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## The Effects of Anthropogenic Nitrogen on Public Health

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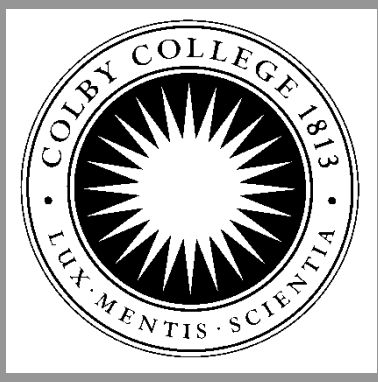


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# THE EFFECTS OF ANTHROPOGENIC NITROGEN ON PUBLIC HEALTH

Jack Sears and Grace Fowler

## Abstract

Changes made by human activities to the global nitrogen cycle affect public health directly and indirectly. The positive health impacts of intense fertilization of agriculture have negative side effects that are often overlooked, and excessive air-and water-borne nitrogen has been linked to many respiratory diseases, cardiac disease, and cancers. Recent data suggests that nitrogen also affects the dynamics of certain vector-borne infectious diseases and results in an increasing number of harmful algal blooms globally. Such data suggests that fluxes in reactive nitrogen due to anthropogenic actions pose a significant risk to global public health.

## Background

- **Nitrogen Cycle**
  - Nitrogen is a limiting factor for growth in many ecosystems
  - The nitrogen cycle is the most impacted nutrient cycle of the Anthropocene

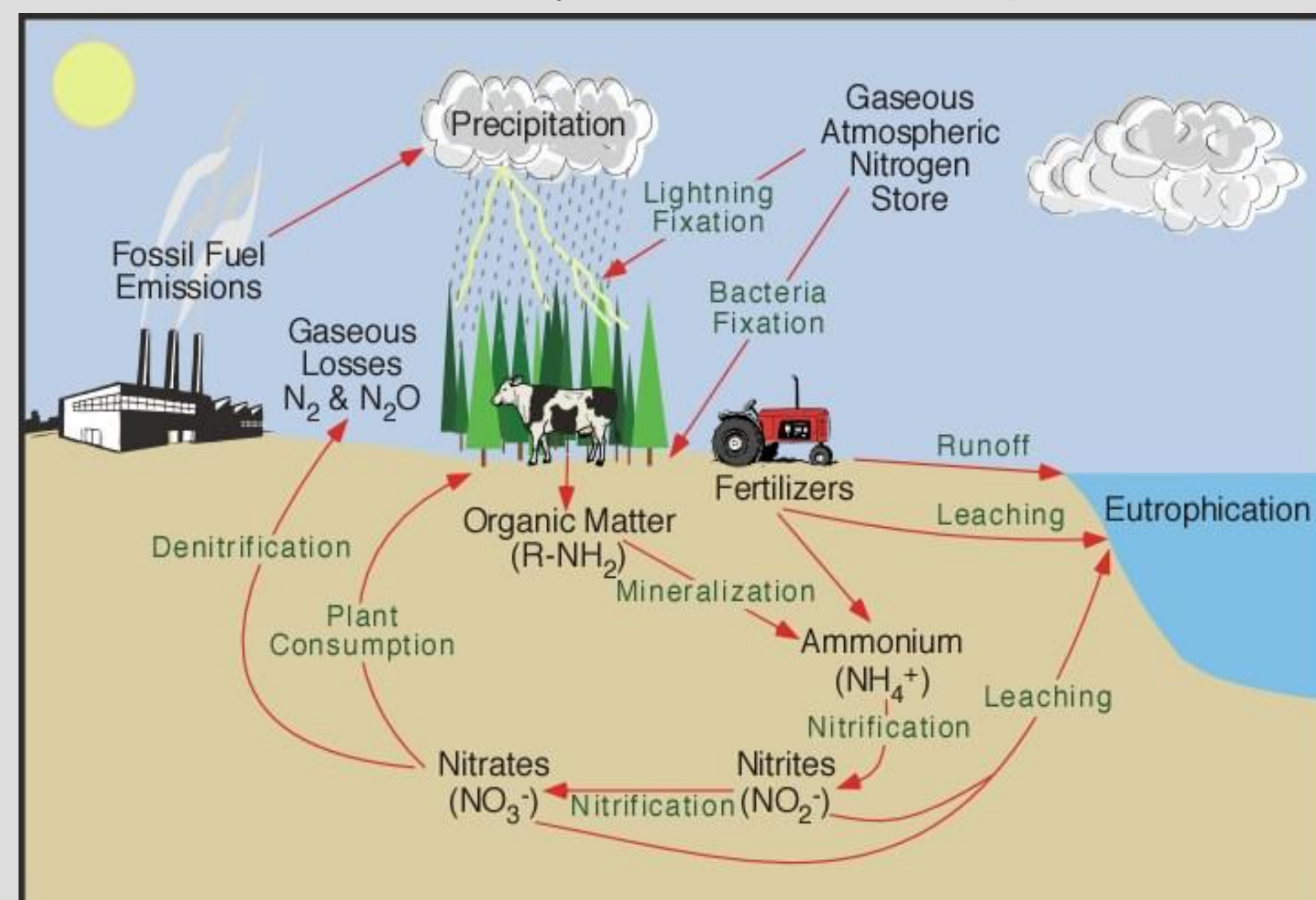


Figure 1. Nitrogen Cycle with Anthropogenic Inputs

- **Sources of Anthropogenic Nitrogen**
  - Agricultural Fertilizers
  - Fossil Fuel Combustion
  - Atmospheric Deposition
- **Environmental Impacts of Anthropogenic Nitrogen**
  - Eutrophication
  - Greenhouse Effect
  - Nitrogen Saturation
- **Health Impacts are Diverse**

## Positive Impacts

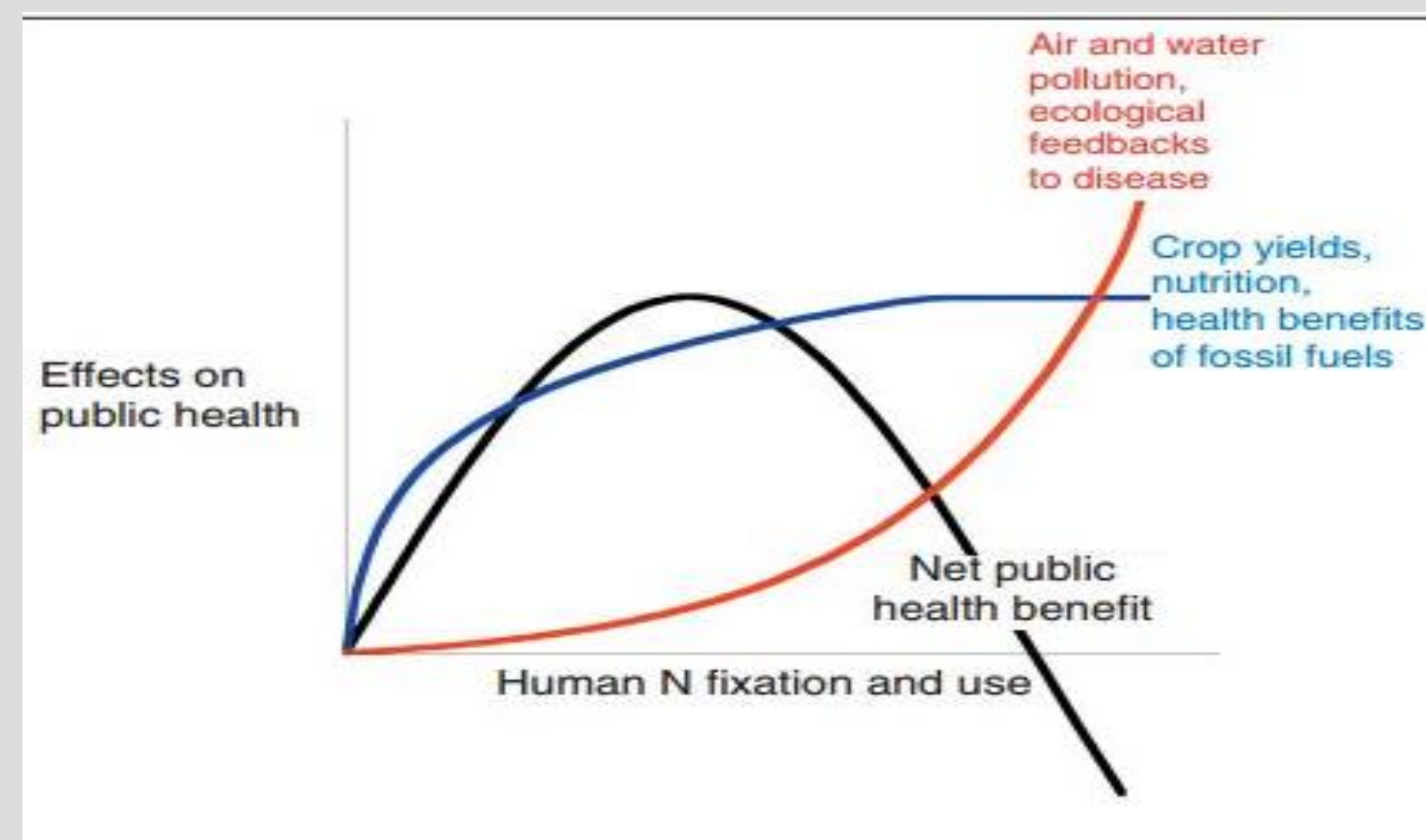


Figure 2. Conceptual model of the public health effects of increasing anthropogenic nitrogen use. Positive effects to public health occur when low levels of nitrogen are used. As usage increases, the positive impacts level off and negative impacts increase at an exponential rate.

- **Production of nitrogen supports the global population**
  - Despite dramatic population increases in the 20<sup>th</sup> century, starvation and malnutrition have declined in many areas
- **Increased use of nitrogen fertilizers considerably reduces malnutrition in poor nations**
  - Decreases in hunger and malnutrition result in healthier immune systems
- **Increased food production by the use of nitrogen fertilizers does not always mean equal distribution**
  - Nitrogen fertilizer creates malnutrition through both over and under consumption

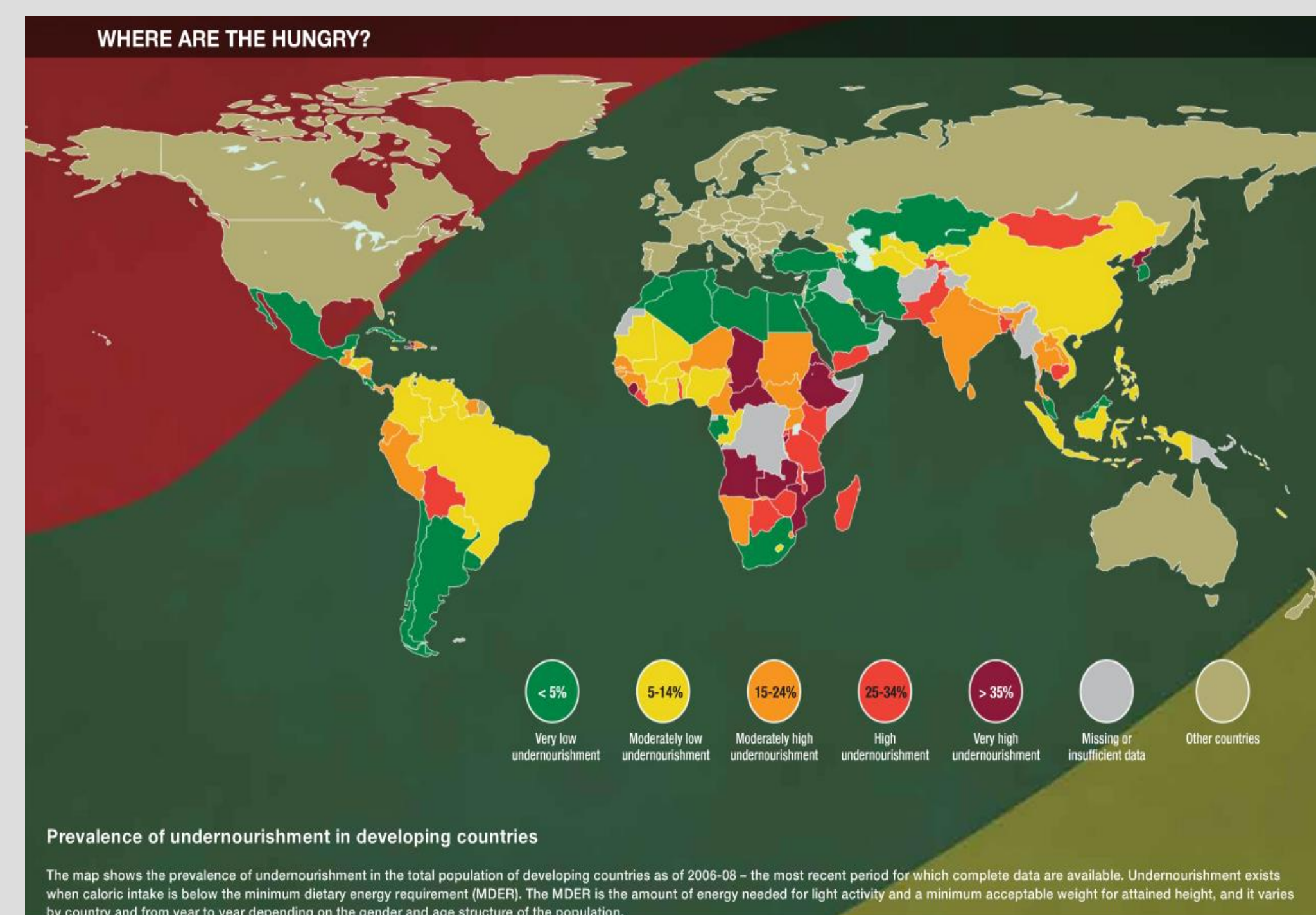


Figure 3. Map of global food insecurity. Food insecurity is a measure of the availability of food. High uses of nitrogen fertilizer correlates closely to low food insecurity.

## Worker Safety

- **Production of nitrogen fertilizer is a potentially harmful process**
  - Moderately hazardous in acute contact
  - Long term effects can include harm to respiratory, circulatory, and gastrointestinal systems
- **Ammonium Nitrate is Explosive**
  - Plants often go uninspected for long periods of time, increasing the risk of explosions

## Water Pollution

- **Ground Water Contamination**
  - Common in developed and developing regions
  - Very hard to reverse
- **Health effects of consuming drinking water with high nitrate levels:**
  - Reproductive complications
  - Methemoglobinemia ("Blue-Baby Syndrome")
  - Non-Hodgkin's Lymphoma
  - Bladder and Ovarian Cancers

## Air Pollution

- **Nitrous oxides are major green house gases**
  - Less abundant than CO<sub>2</sub> but 298 times more potent

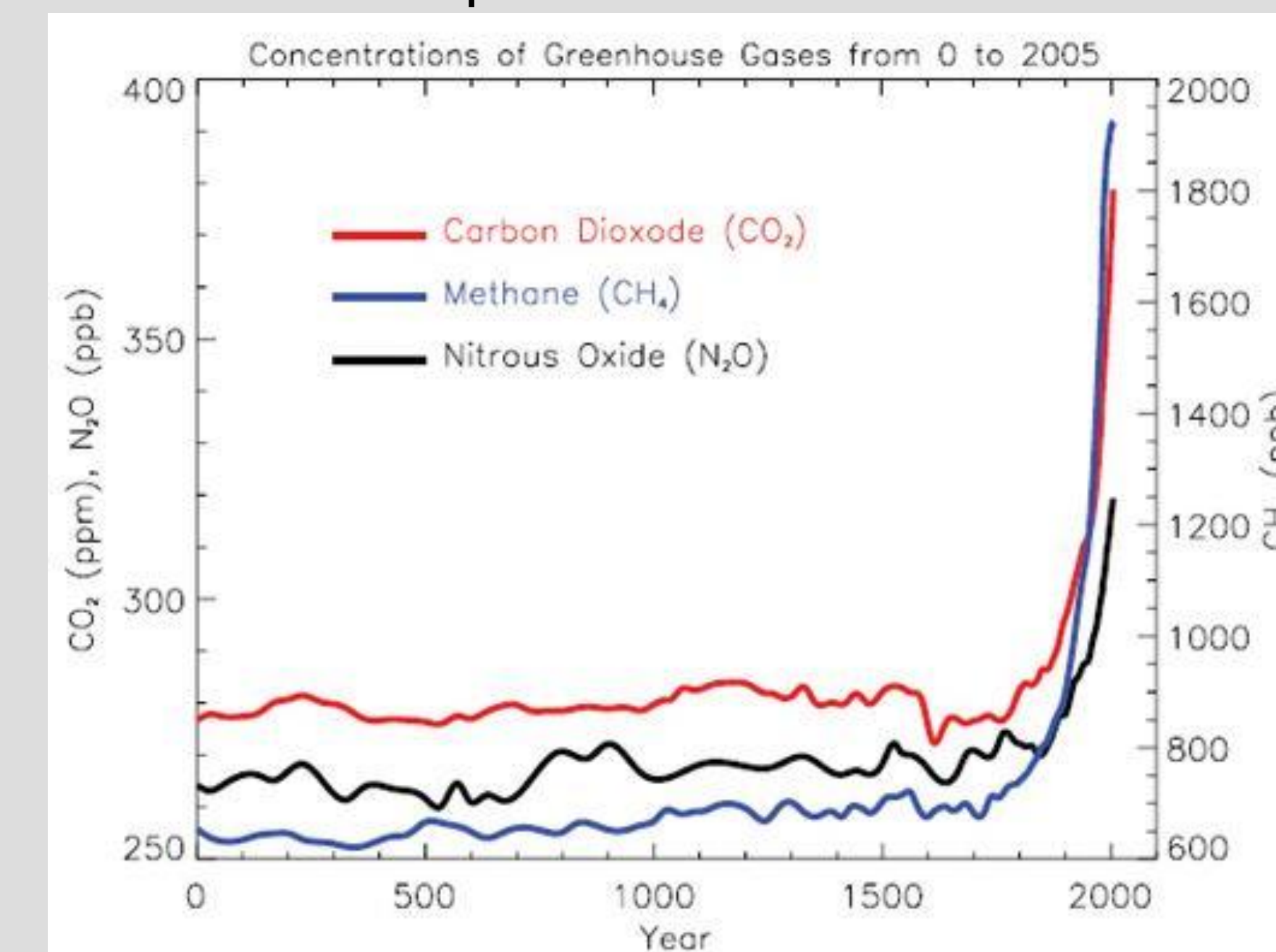


Figure 3. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide from 0 to 2005. There is a clear correlation between the invention of the Haber-Bosch nitrogen production process and the increase in atmospheric nitrous oxide.

- **Nitrous oxides are linked to:**
  - Respiratory ailments
  - Cardiovascular diseases
  - Cancers
  - Increases in allergens

## Infectious Diseases

- **Increases in nitrogen in surface water can lead to increases in vectors of disease, such as mosquitos, that are linked to:**
  - Malaria
  - West Nile Virus
  - Various forms of Encephalitis
- **Many of these increases may be seasonally specific**
- **Cholera is closely associated with coastal algal blooms**
- **Future increases in nutrient availability and temperature favor a rise in the abundance of opportunistic diseases**

## Harmful Algal Blooms

- **Algal blooms are massive fast forming groups of algae that often occur in coastal regions as a result of eutrophication**
- **Certain algal blooms are labeled as harmful when they contain an algae or other organism that causes illness**

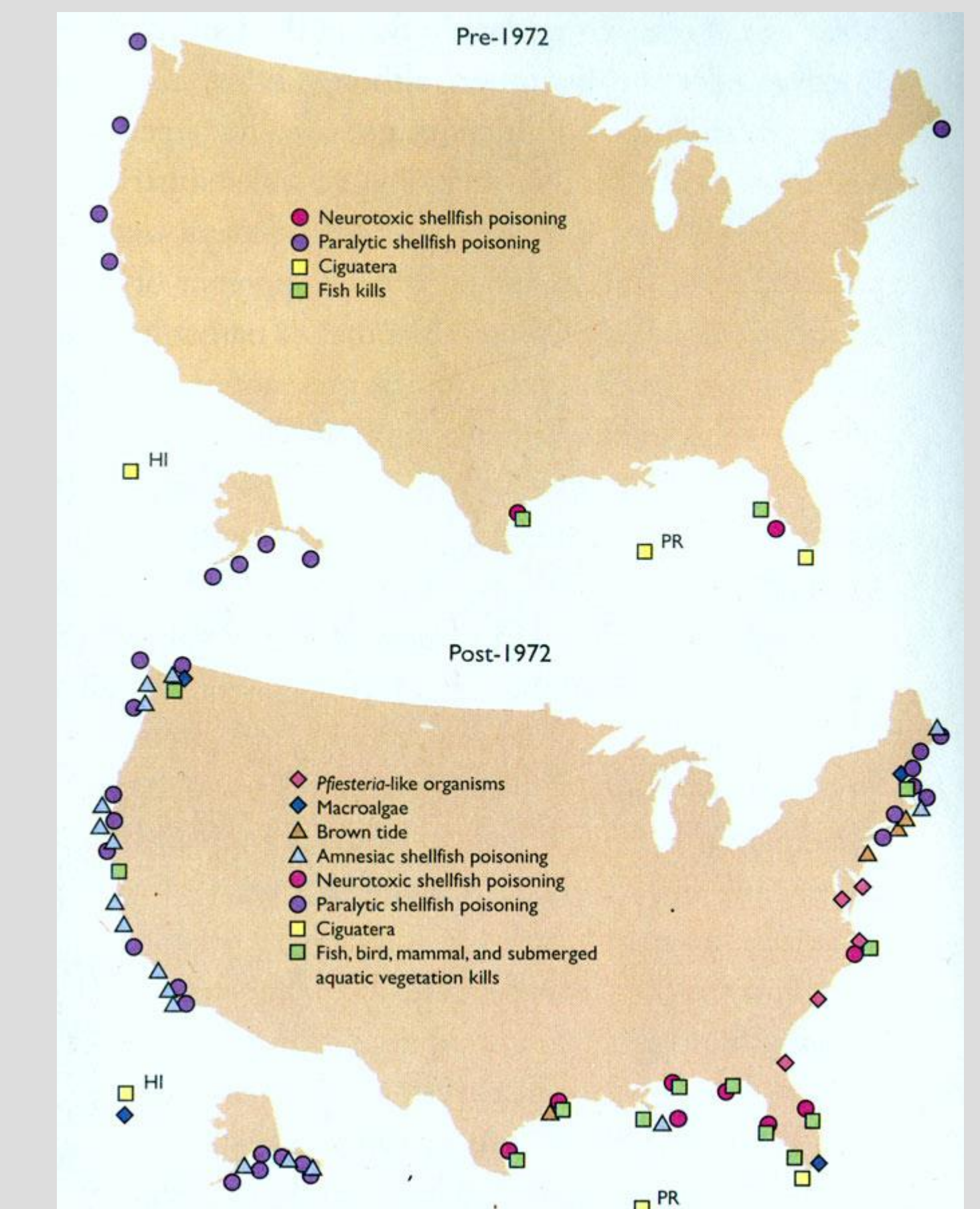


Figure 4. Map of harmful algal blooms in the United States before and after 1972. This clear increase in the number of occurrences correlates with an increase in global nitrogen use.

## Conclusion

It is clear that current trends in nitrogen fixation have had major consequences on public health. While there are positive and negative effects of nitrogen on public health it is clear that the negative impacts greatly outweigh the positive impacts. If left unchanged, this gross misuse of natural resources could have a drastic effect on the health of the global population.