

FACT SHEET

# TOO MUCH OF A GOOD THING: OVERAPPLICATION OF NITROGEN FERTILIZER ENDANGERS HUMAN AND ENVIRONMENTAL HEALTH

Nitrogen is an essential element for crop growth. But nitrogen fertilizer is often applied at a much higher rate than what most crops need. Globally, about half of the nitrogen fertilizer applied to farm fields is not utilized by the crop and instead washes out into waterways or volatilizes into the atmosphere.<sup>1</sup> This excess nitrogen harms human health, threatens biodiversity, and drives climate change.<sup>2</sup> Nitrogen overuse also costs farmers more money because they apply more than what is needed.<sup>3</sup> There is growing consensus that nitrogen management needs to be improved and that overapplication must end.<sup>4</sup>

## INDUSTRIAL AGRICULTURAL PRODUCTION DEPENDS ON FOSSIL FUEL-POWERED NITROGEN FERTILIZER

The 1913 discovery of the Haber-Bosch process enabled nitrogen fertilizer to be produced at an industrial scale and sold at relatively low cost.<sup>5</sup> Today, these fertilizer manufacturing facilities release toxic chemical by-products into surrounding neighborhoods, resulting in major health and occupational safety risks that often disproportionately impact low-income communities and people of color.<sup>6</sup> Production of chemical fertilizer is also highly dependent on the use of fossil fuels as an energy source.<sup>7</sup> Despite these harmful production impacts, most farmers have come to rely on chemical fertilizer and crop yields have increased significantly. Today fertilizer use, and overuse, is widespread in U.S. agriculture, making it the world's third-largest nitrogen polluter, behind China and India.<sup>8</sup>

## NITROGEN IS SIGNIFICANTLY OVERAPPLIED, AND ENDS UP IN THE WATER AND AIR

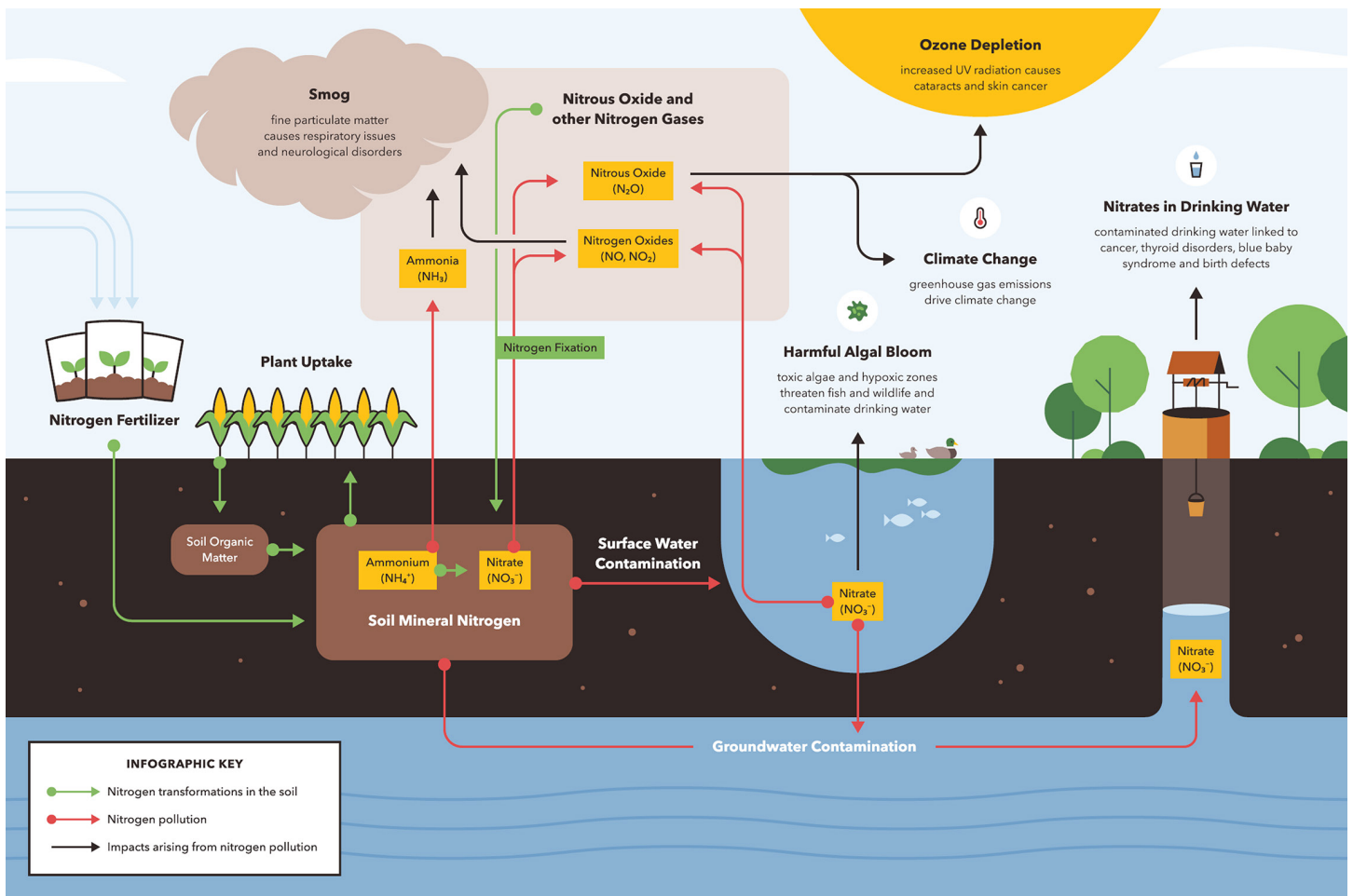
Nitrogen boosts plant growth and yield, but only up to a point; research shows we are applying more than necessary. In the United States, 45 percent of the nitrogen fertilizer applied to agricultural land each year is not used by the



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Nitrates can contaminate drinking water and sicken people, particularly children.

**Figure 1: Excess nitrogen from fertilizer spreads through the environment and impacts human and environmental health**



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crop, which means it is instead lost to the environment.<sup>9</sup> It runs off agricultural land into rivers and lakes, leaches into groundwater, and is released into the atmosphere.<sup>10</sup> This nitrogen waste then harms human and ecosystem health and contributes to greenhouse gas emissions (see figure 1).

## NITROGEN FERTILIZER IS HARMFUL TO HUMAN HEALTH

When nitrogen leaches into groundwater and surface water it transforms into nitrate, a major drinking water contaminant. Nitrate exposure is linked to increased risk of numerous types of cancer and thyroid disorders.<sup>11</sup> Children and pregnant women are especially vulnerable, as nitrate exposure can result in birth defects and low oxygen levels in newborns (sometimes called blue baby syndrome).<sup>12</sup> A 2014 study estimated that 5.6 million Americans using community water systems were exposed to nitrate at levels associated with these health risks.<sup>13</sup> This figure is almost certainly an undercount because the study excluded the 44 million Americans who rely on private wells, which are even more susceptible to nitrate contamination.<sup>14</sup>

Beyond drinking water, nitrogen oxides (NO and NO<sub>2</sub>) and ammonia (NH<sub>3</sub>) emitted from soil contribute to smog formation and air pollution.<sup>15</sup> Exposure to elevated levels



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Increased fine particulate matter from nitrogen gases can cause asthma and neurological disorders.

of these gases has been linked to respiratory issues such as asthma, increased hospital visits for breathing difficulties, and neurological disorders.<sup>16</sup>



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Widespread fish kills occur in water bodies with hypoxic “dead-zones” from nitrogen pollution.



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Birds and other wildlife suffer when harmful algal blooms and “dead-zones” develop.



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Nutrient pollution is linked to sea turtles suffering from fibropapillomatosis and skin tumors.

## NITRATES DEGRADE AQUATIC ECOSYSTEMS

In water bodies, high nitrogen concentrations fuel harmful algal blooms and “dead zones” with low oxygen levels, making them inhospitable for many species.<sup>17</sup> Within the United States, up to 78 species currently listed under the Endangered Species Act are at risk due in part to nitrogen pollution.<sup>18</sup> An estimated one-third of streams, two-fifths of lakes, and two-thirds of coastal water systems are impaired by excess nitrogen concentrations.<sup>19</sup>

## NITROUS OXIDE IS A POTENT GREENHOUSE GAS AND THE MOST ABUNDANT OZONE-DEPLETING SUBSTANCE

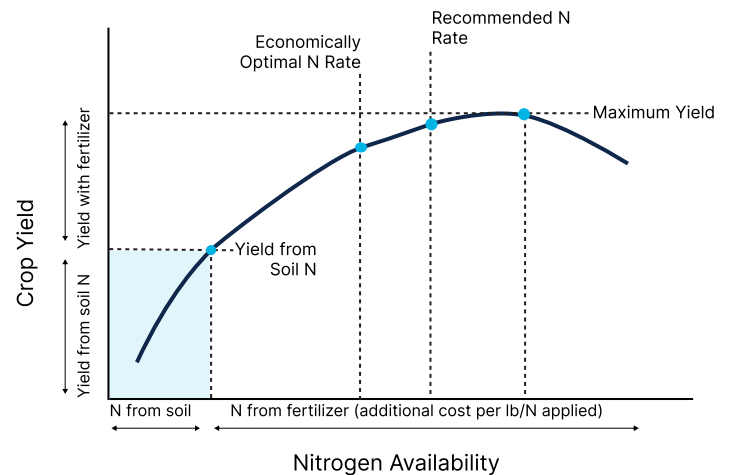
When nitrogen not absorbed by crops reacts with oxygen, it forms nitrous oxide ( $N_2O$ ), a long-lived greenhouse gas.<sup>20</sup> On a molecular level,  $N_2O$  is 273 times more effective at warming the planet in comparison to carbon dioxide ( $CO_2$ ).<sup>21</sup> In addition to driving climate change,  $N_2O$  damages the ozone layer by breaking down stratospheric ozone.<sup>22</sup> This results in increased UV radiation, which raises the risk of skin cancer and cataracts.<sup>23</sup> Agriculture accounts for 75 percent of all U.S. nitrous oxide emissions, primarily from the overuse of nitrogen fertilizers.<sup>24</sup>

## EXCESS NITROGEN OFFERS NO BENEFIT TO FARMERS

More fertilizer does not mean greater yields (see figure 2).<sup>25</sup> Studies show that nitrogen use could be cut by 30 to 70 percent without reducing agricultural productivity.<sup>26</sup> Overapplication is often a result of improper timing of application or external factors such as perceived risk mitigation, where farmers apply extra fertilizer thinking it may guarantee yield.<sup>27</sup> Reducing nitrogen use and optimizing nitrogen timing can lower input costs yet still maintain crop performance.

Significant reductions in nitrogen use are achievable in the United States, and forward-looking policies can help reduce overapplication without diminishing crop yields or farm profitability. This work can be done in partnership with farmers, who can make decisions to decrease fertilizer application, optimize application timing, and diversify crop rotations in an effort to use nitrogen more efficiently, protect their economic interests, and keep their families and the environment healthy.<sup>28</sup>

Figure 2: Nitrogen fertilizer can be economically beneficial and improve yield, but only up to a certain point



Source: Adapted from Santiago Tamagno et al., “Critical Assessment of Nitrogen Use Efficiency Indicators: Bridging New and Old Paradigms to Improve Sustainable Nitrogen Management,” *European Journal of Agronomy* 159 (September 7, 2024).

## Endnotes

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