



**DC Water Resource Research Institute
&
Agriculture Experiment Station**

Effect of Pelletized Poultry Manure on Crop Production and Vadose zone water Quality

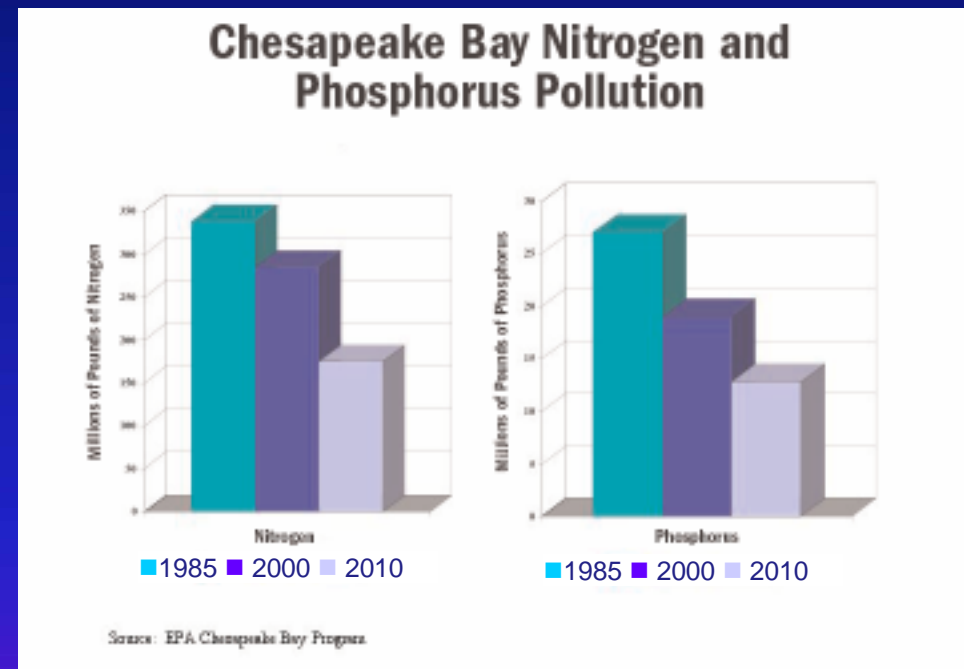
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Outline

- Background
 - Manure and water quality
- Objective
- Materials and methods
- Results
- Conclusion

Background

- Historical decline in the living resources of the Chesapeake Bay
 - 1983 and 1987 Chesapeake Bay agreement
 - After 20 years of restoration effort, only 15% reduction in N and P load, with 17% increase in population
- 2000 Chesapeake Bay agreement:
 - By 2010, a tenfold increase in native oysters upon a 1994 baseline
 - Promised 40% reduction in bay's N and P level

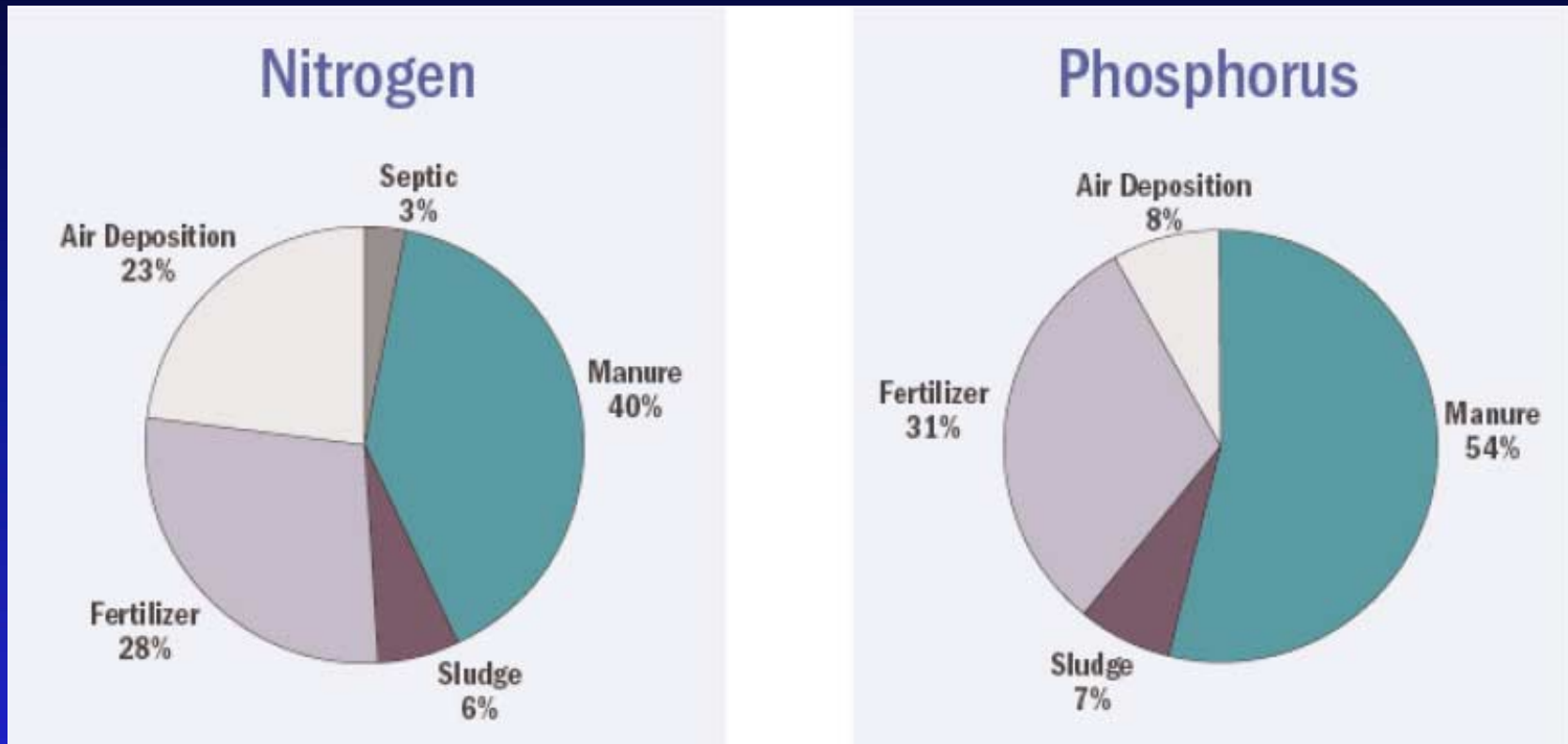


Background: Eutrophication



⇒ Excessive algal blooms, oxygen depletion during night, and mass fish killing

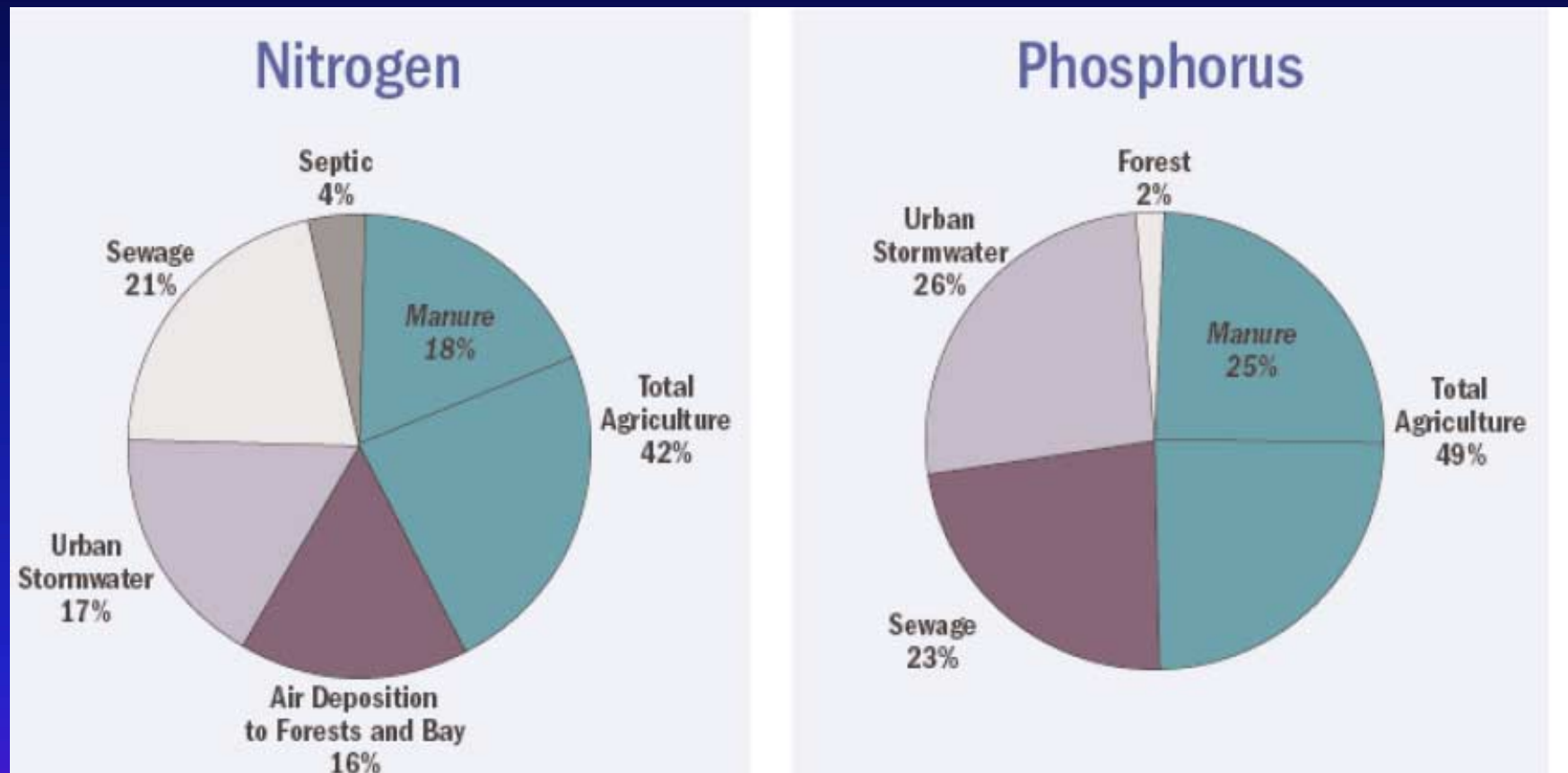
Background: Nutrient source in the bay



Chesapeake bay foundation, 2004

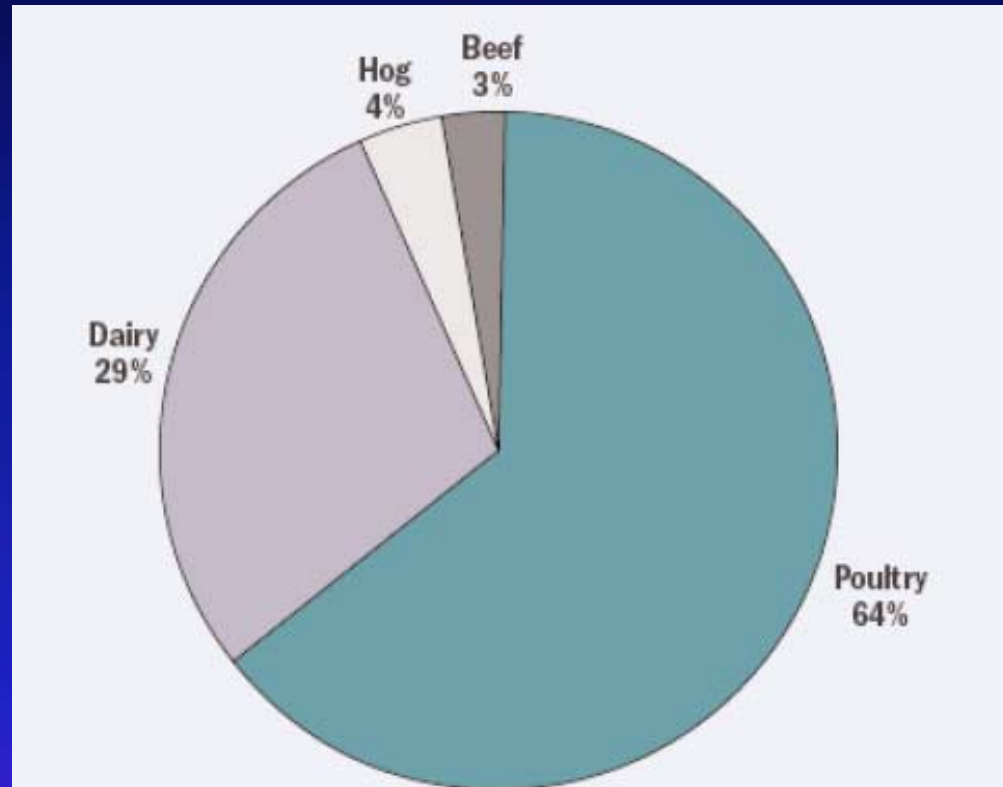
Background: Nutrient source in the bay

- Agriculture is the major contributor



Chesapeake bay foundation, 2004

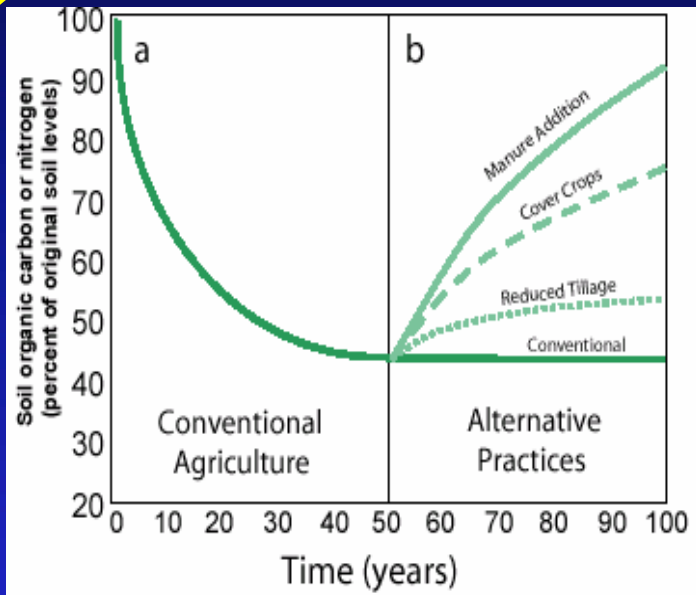
Background: Recoverable manure N by type of Animal



Chesapeake bay foundation, 2004

Organic farming and grain based methanol production

- Require water and fertilizer (Organic and Mineral)



Ethanol

Sustainable Agriculture
(Tilman, 1998)



Water Quality

Pelletized Poultry manure

- Poultry manure as fertilizer:
 - Rich in N, P and essential nutrients
 - Good organic matter content which enhance soil moisture holding capacity, soil structure and infiltration capacity, and microbial activities
 - Releases nutrient slowly
- Poultry manure and human health concern:
 - Fresh poultry manure contains pathogens: *E Coli*
- Federal regulation that governs waste disposal in CAFO
 - Encouraged production of pelletized poultry manure
 - Chemical composition:
 - 4% N, 6% P and 86% Organic matter
 - Processed at 225°F, which pasteurizes the litter to eradicate bacteria and weed seeds



Objective

- To determine the effect of pelletized poultry manure on the vadose zone water quality and corn biomass production

Materials and Method

- Field lay out:

- Experimental plot of 18.3 m x 27.4 m established on a silt loam soil at the Muirkirk Agricultural Research Station in Beltsville, Maryland

Treatments	Experiment 1 (2007)	Experiment 2 (2008)
T1	2000 kg/ha Poultry Pellet + 500 kg/ha 10-10-10 Fertilizer	2500 kg/ha Poultry Pellet + 500 kg/ha 10-10-10 Fertilizer
T2	500 kg/ha 10-10-10 fertilizer	500 kg/ha 10-10-10 fertilizer
T3	1000 kg/ha Poultry Pellet + 500 kg/ha 10-10-10 Fertilizer	1250 kg/ha Poultry Pellet + 500 kg/ha 10-10-10 Fertilizer
T4	2000 kg/ha Poultry Pellet	2500 kg/ha Poultry Pellet
T5	1000 kg/ha Poultry Pellet	1250 kg/ha Poultry Pellet
T6	Control	Control

Materials and method

- Laboratory analysis:
 - Soil and soil water quality analysis
 - Soil pH: 1:1 Soil to DI Water.
 - P: Michelin I extraction method and DR2800 Spectrophotometer
 - OM: Muffel Farnes – 1st 375'F for 1 hour and ashed at 600 ' F.
 - E Coli: IDEXX products (colilert[®]). Using 1: 10 soil to deionized water

- Plant height and biomass:
 - Height: measuring tape
 - Biomass: Fresh weight and air dried weight

- Time of data collection:
 - At the latest growing stage of the plant, blooming stage

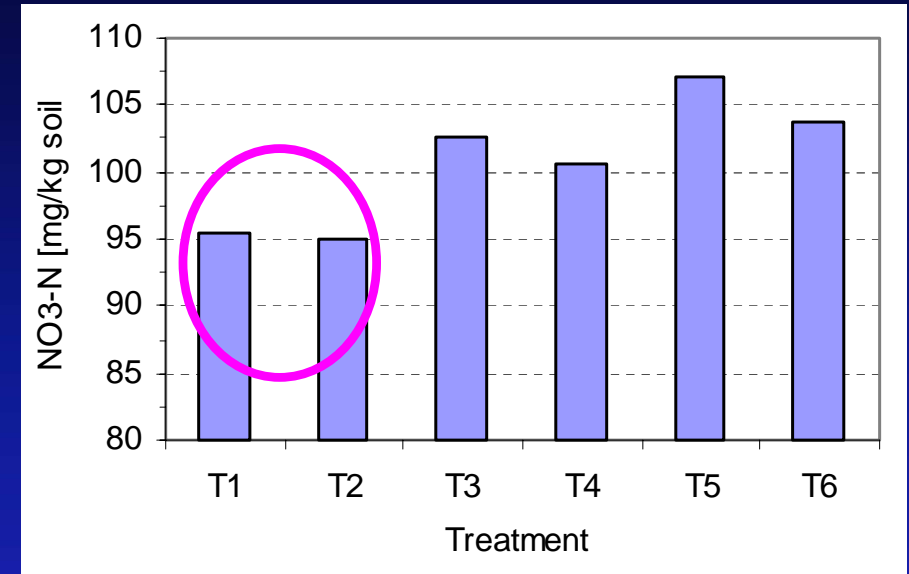
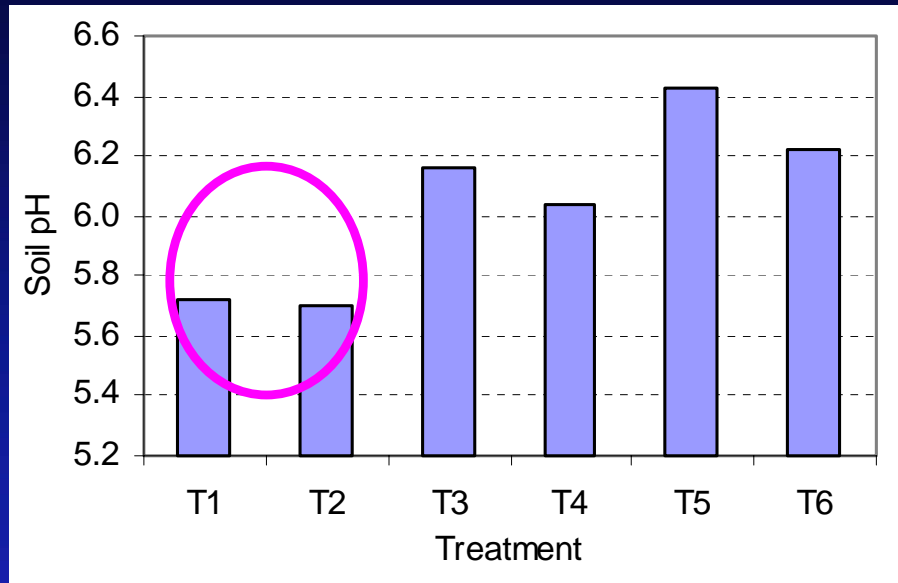
Materials and method

- Chlorophyll:
 - Digital Chlorophyll concentration
- Collection of vadose zone water samples
 - Lysimeter installed at 45 cm and 90 cm depth



Results: Experiment 1

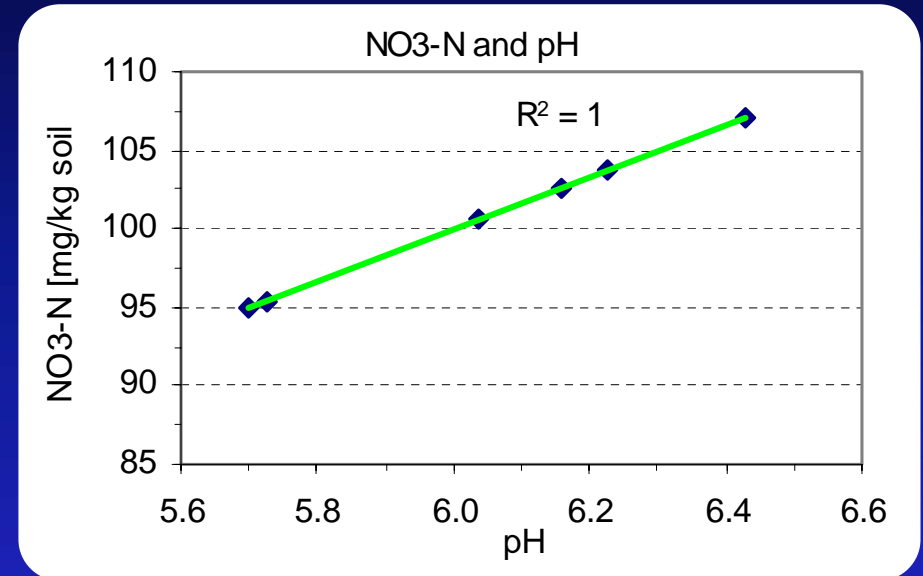
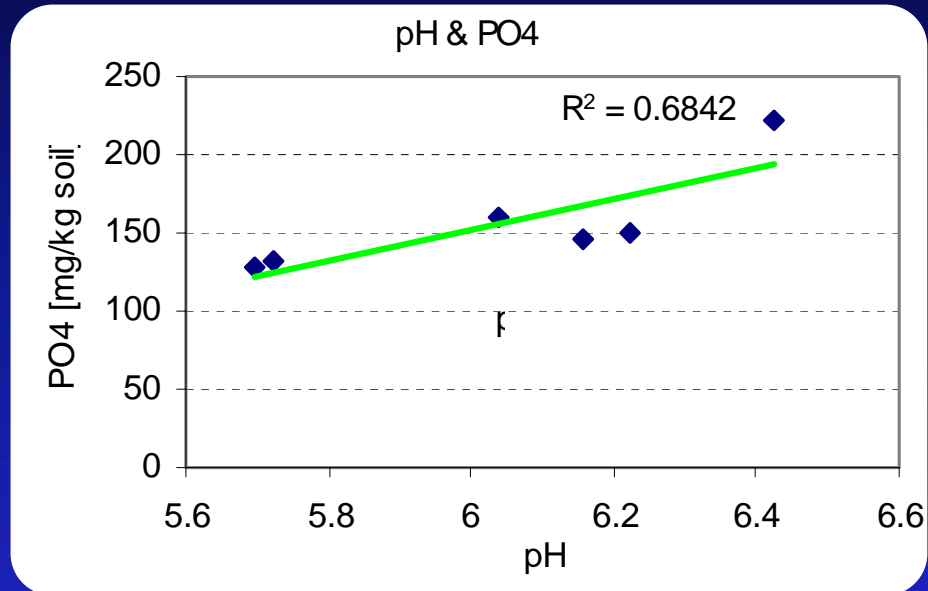
■ Soil



- lower the soil pH
 - Mineral fertilizer plus higher rate of pelletized poultry manure
 - Mineral fertilizer: Water soluble P fertilizer is very acidifying
- Low pH results in leaching of nutrients or plant uptake

Results: Experiment 1

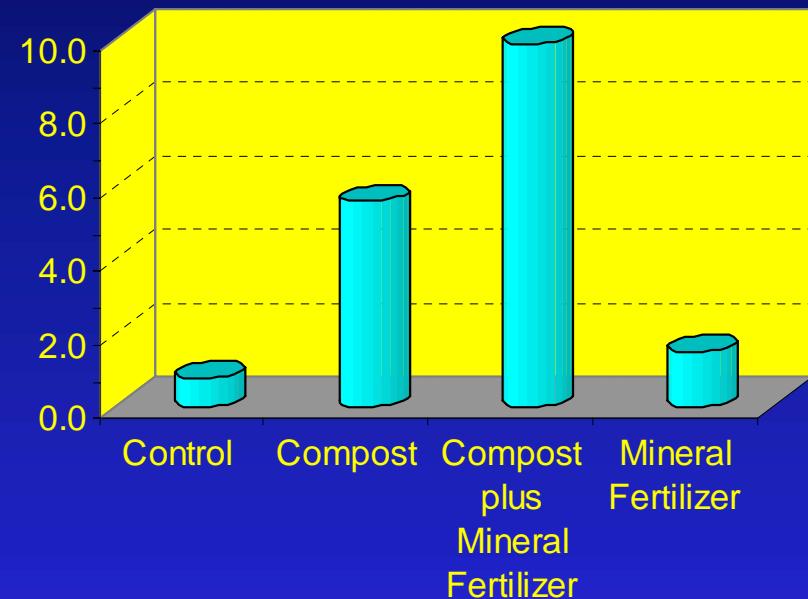
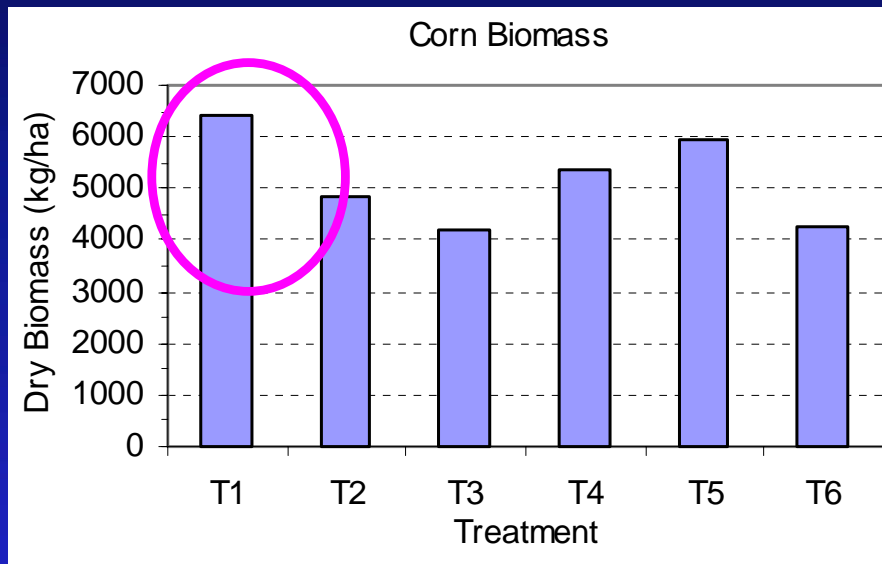
■ Soil



- low pH is related to low extractable NO₃ and P

Results: Experiment 1

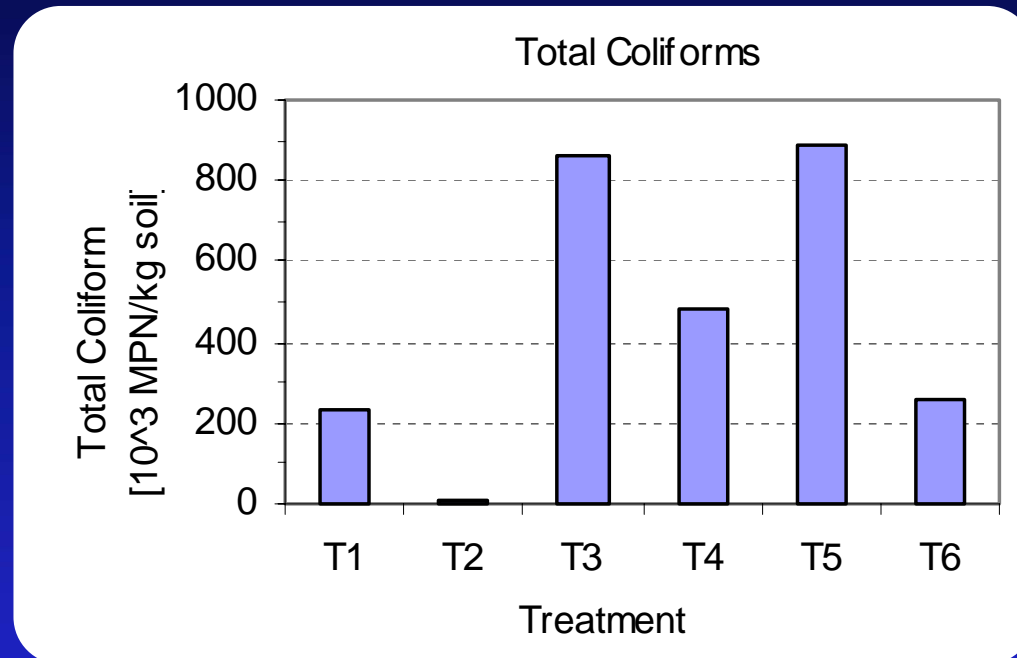
■ Corn biomass



- Highest corn biomass:
 - Mineral fertilizer plus higher rate of pelletized poultry manure
 - Consistent with Deksissa *et al*, 2008

Results: Experiment 1

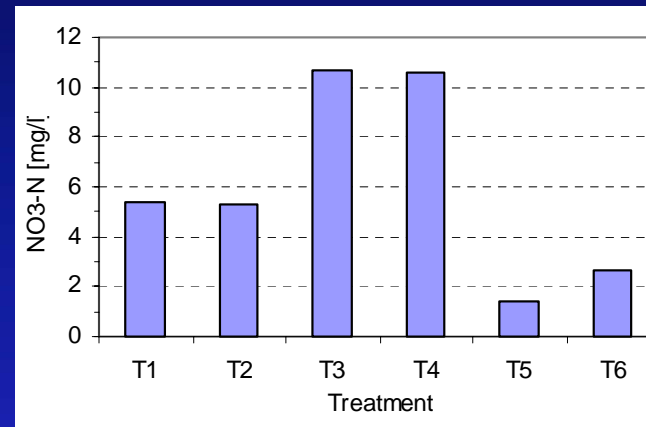
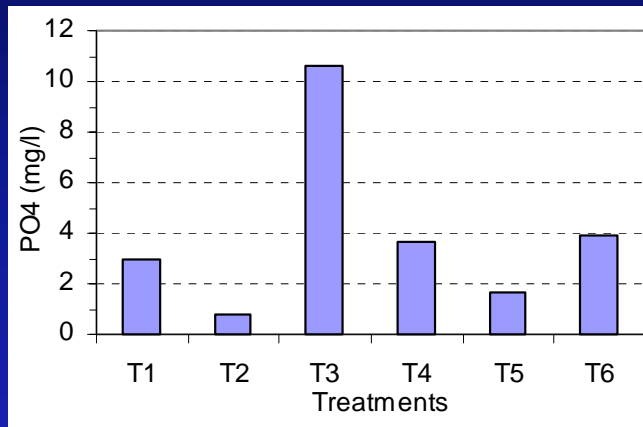
- Total Coliform



- No Fecal Coliform was found, no clear relation of TC with Pelletized manure

Results: Experiment 1

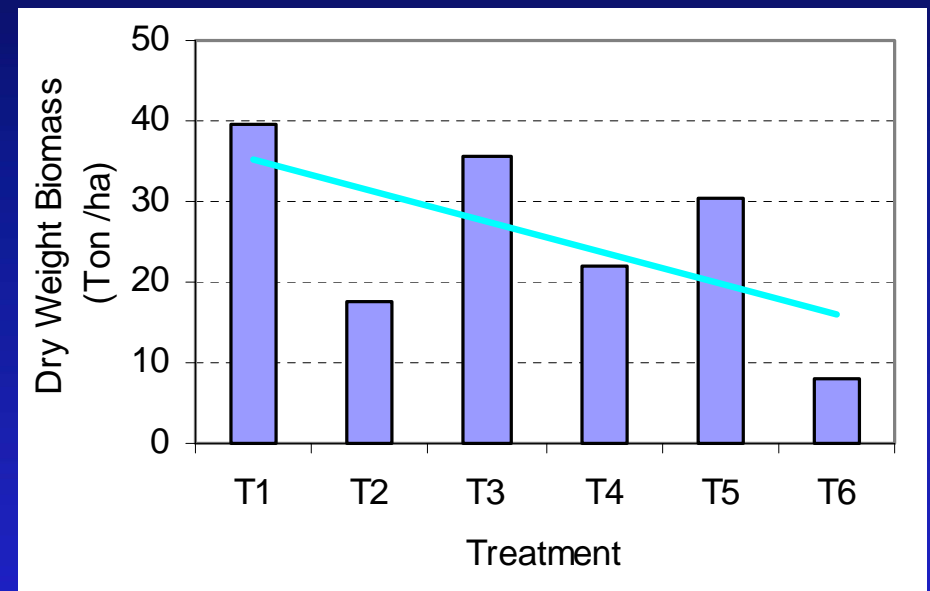
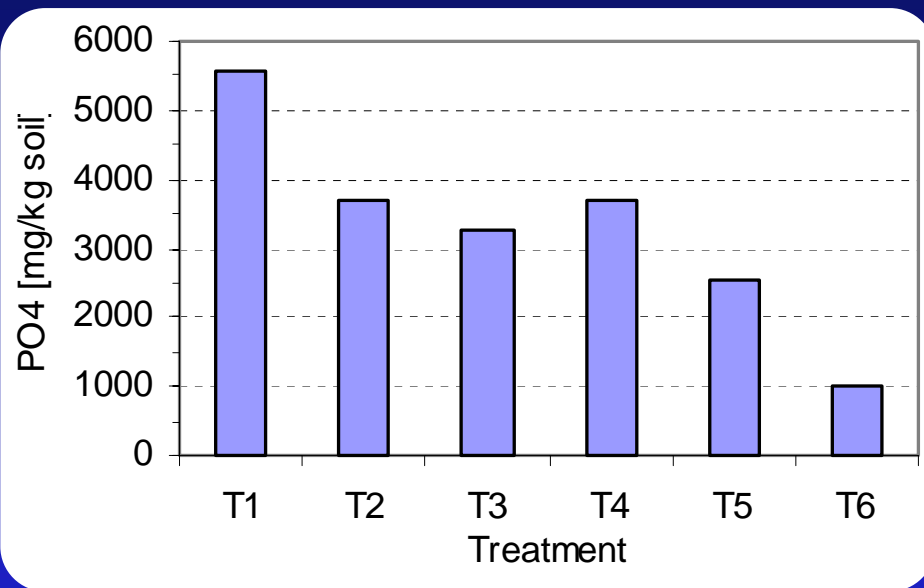
■ Vadose zone water quality:



- Phosphorus: Most P is locked in soil except T3
- Nitrate: Except the lowest rate, all treatments resulted in nitrate leach off

Residual Effect: Cover crop

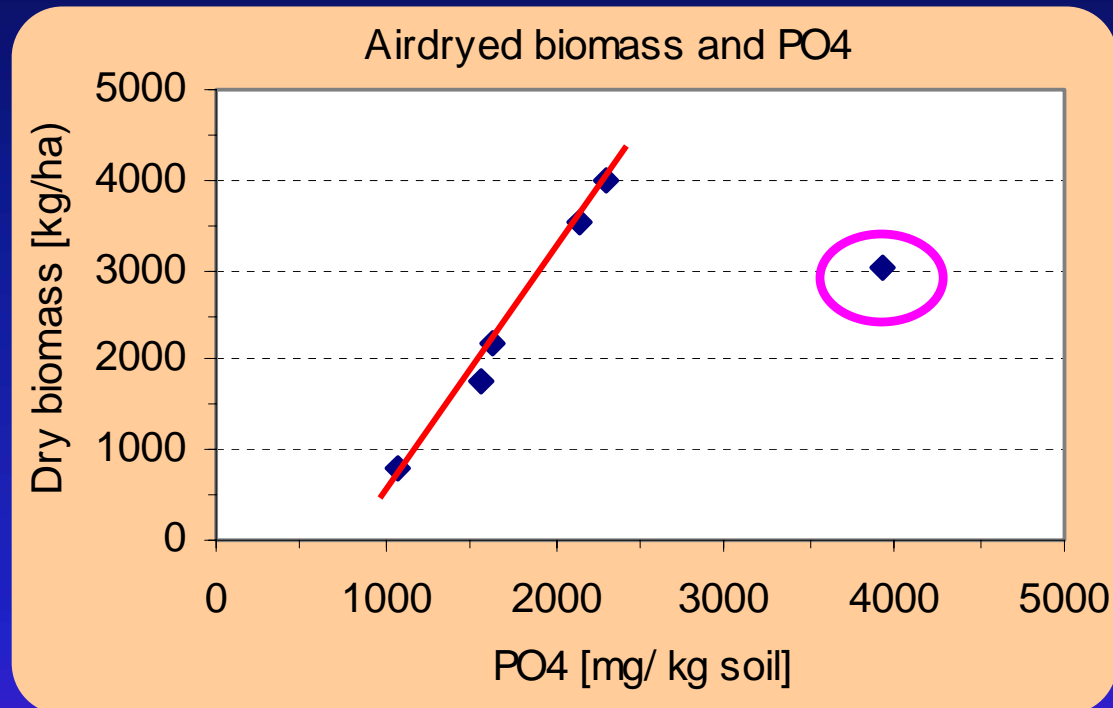
- Residual effect on Wheat Cover Crop, measured in spring



- Extractable P was higher at higher rate of peletized poultry manure
- Higher extractable P is positively correlated with the rate of application

Residual Effect: Cover crop

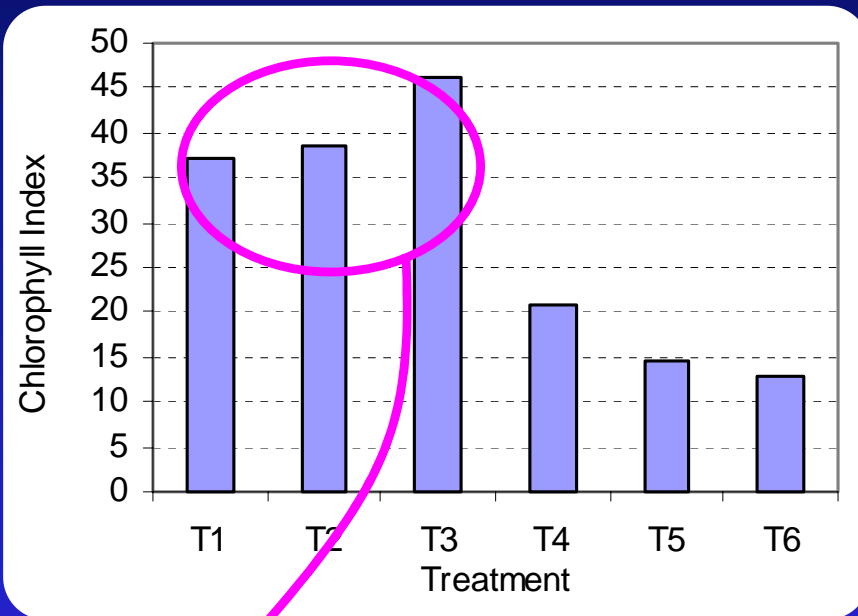
- Residual effect: Wheat Cover Crop, measured in spring



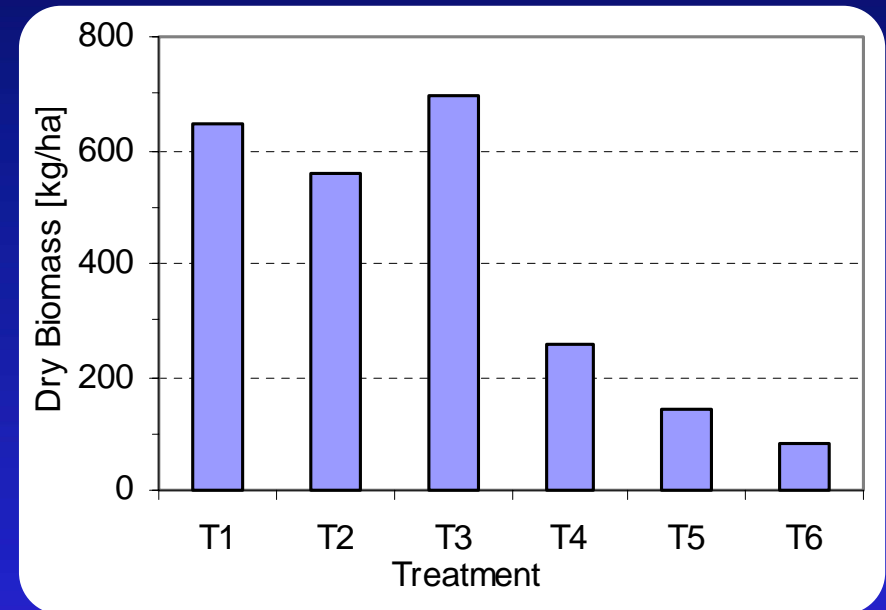
- Higher extractable P is positively correlated with the dry biomass

Results: Experiment 2

- 25% increase of Rate of Pelletized poultry manure:
 - Chlorophyll index and air dried biomass



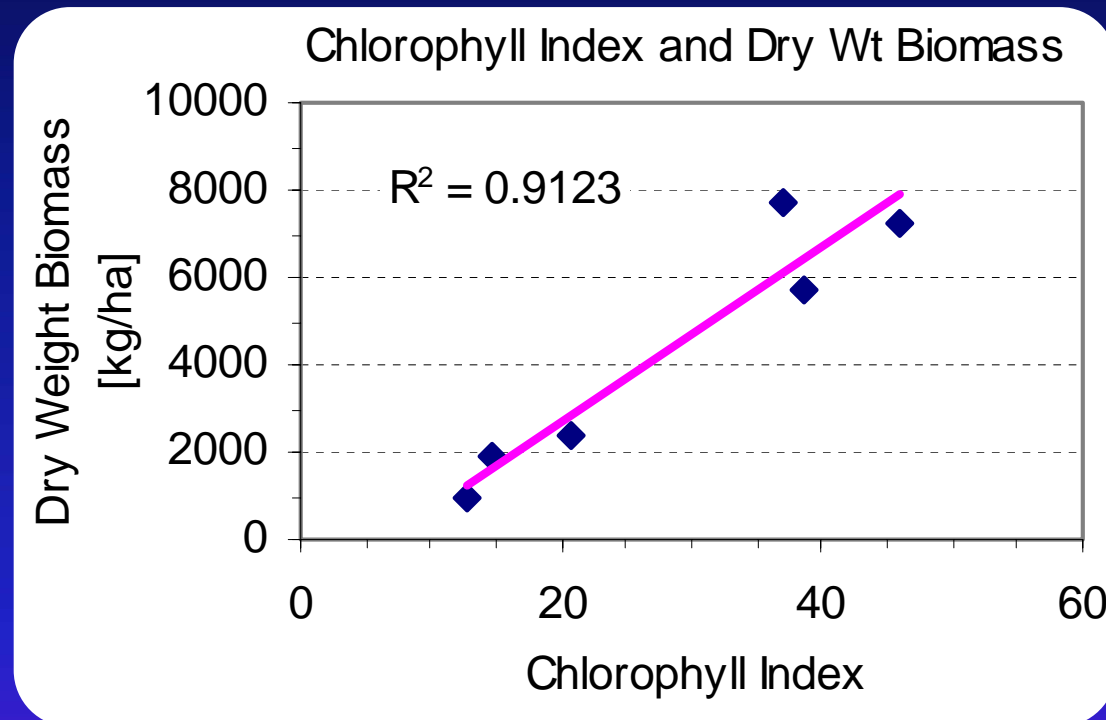
Fertilizer



- Mineral fertilizer had dominated effect on Chlorophyll and dry biomass

Results: Experiment 2

- Dry biomass is strongly related to Chlorophyll index



Conclusion

- Pelletized poultry manure has significant positive effect on the Corn Biomass yield when applied at 1000-2500 kg/ha;
- As it is processed at higher temperature (70°C), pelletized poultry manure has no risk of fecal coliform contamination
- If managed with inorganic fertilizer a manner that will minimize nitrate leaching and prevent P accumulation in soils, pelletized poultry manure can be an effective pathogen free organic fertilizer for both corn biomass production and biofuel production.

Further research

- Determining recommended rate of pelletized poultry manure for biomass production

Acknowledgement

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Questions?