

Sooty Air Cuts China's Crop Yields

China leads the world in grain production, harvesting more than 360 million tons each year. The growing affluence of its 1.2 billion inhabitants, however, has fostered a craving for more than China now grows. As a result, this nation imports grain. As China's population continues to swell, so will its demand for imports—leaving less for poorer grain-starved nations.

A new study finds that by cleaning its air, China might eliminate—at least in the near term—its need for imported grain.

Dust-size particles of soot and other pollutants have created a haze over much of China's grain belt. This pollution can significantly depress photosynthesis, reducing crop yields, the new study finds. In fact, its calculations suggest that the haze could be robbing farmers of more grain than China now imports.

Pollution analysts have viewed haze-causing particulates as a visibility-limiting nuisance and potential health threat. "This new paper looks at an impact that's never been considered," says study leader William L. Chameides of the Georgia Institute of Technology in Atlanta.

His international team put climate and pollution data into a computer model that simulates reactions between pollutants under local meteorological conditions. "From that," Chameides explains, "we get estimates of how much [haze] is in the atmosphere." Haze measurements collected throughout China invariably proved even larger than the estimated levels.

The model only accounts for pollution created by human activities, such as wood and coal burning, Chameides explains. It also ignores the role of particulates in gathering water into clouds.

The researchers put their computed values for haze into a crop-projection model that many governments use to predict harvests. To customize it for a given crop and region, scientists need some 10 years of meteorological and farm data. Such detailed information was only available for rural areas near Nanjing, about 200 miles west of Shanghai. Chameides' team then extrapolated its Nanjing findings to China's other farm regions.

Those harvest estimates, reported in the Nov. 23 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, show that haze may be depressing China's farm yields by 5 to 30 percent. The researchers project the biggest losses for the Sichuan Basin and Yangtze Delta, areas that have especially



Georgia Tech scientist measures haze in rural Zhejiang Province last month. The 5-mile visibility, typical there, represents almost three times the worst haziness in Tennessee's Smoky Mountains.

sooty air.

However, Chameides notes, because haze is a problem worldwide, it probably is diminishing crop yields in developing and industrial nations alike.

Though the new projections represent

"a good effort," they remain by necessity "a bit rudimentary," says Cynthia E. Rosenzweig of NASA's Goddard Institute for Space Studies in New York. The harvest models, for instance, employ overly simplified relationships between crop growth and sunlight. The new study also estimated yield losses from haze in the absence of any other problems. In fact, Rosenzweig notes, yields can be limited at least as much by pests, water shortages, or insufficient nutrients as by haze.

The good news is that China may have begun a transition away from the coal burning that contributes to its serious haze problems, notes agricultural economist Lester Brown of the Worldwatch Institute in Washington, D.C. Cutting coal subsidies has raised the price of this fuel and limited its use, he says.

Moreover, the nation recently activated its first wind farm. "China has enough usable wind to easily double its current national electricity generation," Brown notes. —J. Raloff

One down: A human chromosome sequenced

It's not the biggest, or the smallest, or the one with the most genes. Still, chromosome 22 will go down in history as the first human chromosome to have almost its entire DNA sequence revealed to the world.

Scientists participating in the international effort to decipher the whole human genome announced this milestone in the Dec. 2 NATURE. The investigators report that they've determined more than 33 million bases—the chemical building blocks of DNA—of chromosome 22 and identified at least 545 genes.

"It's very exciting," says Bruce A. Roe of the University of Oklahoma in Norman, a leader of the sequencing project. "We've now got one book of the *Encyclopedia Britannica* of life. . . . We know all the words on its pages. We just have to go back to our dictionary and find out what all those words mean."

Twenty-two pairs of chromosomes, plus the X and Y chromosomes, carry almost all of a person's genes. Chromosome 22 ranks as the second smallest, holding just under 2 percent of all human DNA. It harbors many genes implicated in human disorders ranging from birth defects to cancers. Several studies have suggested that chromosome 22 may also contain a gene predisposing people to schizophrenia.

Four DNA-sequencing teams from Washington University School of Medicine

in St. Louis, the University of Oklahoma, the Sanger Centre in Cambridge, England, and Keio University School of Medicine in Tokyo led the chromosome-22 effort. While a private firm is sequencing the human genome using a so-called shotgun strategy (SN: 5/23/98, p. 334), these investigators pursued a more traditional approach. They took small pieces of DNA whose locations on chromosome-22 were known and identified which of four possible bases—adenine, cytosine, guanine, or thymine—exists at each point along the DNA.

The international human genome project aims for 99.99 percent accuracy. Claiming less than 1 mistake for every 50,000 bases, the chromosome-22 sequencers say they've beaten that benchmark. "Since this is the first chromosome being completed, we wanted to set the standard," says Roe.

He notes that chromosome-22 crossed the finish line first because scientists working on specific regions overcame their competitiveness and freely volunteered copies of their regions' DNA to the four sequencing centers. The centers made the resulting sequence data freely available worldwide. "The community really worked together," says Roe. "There was a tremendous spirit of cooperation."

The ongoing public release of the se-