United States Department of Agriculture
Natural Resources Conservation Service

Conservation Resource Brief

Air Quality

February 2006 Number 0605

Key Points:

- Air quality is an increasingly important issue for agriculture and natural resources conservation.
- Leading agricultural air quality issues include particulate matter, ozone precursors, odors, ammonia and greenhouse gases.
- 12 of the 79 NRCS resource concerns deal with air resources.
- It is estimated that since 1998 EQIP air quality projects in the San Joaquin Valley have reduced more than 10,500 tons of PM10, VOCs and NO_x emissions.
- NRCS developed a web-based tool for farmers, the COMET-VR, for estimating greenhouse gas emissions and for voluntary reporting of GHG savings with conservation systems.
- Regulatory agencies are taking a more detailed look at agricultural air quality.
- Several tools exist to help NRCS employees and partners better understanding air quality issues and estimate impacts.

Contact:

NRCS Web site at www.nrcs.usda.gov.

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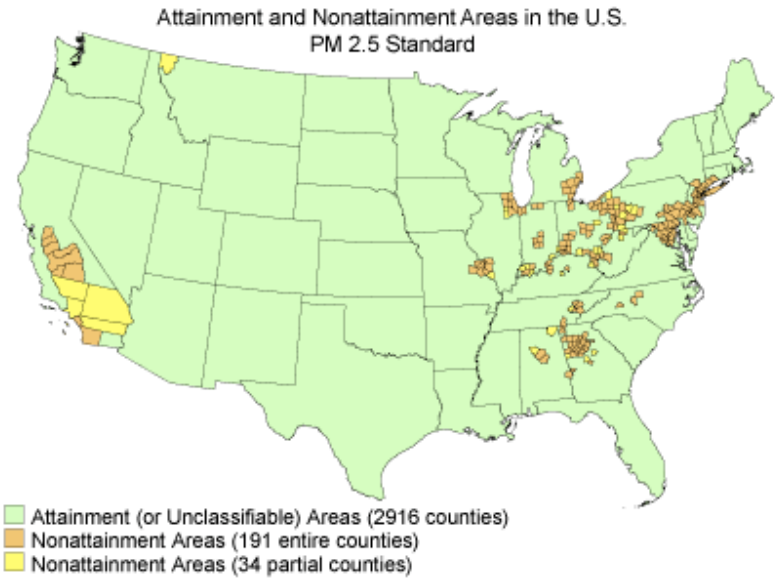
Helping People Help the Land

Description

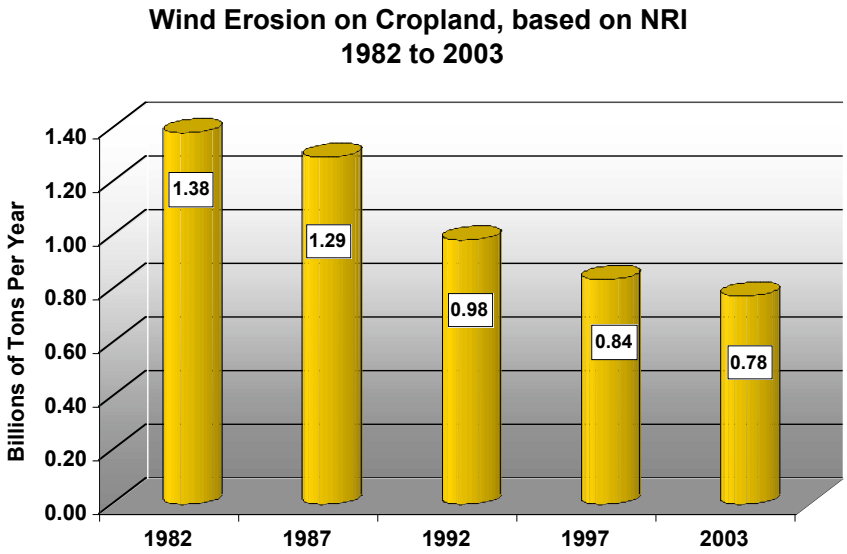
Air quality denotes some measure of health and visibility-related characteristics of air, often derived from measured concentrations of specific contaminants. Air quality directly affects human quality of life, as well as the well-being of nearly every component of the natural system. It has direct relevance to and influence on water and soil quality. Because of the pervasive and well-mixed nature of the atmosphere, air quality sources and impacts can be in close proximity or thousands of miles apart. Increasingly, agricultural operations which affect air quality are receiving attention from the general public and the regulatory community.

There are many rural locations in the United States that are in Environmental Protection Agency (EPA)-designated non-attainment areas. As an example, shown below is the EPA map of fine particulate (less than 2.5 micrometers) attainment and non-attainment areas in the continental U.S. While many of these areas center on a large urban area, the impacted zone of the non-attainment area stretches into the surrounding rural countryside.

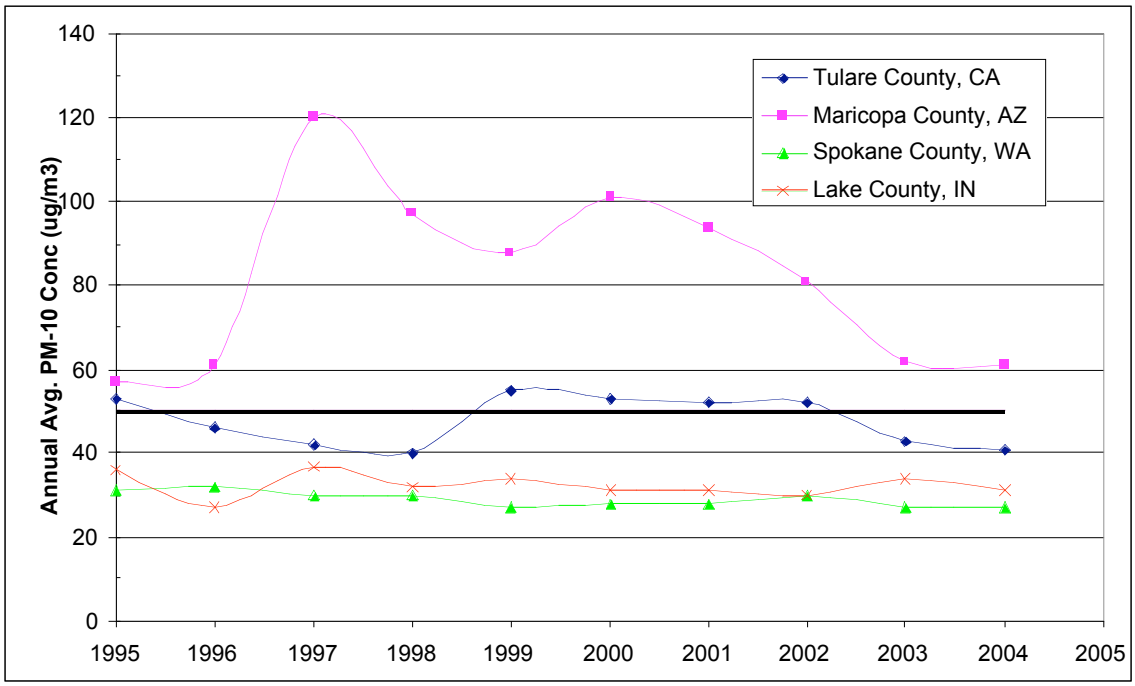


Current Conditions and Trends

Agriculture has always had some impact on air quality, whether through wind erosion and fugitive dust emissions, odors, or smoke. Conversely, the quality of the atmosphere can affect plant and animal production. The EPA and state and local regulatory agencies have been examining, and in some cases regulating certain emissions from agricultural operations. A few of these are among EPA's six *criteria pollutants*—those that are regulated and for which specific, measurable threshold values have been established. Chief among the criteria pollutants related to agriculture are particulate matter (PM) and ozone precursors (emissions that lead to the formation of ozone; i.e., volatile organic compounds—VOC's, and oxides of nitrogen). Also of concern are emissions of ammonia (related to fine PM), and other odorous substances. These latter gases are not necessarily criteria pollutants themselves, but can either chemically reform into a criteria pollutant (like PM), or are considered a public nuisance.

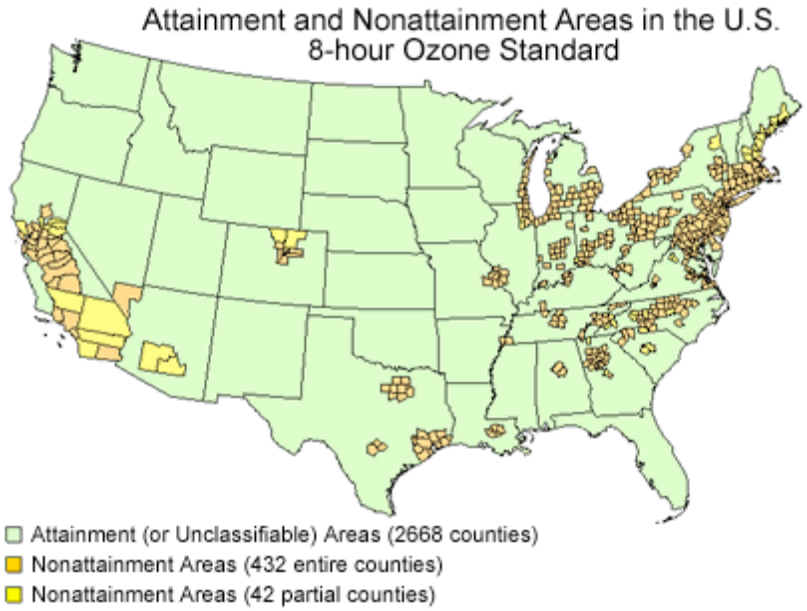


Particulate matter is characterized by particle size. In general, many agricultural emissions have particle sizes in excess of 10 micrometers, which is generally not associated with health effects. The EPA characterizes particles as being smaller than 10 micrometers (PM10), and smaller than 2.5 micrometers (PM2.5). PM2.5 is most significant for human health effects, and EPA has designated PM2.5 non-attainment regions (see map above). There currently is significant debate over the so-called *coarse fraction* and agriculture's contribution, which is the percentage of PM10 that is in the PM10 to PM2.5 range.



The above graph show average annual PM10 concentrations since 1995 for four agricultural counties across the U.S. The dark horizontal line shows the EPA's 50 μg/m^3 average annual PM10 threshold.

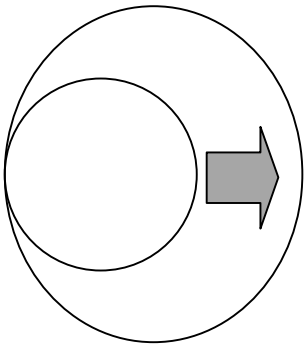
Ozone precursors include VOC's from pesticides and many other sources, as well as oxides of nitrogen (NO_x). 42 percent of NO_x emissions result from fossil fuel combustion, with smaller contributions from other sources, including soil nitrogen reactions. Ground level ozone, of most concern to human health, is formed in a photochemical reaction between VOC's and NO_x. In most urban areas NO_x is relatively plentiful from anthropogenic source, and it is the supply of VOC's from natural and anthropogenic sources that increasingly is of concern. A new 8-hour ozone standard was recently established by EPA; non-attainment areas in the continental U.S. are shown in the map below.



Ammonia emissions result from fertilizer applications, animal waste, and motor vehicle exhausts. Ammonia contributes to atmospheric concentrations of PM2.5, and has an associated objectionable odor. For these reasons, ammonia increasingly is being examined, and all sectors of the economy, including agriculture are now being assessed.

An air quality issue impacting all states is *agricultural odor*. New methods for controlling odors and preventing their transport are being developed, including changes in animal feed, air filtering technologies, chemical reformulations, and increased awareness in animal waste application technology.

Urban encroachment into rural areas is a burgeoning issue in many parts of the nation, placing enhanced scrutiny on agricultural operations and their air emissions in these interface zones. As an urban boundary moves outward into a rural area the urban-rural boundary interface length increases approximately 3 times faster than the linear outward expansion rate (assuming a somewhat circular urban boundary). Thus, as a city grows outward 2 miles in one direction the resulting increase in the urban-rural interface is more than 6 miles. Allowance of "pocket" development beyond simple linear expansion in rural areas greatly exacerbates the interface issue. An example of what actual growth looks like is this map of urban growth projection in Lincoln, Nebraska.



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Urban encroachment may raise the public's concerns with agricultural air emissions. While actual agricultural emissions may remain constant or actually decrease, *perceived* emissions to the new population in the interface zone may give rise to complaints or heightened standards.

In many urban locations across the U.S. absolute concentrations of many of the criteria pollutants, including ozone and PM, have remained rather constant or trended downward for the past 30 years or longer, though some areas have seen slight increases. The vast majority of these downward trends have been due to much improved combustion and fuel technologies, spurred by both regulation and economics. Contaminant concentrations in rural areas are less intensively monitored, but of those that are, some show increasing airborne contaminant levels. In both urban and rural areas there is considerable interannual and seasonal variability in ozone and PM concentrations, mostly due to meteorological variability.

A significant but related issue is the rise in atmospheric concentrations of greenhouse gases (GHGs), and the role that agriculture and the USDA are playing in this issue. For agriculture and natural resources the primary GHGs of concern are carbon dioxide, methane and nitrous oxide. Agricultural lands afford great opportunities for sequestering carbon (reducing carbon dioxide levels) and reducing or mitigating emissions of other GHGs. Efforts to quantify and encourage such actions are on-going in the Natural Resources Conservation Service (NRCS).

NRCS has formed a technology development team to address agricultural air quality and atmospheric change issues, and by identifying 12 of its 79 resource concerns as having an air quality focus. In some parts of the country, particularly California, a large portion of conservation plans and practices specifically target reductions in air emissions from agricultural operations. More information and better technology and information will be needed by the agency to fully address all of the current and projected issues.

Major Opportunities and Barriers

Many persons in the agricultural community understand the general relationships between agricultural activities and air quality. However, in many cases, more specific and targeted education, information and technologies are needed by agriculturalists to best address the increasing complexity of agricultural air quality issues. Much of this information does not presently exist, so more targeted research is needed. Priority should be placed on emerging and "hot button" issues that require attention, and which have a high probability of successful mitigation. NRCS is engaged in this process by developing informational resources, providing technical assistance and training, and developing or implementing appropriate air quality technologies that ultimately will assist landowners and producers in making wise management decisions.

Science and Technology Status

New and alternative technologies for the animal agriculture community are needed to assess and mitigate odor, ammonia, PM and VOC emissions. Many of these technologies exist, and need to be evaluated by NRCS for relevancy and possible use. Current NRCS testing of the Wind Erosion Prediction System (WEPS) should be implemented as soon as possible to assist with wind-generated PM estimation for air-quality planning. Better climate data, particularly for wind and transport phenomena, are needed to support WEPS and other applications. University and USDA-Agricultural Research Service (ARS) research and air quality tools need to be better integrated into NRCS field operations. An NRCS National Engineering Handbook (NEH) Part 629 on Agricultural Air Quality is in preparation and needs to be completed within 2 to 3 years. The first three chapters covering odors, tropospheric ozone, and greenhouse gases are now in final review. More research regarding agricultural sources of greenhouse gases, most notably carbon dioxide and nitrous oxide, is needed. Efforts are underway to integrate the voluntary reporting of GHGs and carbon sequestration into NRCS conservation planning and programs. The CarbOn Management Evaluation Tool for Voluntary Reporting (COMET-VR) is being refined and tested for possible adoption within the NRCS and the agricultural community as a means of estimating annual GHGs and carbon sequestered on land parcels. For more information visit: http://www.cometvr.colostate.edu/.

The NRCS Air Quality and Atmospheric Change web page is available at: http://www.airquality.nrcs.usda.gov/. This site contains information and relevant links associated with agricultural air quality, including many job sheets and worksheets describing air quality enhancements for the Conservation Security Program.

Resource Investment

NRCS has provided millions of dollars in program funds and technical assistance for air quality improvements during recent years. For instance, approximately $125,000 is expended per year for development of agricultural air quality chapters in the NRCS National Engineering Handbook. For the past several years NRCS has funded the USDA-Agricultural Air Quality Task Force (AAQTF) with $75,000 annually. About $200,000 has been expended annually for the development, testing and adoption of the COMET-VR web tool for estimating greenhouse gas emissions and for voluntary reporting of GHGs. Approximately $5.2 million was expended in FY04 in support of air quality-related projects under the NRCS Conservation Innovation Grants (CIG) process. These projects include hog manure treatment technology, reducing poultry litter ammonia emissions, conservation tillage adoption, and testing of new and innovative anaerobic digester systems. Approximately $60,000 annually is invested by NRCS in development and testing of the WEPS model by the ARS. NRCS has approximately 6 staff members devoted to developing and transferring relevant technology for more general field use (Air Quality and Atmospheric Change Team, National Air Quality Specialist, National Atmospheric Resource Specialist, among others.

Conservation Connection

Practices to improve air quality include conservation tillage, residue management, wind breaks, road treatments, burn management, prunings shredding, feed management, manure management, integrated pest management, chemical storage, nutrient management, fertilizer injection, chemigation and fertigation, conservation irrigation, biofilter or dry scrubber use, and equipment calibration. NRCS is encouraging these and other conservation activities through air quality enhancements in the Conservation Security Program (CSP), the Environmental Quality Incentives Program (EQIP), and other agency programs and conservation planning activities. An example is the San Joaquin Valley of California which is a major non-attainment area for both fine particulates and ozone. Since 1998, NRCS has invested nearly $19 million in cost-share funds under EQIP for San Joaquin Valley farmers to reduce various air emissions. This includes $4 million for replacement of older irrigation pump engines, $3 million for conversion to conservation tillage, $6.5 million for conversion from orchard waste burning

to chipping, and $5 million for road dust control. In 2003-2004 nearly 300 large diesel engines were replaced, resulting in a greater than 600 tons/year reduction in NO_x emissions in the valley. It is estimated that since the first EQIP air quality projects were initiated, more than 10,500 tons of PM10, VOCs and NO_x emissions have been reduced. Also in the San Joaquin, more than 6,400 Conservation Management Practice (CMP) Plans specifically addressing air quality issues were developed and signed by Valley growers in 2005. More than 3.2 million acres of agricultural land, more than 1.2 million dairy cows, and more than 49 million chickens and turkeys are covered by these Plans. The Plans are good-faith agreements between the growers and the San Joaquin Valley Air Pollution Control District, and facilitated by NRCS, that will result in substantial decreases in on-farm emissions of PM10 and PM2.5. Nearly 160 tons of PM10 are generated by agricultural activities daily in the San Joaquin. The CMP Plans have already reduced emissions by 34 tons daily, or more than 20 percent of the total. This project represents the type of cooperative conservation among the agricultural community, the regulatory community and NRCS that is making a difference in air quality in many parts of the nation.

NRCS Program Funding, Air Quality 2002-2005

Program	Financial Assistance Funding 2002-2005	Technical Assistance Funding 2002-2005	% of FA	% of TA
Conservation Technical Assistance (CTA)	$0	$28,600,000		74%
Environmental Quality Incentives Program (EQIP)	$40,913,539	$9,192,607	79%	24%
Conservation Innovation Grants (CIG)	$5,053,714	$25,007	10%	0%
Conservation Security Program (CSP)	$3,999,990	$599,999	8%	2%
Agricultural Management Assistance (AMA)	$1,572,564	$369,444	3%	1%
Ground & Surface Water Conservation (GSWC)	$164,040	$38,841	0%	0%
Wildlife Habitat Incentives Program (WHIP)	$68,945	$8,188	0%	0%
Total	$51,772,792	$38,834,086	100%	100%