

The AAQTF recommends the following nitrogen research issues be given priority consideration for funding by USDA agencies.

1. Fate and transport of ammonia

- a. Research is needed to better understand the bi-directional flux of ammonia to/from surfaces. Specific research needs include improvements in flux measurement techniques, studies of ammonia fluxes over various natural and agricultural systems both near sources and at downwind receptors, and development and field validation of bi-directional flux modeling approaches.
- b. Additional research is needed regarding the contributions of ammonia to fine particle concentrations. The partitioning of ammonia between the gas and particle phase needs to be examined, particularly in the face of changing emissions of sulfur and nitrogen oxides. Effects of ammonia on organic aerosol formation also need to be investigated. Impacts of changes in the gas-particle partitioning of ammonia/ammonium on ammonia deposition fluxes and spatial patterns need to be examined.

2. Emissions

- a. Inventory data: As inputs to the atmospheric chemical transport models (e.g., CMAQ), EPA's emission inventory needs to be improved to account for significant emission variations among different production practices and the variations in animal activity levels over different geographic locations (county by county) and time (diurnal, seasonal, yearly).
- b. Management practices: The need for effective, practical, and economical on-farm/field air quality management practices is ongoing. Practices need to be tested in both the lab and "real-world" settings to ensure effectiveness and provide emissions reduction potential values regionally. Additionally, adaptation of practices into NRCS Practice Standards (when applicable) is desired.
- c. Inventory assessment tools: Easy to use, quantitative tools for conducting on-farm/field air quality emissions inventory assessments are needed for technical advisors and land owners across the US.

These tools should be based on science and come with training outlines.

- d. Systems approach: Better understanding of the influence and interaction of ammonia with other resources such as soil and water is needed to better understand emissions potential and management practice effectiveness.

3. Monitoring

- a. Long-term monitoring: Long-term monitoring programs need to be expanded and enhanced to improve our understanding of spatial and temporal variations of ambient concentrations of air pollutants (e.g., NH₃, PM_{2.5}) in agricultural areas, such that the impacts of air emissions from agriculture on ambient air quality may be accurately assessed. Moreover, measurements of gas phase NH₃ and particle phase NH₄⁺, along with other precursor gases (e.g., NO_x, HNO₃, SO_x) should be simultaneously taken to investigate gas-particle phase partitioning and the formation of inorganic secondary PM_{2.5} as impacted by agricultural emissions. Such multi-species, multi-phase measurements, at a time resolution of 24 hr or better, are critical to validate models used to predict secondary PM_{2.5} formation and to apportion contributions from agriculture and other source types.
- b. Monitoring of BMPs: Assessment of the effectiveness of best management practices (BMPs) requires monitoring of emission reductions and associated impacts on spatial and temporal variations of ambient concentration of the pollutant in question.
- c. Systems approach monitoring: [Research should be conducted in the context of the full N cycle (i.e., air, water, soil, plant system) to ensure that practices are not resulting in creating “trade-off” problems elsewhere in the environment and to ensure that unintended consequences are not resulting.]

4. Education

- a. Education will play a critical role in the implementation of the science and research previously discussed. Farmers and their advisors including consultants, technical service providers, extension educators, agronomists and agency personnel will be adopting new technologies and best management practices to improve nitrogen use

efficiency and reduce losses to the environment. To achieve these goals, the development of multiple forms of educational resources will be required including:

- Education of the effectiveness and proper implementation of improved BMPs that will reduce nitrogen losses while maintaining, or improving, the current level of production. These BMPs need to be able to be evaluated and monitored by knowledgeable technical advisors to assure that they meet the expected reduction in emissions while being cost effective to implement.
- Technical papers will be required to inform educators of the need for reduced emissions, justify the improved BMPs and assist with the development of additional education materials.
- Factsheets and bulletins written in a one to two-page format that are easily distributed but contain in a concise format the critical information pertinent to the user.
- Field days and local demonstrations that showcase and explain the recommended BMPs.
- Recognizing the localization of BMPs applicable to various regions, states and even soil types, these educational resources need to be developed to service the varying regions of the US, crop rotations and production schemes.