NITRATE POLLUTION IN WATER : A EUROPEAN PLAGUE

HOW OVERPRODUCTION OF MEAT AND DAIRY BOOSTS **NITRATE EMISSIONS**

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WHAT ARE NITRATES ?

Nitrate is one of the forms taken by the element nitrogen (N) at **different stages of the nitrogen cycle**: in the form of ammonitrate, it is one of the main fertilisers used for crops. Nitrates are found in water as salts (e.g. potassium nitrate, ammonia nitrate), esters, or nitricacid. Nitrates can be converted to nitrites by bacteria and enzymes in the soil or in thedigestive systems of animals or humans.

EXCESS NITRATES IN WATER ARE MAINLY DUE TO LIVESTOCK FARMING

Excessive levels of nitrates in aquatic environments are mainly due to agriculture, specifically livestock farming. Agriculture has long used natural potassium nitrates such as nitre or saltpetre. However the widespread use of industrial produced fertilisers (based on ammonia) and the expansion of livestock farming has resulted in increased concentrations of nitrate in groundwater. Today these sometimes exceed the threshold considered safe for drinking water.[1]

In Europe, livestock production is responsible for about 81% of agricultural nitrogen in aquatic environments.[2]

Nitrogen (in all its forms) applied to crops as a fertiliser should correspond to the plants' needs. When the nitrogen inputs are higher, the excess nutrients that are not used by the plants, can accumulate in the soil, seep into the groundwater or run off into rivers.

In regions with high levels of livestock farming, fertiliser runoff is compounded with runoff from manure. The resulting surpluses can be very large, with crops and the land losing the ability to absorb all the excess nitrogen from both animals and fertilisers. The link to the soil is lost, and the nitrogen produced by animals is out of balance with what is needed by plants. Today this is the case in several European regions.[3]

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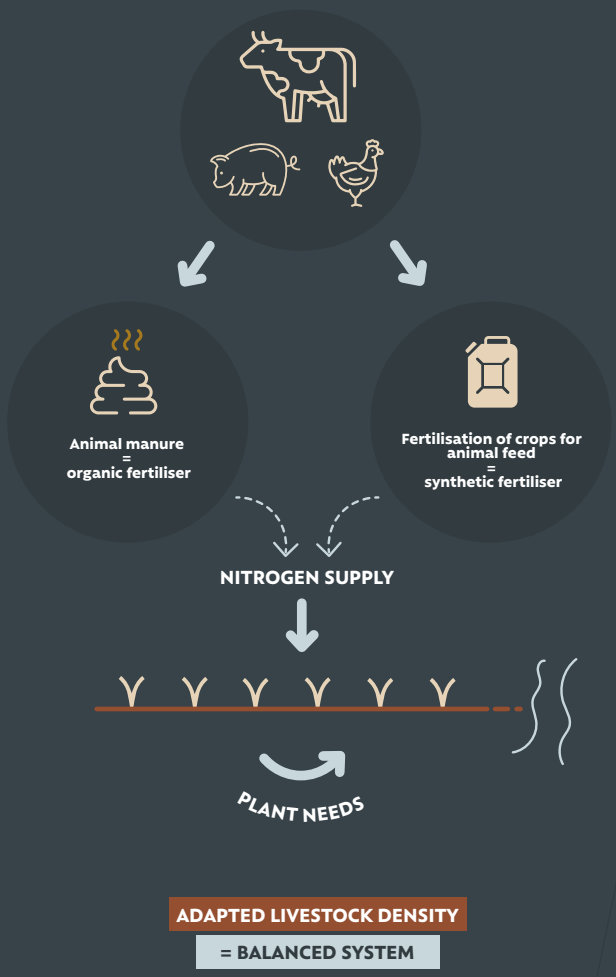
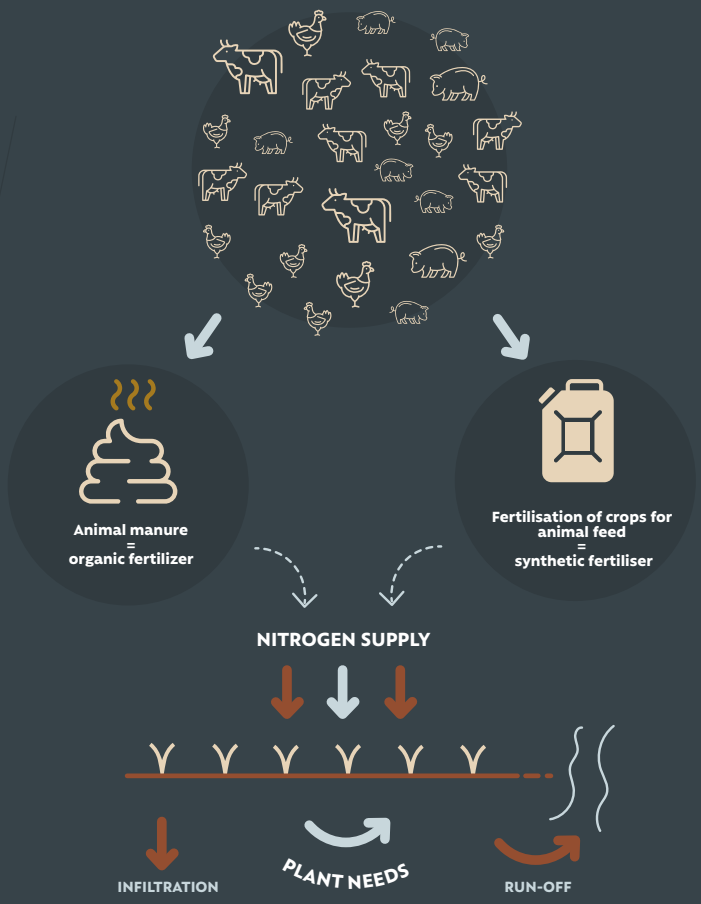
2. https://www.pbl.nl/sites/default/files/downloads/Nitrogen_on_the_Table_Report_WEB_1.pdf
3. C. Roguet et al, 2015. Spécialisation territoriale et concentration des productions animales européennes : état des lieux et facteurs explicatifs. INRA Prod. Anim., 2015, 28 (1), 5-22

ENVIRONMENTAL AND HEALTH IMPACTS OF NITRATE EMISSIONS FROM LIVESTOCK AND ANIMAL PRODUCTS



ADAPTED LIVESTOCK DENSITY

= BALANCED SYSTEM



HIGH STOCKING DENSITY

= EXCESS NITRATES

EXCESS NITRATES, A MAJOR CONTRIBUTOR TO WATER POLLUTION IN EUROPE

The natural biogeochemical cycle of nitrogen is deeply disrupted by human activities and one only has to look at the global scale to see the extent of the problem.[4] Global discharges of nitrogen into the oceans should not exceed a «global limit» estimated at 62 to 82 million tonnes per year.[5] However, they are estimated at more than 150 million tonnes[6] , i.e. twice the global limit. As a result, oxygen-poor or anoxic zones can be found for example in the Baltic Sea, the Laurentian Great Lakes, Chesapeake Bay, the Gulf of Mexico, and many lakes and coastal areas in China. Nitrate is a natural element, but its excessive concentration in water can generate severe impacts on the environment especially on water. For example, the WHO established the threshold for safe drinking water at 50 mg/L. However, many measuring points in Europe exceed this threshold: this is the case for 14% of groundwater in Europe, a figure that is increasing.[7]

In Europe, more than one in seven measuring points exceeds the safe drinking water nitrate threshold of 50 mg/L.

Nitrates contribute to the eutrophication of environments: in rivers, estuaries or coastal waters, excess nutrients encourage the proliferation of plants on the surface. This stimulates the activity of certain bacteria that consume the oxygen dissolved in the water, thus suffocating the other species present in the environment. This phenomenon is the cause of green tides and the colouring of the water in estuaries.

The toxic effects can be felt at very low nitrate concentrations for certain species. For example, the pearl mussel, considered globally endangered, cannot survive in watercontaining more than 5 mg of nitrates per litre.[8] According to the European Commission, the total environmental costs of nitrogen pollution in Europe would amount to €70-320 billion per year, which is much higher than the estimated costs of reducing pollution at the source.[9] For a comparison, the annual budget for the EU's Common Agricultural Policy in 2021 was €56 billion.[10]

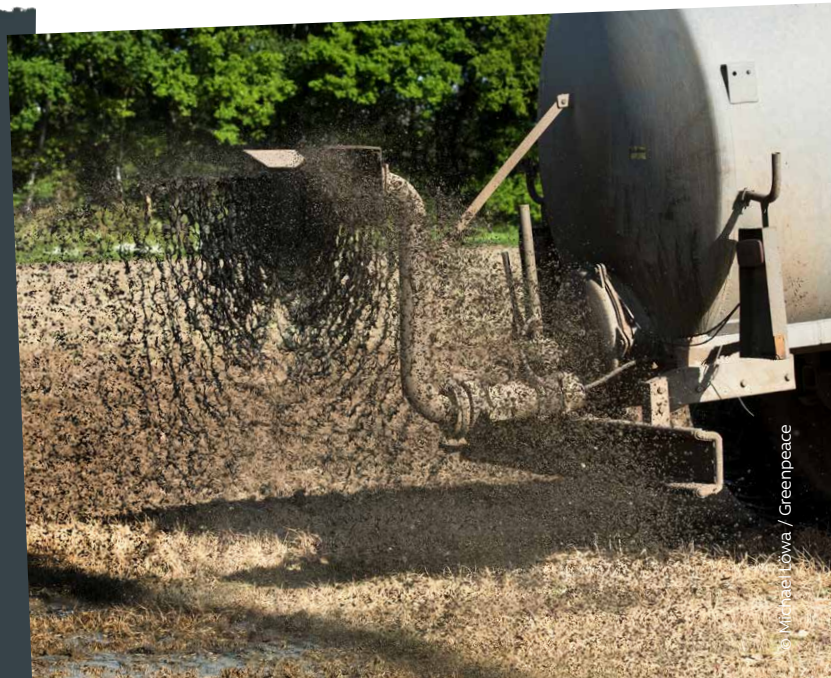
Nitrogen pollution costs the European Union up to €320 billion per year.

The EU's Nitrate Directive[11] aims to reduce water pollution caused by nitrates used for agricultural purposes and to prevent further pollution. It is an integral part of the Water Framework Directive and is closely linked to other EU policies dealing with air quality,climate change and agriculture. It obliges national governments to designate vulnerable zones and to establish mandatory action programmes for these zones, to avoid further water pollution.

4. M. Le Moal et al, 2017. L'eutrophisation : manifestations, causes, conséquences et prédictibilité. Synthèse de l'Expertise scientifique collective, CNRS - Ifremer - INRA - Irstea (France). https://www.inrae.fr/actualites/leutrophisation-mieux-comprendre-mieux-gerer
5. Voir https://www.notre-environnement.gouv.fr/themes/societe/limites-planetaires-ressources/article/perturbation-des-cycles-biogeochimiques-de-l-azote-et-du-phosphore
6. Id.
7. European Environment Agency, 2022. Percentage of groundwater stations in each country exceeding the drinking water standard (50 mg of nitrates per litre) during the last two reporting periods under the Nitrates Directive. https://www.eea.europa.eu/data-and-maps/figures/percentage-of-groundwater-stations-in.
8. Voir https://www.cantal.gouv.fr/la-moule-perliere-a3778.html et https://www.ecologie.gouv.fr/sites/default/files/PNA_Mulette-perliere_2012-2017.pdf
9. European Commission, Cctobre 2021. Questions and answers on Nitrates Directive Imlementation Report https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_5110
10. https://www.europarl.europa.eu/factsheets/en/sheet/106/le-financement-de-la-pac
11. Commission européenne, 2022. Lutter contre la pollution causée par les nitrates agricoles. https://eur-lex.europa.eu/FR/legal-content/summary/fighting-water-pollution-from-agricultural-nitrates.html

Nitrate pollution is also hiding phosphorus pollution

Phosphorus plays as important a role in eutrophication as nitrogen does. As with nitrates, the «global limit» for phosphorus is considered to have been exceeded: the amount applied are out of balance with the needs.[12] Moreover, phosphorus is a «critical» element that is involved in food production and for which there is no possible substitute, even though its resources are finite.



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HEALTH EFFECTS VIA FOOD OR EXPOSURE TO GREEN ALGAE

Excess nitrate in the environment can affect human health directly, through food or water consumption, or indirectly through the ecological problems to which it contributes.

> Through food or water consumption

Nitrates and nitrites are known to cause the formation of nitroso compounds, some of which are carcinogenic and genotoxic to humans. Nitrite can reduces the ability of red blood cells to bind and transport oxygen in the body:[13] this is also known as the «blue baby syndrome» affecting children under six months old.

The association of nitroso compounds with colorectal cancer is well established.[14] Other cancer risks are suspected but without causality being established to date.

According to the WHO, drinking water should not contain more than 50 mg per litre, and it is recommended that pregnant women and infants should not exceed 25 mg: they may be advised against drinking tap water occasionally.[15]

Dietary exposure to nitrites is also associated with an increased risk of type 2 diabetes.[16]

Finally, by reacting with other molecules, nitrites and nitrates can be transformed into nitrosamines, compounds that raise health concerns according to a recent opinion of the European Food Safety Authority (EFSA). [17] Some of these nitrosamines are carcinogenic and genotoxic, and the food group that contributes most to nitrosamine exposure includes meat and meat products.

> Through the toxic effects of green algae and cyanobacteria

Green algae[18] are dangerous due to hydrogen sulphide fumes they emit. There have been several accidents involving humans, pets and wildlife.[19]

Cyanobacteria[20] can proliferate massively and rapidly, sometimes within days, causing a change in the colour of the water (red, green) and a foul smell. They can produce cyanotoxins,[21] which are toxic or even fatal, for instance for dogs. The proliferation of cyanobacteria can lead to bans on fishing and swimming, and local authorities regularly collect green algae on bathing beaches to avoid accidents, sometimes at great cost.

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12. Stephen R Carpenter and Elena M Bennett 2011, Reconsideration of the planetary boundary for phosphorus, Environ. Res. Lett. 6 014009.
13. Fiche Méthémoglobinémie, CEREMA, 2022.
http://wikhydro.developpement-durable.gouv.fr/index.php/M%C3%A9th%C3%A9moglobin%C3%A9mie_(HU)
14. ANSES, 2022. Réduire l'exposition aux nitrites et aux nitrates dans l'alimentation.
https://www.anses.fr/fr/content/réduire-l'exposition-aux-nitrites-et-aux-nitrates-dans-l'alimentation.
15. F Voir https://www.ouest-france.fr/pays-de-la-loire/nort-sur-erdre-44390/l-eau-du-robinet-deconseillee-aux-femmes-enceintes-et-aux-bebes-dans-12-communes-de-loire-atlantique-a9cd1cc8-98a8-11ed-838e-db5cb73079c3
16. INSERM, 2023. L'exposition alimentaire aux nitrites associée à un risque accru de diabète de type 2.
https://presse.inserm.fr/lexposition-alimentaire-aux-nitrites-associee-a-un-risque-accru-de-diabete-de-type-2/66139/
17. https://www.efsa.europa.eu/fr/news/nitrosamines-food-raise-health-concern.
18. Mainly Ulva type
19. Les risques liés aux marées vertes. Agir contre les algues vertes en Bretagne.
https://www.algues-vertes.com/prevenir/les-risques-lies-aux-marees-vertes/
20. Cyanobacteria are sometimes called blue-green algae or blue-green algae, but they are bacteria and notalgae
21. Les cyanobactéries en questions, ANSES, 2020.
https://www.anses.fr/fr/content/les-cyanobact%C3%A9ries-en-questions

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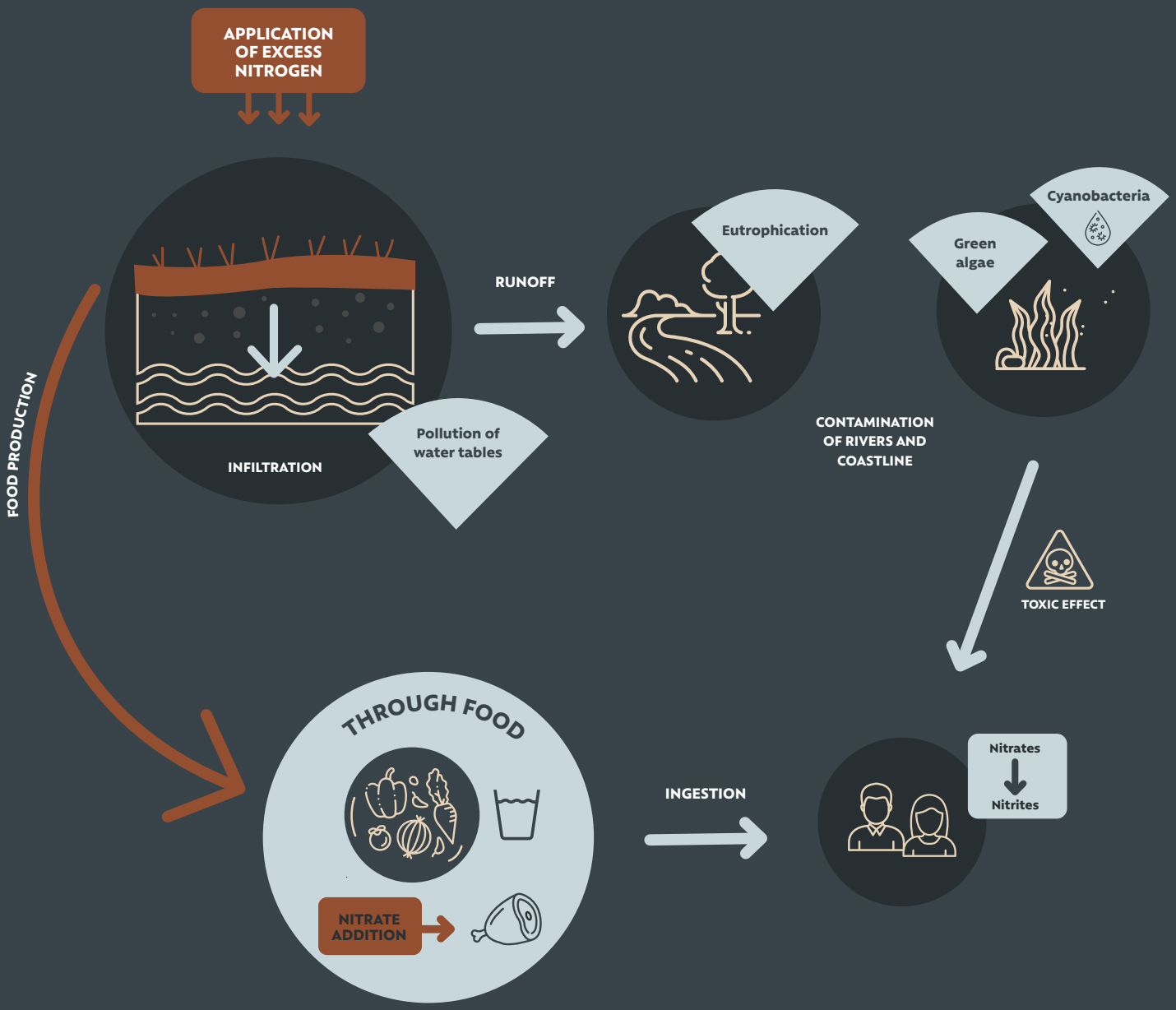

INDUSTRIAL LIVESTOCK FARMING IN THE SPOTLIGHT FOR NORMALISING OVERPRODUCTION OF MEAT AND DAIRY

Nitrate emissions depend on the type of animal (poultry, pigs, cattle, etc.), the type of product (milk, meat, eggs, etc.), to a certain extent the farming system, but above all on the number of animals raised. Thus, although the most intensive livestock farms may have lower emissions per kilo of meat or per litre of milk, the number of animals on these factory farms is so high that their emissions in absolute terms are much higher than those of smaller livestock farms.

The impacts of these nitrate emissions are closely related to local conditions and concentrations. What matters is not so much the amount of nitrates emitted per quantity of meat produced, but the overall emissions in a territory.

There is a clear correlation between the concentration of nitrates in surface waters and the density of livestock – the number of animals in a given area.[22] Although European regulations already exist, they are far from sufficient and the European Commission itself states that «the low-hanging fruit has already been picked and more ambitious measures are now needed to improve this positive trend».[23] In order to limit the most emitting livestock farms on a national scale, Greenpeace calls for a ban on all new factory farms, especially in nitrate-vulnerable zones. This could be done through the European regulation 2010/75/EU on industrial emissions (known as the IED directive) by prohibiting the issuing of new operating permits to livestock factory farms in nitrate vulnerable zones.

22. Heinrich-Böll-Stiftung, 2021. Fertilizers: too much of a good thing
. https://eu.boell.org/en/2021/09/07/fertilizers-too-much-good-thing
23. https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=COM%3A2021%3A1000%3AFIN&qid=1633953687154

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Excess of nitrates is hugely problematic, and this excess is linked to high livestock densities in many European regions. This high livestock density creates an imbalance, in which the land is no longer able to adequately absorb the nitrate-heavy waste the animals produce. Reducing livestock production in the densest regions must therefore be a priority in order to restore the nitrogen cycle that is now broken due to these excessive nitrate levels. This reduction must be accompanied by public support for ecological livestock farming, which works with nature instead of against it.

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