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# The Nitrogen Issue

## Conventional vs Organic Agriculture

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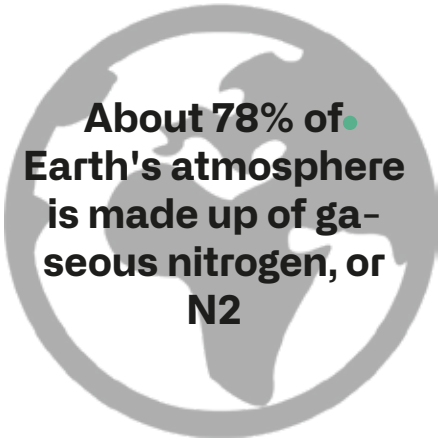
# Introduction [1]

**Nitrogen** is the most important nutrient when it comes to crop production; it is also one of the most difficult to manage. This compound is essential for agriculture worldwide production; but when the **excess of nitrogen** fertilizers filtrates into the environment, it might cause harmful consequences.

## What is Nitrogen?[1]

**Although it makes up a large part of the air we breathe, most living organisms cannot access it in this way.**



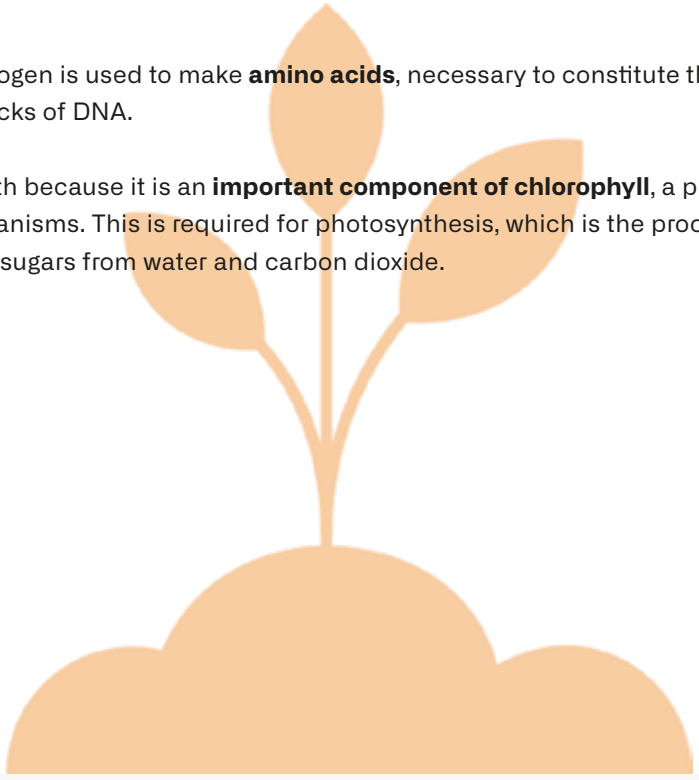


Atmospheric nitrogen must go through a natural process called nitrogen fixation to be transformed before it can be used for plant nutrition.

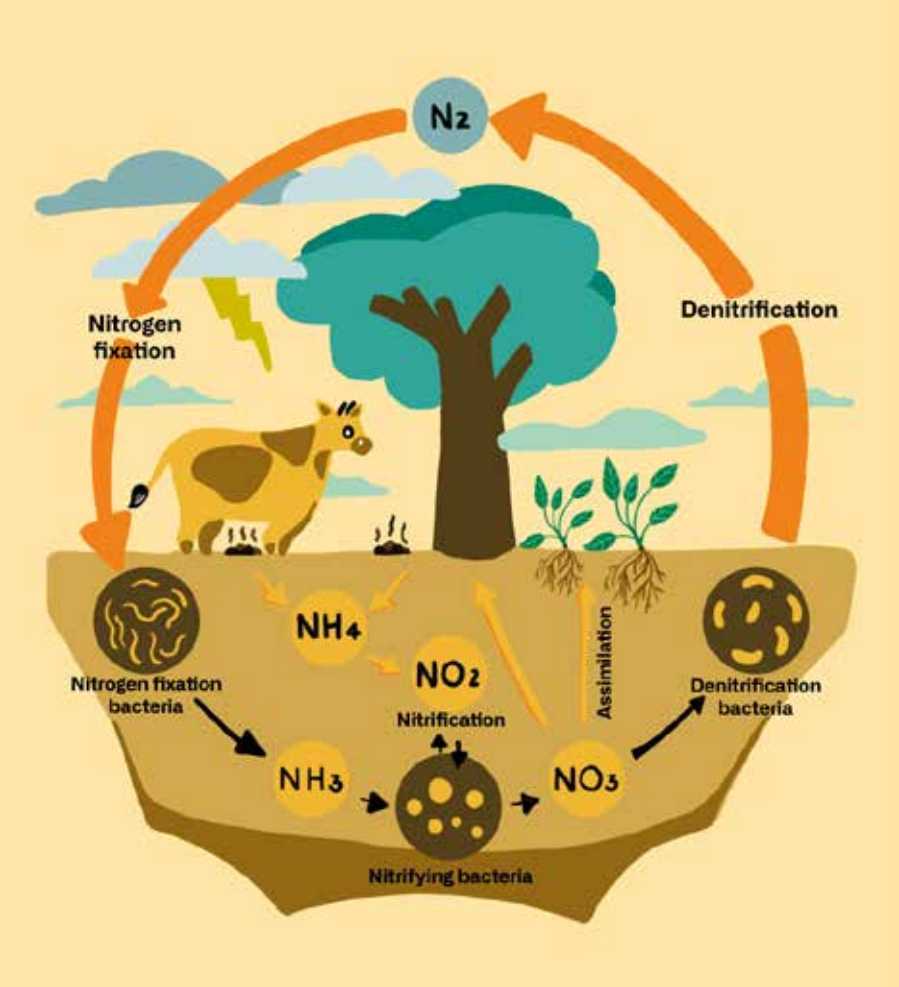
## Why do plants need Nitrogen?[1 2]

In both, plants and humans, Nitrogen is used to make **amino acids**, necessary to constitute the proteins and nucleic acids, which are the building blocks of DNA.

It is also essential for plant growth because it is an **important component of chlorophyll**, a pigment present in all green plants and a few other organisms. This is required for photosynthesis, which is the process by which plants use energy from sunlight to produce sugars from water and carbon dioxide.



# The Nitrogen Cycle [3] [4]




*Graphic made based on:*
*https://www.geeksforgeeks.org/nitrogen-cycle-definition-stages-importance-effects/*

1

The process might be the heat of lightning breaking the triple bonds of atmospheric nitrogen, and releasing its atoms. These combine with oxygen and create nitrous oxide gas, which dissolves in rain as nitric acid and it is absorbed by the soil.

2

There's a biological nitrogen fixation, carried out by a specialized group of prokaryotes in the soil. These include aquatic organisms, such as cyanobacteria, free-living soil bacteria, such as Azotobacter, bacteria that form associative relationships with plants, such as Azospirillum, and most importantly, bacteria, such as Rhizobium and Bradyrhizobium, that form symbioses with legumes and other plants. All of them convert organic matter into ammonium (NH3) and subsequently into nitrate (NO2)

3

So, Nitrogen moves from the atmosphere to land, through soils, and is released back into the atmosphere — converted into its organic and inorganic forms.

# Adding fertilizers into the soil [2 4 5 6]

**For thousands of years, humans didn't have to worry about Nitrogen, but by the early 20th century it was apparent that intensive agriculture was depleting the amount of nitrogen in the soil; with an alarming raise of the world's population, this brought concern about a possible food crisis.**

That's one of the reasons why in today's intensive farming systems, synthetic nitrogen fertilizers have become increasingly important.

The Food and Agriculture Organization of the United Nations (FAO) predicts that demand will continue to rise steadily, especially in Africa and the South of Asia.

**The United Nations Environment Program's (UNEP's) 2018-2019 Frontiers Report called Nitrogen pollution**

**one of the most important pollution issues facing humanity**

Half the world's crops today are grown with the aid of fertilizer made by capturing inert nitrogen from the air.

Earth system
**scientists**
say:

**Nitrogen** is the major factor in biogeochemical pollution, one of four "planetary boundaries" that we have exceeded, risking "irreversible and abrupt environmental change."

**120 million tons**
of **synthetic nitrogen**
are used globally in agriculture each year.

That is twice the amount of nitrogen reaching fields from organic sources such as animal manure, crop waste, and leguminous plants that fix their own nitrogen.

**The nitrogen-use efficiency (NUE)**

**of the world's farmers has slipped from**

# more than 50% in 1961 to about 42% today,

according to Xin Zhang, an environmental scientist at the University of Maryland

The problem with these fertilizers is that they use big amounts of nitrogen in order to be more efficient and optimize the plants growth. But the plants won't absorb all the Nitrogen. A big part will end up into:

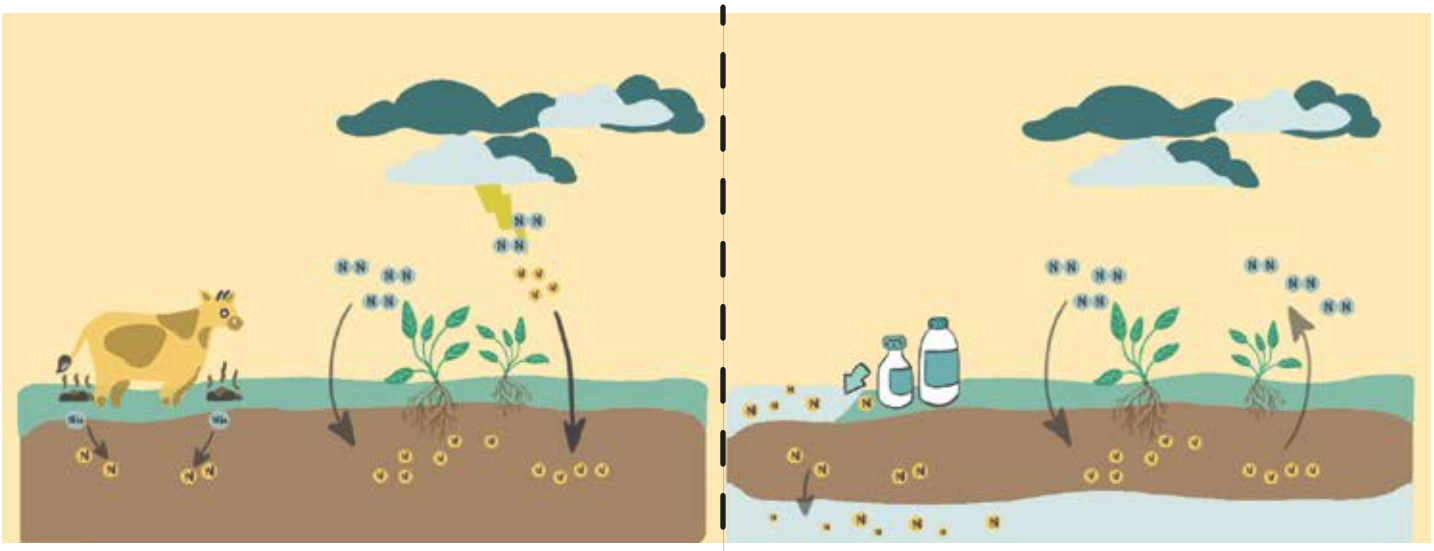
## Groundwater streams

In waterways, the addition of external nutrients (like excess nitrogen) is called eutrophication. This is an unwanted fertilization that promotes the growth of microorganisms, algae, and plants. Their fast growth can use up all the oxygen in the waterways and turn them into so-called dead zones, as aquatic animals cannot live without oxygen. This can also lead to the growth of algal species that produce toxic chemicals, called harmful algal blooms

## Back into the atmosphere

This contributes to global warming. Some soil microorganisms can transform nitrogen provided in fertilizers into nitrogen-containing gases, which get released into the atmosphere like the greenhouse gas nitrous oxide ($N_2O$)

**Nutrient pollution is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer, causing excessive growth of algae.**



## NATURAL

Natural environment with Nitrogen inputs from natural sources

## ARTIFICIAL

Environment with extra Nitrogen from fertilizers polluting water streams and atmosphere

## Unused Nitrogen is **300 times greater** than CO2

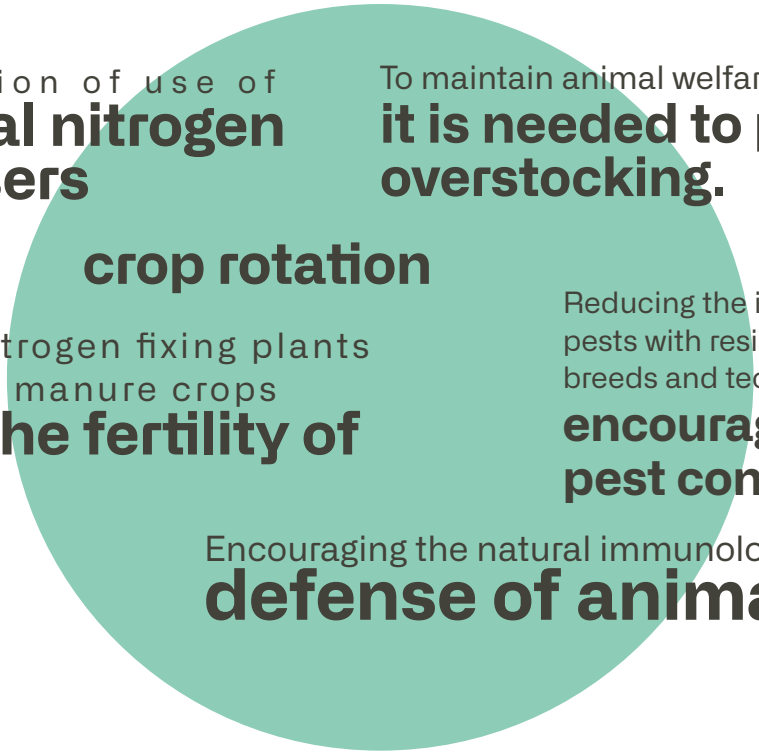
While we need nitrogen from fertilizers in our agricultural soils, **we do not want additional nitrogen** in our atmosphere or waterways. This means we have to balance the positive benefits of nitrogen fertilization (more food) with the negative consequences of excess fertilizer (environmental problems). Scientists are currently working to find this balance to improve our current situation, as the unused Nitrogen is **300 times greater** than the most commonly mentioned greenhouse gas, **carbon dioxide** (**CO2**).

**These effects are felt in the UK too, only 16% of rivers, lakes and seas in England are considered close to their natural state - largely as a result of nitrogen and phosphorous surplus.**

# Nitrogen and Organic Agriculture [7 8 9]

## How does Organic Agriculture help with this?

Organic farmers, like any others, need to provide **enough nitrogen** (**N**) **for crops**. But unlike conventional farmers, organic farmers rarely rely primarily on bagged N fertilizers. That would be costly and inconsistent with the organic approach to soil fertility, which emphasizes **rotation** with leguminous cover crops and application of **compost** or manure.




## How is the Nitrogen Regulation in Organic Agriculture?

Producing organically means respecting the rules on organic farming. In the European Union, these regulations govern all areas of organic production, and specifically about Nitrogen, they state that organic producers need to adopt different approaches to maintaining soil fertility and animal and plant health

**Organic fertilizers include animal by-products, plant-derived materials and mined minerals.**

| | |
|---|---|
| 1) The total amount of manure you can apply to your organic land, averaged over the whole area, must not be more than 170kg of nitrogen (N) per hectare per year. | **European Regulation Number: (EC) 889/2008 Art. 3(2)** |
| 2) Mineral nitrogen fertilisers cannot be used. | **European Regulation Number: (EC) 834/2007 Art. 5(a)(c); Art. 12(1)(a)(b)(e)** |

# References

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9) Soil Association Standards Farming and growing, 2021