

MICHIGAN STATE UNIVERSITY

## Nutrient Management *A Michigan Perspective*

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### Regulations & Michigan Livestock

- Right to Farm Act (voluntary)
  - Generally Accepted Agriculture and Management Practices (GAAMPs)
- National Pollutant Discharge Elimination System (NPDES) permit
  - No Potential to Discharge
  - Non-contact process water discharge
- Groundwater permitting
- Ground water well
- Bodies of Dead Animals Act
- Air permitting (incinerators, flares, engines & boilers)
  - To install
  - Operate

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### Michigan Right to Farm Act (1981)

“AN ACT to define certain farm uses, operations, practices, and products; to provide certain disclosures; to provide for circumstances under which a farm shall not be found to be a public or private nuisance; to provide for certain powers and duties for certain state agencies and departments; and to provide for certain remedies for certain persons.”

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### Michigan Right to Farm Act (1981)

- Investigate complaints, normal agricultural practice not a nuisance
  - Verified – 30 days to correct
  - Unverified – no further action
  - 3 unverified complaints from a single citizen can result in legal action
- 2000 clarification that the “act preempt any local ordinance, regulation, or resolution”
  - Local ordinance require approval by Ag. Commission
- Generally accepted agricultural and management practices (GAAMP’s)

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### GAAMP’s

- Manure Management/Utilization (1988)
- Pesticide Utilization/Pest Control (1991)
- Nutrient Utilization (1993)
- Care of Farm Animals (1995)
- Cranberry Production (1996)
- Site Selection/Odor Control for New Expanding Livestock Facilities (2000)
- Irrigation Water Use (2003)
- Farm Markets (2010)

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### Livestock Regulatory Timeline

- Manure Management/Utilization (1988)
- Nutrient Utilization (1993)
- Care of Farm Animals (1995)
- Concentrated Animal Feeding Operations (CAFO’s) required to be permitted (2001)
- Site Selection/Odor Control for New Expanding Livestock Facilities (2000)
- Irrigation Water Use (2003)
- Annual Water Use Conservation Plan (2009)
- All CAFO’s waste storage facilities must comply with the NRCS 313 practice standard (2012)

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### Michigan Thresholds

- CAFO's
  - 1,000 animal units
  - 700 manure cows
  - 2,500 feeder pigs
- Manure application
  - Phosphorus limiting 0-75ppm Bray P II (<150 lb/ac)
    - One application can supply 2 year crop removal
  - Nitrogen limiting 75-150 ppm Bray P II (<300 lb/ac)
  - No manure application >150ppm Bray P II
- Groundwater permitting: 5,000 animal units or 3,500 mature dairy cows

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### Changes in Michigan Agriculture

- Michigan's shrinking agricultural land
  - 1920 – 19.0 M acres of cropland
  - 1970 – 12.7 M acres
  - 2004 – 10.1 M acres
- Increasing fertilizer use
  - 1970 – 0.9 M tons/yr
  - 2004 – 1.4 M tons/yr
- Livestock changes
  - Dairy
  - Swine
  - Poultry

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### Michigan Phosphorus Balance

- Soil test results showed elevating soil tests<sup>1</sup>
  - 1994-95 median soil test level was 106 lb Bray P1/ac (MSU Soil Testing Laboratory)
  - >50% of the samples required no additional P based on current nutrient recommendations
- Phosphate<sup>2</sup>
  - Without fertilizer: -21 lb/ac
  - With commercial fertilizer: +13 lb/ac
- County by county balance
  - 69 of 83 counties have excess phosphate
  - 15 counties exceed by >22 lb/ac

<sup>1</sup>Michigan Right to Farm.  
<sup>2</sup>von Bernuth, R.D. & G. Salthouse. 1999. Applied Engineering in Agriculture. 15(6) 695-700.

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### Statewide Nutrient Balance

- Manure phosphorus production 37,500 Mg/yr<sup>1</sup>
  - Cattle (71%)
  - Swine (24%)
  - Horses (2.5%)
  - Layers (1.8%)
- Nutrients from manure for crop removal:
  - Phosphorus 30 to 40%
  - Nitrogen 10 to 20%
  - Potassium 20 to 30%

<sup>1</sup>von Bernuth, R.D. & G. Salhouse. 1999. Applied Engineering in Agriculture. 15(6) 695-700

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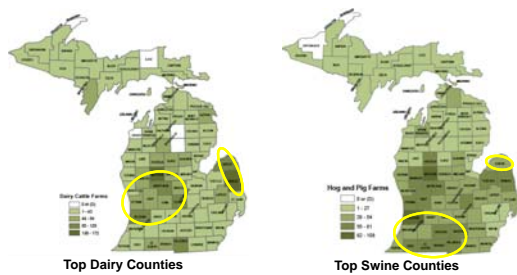
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### Potential for Nutrient Imbalance



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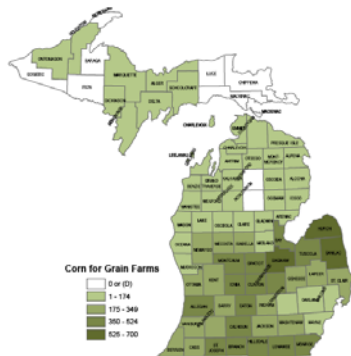
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### Corn Production



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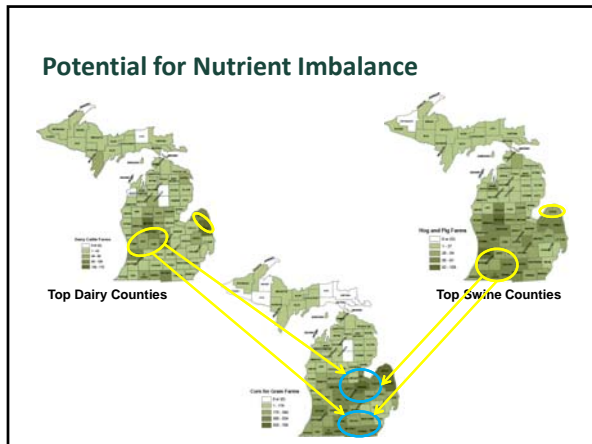
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- ### Improving Manure Nutrient Distribution
- Goals
    - Concentrating nutrients
    - Reducing volume & water content
    - Creating organic rich material
  - Approaches
    - Land application
    - Direct export
    - Chemical phosphorus separation
    - Gasification

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### Direct Export

- Primarily poultry facilities (turkey & layers)
- Dry material (<20% moisture)
  - Bedding
  - Natural drying (long-term, covered storage)
  - Mechanical drying
- Export radius 50 to 100 miles
- Stackable – short term head land stacking acceptable
- Good nutrient content

Type	Housing	TN (lb/ton)	NH <sub>4</sub> -N (lb/ton)	P <sub>2</sub> O <sub>5</sub> (lb/ton)	K <sub>2</sub> O (lb/ton)
Layer	High rise stored	38	18	56	30
Turkey	Grower house litter	15	16	72	40

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### Chemical Phosphorus Separation

- Addition of chemical compounds to bind soluble phosphorus
  - Metal salt to bring about precipitation
    - Negatively charged dissolved phosphorus
    - Positively charged calcium, iron or aluminum
  - Polymer to achieve flocculation
- Separation (dewatering) achieved by:
  - Passive settling/separation (clarification)
  - Dissolved air floatation (DAF)
  - Mechanical separation (belt filter press, rotary drum thickener....)

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### Chemical Phosphorus Separation, cont.

- 3 systems in Michigan over the past 10 years
  - DAF system (1) operated for 18 months
  - Belt press systems (2) have operated continuously for 8 to 10 years
- Goal to concentrate nutrients and reduce overland transport of liquid manure
- System products
  - Effluent – low phosphorus, solids & odor
  - Solids (cake) – >20% solids, >90% phosphorus, stackable, & compostable
- Nutrient composition

Material	TN	NH <sub>4</sub> -N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Unit
Effluent	5.3	4.6	0.2	7.7	lb/1,000 gal
Cake	10.9	1.7	5.2	2.8	lb/ton

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### Chemical Phosphorus Separation, cont.

- Benefit
  - Effective at reducing phosphorus in effluent
  - Good solids separation
  - Low odor products
- Challenges
  - Mechanically intensive
  - Sensitive to temperature and manure composition changes
  - O&M
    - Labor
    - Chemicals
    - Wear

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### Belt Press & Cake



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### Gasification System

- Biomass gasification process
  - Starved-air/low-temperature (SALT) retort / rotary kiln
    - Approximately =600°C
    - Oxygen level 10 to 15%
  - Products are producer gas & ash
    - Producer gas is a mix of CO, H<sub>2</sub>, CO<sub>2</sub>, hydrocarbons and other gases
  - Thermal oxidizer (>1000°C)
  - Boiler/air turbine
- Feedstock – 35 ton/d of turkey litter
- >90% volume reduction
- Energy output
  - 500 kW
  - 8,500 lb/hr steam @ 150 psi

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### Gasification system



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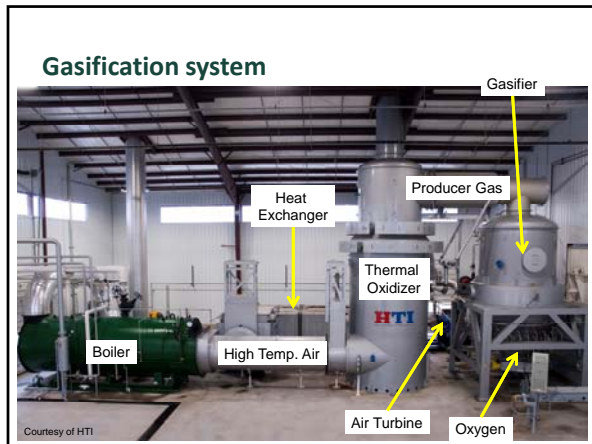
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### Conclusions

- Long history of environmental sensitivity
  - Voluntary programs (RTF, GAAMP's)
  - Regulatory programs (NPDES)
- Significant improvements in manure & nutrient management
  - Improved direct application
  - Manure export
  - Nutrient separation
  - Innovative thermal systems
- Healthy and growing animal agriculture sector in Michigan

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**Question?**

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