

Surprising origins of deadly dirty air

Farming, cook fires top causes of pollution-linked deaths

BY BETH MOLE

There's no doubt air pollution is a killer, causing more than 3 million deaths worldwide each year. But the top culprits behind the deadly air may come as a surprise.

Particles from small-scale energy use, mainly household fires for cooking and heating, are the leading cause of air pollution-related deaths in many areas of Asia, researchers report in the Sept. 17 *Nature*. But in the northeastern United States, Russia and Europe, agricultural fumes from livestock and fertilizer are the deadliest air pollution. In all of these areas, small-scale energy use and agriculture beat out the more expected suspects: traffic and power plant pollution.

Though not all researchers are convinced by the estimates, the findings may help guide new strategies on reducing pollution. In China, for instance, some policy makers battle smoggy days by regulating traffic, says coauthor Johannes Lelieveld, an atmospheric chemist at the Max Planck Institute for Chemistry in

Mainz, Germany. "But this has actually done very little" to reduce pollution in some places, he says, because the major source of smog is home energy use.

Lelieveld and colleagues combined population and health data, satellite observations of atmospheric particles and a computer simulation of particles circulating and reacting in the atmosphere. The researchers then considered the sources of those particles in each part of the world, attributing pollution to seven main categories, including agriculture, forest fires, power plants and traffic.

Drawing on earlier studies linking air pollution exposure to risk of death, the group estimated that air pollution causes 3.3 million deaths worldwide each year. Previous estimates pegged the death toll at around 3.2 million.

Next, by systematically removing one source of pollution at a time from the simulation, the team estimated each source's deadliness. Small-scale energy use and agriculture were the two leading killers globally, accounting for 1 million and 660,000 deaths.

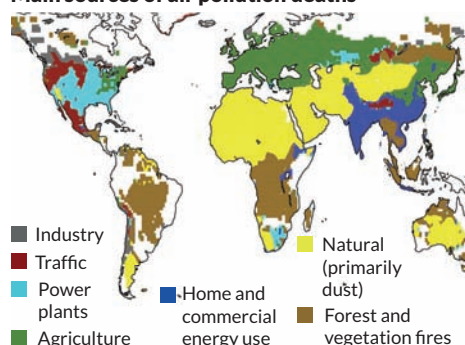
The researchers also estimated the regional health impacts from each of the seven sources. For instance, in India and Vietnam, cooking and heating fires accounted for up to 60 percent of air pollution deaths.

Looking forward, Lelieveld and

colleagues estimate that if there are no new constraints on pollution emissions worldwide, deaths could double by 2050.

Some of the death figures may be overestimates, says UCLA environmental health scientist Michael Jerrett. The calculations assume that all particles are equally toxic. So the agriculture estimate, for instance, would hold true only if the nitrogen-based fumes from fertilizer and livestock urine are really as deadly as the pollution from, say, coal burning or traffic, he says. Some toxicological studies suggest that fumes from agriculture cause few health effects, he notes, although researchers still debate the topic. ■

Main sources of air pollution deaths



Unusual suspects Some of the deadliest air comes from unheeded polluters such as agricultural fertilizer and home cooking. Researchers calculated the largest source of air pollution deaths by different region.

Loss of vision saved cavefish energy

In dark, eyesight can be costly, oxygen measurements show

BY SUSAN MILIUS

Eyes and the brain tissue needed for vision demand about 15 percent of the energy budget of a young Mexican fish, researchers say. This percentage supports the idea that energy cost-cutting helps explain how cavefish go blind.

That 15 percent represents a notable energy demand for a 1-gram juvenile Mexican tetra fish (*Astyanax mexicanus*) at rest, says Damian Moran of Plant and Food Research in Nelson, New Zealand. Vision could therefore become a liability

in food-sparse caves, where no sunlight supports energy-catchers such as plants, Moran and colleagues argue September 11 in *Science Advances*.

The cost is greater for juvenile fish than for older ones. As fish grow, their bodies enlarge more than their brains do. By the time a Mexican tetra reaches 8.5 grams, vision demands only about 5 percent of its total resting energy budget.

Some Mexican tetras of this species live in aboveground streams and have functioning eyes. There's debate, Moran says,

over what factors, such as simple disuse or repurposing of genes, drove vision loss in the populations that colonized caves.

Flushing artificial bloodlike fluid over excised brains and eyes allowed the team to compare the demands of vision-related body parts in blind cavefish with the demands in tetras with fully functioning eyes. The team calculated energy use based on differences in oxygen demand.

This cost of vision "has not been tested directly before, or as elegantly," says William Jeffery, who studies the same species at the University of Maryland in College Park. He's surprised that vision doesn't use more energy. "I would have expected large differences if this is a key driver of regressive evolution." ■