



RMNP Ag Subcommittee

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-- CROPPING SYSTEMS --

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General

Q So agencies can better understand agriculture's story, what changes have occurred in each industry's history that may affect ammonia emissions?

- ✓ **Research done primarily in the 70's, 80's, and 90's led to better understanding of factors affecting ammonia volatilization from applied fertilizer sources** such as Urea, Urea-Ammonium-Nitrate (UAN Solution), and Anhydrous Ammonia. Specifically:
 - Temperature, Wind speed, and Surface moisture available to evaporate - affecting volatilization from Urea
 - Soil structure, cation exchange capacity, soil moisture, and organic matter content – affecting volatilization from subsurface applications of Anhydrous Ammonia, which was a common product and application method for supplying nitrogen to crops in the mid to late 20th century.
- ✓ **Research also demonstrated:**
 - Optimum timing for multiple split applications of nutrients throughout the growing season
 - Plant's ability to more efficiently absorb and utilize different N sources at different growth stages



General (continued 2)

Q So agencies can better understand agriculture's story, what changes have occurred in each industry's history that may affect ammonia emissions?

- ✓ **Changes in cost structure and unintended consequences.** For many decades, Anhydrous Ammonia was by far the lowest cost nitrogen source. But safety and negative impacts on soil were factors.
 - Farmers experienced numerous serious injuries associated with handling the compound
 - Anhydrous was found to have negative impacts on soil organisms and soil structure
- ✓ **Development of geo-spatial mapping of variability** related to:
 - soil structure, yields, and nutrient needs
- ✓ **Development of Variable Rate Technologies** for nutrient applications:
 - Enabling efficient use of grid and zone soil sampling methods
 - Enabling farmers to more precisely match crop needs with nutrient applications – zone by zone within fields



General (continued 3)

- Q So agencies can better understand agriculture's story, what changes have occurred in each industry's history that may affect ammonia emissions?
- ✓ **Research, Development, and Utilization of Fertigation (fertilizer with irrigation) techniques and injection system technology.** As irrigation methods evolved to gated pipe, center pivot, and below ground drip systems, injectable fertilizer solutions and field-based metering equipment were also developed to maximize efficiency of delivery to the plant, while minimizing nutrient loss through volatility or leaching.
 - ✓ **Technology development related to droplet size, volume, and height** of nozzle or orifice used to emit the water/nutrient solution.
 - ✓ **Research and development of nitrification and volatilization inhibitors** effectively delaying the conversion of nitrogen sources to their more volatile and/or leachable forms, holding them in forms more readily available and useable by the plant. (see Nitrogen Cycle)



General (continued 4)

- Q So agencies can better understand agriculture's story, what changes have occurred in each industry's history that may affect ammonia emissions?
- ✓ **Development of high-clearance equipment** to accurately and efficiently apply liquid solutions to mid and late season crops using Variable Rate Technology supplying prescriptive geo-spacial nutrient supplements - Maximizing efficiency of delivery to the plant, while minimizing nutrient loss through volatility or leaching.



General

- Q What other agencies, entities, and factors influence your nitrogen management decisions?
- ▶ Science and technology advances/improvements
 - ▶ Equipment resource limitations; availability, cost, anticipated potential R.O.I.
 - ▶ Secondary cost factors of new technology adoption
 - ▶ Cost variability of specific nutrient sources
 - ▶ Anticipated price to be received from crop produced
 - ▶ Labor availability
 - ▶ Timing required to optimize a practice or product
 - ▶ Weather limitations
 - ▶ Nutrient management plan input from Crop Consultant

AGENCY QUESTIONS & DATA GAPS FOR COLORADO AGRICULTURE



General

- Q So that agencies and agriculture are getting the “biggest bang for the buck”, how do we focus our efforts within Colorado for each agricultural industry sector? (Operation size, location, etc... Answer will inform other questions below.)
- ▶ **Fortunately, a crop producer is naturally incentivized** through desire for economic and environmental sustainability - to be as efficient as possible with the purchase and application of nutrients, particularly with Nitrogen applications.
 - ▶ **Since some BMP technologies require substantial capital investment**, many smaller farm operators may not farm enough land to be able to make the investment with a reasonable ROI.



Participating Partner Producers

- Q How can we define a “partner” producer by industry for the purpose of this project to reduce ammonia emissions? (EWS participation, livestock nutrient management plans, crop advisors may be involved, number of BMPs, etc...)
 - ▶ That’s a tough thing to define, since **so many factors come in to play for any particular farm operation**, and no two farms are exactly the same in terms of available resources, access to capital, debt, size, location, etc. A “cookie cutter” approach could be difficult to implement.



Participating Partner Producers

- Q Is the number/percentage of participating “partner” producers measurable by industry?
 - ▶ **Depends** ...on the definition. Some BMP factors might be estimated with some degree of accuracy, others may not be.



Participating Partner Producers

- Q What is an achievable goal (e.g., operation size, percentage) by industry for increasing participating “partner” producer numbers? Possibly achieving participating “partner” producer status for all large operations or significant producer percentage?
- ▶ **Evidence supports that the vast majority of crop producers would already qualify**, due to the fact that most have been incentivized to adopt practices which optimize nutrient management efficiencies in order to survive.
 - ▶ **However, many will want no part in alignment with a federal agency in order to achieve a “good guy” label.** A common perspective is -- they do what they do because they are already oriented toward economic and environmental sustainability ...and won't likely appreciate any regulatory agency or bureaucracy telling them what to do, or how to do it. Agency intervention could actually be counter-productive.

AGENCY QUESTIONS & DATA GAPS FOR COLORADO AGRICULTURE

Participating Partner Producers



Q How to achieve the industry goal from the previous question?

- ▶ **Let the current inherent incentives continue to work without intervention**, capitalizing on the intensely independent character of American farmers and their motivation to sustain their operations.



S.M.A.R.T. Measures and BMP's

Q What are “S.M.A.R.T” measure(s) for each industry? (production, manure, applied fertilizer/biosolids, EWS participation, etc...)

▶ BMP's related to **Soil Health:**

- Practice Integrated pest management
- Crop rotation
- Reduced-tillage or Conservation-tillage methods
- No-till methods
- Planned interval Soil testing for amendment management planning





S.M.A.R.T. Measures and BMP's

Q What are “S.M.A.R.T” measure(s) for each industry? (production, manure, applied fertilizer/biosolids, EWS participation, etc...)

- ▶ BMP's relevant to Nutrient Management protecting **water** and **air quality**
 - Planned-interval soil testing as part of nutrient management planning
 - Split applications of nutrients throughout growing season
 - Variable rate applications based on zone or grid analysis prescription
 - Matching nutrient applications to plant uptake needs
 - Use of nitrification inhibitors
 - In-season tissue testing
 - Low pressure and low profile nozzle orientation





S.M.A.R.T. Measures and BMP's

Q What are “S.M.A.R.T” measure(s) for each industry? (production, manure, applied fertilizer/biosolids, EWS participation, etc...)

- ▶ BMP's relevant to Nutrient Management protecting **water** and **air quality** (continued)
 - Emphasis on the four ‘R’s
 - Right Amount,
 - Right Time,
 - Right Place,
 - Right Product
 - Use of Hybrids with state-of-the-art Trait technology
 - These accommodate reductions in tillage, compaction, volatilization, evaporative loss





S.M.A.R.T. Measures and BMP's

- Q For identified “S.M.A.R.T” measure(s), request data record and forecast by industry sector, to establish trends and understand future scenarios.
- ▶ **Trend indicators of BMP adoption and management approaches could potentially be estimated** from synthesis of a variety of sources that might include:
 - Farm Service Agency summarization
 - NRCS program participation
 - Cooperative Extension County Agent perspective.
 - Independent Crop Consultant perspectives

S.M.A.R.T. Measures and BMP's



- Q Request cumulative BMP list (those that are known to directly/indirectly affect ammonia emissions) by industry.
- ▶ Reference the **contingency plan** document put together by Brock Faulkner in about 2009.
 - ▶ Reference the **producer survey** implemented by CSU's Troy Bauder a few years ago.
 - ▶ Reference the **Best Management Practices for Colorado Corn** publication from CSU Extension.
 - ▶ Reference similar **BMP guides** published for other crops.



S.M.A.R.T. Measures and BMP's

- Q Request BMP implementation data record/history by industry. (Cumulative BMP list must be referenced.)
 - ▶ A survey exists from approximately 6 or 7 years ago, done by CSU (Bauder)
 - ▶ NRCS may be able to provide an estimate, although all producers don't participate in NRCS programs. (portion of whole not known by slide preparer)



S.M.A.R.T. Measures and BMP's

- Q What frequency (biannual, annual, etc...) are “S.M.A.R.T” measure(s) and BMP implementation data available, and what data lags are required?
- ▶ Best possible potential – if available - would be on an annual basis.
 - ▶ Estimated lag could be 2 to 6 months (depending on cropping system specifics such as; crop rotation specifics, fiscal year cycle)



S.M.A.R.T. Measures and BMP's

Q What are the barriers to BMP adoption by industry? How to overcome and incentivize?

▶ **Typical Barriers:**

- Cost of transition to the particular BMP practice
 - Capital cost of equipment or technology needed
 - Cost of adapting associated practices or equipment. Seldom can a system change be made without affecting other secondary or supporting practices or equipment.
- Other factors of an operation related to: size, economies of scale, labor availability...

▶ **Overcome/incentivize:**

- Science, and new method development
- Economic assistance or partnership,
- Outreach and education

AGENCY QUESTIONS & DATA GAPS FOR COLORADO AGRICULTURE

S.M.A.R.T. Measures and BMP's



- Q What are the best data sources for participating “partner” producer numbers, “S.M.A.R.T” measure(s), and BMP list and implementation data for each industry?
 - ▶ (already addressed?)



S.M.A.R.T. Measures and BMP's

- Q Request Early Warning System records (including aggregate operator participation and practices data), goals, and roll-out/implementation plan.
 - ▶ Not confident this question reflects a significantly impactful way to assess cropping system BMP effectiveness.
 - ▶ Depends ...on other factors, such as the amount of moisture anticipated with a particular upslope event. When ¼ inch or more of moisture is anticipated, an upslope may be considered a useful incorporation tool to reduce volatility.