MEDIA BRIEFING

Europe: Nitrate in drinking water

How agricultural pollution and outdated standards threaten public health

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An international expert group, commissioned by the Danish Ministry of Environment, has recently concluded that **the current limit of nitrate in drinking water, set at 50mg/L NO_3 in EU and World Health Organization (WHO) guidelines, is insufficient to protect public health and recommends lowering it to 6 mg/L NO_3 (1.35 NO_3-N) to minimize the risk of colorectal cancer[1].**

This recommendation comes in response to an assessment by the National Food Institute of Denmark, which concluded that exposure to nitrate in drinking water is positively associated with an increased risk of colorectal cancer[2]. Building on this assessment, existing large population cohort studies, and a review of scientific literature published after 2024, the expert group determined that a more protective value is justified as a precautionary public health measure.

Against this backdrop, it is essential to address the systemic roots of nitrate pollution. In Europe, intensive agriculture, particularly livestock production, is the main cause of nitrate pollution in groundwater[3]. Communities in rural areas that rely on smaller, less transparent local water systems, such as wells, are particularly at risk. These systems receive less long-term investment and are at greater risk of sustained exposure over time.[4]

[1] Halldorsson, T. I. et al (2025). *Evaluation of the parametric value for Nitrate in drinking water.* Report delivered to the Ministry of Environment and Gender Equality of Denmark on November 24, 2025. (Link)
[2] *ibid.*
[3] European Environment Agency. (2025). Nitrate in groundwater in Europe (Link); Westhoek H. et al (2015). Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment. *European Nitrogen Assessment Special Report on Nitrogen and Food*. Centre for Ecology & Hydrology, Edinburgh, UK. (Link)
[4] World Health Organization. (2024). Guidelines for drinking-water quality: Small water supplies. World Health Organization. (Link)

Key points

- **Outdated safety standards:** Current drinking water limits for nitrate (50 mg/L NO_3) are set to prevent 'Blue Baby Syndrome'[5] and pre-date emerging evidence linking lower levels to colorectal cancer.
- **Scientific consensus shift:** An international expert group commissioned by the Danish government recently recommended lowering nitrate limits to 6 mg/L NO_3 to protect against colorectal cancer - nearly ten times lower than current standards in most countries and the EU.
- **Agriculture as the source:** According to the EEA, mineral fertilisers and manure are the main sources of nitrate concentrations in EU groundwaters and an estimated 80% of the nitrogen discharge to the EU aquatic environment stems from agriculture.[6]
- **Structural inequality:** Rural water supplies are significantly more vulnerable to nitrate contamination than large urban systems, often serving the communities closest to intensive agricultural sites.[7]
- **Economic burden:** According to experts, health-related costs from nitrate-linked colorectal cancer in Denmark are estimated at $317 million (€272 million) annually.[8] Contamination also increases the cost of water treatment, which is potentially passed through to consumers[9]. Across Europe, the wider annual environmental and health costs related to reactive nitrogen pollution (including nitrates, ammonia and nitrogen oxides) were estimated in 2011 to be between 70-320€ billion, with around 60% of these costs linked to impacts on human health.[10]
- **Expanded health risks:** New research also links nitrate in drinking water to other types of cancer, pregnancy loss, preterm birth, birth defects, and thyroid disruption at levels well below current regulatory limits.[11]

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[5] World Health Organisation. (2022). Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda. Geneva. (Link)

[6] European Environment Agency. (2024). *Nitrate in groundwater in Europe*. (Link); EU Commission. (2025). REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC) Third river basin management plans Second flood risk management plans. (Link)

[7] Andries, D. M. et al (2025). Addressing drivers and data gaps in Spain's non-compliance of drinking water quality standards. *Science of The Total Environment*, 963, 178412. (Link); World Health Organization. (2024). *Guidelines for drinking-water quality: Small water supplies*. World Health Organization. (Link)

[8] Jacobsen, B. et al (2024). *Health-economic valuation of lowering nitrate standards in drinking water related to colorectal cancer in Denmark. Science of The Total Environment*, 906, 167368. (Link)

[9] Cullmann, A. et al (2024). External costs of water pollution in the drinking water supply sector. *American Journal of Agricultural Economics*, *107*(2), 504–531. (Link)

[10] Brink, C. & van Grinsven, H. (2011). Costs and benefits of nitrogen in the environment. In: Sutton, M. et al (2011). *European Nitrogen Assessment* (ENA). Cambridge University Press. (Link)

[11] Lin, L. et al (2023). Nitrate contamination in drinking water and adverse reproductive and birth outcomes: a systematic review and meta-analysis. *Scientific Reports*. 13. (Link)

For more information, see the “Further Reading” section below.

What are the issues with current nitrate standards?

There is a significant gap between current regulations and the latest health science research. Many governments continue to rely on nitrate limits designed over 50 years ago.

The World Health Organisation last performed a review of the science on drinking water nitrate in 2016.[12] Since that time, a number of peer-reviewed studies have been released, connecting nitrate in drinking water to health risks at much lower levels than the current 50mg/L limit.[13]

Researchers in Denmark attribute 127 annual bowel cancer cases to nitrate exposure in drinking water, and stress that nitrate concentrations in groundwater, which is the sole source of drinking water in Denmark, correlate with nitrogen surpluses from agriculture[14]. Researchers in Aotearoa New Zealand conclude that 100 colorectal cancer cases and 41 deaths per year could be attributed to drinking water nitrate, with earlier studies identifying intensive dairy farming as the main source of nitrate pollution in the country’s water sources.[15]

The "canary" pollutant and climate change

Environmental scientists refer to nitrate as a "proxy" or "canary" pollutant as it moves easily through soil into groundwater.[16] So high nitrate levels are a good indicator that other contaminants, such as pesticides and pathogens, may also be reaching the water supply.

Furthermore, the climate crisis is aggravating this issue. Droughts and water scarcity lead to the over-extraction of aquifers, which can concentrate existing nitrate pollution and increase the health risk to those relying on groundwater for drinking.

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[12] World Health Organization. (2016). Nitrate and nitrite in drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality. (Link); World Health Organization. (2022); Nitrate and nitrite in drinking-water. World Health Organization. (Link)
[13] Vilsbøll, C. (2025). Nitrat i drikkevandet kan give dig tarmkræft: Ekspertgruppe vil have grænseværdi sænket markant. DR Nyheder. (Link)
[14] Jacobsen, B. et al (2024). Health-economic valuation of lowering nitrate standards in drinking water related to colorectal cancer in Denmark. *Science of The Total Environment,* 906, 167368. (Link)
[15] Richards, J. et al. (2022). Nitrate contamination in drinking water and colorectal cancer: Exposure assessment and estimated health burden in New Zealand. *Environmental Research*, 204, 112322. (Link)
[16] Viana et al. (2025). Nitrate as a proxy for agricultural groundwater contamination: Leaching mechanisms and legacy effects. *Science of The Total Environment*, *958*, 174212. (Link)

Nitrate pollution in Europe's waters: a snapshot

Groundwater provides around 65% of the drinking water in the EU[17]. Austria, Denmark and Lithuania source nearly 100% of their drinking water from groundwater, followed by Italy, Hungary and Germany[18]. At the same time, nitrates are the predominant groundwater pollutant throughout the EU[19].

According to the latest Nitrates Directive synthesis report (2016-2019) 14.1% of all groundwater monitoring stations across the EU exceeded the legal limit of 50 mg/L[20]. Average nitrate concentrations have remained stable at around 21 mg/L from 2000 to 2022, suggesting that while the Directive has delivered some improvements, progress in reducing nitrate pollution has largely stalled in recent decades[21].

In the absence of the 2020-2023 synthesis report (expected mid-2026), the most recent consolidated picture comes from Eurostat and EEA assessments. The available data show that nitrate pollution in groundwater bodies remains widespread across the European Union.

According to Eurostat[22], the countries with the highest average nitrate concentrations in groundwater in 2023 were Spain (32 mg/L), Belgium (30 mg/L), Bulgaria (29 mg/L), Denmark (24 mg/L) and Germany (22 mg/L). At the same time, data gaps are quite common, with no data for the entire 2007-2023 period for several Member States (Greece, Croatia, Luxembourg, Hungary and Malta).

Overall, average nitrate concentrations in groundwater have shown a steady, yet slow decrease[23]. However, this trend masks variations that are worthy to be mentioned. In some countries, concentrations have steadily increased throughout the entire period, like Bulgaria and Romania, with an increase of 22.4% and 14% respectively. Others are showing signs of reversal after early improvements, such as Slovenia (+7.3% since 2016), Denmark (+7.2% since 2011, after reaching a low point), and France (+5.7% since 2018).

In the absence of a consolidated EU wide assessment, some national monitoring data provide a snapshot of the most recent evidence available, drawing on country level

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[17] European Environmental Agency. (2022). Europe's Groundwater - a key resource under pressure. (Link)
[18] European Commission. (2024). Drinking Water Quality Synthesis Report 2017 - 2019. (Link)
[19] EurEau. (2025). Change to nitrate rules threatens Europe's water quality. (Link); EU Commission. (2025). REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC) Third river basin management plans Second flood risk management plans. (Link); European Environment Agency. (2024). Nitrate in groundwater in Europe. (Link)
[20] European Environmental Agency. (2025). Nitrate in Groundwater in Europe. (Link)
[21] European Environmental Agency. (2022). Zero Pollution Monitoring and Outlook 2025. (Link)
[22] Eurostat. (2026). Nitrates in groundwater. (Link)
[23] ibid

datasets. While a more systematic analysis would be needed for a complete picture across the Union, these data highlight the scale and uneven distribution of nitrate pollution.

In France, around 12% of groundwater monitoring stations exceeded in 2023 the limit of 50 mg/L, while only around one in five are below the 6 mg/L threshold[24]. Significantly higher concentrations are recorded in northern regions such as Loire-Brittany, Seine-Normandy and Artois-Picardy, where around 24% of shallow groundwater exceeded 40mg/L, compared to 8% in the south[25]. In Italy, overall data from 2020 to 2023 show that 11.7% of monitoring stations exceeded 50 mg/L during that period[26]. In Germany, the reporting of 2024 shows that 15.7% of monitoring stations were above 50 mg/L, with significantly higher exceedance rates (25.6%) in monitoring stations located in agricultural areas[27].

Taken together, these trends indicate that progress remains uneven and fragile. Despite some improvements, the European Environment Agency points out that the EU is highly unlikely to meet its 2030 target of reducing nutrient losses (especially nitrogen and phosphorus) by 50%, as set out under the Zero Pollution Action Plan, the Biodiversity Strategy and the Farm to Fork Strategy[28].

On paper, Europe's drinking water appears almost universally compliant. Under the Drinking Water Directive, nitrate compliance in Large Water Supply Zones reached 99.7% in 2019, meaning only 1 in 300 large systems failed to meet the 50mg/L standard[29]. However, the picture is different for Small Water Supply Zones, where compliance rates, when reported, are closer to 95%, meaning around 1 in 20 small systems exceed the nitrate limit.[30] This gap matters because small systems service around 45 million people in the EU and are typically located in rural and agricultural areas[31], where groundwater nitrate pressure is usually highest. While this estimate is based on older data, it still illustrates the scale of reliance on these systems. Moreover, these systems rely on untreated springs of shallow wells, have less frequent monitoring, and operate with more limited technical and financial capacity, making them more vulnerable to contamination and less able to address pollution through treatment or blending[32].

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[24] République française. (2024). Résultats des mesures à la station de la 8ème campagne Nitrates 2022-2023 dans les eaux de surface et dans les eaux souterraines. (Link)
[25] République française. (2026). La pollution de l'eau par les nitrates. (Link)
[26] ISPRA. Nitrates in Groundwater. (Link)
[27] Umweltbundesamt. (2026). Grundwasserbeschaffenheit. (Link)
[28] European Environment Agency. (2025). *Monitoring report on progress towards the 8th EAP objectives 2025*. (Link)
[29] European Commission. (2024). *Drinking Water Quality Synthesis Report 2017 - 2019*. (Link)
[30] United Nations Economic Commission for Europe and World Health Organization. (2011). Small-scale water supplies in the pan-European region. (Link)
[31] United Nations Economic Commission for Europe and World Health Organization (*ibid*)
[32] World Health Organization. 2024. *Guidelines for drinking-water quality*. (Link); United Nations Economic Commission for Europe and World Health Organization (*ibid*)

The risk of livestock expansion and deregulation

In Europe, livestock production accounts for about 81% of the agricultural nitrogen entering aquatic ecosystems, according to estimates from the European Nitrogen Assessment[33]. They further estimate that cattle production (beef and dairy) is responsible for the largest share of overall nitrogen losses, followed by pigs.

Across the EU, livestock production has become increasingly concentrated in fewer and larger farms, intensifying environmental pressures in already heavily impacted regions. Eurostat data[34] show that very large farms (standard output above €100,000)[35] held more than 80% of all livestock units in the EU in 2020, up from around 65% in 2010. At the regional level, the largest absolute numbers of livestock units on very large farms are found in Brittany (France), Catalonia (Spain), Pays de la Loire (France), Weser-Ems (Germany) and Lombardy (Italy).

It is also worth noting that, even if they do not rank among the regions with the largest absolute numbers, some regions play an outsized role for very large farms within their national livestock sectors[36]. In Flanders (Belgium), Syddanmark and Midtjylland (Denmark), and Noord-Brabant (Netherlands), 35%, 33%, 34% and 29% respectively of their countries' livestock units on very large farms are located in these regions, highlighting the strong territorial concentration of intensive livestock production.

Another essential aspect relates to the stocking density of animals[37]. The higher the livestock density value per hectare of land, the higher the number of animals raised, the higher the amount of nitrogen loaded on soils and waters. The member state with the highest concentration of animals is the Netherlands, with a density of 3.4 LSU per hectare, followed by Malta with 3.3 LSU/ha and Belgium with 2.7 LSU/ha. At regional level animal density varies significantly, with the highest livestock densities being located in south and central Netherlands (Nord-Brabant with 7.4 LSU/ha, and Limburg

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[33] Westhoek, H. et al. (2015). Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment. *European Nitrogen Assessment Special Report on Nitrogen and Food.* Centre for Ecology & Hydrology, Edinburgh, UK. (Link); EU Commission. Nitrates (Link)

[34] Eurostat. (2026). Main livestock indicators by NUTS 2 region, 2005-2023. (Link)

[35] One of the ways farms are classified is by economic size. In the EU this is done through their standard output – the average monetary value of the agricultural output at the farm gate per hectare or per head of livestock. Summing all the standard output per head of livestock in a farm is a measure of its economic size. Very small farms have standard annual output of less than €2,000, small farms have €2,000-€8,000, medium sized €8,000-€25,000, large €25,000-€100,000 and very large farms over €100,000 (Greenpeace, 2019)

[36] Eurostat. (2026). Main livestock indicators by NUTS 2 region, 2005-2023. (Link)

[37] Eurostat. (2023). Agri-environmental indicator - livestock patterns (Link)

with 6.7 LSU/ha), north Belgium (West-Vlaanderen with 6.2 LSU/ha, and Antwerpen with 6.1 LSU/ha) and west Germany (Münster with 3.4 LSU/ha).

Investigative mapping further illustrates the concentration trend that livestock farms have been subject to, particularly in the case of granivores. A cross-border journalistic investigation[38] identified 24,087 industrial pig and poultry units operating across Europe, and records show that at least 2,949 new industrial-scale farms began operating between 2014 and 2023. This is likely to be a significant underestimate, as many Member States do not systematically collect or disclose this information.

More broadly, concerns are growing that livestock expansion may continue in regions already facing significant environmental pressures, particularly where governments are considering loosening environmental safeguards in the name of regulatory simplification. In Aotearoa New Zealand for example, according to the Public Health Communication Centre, the government is weakening freshwater protection standards, enabling tens of thousands more dairy cows after several years of leveling off.[39] Similarly in Europe, a recent amendment[40] of the Nitrates Directive, allows the use of so-called "RENURE" fertilisers (recycled manure products) above the established limit of 170 kg of nitrogen per hectare. Presented as a measure to reduce reliance on synthetic fertilisers, the decision has been criticised[41] for weakening existing safeguards at a time when many Member States are failing to reduce nitrate pollution.

At the same time, regulatory gaps leave key parts of the sector insufficiently controlled. For example, in the European Union, intensive cattle farms remain excluded from the scope of the Industrial Emissions Directive, leaving one of the most polluting segments of livestock production outside a key regulatory framework for industrial agriculture[42].

This push for deregulation is often driven or supported by powerful industrial agriculture lobby groups that frequently have disproportionate access to decision-makers[43]. In some cases political influence is even more direct. Several

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[38] Prandi, S. et al (2024). The face of European farming. AGtivist.agency. (Link)
[39] Prickett, M. et al. (2025). Government cannot achieve "enduring freshwater policy" by siding with narrow commercial interests. Public Health Communication Centre Aotearoa. (Link)
[40] EU Commission. (2026). COMMISSION DIRECTIVE (EU) of 9.2.2026 amending Council Directive 91/676/EEC as regards the use of certain fertilising materials from livestock manure. (Link)
[41] EEB. (2025). Letter to Commissioner Jessika Roswall RE: RE: The Commission's initiative to amend the Nitrates Directive as regards the use of certain fertilising materials from livestock manure. (Link)
[42] Greenpeace EU Unit. (2023). EU gives factory farms a free pass to pollute (Link)
[43] Appelbe, W. (2025). 'Milking it: how the intensive dairy industry rewrote freshwater rules in their favour', Greenpeace Aotearoa (Link); Carlile, C. (2023, October 4). Revealed: Meetings blitz between Big Ag and anti-green lawmakers in Europe. *DeSmog* (Link)

landowners and farmers sit in the European Parliament and have a direct role in the EU's agricultural policy, including the Common Agricultural Policy[44].

Community resistance to industrial livestock expansion

As industrial livestock farming expands and becomes increasingly concentrated, we are witnessing impacted communities across Europe mobilising to stop new projects.

Resistance takes many forms and can start at different moments of the project. In some cases, communities organise for many years to prevent a project from even taking off the ground, as seen in San Clemente, Spain[45]. In other situations, projects already built are challenged on legal grounds, such as in Landunvez, France[46], or when developers try to restructure the project to bypass environmental measures, as has happened in the Sisak-Moslavina County in Croatia[47].

Beyond the local level, an increasing number of ties are being developed between the struggles, with the emergence of multiple national or international networks against industrial farming. Some examples include the RAFU national platform[48] (France), the Spanish Stop Ganaderia Industrial platform[49], the Landsforeningen mod svinefabrikker platform[50] in Denmark, and the Stop Factory Farming European platform[51].

Arguments brought forward against industrial animal farms are often a combination of different factors, including access to clean and safe drinking water and air, odour and noise, declining quality of life, lack of transparent, inclusive and accountable decision making, pressure on local infrastructure (like roads and water treatment plants), as well as the cumulative strain on already stressed groundwater sources.

What do we need to do about nitrate?

- **Update health limits in line with science:** Governments must immediately review and lower nitrate limits in drinking water to reflect modern cancer and reproductive health research, applying a precautionary approach.

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[44] Greenpeace European Unit. (2018, May 24). Out of balance: Industry links in the European Parliament AGRI committee (link).
[45] Public.es (2025) Una nueva macrogranja para un millón de gallinas planea sobre San Clemente en pleno repunte de la gripe aviar (Link)
[46] Greenpeace France. (2026). Extension de la méga-porcherie Avel Vor (29) : malgré son illégalité, l'exploitant obtient un nouveau délai de régularisation. (Link)
[47] Stop Factory Farming Europe. (2026). *"Chicken eco-bomb": Protest against the destruction of a county* (Link)
[48] Résistances aux Fermes-Usines (Link)
[49] Stop Ganaderia Industrial (Link)
[50] Landsforeningen mod svinefabrikker (Link)
[51] Stop Factory Farming (Link)

- **Stop pollution at its source:** Reducing nitrate pollution requires decisive action on its main sources, namely excessive fertiliser and manure use. This means ending the expansion of industrial animal farming, reducing the number of animals raised, particularly in high concentration areas, and significantly cutting the use of synthetic nitrogen fertilisers.
- **Fund the necessary transition in the animal farming sector:** Public funds, notably from the Common Agricultural Policy (CAP), must be used to support the extensification of the livestock sector, targeting as a priority the areas with high concentration of animals, whose numbers exceed the environmental capacity of the receiving environments, particularly in terms of nutrients overload.
- **Incentivise ecological farming & sustainable diets:** In addition to diverting public funds away from intensive livestock production systems, including monocultures of cereals for feed, government policies must also encourage ecological farming practices that do not rely on chemical inputs. Governments must support healthier diets with lower meat and dairy consumption and higher intake of fruits, vegetables and pulses, which will further reduce nitrogen pollution while improving resilience, food security and public health.
- **Ensure the full implementation and enforcement of existing environmental rules:** Essential elements of the EU environmental acquis, such as the Nitrates Directive, must be fully implemented. This means properly applying limits on manure and fertiliser use, verifying compliance through monitoring and inspections and extending actions to areas where water pollution persists. Those responsible for pollution must be held accountable, in line with the polluter pays principle.
- **Ensure comprehensive and transparent monitoring:** Reporting of nitrate levels must be mandatory and transparent for all water supplies, regardless of size, to eliminate data gaps that hide the scale of exposure. Monitoring systems must be properly funded (supported through polluter-pays mechanisms) so that the cost of tracking pollution does not fall solely on water utilities or consumers.

Comments from Greenpeace spokespeople

Global Project Lead for Agriculture, Amanda Larsson:
"Water should be life-giving, not life-threatening. For too long, agribusiness executives have treated our water as their private sewer while reaping record profits. This isn't just an environmental issue; it’s a matter of basic fairness. With mounting scientific evidence of the health risks from nitrate, it’s time for Governments to end livestock expansion and phase out chemical fertilisers to ensure that 'safe and clean' water isn't a luxury, but a guarantee.”

EU Project Lead for Agriculture, Alkis Kafetzis, Greenpeace Greece:
"Europe has a robust framework of water protection rules, yet they are undermined by weak implementation and political pressure to deregulate industrial farming. The consequence is that communities closest to intensive livestock production face the highest risks of nitrate pollution in their drinking water. Protecting public health means enforcing existing rules, updating standards following scientific evidence and supporting farmers in moving away from highly concentrated livestock systems. A transition towards farming that protects water, supports vibrant rural communities and strengthens the resilience of Europe's food system is in everyone's interest."

Key scientific findings

The following provides an overview of current scientific literature on the health impacts of nitrates. The consensus is still emerging, requiring long-term, group-specific and localised studies. The three Danish studies that informed the expert group's recommendation are summarised below, while additional relevant studies are listed for further reading.

Colon and colorectal cancer: A 2024 case study of Denmark[52] confirms epidemiological evidence linking nitrate exposure in drinking water to increased colorectal cancer risk. Total annual health-related costs from nitrate-related colorectal cancer reportedly amounts to $317 million (€272 million) per year in Denmark, including healthcare expenses, lost productivity, lost life years, societal and indirect costs. The study identifies mitigation strategies such as reducing the amount of agricultural runoff (fertilisers leaching into the soil), among other measures.

- The study found that lowering the nitrate limit in drinking water to 9.25 mg/L would prevent about 72 colorectal cancer cases per year. A limit of 3.87 mg/L would prevent another 55 cases per year (127 in total).
- In terms of health costs, the study found that a limit of 9.25 mg/L would save $179 million (€153 million) per year, and lowering to 3.87 mg/L would save an additional $138 million (€118 million).
- According to the report, economic gains exceed costs of reducing nitrate. Net economic gains are estimated to be $170 million (€145 million) per year at 9.25 mg/L and about $302 million (€259 million) per year at 3.87 mg/L.

In a 2018 case study of Denmark[53], researchers tracked 2.7 million individuals over several decades (1978–2011). They discovered that the risk of colorectal cancer increased significantly at nitrate levels as low as 3.87 mg/L — less than one-tenth of the current 'safe' limit of 50 mg/L. Those in the highest exposure group (consuming

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[52]Jacobsen, B. et al (2024). Health-economic valuation of lowering nitrate standards in drinking water related to colorectal cancer in Denmark. Science of The Total Environment, 906, 167368. (Link)
[53] Schullehner, J. et al (2018). *Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study.* International Journal of Cancer, 143(1), 73–79. (Link)

water with more than 16.7 mg/L of nitrate) were 16% more likely to develop colorectal cancer than those in the lowest exposure group (consuming water with less than 0.69 mg/L of nitrate). The study revealed a clear 'staircase' effect: as nitrate concentration in drinking water increased, so did the risk of cancer. This linear relationship provides strong evidence that nitrate itself is the likely cause. The study also found that the increased risk was consistent for both colon and rectal cancers. As the researchers had tracked residential history and water quality for over 30 years, they could demonstrate that it is chronic, long-term exposure to these low levels that drives the cancer risk rather than short-term spikes.

Another Danish study, based on 27 years of data and more than 2,200 colorectal cancer cases[54], found no link between nitrate or nitrite intake from food sources and cancer risk. However, higher nitrate intake from drinking water was associated with an increased risk of colon cancer. In particular, nitrate concentrations in tap water above around 9 mg/L were linked to higher cancer rates compared to very low levels. The association was stronger among individuals with known risk factors such as smoking and high red meat consumption.

Further reading:

Chambers, T., Douwes, J., Mannetje, A., Woodward, A., Baker, M., Wilson, N., & Hales, S. (2022). Nitrate in drinking water and cancer risk: the biological mechanism, epidemiological evidence and future research. Australian and New Zealand Journal of Public Health, 46(2), 105–108. https://doi.org/10.1111/1753-6405.13222

Ebdrup, N. H., Schullehner, J., Knudsen, U. B., Gissler, M., Ramlau-Hansen, C. H., & Stayner, L. T. (2022). Drinking water nitrate and risk of pregnancy loss: a nationwide cohort study. Environmental Health, 21(1), 87. https://doi.org/10.1186/s12940-022-00898-w

Espejo-Herrera, N., Gràcia-Lavedan, E., Boldo, E., Aragonés, N., Pérez-Gómez, B., Pollán, M., Molina, A. J., et al. (2016). Colorectal cancer risk and nitrate exposure through drinking water and diet. International Journal of Cancer, 139(2), 334–346. https://doi.org/10.1002/ijc.30083

Essien, E. E., Abasse, K. S., Côté, A., Mohamed, K. S., Baig, M. M. F. A., Habib, M., Naveed, M., Yu, X., Xie, W., Jinfang, S., & Abbas, M. (2022). Drinking water nitrate and cancer risk: A systematic review and meta-analysis. Archives of Environmental & Occupational Health, 77(1), 51–67. https://doi.org/10.1080/19338244.2020.1842313

García Torres, E., Pérez Morales, R., González Zamora, A., Ríos Sánchez, E., Olivas Calderón, E. H., Alba Romero, J. de J., & Calleros Rincón, E. Y. (2022). Consumption of water contaminated by nitrate and its deleterious effects on the human thyroid gland: a review and update. International Journal of Environmental Health Research, 32(5), 984–1001. https://doi.org/10.1080/09603123.2020.1825501

[54] Erichsen, D. W. et al. (2025). Source-specific nitrate and nitrite intake and association with colorectal cancer in the Danish Diet, Cancer and Health Cohort. Environ Int. 2025 Aug. (Link)

Jacobsen, B. H., Hansen, B., & Schullehner, J. (2024). Health-economic valuation of lowering nitrate standards in drinking water related to colorectal cancer in Denmark. Science of The Total Environment, 906, 167368. https://doi.org/10.1016/j.scitotenv.2023.167368

Lin, L., Clair, S. L. S., Ulyatt, C. M., Corkin, M. T., Lord, L. G., Crowther, C. A., & Harding, J. E. (2023). Nitrate contamination in drinking water and adverse reproductive and birth outcomes: a systematic review and meta-analysis. Scientific Reports, 13(1), 563. https://doi.org/10.1038/s41598-022-27345-x

Picetti, R., Deeney, M., Pastorino, S., Miller, M. R., Shah, A., Leon, D. A., Dangour, A. D., & Green, R. (2022). Nitrate and nitrite contamination in drinking water and cancer risk: A systematic review with meta-analysis. Environmental Research, 210, 112988. https://doi.org/10.1016/j.envres.2022.112988

Richards, J., Chambers, T., Hales, S., Joy, M., Radu, T., Woodward, A., Humphrey, A., Randal, E., & Baker, M. G. (2022). Nitrate contamination in drinking water and colorectal cancer: Exposure assessment and estimated health burden in New Zealand. Environmental Research, 204, 112322. https://doi.org/10.1016/j.envres.2021.112322

Schullehner, J., Hansen, B., Thygesen, M., Pedersen, C. B., & Sigsgaard, T. (2018). Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study. International Journal of Cancer, 143(1), 73–79. https://doi.org/10.1002/ijc.31306

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