

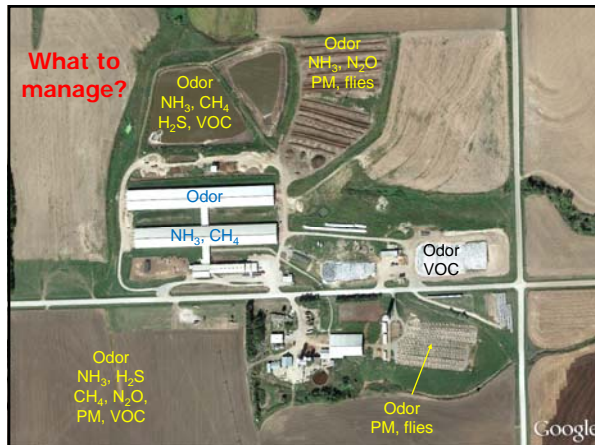
Best Management Practices for Reducing Odor & Emissions on Midwest Dairies

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Why manage odor? Today's realities:

- Every dairy produces odor
 - Smells like? How often? ? For whom? ? ?
- Odors may evoke complaints and complaints can be bad news for business
 - Communication divide with neighbors
 - Draw unwanted attention and scrutiny
 - Potential for litigation
 - Distraction for management of dairy



Why manage odor? Tomorrow's challenges:

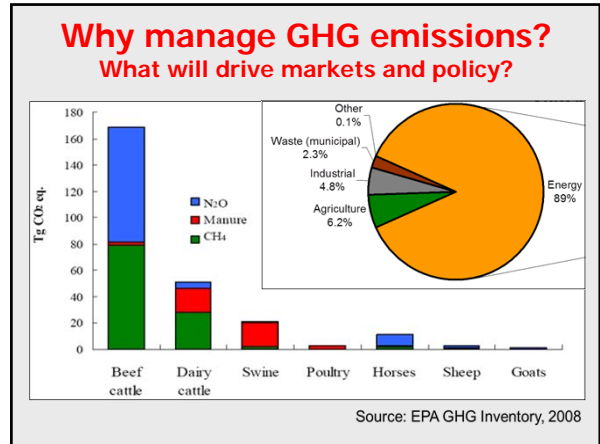
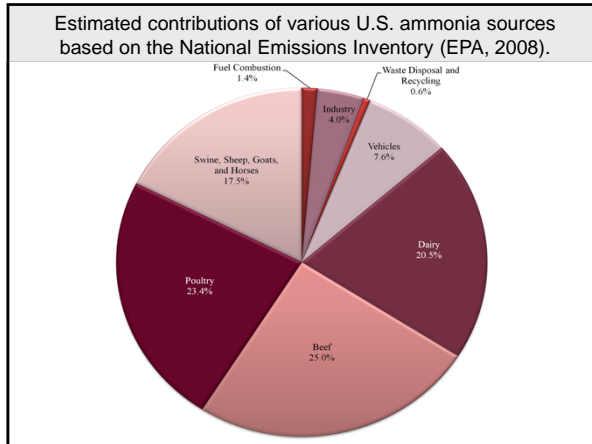
- Odor affects farm sustainability
 - Image and acceptance in rural community
 - Tolerance for growth/expansion

Air Quality Issues for Dairies

- Odor
 - A real concern for most producers
- Ammonia
 - An imminent concern for many producers
- Greenhouse gases (GHG)
 - A growing concern / opportunity for some producers
- Other gases and dust
 - A potential concern for a few producers

Why manage ammonia (NH₃) emissions?

- Growing environmental concern
 - Chesapeake Bay, nutrient loading
 - Reactive N, fine particulates (PM_{2.5})
- Expanding reach of regulations
 - Enforcement of EPCRA reporting
 - Role of Clean Air Act??
- Significant loss of nitrogen
 - Fertilizer value



Concern about Reactive N

While air consists of mostly N_2 gas, other forms of N in the atmosphere (e.g. NO_x , NH_3 , N_2O) are being assigned negative environmental impacts.

Example:

- Health studies have shown a significant association between exposure to fine particles and premature death from heart or lung disease.
 - PM is a regulated criteria pollutant
- NH_4NO_3 is a common fine particulate in agro-industrial areas
 - NO_x (nitrogen oxides) is a regulated criteria pollutant. Power plants, automobiles, and other combustion sources emit NO_x .
 - Farms emit ammonia (NH_3), a $PM_{2.5}$ precursor.

Source: www.epa.gov

National Air Quality Site Assessment Tool

Select a species to begin:

- Swine
- Broiler Chickens
- Dairy**
- Laying Hens
- Beef
- Turkeys

NAQSAT National Air Quality Site Assessment Tool

Purpose: The National Air Quality Site Assessment Tool (NAQSAT) has been developed for the voluntary use of livestock producers and their advisors or consultants. It is intended to provide assistance to livestock and poultry producers in determining the areas in their operations where there are opportunities to make changes that result in reduced air emissions. Air emissions research from livestock production systems is increasing every year. NAQSAT is based on the most accurate, credible data currently available regarding mitigation strategies for air emissions of ammonia, methane, volatile organic compounds, hydrogen sulfide, particulates, and odor.

NAQSAT was designed to provide information and education, only. It is not intended to provide emissions data and/or regulatory guidance. All users receive a report of priority areas where improvements can be made. Regardless of the amount of emissions produced by the facility. These priorities are not a reflection of risk, but rather a relative evaluation of current production systems based on the most accurate data and understanding of management systems currently available. The report generated cannot be used to compare one livestock facility to another because the evaluation is of a facility relative to its potential given current understanding of management practices and mitigation options.

Scores for each emission are generated upon online completion of NAQSAT. Scores reflect the degree to which an operation has incorporated all of the possible practices needed that would effectively minimize air emissions from the facility. Trade-offs may exist within a housing type that all categories of emissions cannot effectively be minimized. The tool considers the impact of diet, housing management, manure handling, management, transport, land application of manure, neighbor relations, and internal and nearby road management practices. Once areas where changes could be made are identified, resources to help implement changes are identified for the user. A user can run NAQSAT a second time with a proposed change included to determine the impact a change would have on emissions. Comparing results from multiple runs of the program may highlight unintended consequences where a mitigation measure to reduce one constituent may inadvertently increase one or more other constituents of concern.

<http://naqsat.tamu.edu/>

Why manage GHG emissions? Dealing with misperception & uncertainty

Issue	Perception or feared outcome	Reality now or likely outcome
Regulation of Ag emissions	<ul style="list-style-type: none"> EPA regulation via CAA New state policy (e.g. CA) Congress pass a 'cow tax' 	<ul style="list-style-type: none"> EPA reporting rule on books for >3,200 cows Lack legislative support
Consumer demand & milk market	<ul style="list-style-type: none"> 'Green' consumers want 'low-carbon-footprint' food Barrier for market growth 	<ul style="list-style-type: none"> Lag in willingness to pay (consumer & retailer) Niche → market-wide
Methane capture and market	<ul style="list-style-type: none"> Profit from carbon credits or producing bioenergy Digesters will be required 	<ul style="list-style-type: none"> No/poor U.S. market for carbon credits / biogas Digesters in select cases
Role of U.S. Animal Ag	<ul style="list-style-type: none"> Leading GHG emitter Bear large burden of reducing emissions 	<ul style="list-style-type: none"> Relatively minor source of U.S. GHG emissions A model for efficiency

NAQSAT Output

Effectiveness Results: Freestall barn, sand bedding, scrape 2x to basin, surface apply and incorporate SLDM

Width of white box signifies room for improvement to reduce emissions within each constituent of concern. More white area signifies greater opportunities to make changes and reduce air emissions. Click on a management category to quickly modify your answers.

Management Category	Odor	Particulate Matter (PM ₁₀)	Ammonia (NH ₃)	Hydrogen sulfide (H ₂ S)	Methane (CH ₄)	Volatile organic compounds (VOCs)
Animals and Housing	██████████	██████████	██████████	██████████	██████████	██████████
Feed and Water	██████████	██████████	██████████	██████████	██████████	██████████
Collection and Transfer	██████████	██████████	██████████	██████████	██████████	██████████
Manure Storage	██████████	N/A	██████████	██████████	██████████	██████████
Land Application	██████████	N/A	██████████	██████████	██████████	██████████
Mortality	██████████	N/A	██████████	██████████	██████████	██████████
On farm Roads	██████████	██████████	██████████	N/A	N/A	██████████
Perception	██████████	██████████	N/A	N/A	N/A	N/A

Print My Report

Saved Session Information: If you wish to retrieve your session at a later time, copy the following ID

Results after BMPs for Odor

Effectiveness Results:

Width of white box identifies room for improvement to reduce emissions within 4
More white area signifies greater opportunities to make changes and reduce air.
Click on a management category to quickly modify your answers.

Management Category	Odor	Particulate Matter (Dust)	Ammonia (NH ₃)
Animals and Housing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feed and Water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collection and Transfer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Manure Storage	<input type="checkbox"/>	N/A	<input type="checkbox"/>
Land Application	<input type="checkbox"/>	N/A	<input type="checkbox"/>
Mortality	<input type="checkbox"/>	N/A	<input type="checkbox"/>
On-farm Roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perception	<input type="checkbox"/>	<input type="checkbox"/>	N/A

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On-farm Roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perception	<input type="checkbox"/>	<input type="checkbox"/>	N/A

<http://nagsat.tamu.edu/dairy/?key=cc170445>

Manure Injection

Can conserve 90% of N value



Tank wagon
(1,500–10,000 gal)



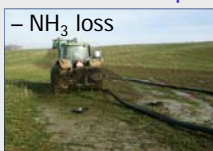
Hose-drag injector
(900,000 gal/day)

How fast can/must manure be applied?
More compaction, but tillage benefits

↓ Odor, ↓ NH₃, ↓ H₂S
Also reduces runoff

Priority #1 - Land Application

- Odor hot button
 - Strong eye-nose-brain connection
 - Acute, intense emissions
 - Proximity concerns
 - Perceived lack of control
- Gas emission spike
 - NH₃ loss



Manure Incorporation

Effective emissions reduction when done promptly (< 24 hours) [WDNR NR 243, <48 hr]



Land Application AQ BMP

- Get it below
 - Keep it low
 - Think about how the wind will blow
 - Manage how your neighbors know
- } Manage emissions
- } Manage impacts



Subsurface Agitation

Minimize throwing and splashing

Do



Don't



Photos by: C. Fulhage

Keep a Low Profile



Less drift and attention

- Maximize droplet size
 - Large nozzles
 - Low pressures
- Control spray distance
 - Little or no upward spray
- Spray within the canopy or close to the ground



↓ Odor, ↓ NH₃, - H₂S, ↓ Drift

Dairy Facilities

- Baseline emission sources (24-7-365)
 - Source of chronic odor complaints
 - Regulatory control and action most likely
- Dairy herd management tends to:
 - Limit cattle areas as odor emission sources
 - Shift emissions to manure storage & handling



How the wind blows...

- Monitor weather forecast
 - Esp. wind direction and speed
 - Who / what is likely downwind of application area?
- Avoid calm days and dusk/dawn application for manure application
 - Odor plume stays concentrated and near the ground
- Avoid windy days for irrigation
 - Don't irrigate if wind > 10 mph



Feed Mgt. – Balance Rations

- Overfeeding protein → NH₃ emissions
 - Use multiple rations
 - Test feeds regularly
 - Balance for metabolizable protein
 - Manage byproduct use (distillers grains, etc.)

How do neighbors know?

- Communicate with them ahead of time
 - Convey appreciation of their interests
 - Neighbor activities?
 - Convey your efforts to minimize impacts
- Limit sensory effects
 - Property line windbreaks (vegetative buffers)
 - Visual and olfactory benefits
 - Limit use of public roads and tracking
 - Turn off or remove end-guns on pivots

Feed Management

- Manage feed for less shrink and wastage
 - Good cover and seal
 - Manage bunker face [exposure]
- Manage feed bunks and water tanks
 - Clean bunks and tanks regularly
 - Limit unintended wetting of feed
 - Limit water spillage / promptly fix leaks



Barn Practices

- BMP for odor and gases are same as for cow cleanliness and mastitis control
 - Clean
 - Dry
 - Comfortable



Storage BMP – Liquid Manure

- Maintain/enhance solids removal
 - Maintain mechanical separators
 - Clean out settling basins regularly
 - Clean out storage basins fully
 - Manage manure treatment system



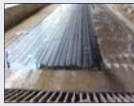
OR

- Maintain crust as natural cover



Manure Collection

- Consider effects of cleaning frequency
 - Scrape systems
 - More often is better for odor
 - Less often may be better for ammonia emissions
 - Flush systems
 - More often is generally better
 - Depends upon quality of flush water (burst emissions)
- Maintain cleaning effectiveness



Storage BMP – Solid Manure

Limit moisture addition (keep high & dry)

- Helps control odor, ammonia loss & flies
 - Divert clean runoff
 - Divert precipitation
 - Drain off seepage
- Partial compost
 - Benefit for odor control
 - May increase NH₃ loss



Manure Transfer to Storage

- Load into storage below surface
- Use closed pipe or conduit

Minimize exposure to air [and eyes]



Summary

- Odor and ammonia emissions likely key
- Land application can invite trouble
 - Immediate incorporation → less emissions
 - Don't ignore the power of communication and perception
- Facility emissions may become challenge
 - Reducing emissions probably means managing manure better or differently
 - Managing manure emissions may entail inconvenience, cost, complexity, etc.