

Farms a major source of air pollution, study finds

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Fumes from nitrogen-rich fertilizers and animal waste combine in the air with combustion emissions to form solid particles in the air. These aerosols outweigh all other human sources of fine-particulate air pollution in much of the United States, Europe, Russia and China, according to new research. Credit: Dirk Ingo Franke via Wikimedia Commons.

Emissions from farms outweigh all other human sources of fine-particulate air pollution in much of the United States, Europe, Russia and China, according to new research. The culprit: fumes from nitrogen-rich fertilizers and animal waste combine in the air with combustion emissions to form solid particles, which constitute a major source of disease and death, according to the new study.

The good news is if combustion [emissions](#) decline in coming decades, as most projections say, fine-particle pollution will go down even if fertilizer use doubles as expected, according to the [new study](#) published in *Geophysical Research Letters*, a journal of the American Geophysical Union.

Agricultural air pollution comes mainly in the form of ammonia, which enters the air as a gas from heavily fertilized fields and livestock waste. It then combines with pollutants from combustion—mainly nitrogen oxides and sulfates from vehicles, power plants and industrial processes—to create tiny [solid particles](#), or aerosols, no more than 2.5 micrometers across, about 1/30 the width of a human hair.

Aerosols can penetrate deep into lungs, causing heart or pulmonary disease. A [2015 study](#) in the journal *Nature* estimates they cause at least 3.3 million deaths each year globally, and a [recent study](#) in *Geophysical Research Letters* found they cause over 500,000 annual deaths in India alone.

Many regional studies, [especially in the United States](#), have shown agricultural pollution to be a prime source of fine-particulate precursors, but the new study is one of the first to look at the phenomenon worldwide and to project future trends. The study's results show more than half the aerosols in much of the eastern and central United States come from farming.

"This is not against fertilizer—there are many places, including Africa, that need more of it," said Susanne Bauer, an atmospheric scientist at Columbia University's Center for Climate Systems Research and NASA's Goddard Institute for Space Studies in New York and lead author of the study. "We expect population to go up, and to produce more food, we will need more fertilizer."

The fact that agricultural emissions must combine with other pollutants to make aerosols is [good news](#), according to Bauer. Most projections say tighter regulations, cleaner sources of electricity and higher-mileage vehicles will cut industrial emissions enough by the end of this century that farm emissions will be starved of the other ingredients necessary to create aerosols, she said.

"You might expect air quality would decline if [ammonia emissions](#) go up, but this shows it won't happen, provided the emissions from combustion go down," said Fabien Paulot, an atmospheric chemist with Princeton University and the National Oceanic and Atmospheric Administration who was not involved in the study. That means pollutants other than ammonia should probably be targeted for abatement, he said.

Johannes Lelieveld, lead author of the 2015 Nature study, disagreed. "One should be cautious about suggesting that food production could be increased" without increasing pollution, because that "critically depends" on the assumption that societies will successfully curb industrial emissions, he said. Lelieveld pointed out that even with recent reductions in industrial pollution, most nations, including the United States, still have large areas that exceed the World Meteorological Organization's recommended maximum of particulate matter.

If future industrial emissions do go down, much farm-produced ammonia will end up in Earth's troposphere, roughly 2 to 10 kilometers (1 to 6 miles) above the surface, Bauer said. There, lightning and other

natural processes may also help create fine particulates, but most of these particles would be trapped by raindrops and harmlessly removed from the atmosphere, she said.

More information: *Geophysical Research Letters*, [DOI: 10.1002/2016GL068354](https://doi.org/10.1002/2016GL068354)

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