

# Lake Erie Basin Livestock and Poultry Discussion of Trends and Manure Management

Lake Erie P-Task Force  
Ag report info.

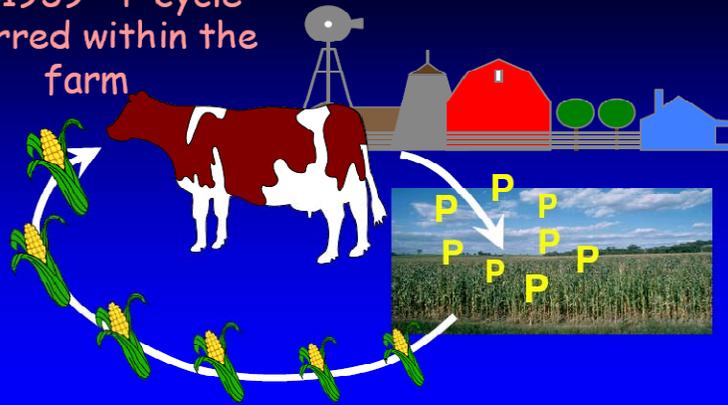
## Overview:

- Annual LEB Livestock (2007 or 2008)
  - w/ discussion of assumptions and limitations of livestock and poultry data mining
- Ohio manure brokers (poultry manure transport into LEB)
  - discussion of Grand Lake Saint Marys Watershed and Wabash Watershed poultry manure export.
- Biosolids land applied in Ohio LEB in 2007
  - w/ discussion of assumptions and limitations
- Comparison annual elemental P application from Manure, Inorganic Fertilizer, and Biosolids in the Lake Erie Basin.

Phosphorus and Water Quality (beyond erosion control),  
Peter Kleinman, USDA-ARS, University Park, PA

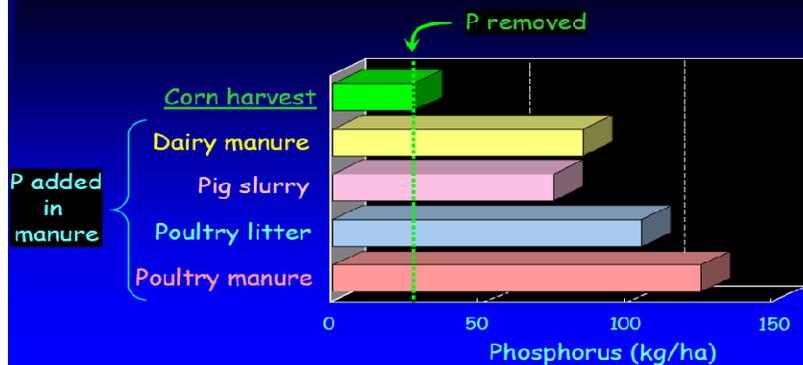
### *The New Problem: Changes in the P Cycle*

Pre 1939 - P cycle  
occurred within the  
farm

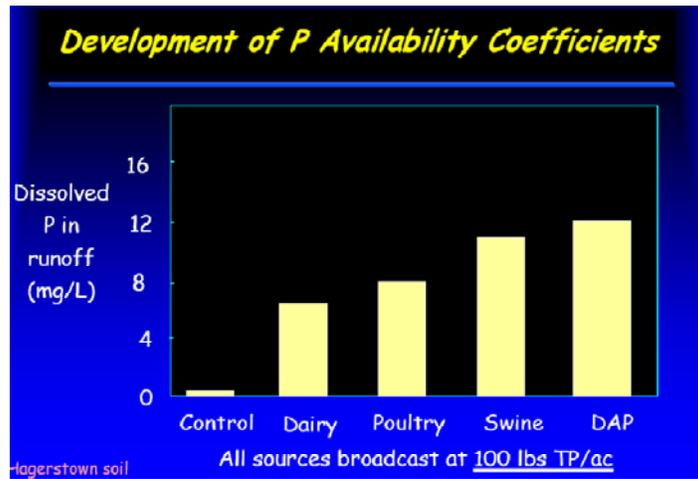


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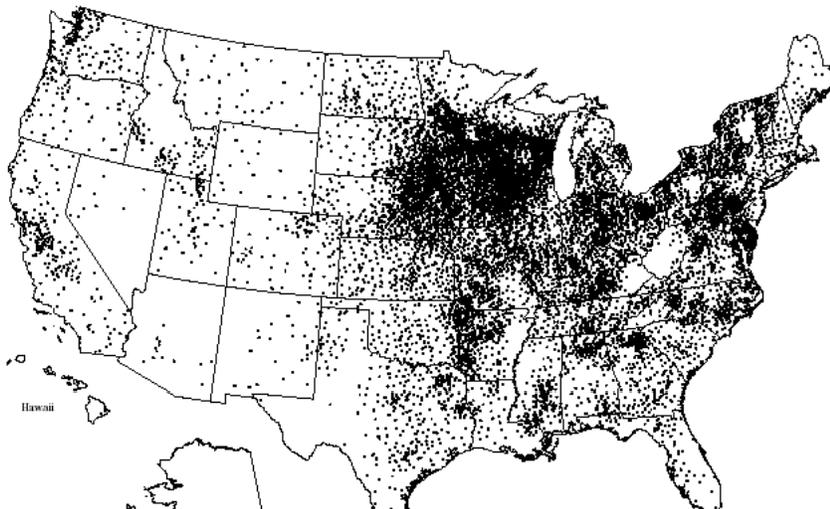
### *N-Based Manure Management*



Phosphorus and Water Quality (beyond erosion control),  
Peter Kleinman, USDA-ARS, University Park, PA



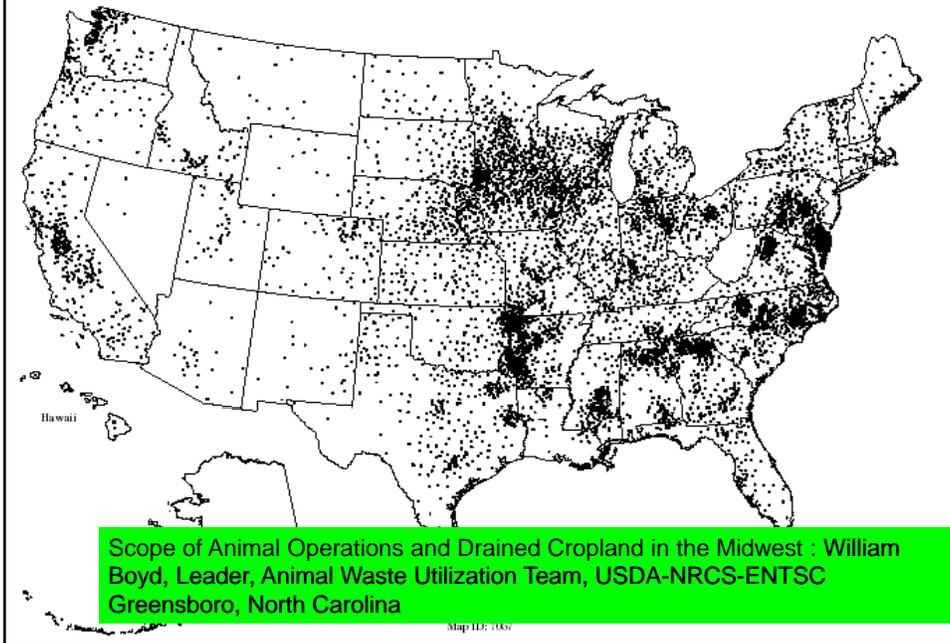
**Figure 1** Livestock operations potentially needing comprehensive nutrient management plans (257,201 operations)



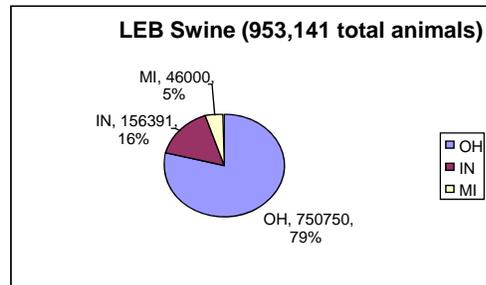
Scope of Animal Operations and Drained Cropland in the Midwest  
William Boyd, Leader, Animal Waste Utilization Team, USDA-NRCS-ENTSC  
Greensboro, North Carolina

Map 101: 6/10/26

**Figure 15** CNMP farms with excess manure after implementing CNMPs (71,999 farms)



## Lake Erie Basin-Swine



-Ohio and Michigan Data From National Agriculture Statistics Service-County Estimates

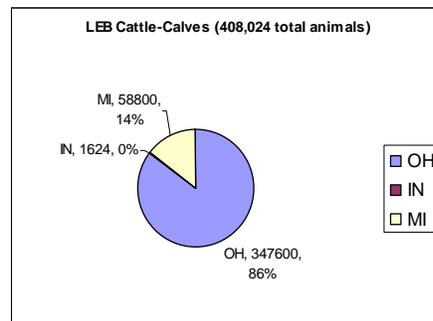
- Just as Dr. Mullen provided in presentation on 7-17-07, these estimates are broken out for counties in wholly or partially in Lake Erie Watershed. (\*Except for Mercer County, OH where 187K of 232K swine are estimated to be housed outside of LEB)

- Indiana numbers only represent facilities that are permitted by Indiana Dept. of Env. Mgmt. (>300 A.U.), so this estimate is likely to be low.

## LEB-Swine Discussion

- In Ohio-LEB, Swine numbers have increased 32% since 2002.
- Per discussions with swine industry leaders and from experience. The trend toward larger, and more concentrated swine finishing facilities (e.g., the 960 to 1000 hd---up to 2000 hd) capacity finisher barns began in mid-1990s and continues today.
- Almost all swine operations handle manure as a liquid.

## Lake Erie Basin-Cattle



- Data From National Agriculture Statistics Service-County Estimates

- Just as Dr. Mullen provided in presentation on 7-17-07, these estimates are broken out for counties in wholly or partially in Lake Erie Watershed. (\*Except for Mercer County, OH)

- Indiana numbers only represent facilities that are permitted by Indiana Dept. of Env. Mgmt. (>300 A.U.), Indiana had only 2 permitted facilities where beef cows were primary species (heifers from another facility were added too). Estimate is likely low.

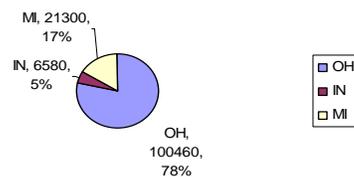
## LEB-Cattle Discussion

- In Ohio-LEB cattle numbers have increased 5% since 2002.
- Depending on the size and type of housing, Beef and calf manure is handled both as a liquid and solid.

## Lake Erie Basin-Dairy



LEB Dairy (148,340 total animals)



-Ohio and Michigan Data From National Agriculture Statistics Service-County Estimates

-Dr. Mullen's presentation did not include an analysis for dairies. (\*Except for Mercer County, OH where dairy cows 15740 of 19,990 dairy cows are estimated to be housed outside of LEB)

- Indiana numbers only represent facilities that are permitted by Indiana Dept. of Env. Mgmt. (>300 A.U.), so this estimate is likely to be low.

## LEB-Dairy Discussion

- In Ohio-LEB, dairy numbers have increased 39% since 2002.
- The trend toward larger, and more concentrated dairies facilities 675 herd dairies began in late 1990s and continued extensively through the early and mid 2000's. Growth has slowed recently..
- The largest dairy operations (i.e., greater than 500 head or so) handle the bulk of their manure as a liquid. Smaller Dairies tend to have more pen pack and solid/semi-solid lot manure.

## Lake Erie Basin-Layer Poultry

Ohio LEB Laying Hens and Pullets in Lake Erie Basin include:

~**841,000 hens** (current numbers) wholly situated in LE Basin. (Permitted for ~1.2 Million)

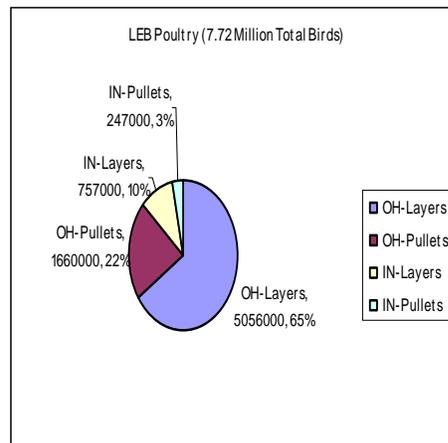
~**4.215 Million hens** in facilities on the watershed boundary, where it is estimated 50% of the manure is applied in the Lake Erie Basin.

~**1.66 Million Pullets** are also located on the watershed boundary where it is estimated 50% of the manure is applied in the Lake Erie Basin.

Indiana LEB Laying Hens and Pullets in Lake Erie Basin include:

~ **757,000 hens** and **247,000** pulltets

No data for Michigan LEB poultry operations.



## Lake Erie Basin-Poultry Discussion

- Estimate of total tons of poultry layer manure land applied per year ~ 38,380 tons (based on analysis of ODA-LEPP inspection data).
- Almost all existing poultry layer facilities in LE Basin were built after 1995. (I.e., from ~200,000 to >6 Million).
- Almost all poultry manure is sold and handled by 3<sup>rd</sup> party brokers.
- All manure is handled as a solid with typical moisture contents ranging from 13%-30%.



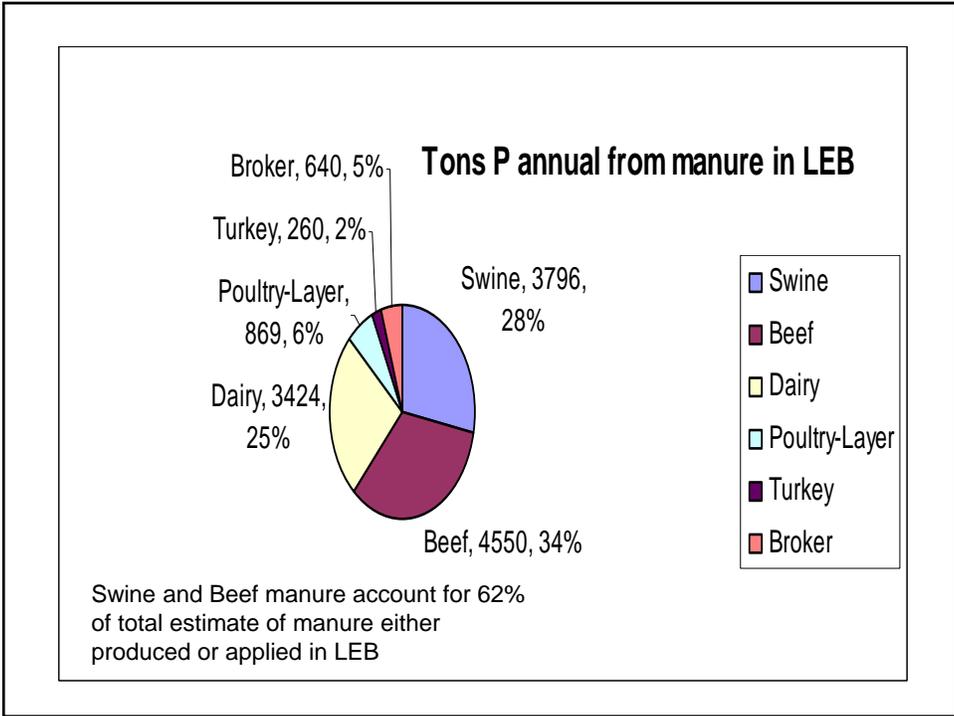
## Lake Erie Basin-Turkeys

\*Information provided by turkey integrator/processor (involved with almost 100% of Turkeys raised in Lake Erie Basin)

- 266,000 breeding and grower turkeys at any one time produce ~14,500 tons/year @ ~28% average moisture content.
- Production has increased by 80% since 1988 (Including facilities located in the Lake Erie Basin).
- No data from Michigan
- Only one facility in Indiana LEB that is regulated (1014 birds)







## OH, MI, IN Lake Erie Livestock- Manure generated- elemental P

Best estimate \*

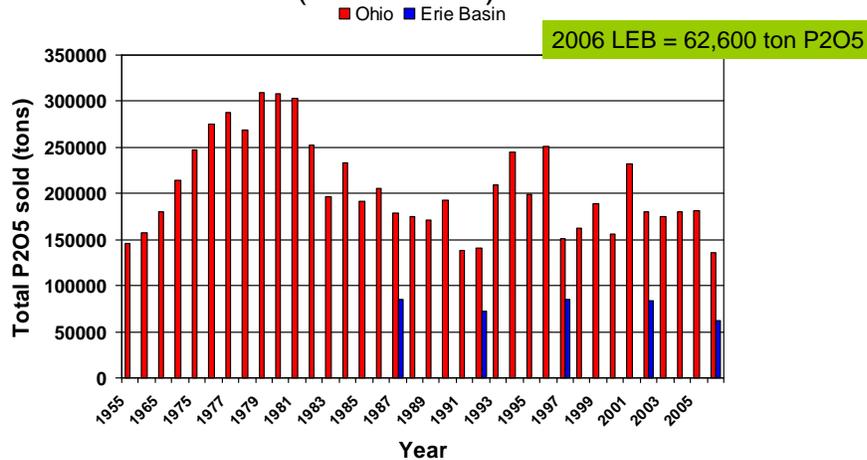
Year (with most recent data available)	Swine (tons-P)	Beef (tons-P)	Dairy (tons-P)	Layers (tons-P)	Turkeys (tons-P)	Brokers (tons-P)	Sum Tons Total Manure-P
2007 or ('08) <small>MI</small>	3796	4550	3424	869	260	640	13,538 Tons-P

no calculations for horses, broiler-chickens, sheep, or goats from IN, OH or MI

\*\*Includes animal counts from all Ohio Counties in (or partially within LEB...minus non-LEB basin facilities in Mercer County, OH.

## Phosphorus Sales Trends Mullen/Elder 07-17-08

- Ohio statewide (1955-2006)



### In organic fertilizer elemental P

Best estimate \*

Per Dr. Robert Mullen Kevin Elder Report to P Task Force on July 17, 2007: ~62600 tons P<sub>2</sub>O<sub>5</sub> in 2006.

Using factor of 2.29 to translate to elemental P gives:

**27,320** tons elemental Phosphorus sold for LEB application in 2006.

\*It is impossible to know what percentage of P fertilizer sold in Maumee port was applied to LEB acreage.

## Manure and Phosphate weight generation estimate sources by species

Swine: 1.05 lb manure/day/150# pig (OSU Ext. Bulletin 604),  
0.05 lb P<sub>2</sub>O<sub>5</sub>/day/150# pig

Beef: 4.96 lb manure/day/750# high forage beef cow (OSU Ext. Bulletin 604), 0.14 lb P<sub>2</sub>O<sub>5</sub>/ lb/day/750# high forage beef cow

Dairy: Using 18.41 lb manure/day/1400# lactating cow (OSU Ext. Bulletin 604), 0.335 lb P<sub>2</sub>O<sub>5</sub>/day/1400# lactating cow

Poultry Layers and Pullets: Actual reporting data from Ohio Department of Agriculture facilities, ratios used to extrapolate for facilities w/o data

Turkey: Actual data provided (number of birds) and actual tonnage and P<sub>2</sub>O<sub>5</sub>/ton from haul out reports from typical Ohio regulated facilities

## Land Applied Biosolids (Ohio)

No data analyzed from IN and MI



## Lake Erie Basin-Ohio generated Biosolids Total P Applied to Land

- Biosolids generated at Ohio Wastewater Treatment Plants (WWTP) in Lake Erie Basin that was land applied in 2007:  
**~123,000 tons**

A literature review along with cross verification of Ohio NPDES biosolids monitoring reports:

Typical range: 10000-36000 mg/kg (1.0-3.6%)

Using tonnage described above, this calculates to:

**1230-4428** tons Total P/year from Ohio generated and land applied biosolids in LEB

Ground truth estimate with Ohio NPDES biosolids data:

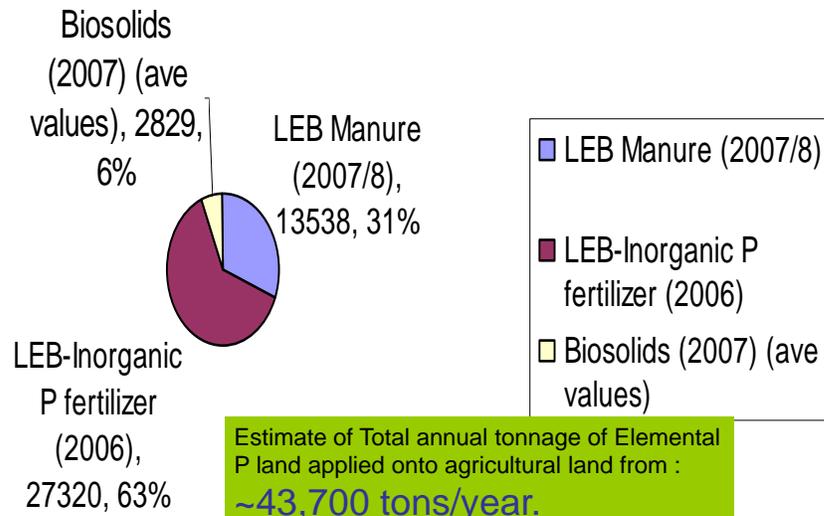
--Dayton WWTP past 22 months monitoring:

Average = 7368 mg/kg (0.74%), Max= 29900 mg/kg (2.99%)

--Toledo WWTP past 11 months monitoring:

Average = 3500 mg/kg (0.35%), Max= 5200 (0.52%) mg/kg

### Tons Elemental P/year\* (see estimate caveats)



## Biosolids general information

- Biosolid P-concentration: widely variable. Solubility is dependent on treatment process (e.g., alum addition binds soluble P, lime stabilization adds weight and reduces P concentration).
- Liquid anaerobic biosolids tend to have highest P concentration. Dewatered anaerobic biosolids has lower more average values: (~27,000 mg/kg).
- Lime Stabilized biosolids -the lowest concentration (~1.0%)

“Compared to inorganic P fertilizers, a smaller fraction of the total P in biosolids is soluble....Research has demonstrated that P solubility in biosolids typically is 40% of that in commercial fertilizers.”

Sullivan, Cogger, Bary, “Fertilizing With Biosolids, PNW 508-E, Revised June 2007.

## Relative Solubility of Inorganic and Organic fertilizers

- Inorganic fertilizers are intended to be highly water soluble (Glendinning 1999). As such, as monocalcium phosphate, MAP and DAP are more soluble than manure.
- Manure is generally more soluble than treated biosolids.
- References: Pritchard, Thesis for Doctorate, Chapter 6, Leaching of phosphorus in soils following the application of biosolids-laboratory experiment, 2005. “The water extractable phosphorus (WEP) in triple super phosphate (TSP) was higher (85.2%) than animal manures (20.8- 47.6%) and low for typical biosolids (2.5%). Sharpley and Moyer (2000) found that WEP was 51% for dairy manure and 26% for poultry manure. Similarly, water soluble phosphorus (WSP) measured for a range of biosolids was low (0.3 to 0.4%) compared with poultry and swine manures (17.0%) (Montgomery 2002). Cooke and others showed no evidence of high P solubility in biosolids, as did Elliott, O'Connor and Brinton (2002).”

## Relative Solubility of Inorganic and Organic fertilizers (cont.)

- Sullivan, Cogger, Bary, "Fertilizing With Biosolids, PNW 508-E, Revised June 2007. "Biosolids processing methods affect P solubility. Some wastewater treatment facilities add aluminum (aluminum sulfate), iron (ferric chloride), or calcium (lime) compounds during wastewater treatment or solids processing. Iron, aluminum, and calcium bind phosphorus, rendering it less soluble. As the concentrations of iron, aluminum, and calcium in biosolids increase, the solubility of P decreases."
- Sewage Biosolids-Managing Urban Nutrients Responsibly for Crop Production, Ontario Ministry of Agriculture and Rural Affairs, (<http://www.omafra.gov.on.ca/english/nm/nasm/info/brochure.htm>).  
Used for typical P concentration analysis.