

Managing Air Quality on the Dairy with the National Air Quality Site Assessment Tool (NAQSAT)

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Overview

The National Air Quality Site Assessment Tool (NAQSAT) was developed for livestock and poultry to assist them in determining the areas on their operations where opportunities exist to make changes resulting in reduced air emissions. (<http://naqsat.tamu.edu>). The tool is intended for voluntary and educational use and can be more valuable when conducted in cooperation with agency personnel or private consultants. The tool can be used for swine, dairy, beef, broilers chickens, laying hens and turkeys and has been designed in cooperation with more than 20 university professionals and fifteen partnering agencies to be applicable across the diversity of enterprises in the nation.

The National Air Quality Site Assessment Tool (NAQSAT) is available free of charge and used online. The program will not download onto the user's computer. Each NAQSAT session is assigned its own unique URL, which may be bookmarked and saved by the user. All NAQSAT sessions are maintained on the host computer and may be accessed by the user over the next 30 days for updates and additional comparisons. The on-line tool addresses eight management areas that relate to air emissions: animals and housing, feed and water, collection and transfer of manure, manure storage, land application, mortalities, on-farm records and public perception. NAQSAT is based on the most accurate, credible data currently available regarding mitigation strategies for air emissions of ammonia, methane, volatile organic compounds (VOCs), hydrogen sulfide, particulates, and odor. When the science-based data was lacking, theories were based on the best professional judgment by leading air quality scientists. This allowed for both quantitative and qualitative based information to be used in developing the feedback portion of the tool.

Air Emissions of Interest

The NAQSAT allows input and provides "Effectiveness Results" for the following constituents of potential concern.

Odor. Odors from livestock farms can be made up of hundreds of compounds (odorants). How these odorants interact with one another contributes to the specific character of an odor. Odorous compounds tend to be carried on dust particles, and, therefore, strategies to reduce odors from animal agriculture often include strategies to reduce dust.

Particulate Matter (PM). Particulate matter, or dust, varies in size on the basis of source and formation. The primary concerns related to airborne particles are haze/visibility and health effects. Dust emitted from farms is highly complex in size, physical properties and composition. For regulatory purposes, airborne particulates are commonly classified into PM₁₀ ($\leq 10 \mu\text{m}$ in aerodynamic diameter) and PM_{2.5} ($\leq 2.5 \mu\text{m}$ in aerodynamic diameter). Coarse particles (2.5 to $10 \mu\text{m}$ in diameter) tend to be deposited in the upper airways of the respiratory tract; fine particles (PM_{2.5}) can reach and be deposited in the smallest airways (alveoli) in the lungs. Farms can contribute coarse particles directly through animal activity, feed preparation, animal housing ventilation units and vehicular traffic. They can also contribute fine particles as the result of a secondary formation process (gas-to-particle conversion; see section on ammonia).

Ammonia. Ammonia is a colorless, pungent, nitrogenous gas. It volatilizes from a solid or liquid material when the ammonium ion is present and other physical conditions exist. Ammonia gas can react in the atmosphere with gaseous acidic species to form fine particulates (ammonium $[\text{NH}_4^+]$ aerosols), which are a health concern. Atmospheric NH_3 can be deposited during rain events and lead to soil acidification and increased concentrations of nitrogen in surface waters, potentially contributing to eutrophication.

Hydrogen Sulfide. Hydrogen sulfide is a colorless, pungent gas best known for its characteristic rotten-egg odor. At high concentrations, hydrogen sulfide can be toxic (silo gas), and even at low concentrations it is a respiratory irritant. Although hydrogen sulfide is not transported great distances, at the farm it can mix with other compounds to contribute to odor.

Methane. Methane is a greenhouse gas. It is a natural product of decomposition of organic materials in the absence of oxygen (anaerobic). Sources of methane include landfills, anaerobic manure storages and the rumens of dairy and beef animals (enteric emissions). Methane can be collected and used as an energy source (biogas for compressed gas fuel or electrical generation through a genset engine).

Volatile Organic Compounds (VOCs). VOCs are a large group of organic chemicals that include an atom of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) and that participate in atmospheric photochemical reactions. Some of these reactions may lead to increased concentration of tropospheric ozone (a criteria pollutant) at ground level, thereby contributing to levels exceeding the National Ambient Air Quality Standard. VOCs can be odorous or contribute to farm odor.

Using NAQSAT

To use NAQSAT, a user first selects one of the six animal species listed on the right-hand side of the home page. On the next screen, listed on the left side, are the eight management categories that contribute to farm air emissions and are considered in the NAQSAT effectiveness report: Animals and housing, feed and water, collection and transfer, manure storage, land application, mortalities, on-farm roads and public perception. The user enters information into each category. The program is set up to include or remove questions from view on the basis of user input. Answers to some questions will generate additional questions to be answered.

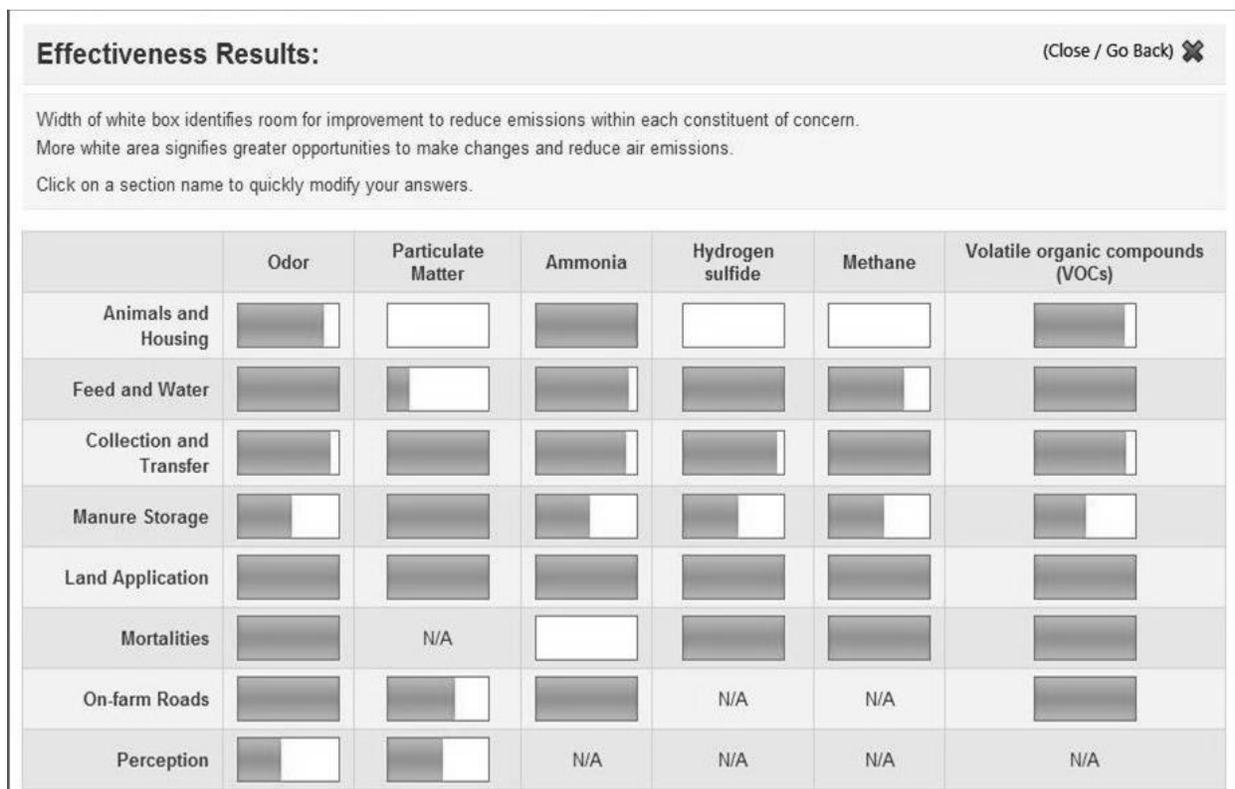
Pop-up pictures assist the user in determining the relative rating to select when questions require a visual evaluation of the existing practices. Pictures are used when a visual appraisal of current practices is most appropriate. Placing the cursor over the picture will generate a text description of the management practice.

A user can complete all eight sections or just those sections that are of specific interest to them.

User results are presented in the form of a bar graph for each of the management areas that estimate the degree to which current management has incorporated practices to manage air emission given the current understanding of how production practices impact emissions and the opportunity for additional changes to mitigate air emissions. The tool works with the current facilities and structures on a farm and provides information based on the facilities and structures present.

Example Output and Results Interpretation

Example output is shown below. The effectiveness of current practices for each management category and each emission of concern is reflected by the percentage of green in the boxes under each emission. The larger the green area in each box, the more effective current management practices are and the fewer the opportunities to reduce emissions of that constituent in that management category. If all boxes are completely green, it does not mean there are no emissions. Fully green boxes simply indicate that the current management practices for the existing structural facilities provide few or no opportunities to reduce the emissions of that constituent in that management category.



Depending on the availability of funds or willingness to change management practices, the producer can use the tool to simulate changes made and the impact on air emissions. The provided example output suggests that improvements might be made in housing management practices that result in reduced particulate matter emissions. One thing that is important to recognize is that such changes might increase expected ammonia emissions, thereby reducing the amount of green in that box. NAQSAT was designed to allow users to save their original inputs and effectiveness results and then run scenarios comparing the results of implementing proposed changes in management practices with the current conditions.

Summary

The NAQSAT assessment tool evaluates management practices and control technologies that are in place or under consideration relative to the potential for managing emissions from the given facility and associated infrastructure. The tool is unique in that multiple gaseous emissions, including odor, particulates, hydrogen sulfide, ammonia, methane, and VOCs will be considered during a single assessment. The tool does not provide emissions data; rather it is designed to provide producers with opportunities to make on-farm changes to reduce air emissions. The tool provides the opportunity to run scenarios with proposed changes to determine the impact a new practice would have on emissions. Trade-offs may exist within a production system such that all emissions cannot effectively be minimized. NAQSAT does not provide emissions data and/or regulatory guidance. The tool provides a free, voluntary, non-threatening, on-line, user-friendly format. When used in concert with consultants, NRCS personnel and published emission mitigation resources, livestock producers will identify areas of concern within their operation and alternative management practices that reduce air emissions from all aspects of their farm.

Benefits of Using NAQSAT for Producers

- Voluntarily assess current management practices using a tool tailored to your farm.
- Make a side-by-side comparison of how different practices or technologies impact emissions.
- See how changing one practice to reduce emission of one gas or pollutant changes other emissions.
- Print your reports to document progress over time.
- Access a list of technical experts involved in tool development.
- Link to other technical resources.

Benefits of Using NAQSAT for Technical or Agency Staff

- Identify mitigation options and cross reference with practice standards.
- Prioritize investments.
- Identify air emissions impacts of potential changes made for other reasons.
- Evaluate land-use decisions.
- Use to confirm that changes and programs can result in real change.
- Provide education about management practices and air emission impacts.

Partners and Funding Sources

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- Michigan Pork Producers Association
- Michigan State University
- National Pork Board
- Nebraska Environmental Trust
- Oregon State University
- Pennsylvania State University
- Purdue University
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