An agricultural engineering, animal science, veterinary, and agricultural economics team in the Amarillo area is developing approaches for air quality management for open-lot beef confinement systems. Open unsurfaced cattle feedyards in the Southern Great Plains can produce odor of high concentration and offensiveness when manure is wet (above 60% wet basis) (Watts et al., 1994, and Sweeten, 2000). Conversely, feedyards can produce organic dust (particulate matter, PM) at relatively high concentrations on an intermittent, diurnal basis when the manure is dry (below 25% wet basis). Basic approaches to mitigate both odor and dust events include: (a) frequent manure harvesting from feedpens, and (b) management of surface moisture content (Sweeten, 2000). Frequent removal of surface manure during the cattle feeding cycle (typically 120-130 days) with precision manure harvesting equipment will help control dust events by minimizing pulverization and entrainment of fine dry manure by cattle hooves with ensuing dust emissions in evening hours (Auermann et al., 2000). Likewise, maintaining uniform pen drainage with relatively low manure inventories will reduce saturation, minimize prolonged mud problems, and speed surface drying after precipitation (Watts et al., 1994).

Management of surface moisture content also includes potential for adjusting the stocking rate to either increase or decrease effective moisture excretion per unit area from the excreted fresh feces and urine (normally about 6 gal/day/1,000 lbs liveweight moisture) (Sweeten and Lott, 1994). Romanillos and Auermann (1999) showed a 20% reduction in dust emissions from feedpens where stocking rate was reduced from 150 ft²/hd to only 75 ft²/hd. Tradeoffs included equal or slightly reduced cattle rates of gain.

Water applications to pen surfaces can supplement frequent manure collection and stocking rate adjustments for dust control for dry weather conditions (Sweeten and Lott, 1994). The use of sub-

regional or on-site weather data may be useful in the future to guide water application decisions where the feedlot is equipped with sprinklers or mobile tankers.

Multidisciplinary research at Bushland, Amarillo, and Canyon, Texas, has reduced ammonia emissions from simulated feedlot pads by up to 80% with alum treatment vs. control treatment (Shi et al, 1999); quantified endotoxin concentrations in feedlot dust; identified biological markers of oxidative stress in arriving feedlot cattle exposed to dust; determined that antibiotic protection in dust-exposed ruminant animals can increase average daily gains by 54% vs. unprotected animals; and determined 18% lower disease protection as indicated by total antioxidant capacity of blood in calves exposed to feedlot dust (Chirase, 2001).

Dust and odor approaches may alter the design and management of conventional cattle feedyards, and each approach has cost/return factors associated with them.

References Cited


Integrating Interdisciplinary Analyses, Multiple Decision Levels and Equitable Allocation Into the TMDL Process:

The Role of Agricultural Economists?

Vent W. Beeson

Total Maximum Daily Load (TMDL) Process

1) Identifies the amount of various pollutants that can be assimilated by an impaired stream or water body and meet the quality standards for its planned use
2) Determines the current pollutant load and likely source
3) Allocates the allowable pollutant loads and future loads to the various sources

TMDL Analyses are often Interdisciplinary

The first of 5 studies discussed today is “Cattle-Fedlot Odor and Dust Control: Approaches and Recent Results”

Texas A&M AgriLife and Extension Center: Amarillo

Animal Production & Air Quality

Parameter:
- Odor
- Odorants (odoriferous gases)
- VOCs
- Particulate matter (PM10)
  - Dust
  - Greenhouse gases

Animal Production & Air Quality

Technologies/Approaches
- Ration/diet manipulation.
- Manure treatment/handling.
- Capture/treatment of emitted gases.
- Enhanced dispersion.

Animal Production & Air Quality

Dust Control Approaches
- Frequent manger cleaning.
- Stocking density adjustments, seasonal.
- Surface treatment
  - Wet sprays
  - Od spray (concentrate buildings)
- Misting, wetting or heating sprays.
- Animal behavior
  - Feeding stations (?)

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Air Quality
Selected Accomplishments—TAMU:
• Improved PM<sub>2.5</sub> emission factors for feedyards through field research.
  • Reduced by 90%.
  • From 70 down to 15 lbs/1000 head/day.
  • 300 ton/year less PM<sub>2.5</sub> emissions.
  • Emission fees at $15/t.
  • Potential $10,000/yr feedyard savings (avg.), emission fees.
• More accurate dispersion model for feedyards (NASA source).

Animal Production & Air Quality

Air Quality and Feeder Cattle Health
ARS/TAMU/WTAMU
• Quantified endotoxin concentrations in manure dust.
• Identified two biological markers of exclusive access in cattle subjected to transportation / forage storage.
• Nutritional status and exposure levels compared, increased ARC 54% vs. unpreserved hay.

Air Quality Selected Accomplishments
ARS/TAMU/WTAMU
• Reduced dust emissions by frequent needle spraying (≈50%) and increased mixing & hayguy (≈20%).
• Reduced TSP 25-50% with plot water sprayed.

Guidelines for Sprinkler Design and Use
• Capacity should be 0.25-0.3 in/day.
• Exclude region near feed bunk.
• H<sub>2</sub>O demand proportional to manure depth.
• Large droplets: less drift, greater compaction.
• Holding pond effluent: unseared, definitely useful for needs, unadulterated compost.
• Prioritize areas: where is water needed most?

Take-Home Messages
• Applying water to the feedyard surface, either passively or actively, is not a cure-all.
• Frequent manure-hosing (≥1 per turn) will decrease water requirements and increase water effectiveness.
• Use the off-season to get ready.
• Prioritize within the yard and the corn.
Increased Regulatory / Social Pressures on the Environment

- Water quality impacts with traditional uses
- Need to pursue environmentally sound alternatives
  > on-farm: economically OK, environmentally not
  > off-farm: environmentally OK, economically not
- Off-farm management options
  > centrally coordinated complexes
  > value-added manufacturing (VAM) & sales

Today's Situation Regarding Aggregation

- Existing clean-out contractors...
- Provide raw litter management services
- Relatively small, local
- Simple infrastructure
- Independent
- Not focused on alternative / distant markets
- Financially constrained

Solutions May Involve Multiple Marketing Decision Levels

"Practical Aspects of Manure Marketing"

H. L. Goodwin
University of Arkansas
Jim Wimberly
Foundation for Organic Resources Management

Poultry Litter Marketing Channels

- Raw Litter Production: Country in abundance
- Assembly/Aggregation: Informational (THE KEY)
- Value-added Manufacturing / Processing: Available
- Wholesaling / Marketing: Can be developed
- Retailing: Can be developed
- Consumption (End-User): Needs better identification

Current Market Constraints on Effective Manure Usage

- Competition from other, more convenient nutrient sources
- Inadequate market valuation of manure as a resource
- Inadequate infrastructure necessary to transport large quantities of litter at distances exceeding 10-20 miles
- Overall negative market sentiment toward using manure as a soil amendment
- Variable manure quality (nutrient content, moisture, etc.)
- Seasonal variation in demand for manure
- Burrnearer regulatory/recycled-lumping requirements
Need for a Third Party Enterprise

- Existing industry structure not conducive
- Need for a entity with primary litter management as purpose
  - i.e.  makes litter collection easier
  - is not involved in poultry production
  - is not geographically bound to specific areas
  - but has an interest in the litter being collected

Roles of a Litter Bank

- Coordinate and Aggregate Raw Materials
- Coordinate Cross-country Contracting
  - Shippers
  - Shippers
  - Manufacturers
  - End Users

- Optional Services
  - Packout management plan
  - Certified transport and application (raw or processed)

Off-farm Litter Management

Potential Structural Options

- Electronic Structure
  - Match buyers and sellers of litter
  - Coordinating timing of render clean-out
  - Providing litter handling/transport services
  - storage facilities
  - Value-added facilities

- Physical Structure
  - Receive clean-out and packaging away from areas
  - Operating litter transfer stations
  - Litter warehousing prior to delivery
  - Litter delivery to Value-added facility or end users
  - Owning / operating Value-added facility

Equitable Allocation Requires Economic & Environmental Assessment

The third of five studies discussed today is: "Economic and Environmental Impacts of Utilizing Feeder Manure Integrated with Conservation Tillage on Irrigated Agriculture, Texas High Plains."

Esha Wang and Hyatt Hamza
Texas A&M, Blackland Research and Ext. Center-Temple

The studies have shown that integrated manure management can provide economic and environmental benefits. The use of conservation tillage practices can help reduce water usage and increase soil health, which in turn can improve the overall sustainability of agriculture in the Texas High Plains region.
**Impacts at the Regional Decision Level**

The final study discussed today is "Regional Implications of Economic and Environmental Alternatives that Reduce Phosphorus on Representative Irrigated Farms in Southwest Missouri."

Valer Benson, D. Todd Freyland, Robert E. Young, III, and Peter Zornick, U. of Missouri

**Phosphorus in SW Missouri**

Currently, broadcast measures in SW Missouri contain more phosphorus than can be removed daily by agricultural production without large expenditures in the upper soil layers. Accumulation of phosphorus in the upper soil layers will lead to increased phosphorus in runoff water.

Increased phosphorus in runoff will likely lead to increased plant and algae growth in streams and lakes resulting in reduced oxygen in the water for other aquatic life.

**Ending Cash Reserve for Lawrence and Barry Counties**

[Graph showing ending cash reserve for Lawrence and Barry Counties over time, with data points marked by months and years.]