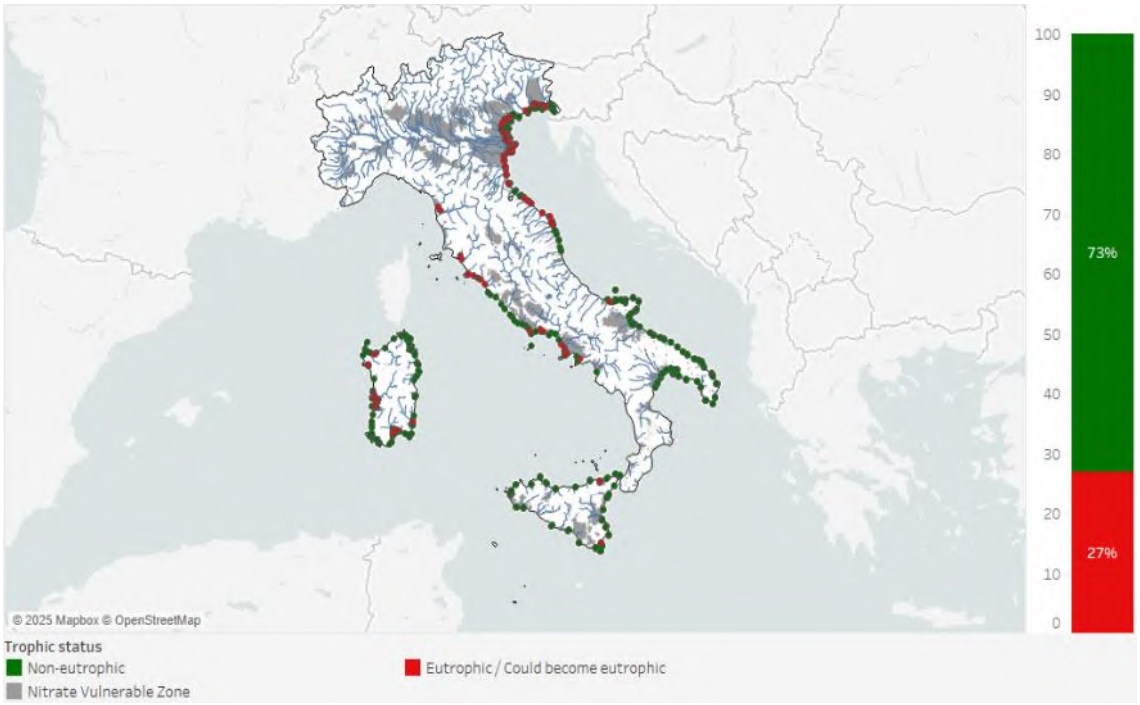
Figure 39 – Share of monitoring points in lakes/water reservoirs by class of trophic status in the current and previous reporting periods



Saline waters

27.0% of saline water monitoring points were eutrophic/could become eutrophic. The figure below shows the shares in respective classes in a graph and spatial distribution in the map.

Figure 40 – Map of trophic status in saline waters and share of monitoring points by trophic class in the reporting period 2020-2023



Note: In the map, eutrophic/could become eutrophic monitoring points are plotted on top.

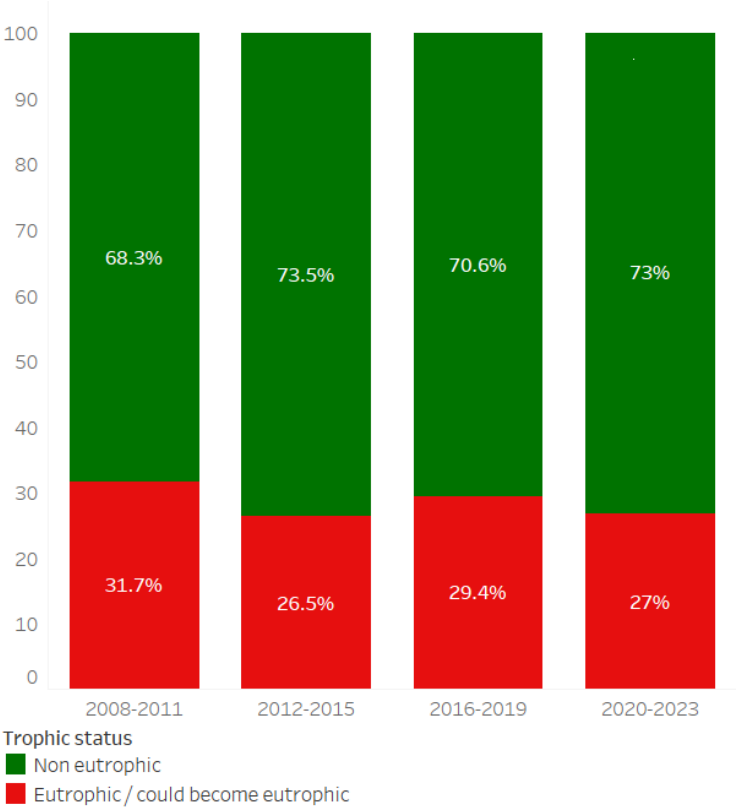
It is relevant to look separately at different types of saline waters (transitional, coastal and marine). In Italy, 45.0% of transitional water and 10.5% of coastal water and 62.5% of marine water monitoring points were eutrophic/could become eutrophic, as shown in the table below.

Table 13 – Share of saline water monitoring points by class of trophic status, categorised by station type

Station type	Number of Stations	% of Total	Non-eutrophic	Eutrophic/could become eutrophic
Transitional water	249	45.8%	55.0%	45.0%
Coastal water	287	52.8%	89.5%	10.5%
Marine water	8	1.5%	37.5%	62.5%
Total	544	100.0%	73.0%	27.0%

Compared to the previous reporting period, the share of eutrophic/could become eutrophic monitoring points in saline waters decreased from 29.4% to 27.0%. The graph below presents the shares of monitoring points according to their trophic status in the last four reporting periods.

Figure 41 – Share of monitoring points in saline waters by class of trophic status in the current and previous reporting periods



6.4. Eutrophication hotspots in surface waters

A eutrophication hotspot in surface waters is defined here as a monitoring point with trophic status evaluated as “eutrophic” or “could become eutrophic”. Overall, there are 862 surface water monitoring points which were reported as eutrophic/could become eutrophic, of which 401 are outside NVZ ([27]), accounting for 46.5% of all eutrophication hotspots in the country.

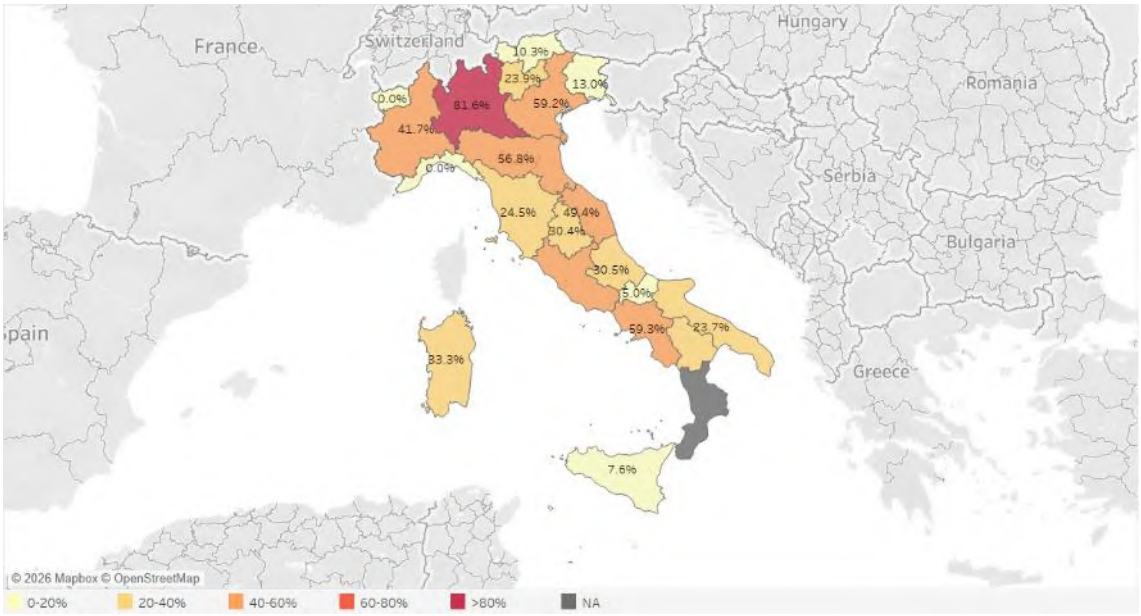
Figure 42 – Eutrophic/could become eutrophic monitoring points (map) and their distribution inside and outside Nitrate Vulnerable Zones (table)

	inside NVZ	outside NVZ	Total
Rivers	417	237	654
Lakes	24	37	61
Transitional water	20	92	112
Coastal water		30	30
Marine water		5	5
Total	461	401	862

([27]) 35 of these eutrophic/could become eutrophic monitoring points are located in coastal or marine waters.

The regions with the highest shares of hotspots are Lombardy (81.6%), Campania (59.3%) and Veneto (59.2%).

Figure 43 – Share of eutrophic/could become eutrophic monitoring points at NUTS2 level



7. NITRATES ACTION PROGRAMME

The Nitrates Directive mandates the establishment of a code of good agricultural practice that shall be implemented by farmers on a voluntary basis and promoted through training and information for farmers. Action programmes with mandatory requirements for farms should be established and enforced in NVZ or across the entire territory with mandatory measures applicable to all farms in those areas. These requirements primarily focus on implementing good practices for the handling of fertilisers and manure on farms to minimise the risk of nutrient leaching and run-off from fields. Annex II and III of the Directive set the types of measures to be included. The directive leaves wide discretion to Member States to design the measures in line with local circumstances. Compliance with the action programme measures is monitored by public authorities.

The action programmes contain measures concerning fertiliser application (periods when land application of different types of fertilisers is prohibited, land application on steeply sloping ground, prohibition of land application on water-saturated, flooded, frozen or snow-covered ground, the conditions for land application of fertiliser near water courses, balanced fertilisation and the amount of livestock manure that can be applied to the land), and the capacity of storage vessels for livestock manure. They may also include additional measures in relation to fertilizer planning and record keeping, land use management, including the use of crop rotation systems, minimum vegetation cover during sensitive periods, irrigation systems and other relevant measures complementing the nitrates action programme.

7.1. Measures in the action programme and code of good agricultural practices

The Italian law transposing the Nitrates Directive is the Legislative Decree of 3.04.2006 n. 152, article 92. The Italian Regions are the administrations responsible for implementing the obligations of the Nitrates Directive. The Ministerial Decree of 25.02.2016, no. 5046 is the reference law for the adoption of the action programmes as it sets out the "*General technical criteria and standards for the regional regulation of the agronomic use of livestock effluents and waste-water, as well as for the production and agronomic use of digestate*". Title V of this Decree lays down the national action programme to which all Regions refer when adopting their regional action programmes. Regional action programmes can adapt (tighten or weaken) the national rules to local conditions, provided that a justification is given. The Decree also contains, in Titles I and **II**, further measures to be implemented outside the NVZ, in the so-called Normal Zones. Ministerial Decree 19.04.1999 lays down the Code of Good Agricultural Practice (CGAP) as defined by the Nitrates Directive. The national code may be regionally adapted to regional or local needs, at the discretion of the competent administrations. Farmers apply the CGAP on a voluntary basis.

During reporting period 2020-2023, there were no changes in the national action programme legislation. However, in a number of regions, additional measures and reinforced actions were taken. These changes mainly concerned winter closed periods for fertiliser applications, minimum storage capacity, the agronomic use of digestate, the spreading of slurry and liquid waste, the time period for the incorporation of manure, the

use of organic fertilisers on rainy days, fertilisation near watercourses, fertilisation standards and maximum allowable N fertilisation for crops, sowing of cover crops and the requirement to draw up agricultural usage plans.

A consolidated overview of the action programme currently in force is provided in a separate document ([28]).

7.2. Controls

Controls of (some of) the requirements of the Nitrates Directive were carried out and reported by the regional authorities of Abruzzo, Basilicata, Campania, Emilia-Romagna, Lombardy, Puglia and Veneto. In these regions, the percentage of inspected farms varies between 1.2% (Campania) and 4.2% (Emilia-Romagna), for both administrative checks and on-site controls. Most of the detected cases of non-compliance concern the manure storage capacity (2.0% of non-compliance cases in Emilia-Romagna, 4.2% in Lombardy, 3.1% in Veneto), the appropriate use of fertilisers (2.6% in Emilia-Romagna, 2.5% in Veneto), issues with the fertilisation register or fertiliser plan (2.6% in Emilia-Romagna), the organic N limit of 170 kg N/ha (0.4% in Emilia-Romagna, 11.2% in Lombardy, 0.3% in Veneto) and the control of irrigation (7.1% in Veneto).

For the regions Friuli Venezia Giulia, Lazio, Liguria, Marche, Piemonte, Sardegna, Sicilia, Toscana, Trentino-Alto-Adige, Umbria and Valle d'Aosta, no information was found on the number and results of inspections.

Neither the national report nor the regional reports provide further information on the main difficulties encountered in implementing the measures.

([28]) https://environment.ec.europa.eu/publications/summaries-national-nitrates-action-programmes_en

8. WATER QUALITY OUTLOOK

For the forecast of water quality, the Italian authorities refer to each of the assessments contained in the management plans of the river basin districts under the WFD. The Italian report does not elaborate on a forecast of nitrate concentrations under the Nitrates Directive. Only the Piedmont region has assessed nitrate trends in groundwater, although other four regions have conducted forecast on water body quality.

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