

Earth's growing nitrogen threat

It helps feed a hungry world, but it's worse than CO2.



Nitrogen fertilizer being used on an Illinois farm.

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By [Mark Clayton](#) Staff Writer of The Christian Science Monitor / January 12, 2010

Dennis Lindsay still recalls the day four decades ago when his father, an Iowa farmer, began using nitrogen fertilizer on the family's 160 acres.



Nitrogen fertilizer at a plant in Xinjiang, China.

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With nitrogen, the family's corn crop suddenly grew much higher and stronger, and produced full ears and big harvests. When fed to their cows and pigs, that high-quality corn produced far more milk and meat. As a result, the family bought more livestock – and the farm grew. “I remember Dad bringing the neighbors over to see how much greener and better the quality of the stalk was,” Mr. Lindsay says. “It was a really big deal then.”

It's an even bigger deal today. Lindsay and his son farm 3,000 acres of corn and soybeans, using about 150 tons of nitrogen fertilizer annually. Farmers from China, Europe, and South America rely on nitrogen, too, to make ends meet and feed a growing world.

Yet it's also becoming clear that too much of a good thing can have a downside for the environment. The world is awash in man-made “reactive” nitrogen (the chemically active form), researchers say.

While greening farms worldwide, much nitrogen washes into lakes, rivers, and the sea, causing rampant algae growth. More nitrogen billows from power-plant smokestacks, blowing in the wind until it settles as acid rain. Still other nitrogen gases remain in the atmosphere consuming the ozone layer. Nitrous oxide is nearly 300 times as potent as carbon dioxide – considered the leading cause of climate change – and the third most threatening greenhouse gas overall.

Last year, reactive nitrogen was identified as one of nine key global pollution threats and second worst in terms of having already exceeded a maximum “planetary boundary,” according to a study reported in the journal *Nature*.

“Nitrogen plays a tremendously important role in feeding the world's peoples, so that's a very positive benefit for humanity,” says James Galloway, a professor of environmental science at the University of Virginia, Charlottesville, and a leading nitrogen researcher. “The problem is how to maximize nitrogen's benefits while diminishing its negatives – especially waste.”

Africa is one of a few places in the world where wider use of nitrogen fertilizers makes sense to help feed the population, many researchers agree. In the US, however, as much as 40 percent of reactive nitrogen is wasted – washing off farm fields into rivers, lakes, and the ocean, where oxygen-depleted “dead zones” are growing in number and size worldwide.

The situation is even worse in China, which uses about twice as much nitrogen fertilizer as the US to yield about the same amount of crops. As much as three-quarters of all nitrogen used to grow rice in China may be wasted, says Vaclav Smil, a nitrogen expert at the University of Manitoba in Winnipeg.

Vehicle exhaust, power-plant exhaust, and large-animal feeding operations are all sources of nitrogen emissions. Rising energy needs have meant more nitrogen oxides (NO_x) – implicated in smog, acid rain, and global warming – emitted from fossil-fueled power plants.

Most nitrogen doesn't stay in the atmosphere the way carbon dioxide from fossil fuel does, but precipitates out within a few days. Ammonia – a mixture of hydrogen and nitrogen – becomes ammonium when mixed with water and acts like fertilizer when it falls to the ground in rain.