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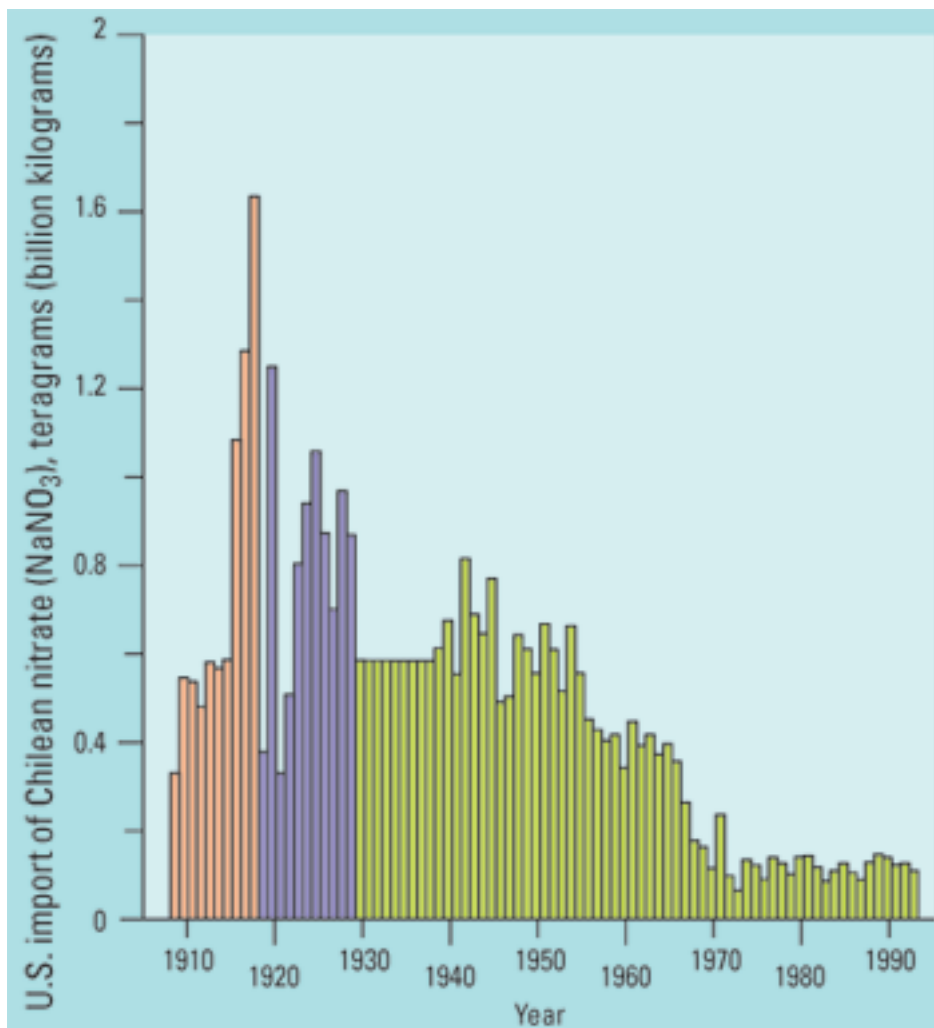
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ES&T News

Fertilizer from Chile puts perchlorate on the table

Researchers recognize three major sources of perchlorate in the food chain: military–industrial activities, agricultural use of Chilean nitrate fertilizer, and natural atmospheric sources. The relative magnitude of each source has long been subject to speculation. New research published in this issue of *ES&T* (pp [6608–6614](#)) shows that the historical use of Chilean nitrate fertilizer is as large a source of perchlorate in food as military–industrial activities are, with natural atmospheric sources coming in far behind.



Wide-ranging data: to track historic imports of Chilean nitrate fertilizers, researchers combined information generated from the U.S. Department of Agriculture (orange), congressional testimony (purple), and the U.S. Bureau of Mines (green).

The paper is the first to quantitatively assess the magnitude of these sources, and it turns current assumptions about the past origins of perchlorate contamination on their head.

Perchlorate is as controversial as it is ubiquitous. The potential health risks from this thyroid disrupter and the huge potential costs of cleaning it up have made the issue one of the most highly politicized scientific debates of the decade.

“We wanted to address the general pervasive presence of perchlorate,” says Purnendu “Sandy” Dasgupta of Texas Tech University, who led the team that wrote the paper. “Precipitation was attractive, but it’s not enough. Most people, including myself, have focused on military–industrial sources of perchlorate,” he says. “But the numbers don’t support it. Stepping back, the best way to get something into the food chain is fertilizer.”

In the past, perchlorate contamination from military activities occurred during manufacture, or when rocket fuel past its prime was washed out of missiles and other devices onto the ground and eventually into groundwater. Chilean nitrate fertilizers, produced from rock deposits, are naturally contaminated

with perchlorate, but their use diminished in the 1950s with the advent of synthetic fertilizers. But military and agricultural activities no longer lead to perchlorate contamination. Rocket fuel washout is now properly contained, and in 2000, Chilean nitrate producers instituted processing changes that removed perchlorate from their product. Atmospheric reactions generate small amounts that fall to earth when it rains.

Production and use estimates of perchlorate are hard to come by: the military considers the numbers secret, and fertilizer producers won't share them, saying they are proprietary information. Dasgupta's team engaged in document detective work to check and cross-check estimates for each military–industrial and agricultural source. The researchers used their own analyses of rainwater and others' analyses of ancient groundwater to estimate atmospheric sources.

To rank the sources, Dasgupta's team estimated the historical sources of perchlorate that could account for the current legacy of water pollution. In terms of production or importation, over the past 60 years, the military–industrial estimate dwarfs the others: 10,600 metric tons (t) per year (yr) compared with 750 t/yr for Chilean nitrate fertilizer and 130–640 t/yr for precipitation. But not all of the perchlorate produced for military and industrial use was washed out to become a water contaminant. Some was used to propel missiles and for outer-space exploration, and some still resides in existing devices. As a result, no one knows how much of the military–industrial perchlorate contributed to water pollution. “This is a big uncertainty,” says Dasgupta.

The Chilean nitrate, however, was used exclusively on agricultural land. This increases the impact of that perchlorate by 5.5 times, to 4200 t/yr, the paper shows. For military–industrial dumping to equal fertilizer as a source, some 40% of the military–industrial perchlorate had to have been dumped. This seems unlikely, the authors note. Dasgupta hastens to add that pockets of high levels of perchlorate pollution may still exist for which the military–industrial complex is solely responsible.

William Herz, vice president of scientific programs at the Fertilizer Institute, a trade group, says that he is skeptical of the paper's conclusions because the estimates ignore studies on the current impacts to food crops of irrigation water contaminated by military–industrial sources. The estimates for these sources also appear low and are based on sketchy data, he says. In addition, Herz questions the detailed calculations that Dasgupta's team used.

Other scientists welcome the work. “The relative contribution of different perchlorate pollution streams has been a hot topic of debate for years,” says Renee Sharp of the Environmental Working Group, an advocacy organization. “It is good to see a quantitative treatment of the subject, rather than one that relies on guesses or conjecture,” adds Sharp, whose comments reflect those of most other scientists contacted for this article.

“The scientific community's understanding of perchlorate in the environment, while incomplete, continues to grow, and this paper makes an important contribution,” says U.S. Air Force scientist Greg Harvey. “I think additional studies in areas like Orange County, Calif., and others that went through

intensive agricultural development in the first half of the 20th century should be illuminating,” he adds.
—REBECCA RENNER

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