

Impacts of Anaerobic Digestion and Solid/Liquid Separation on Nutrient Availability in Manure

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Biological Systems Engineering

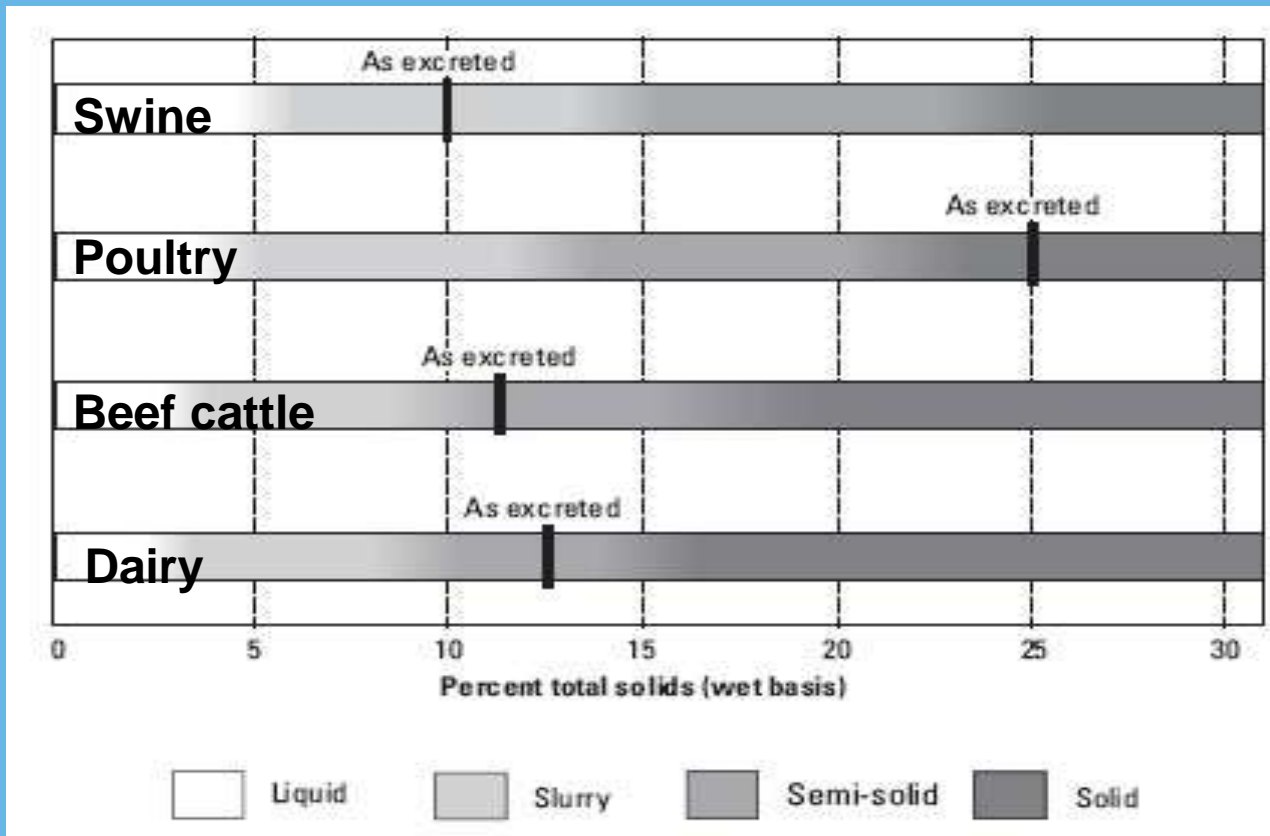
UW-Madison & UW-Extension

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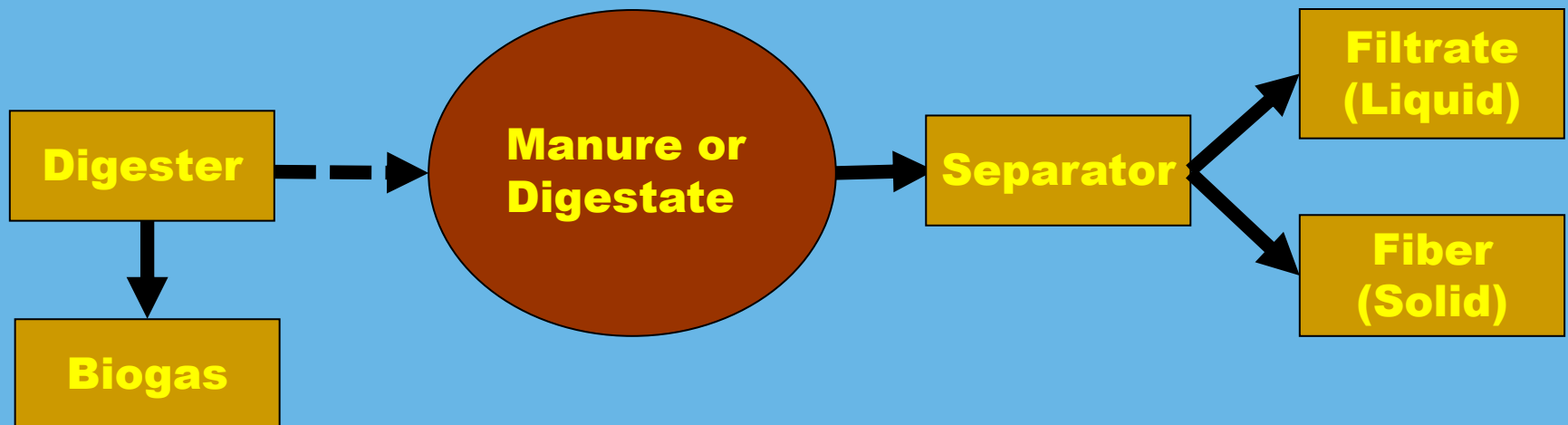
Manure Characteristics

- Contains nutrients: N, P, K
- Organic and inorganic
- Soluble and insoluble
- Variability in characteristics



Manure Processing

- Manure processing to impact characteristics
- Can improve management strategies
 - Reduce hauling costs
 - Increased management of nutrients
- Develop value added products



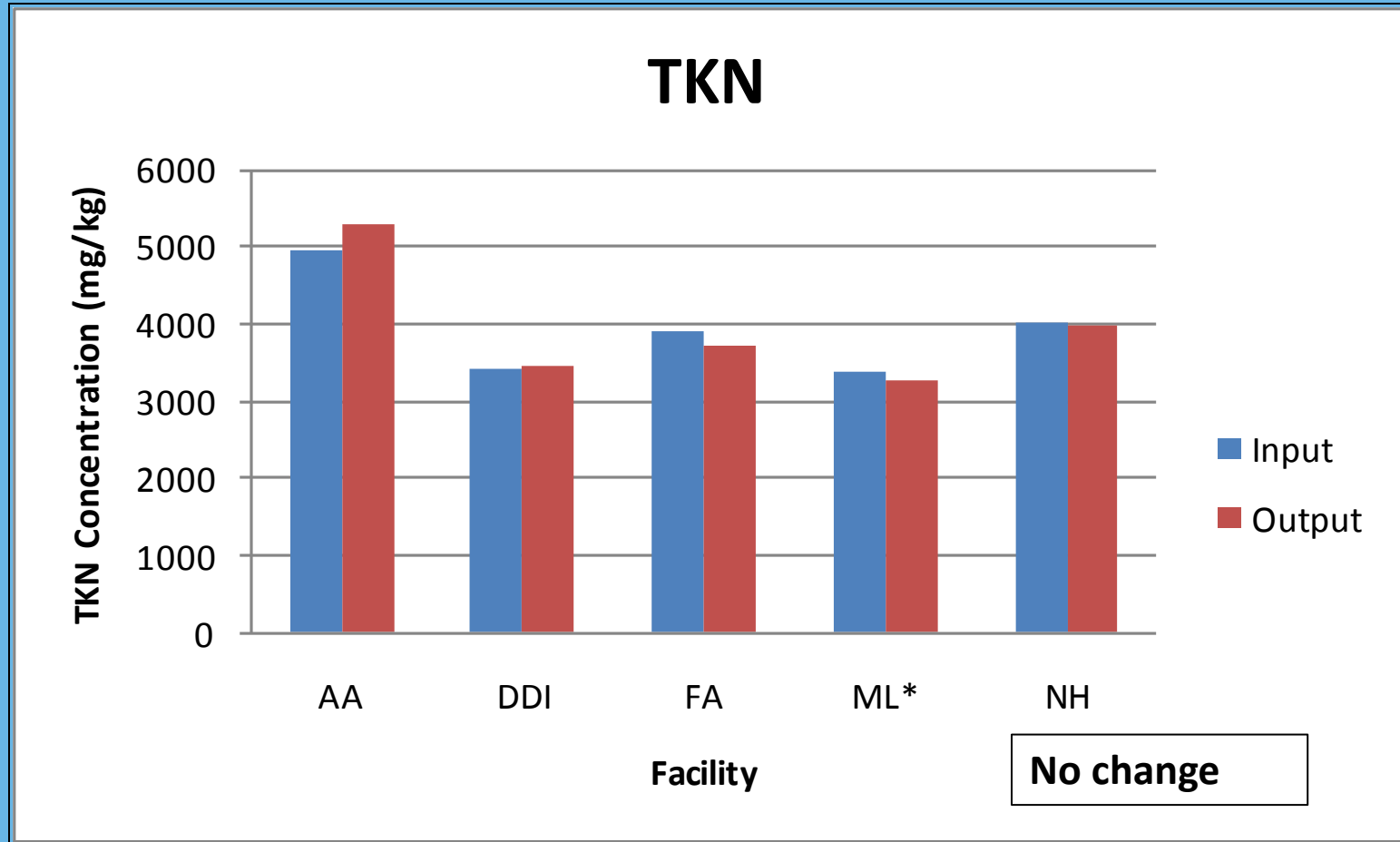
Characteristics Following Digestion (Digestate)

- What goes in must come out!
- Contains Mineralized Nutrients
- Nitrogen
 - 25% more accessible $\text{NH}_4\text{-N}$
- Phosphorus
 - Changes form
 - **Myth – digestion reduces phosphorus content**
- Can be land applied or dewatered

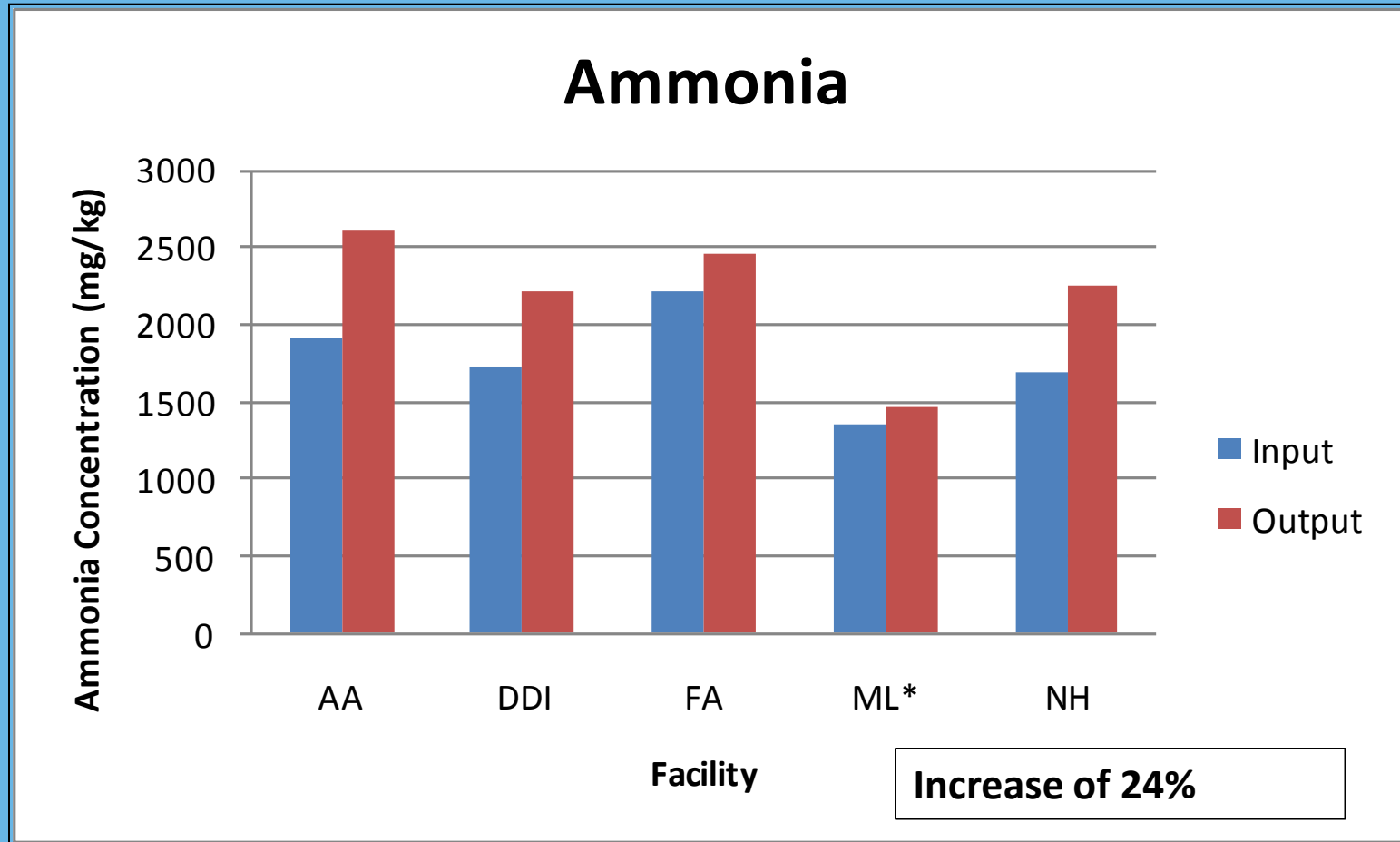
Nutrient Management Implications of Anaerobic Digestion

- Organic nutrients are released as inorganic nutrients during the digestion process
 - Organic-nitrogen is released as ammonium-nitrogen
 - Ammonia nitrogen increases by 37%*
 - Organic-phosphorus is released as ortho-phosphorus
 - Ortho-phosphorus increased by 26%*

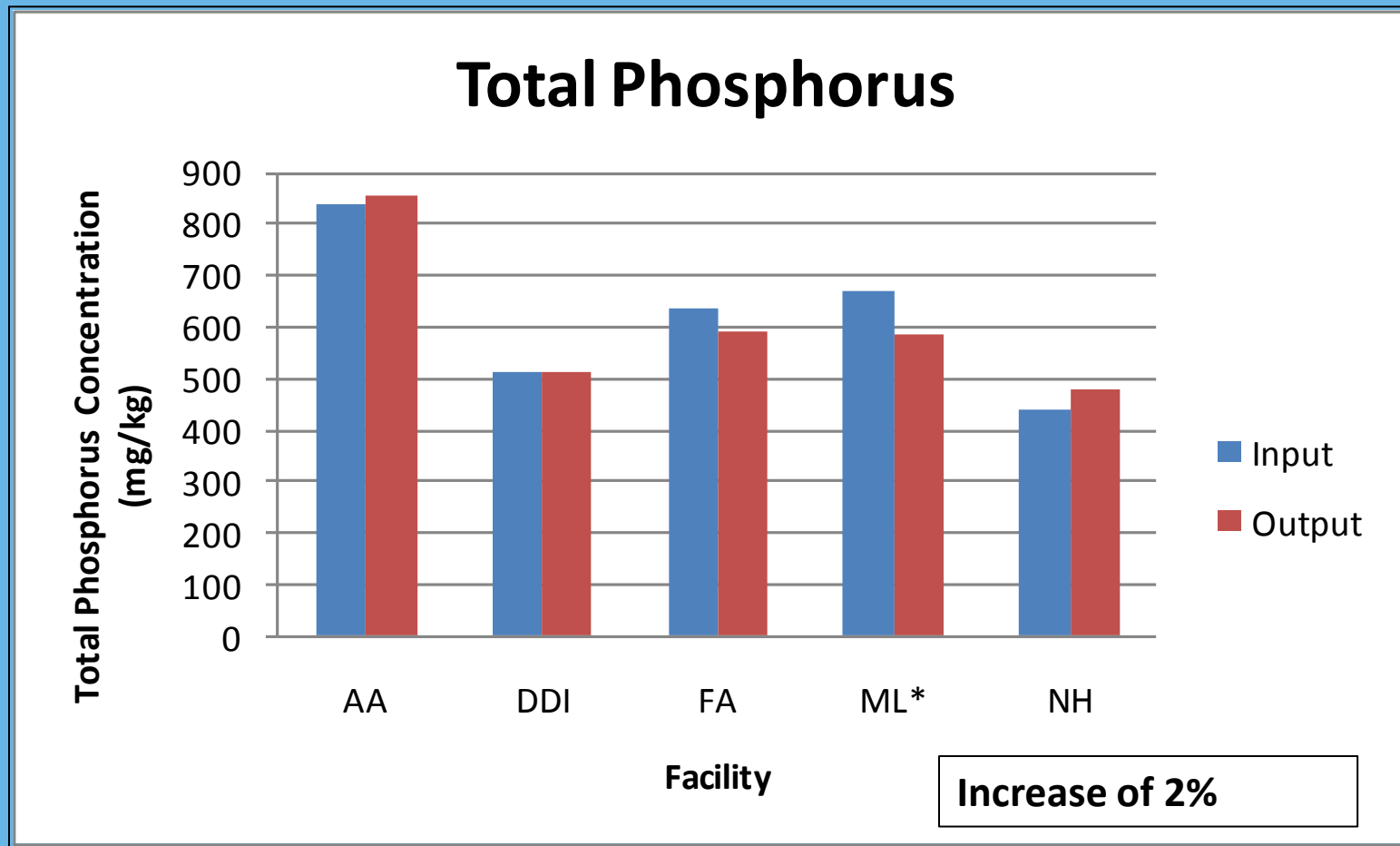
Nutrients & Anaerobic Digestion



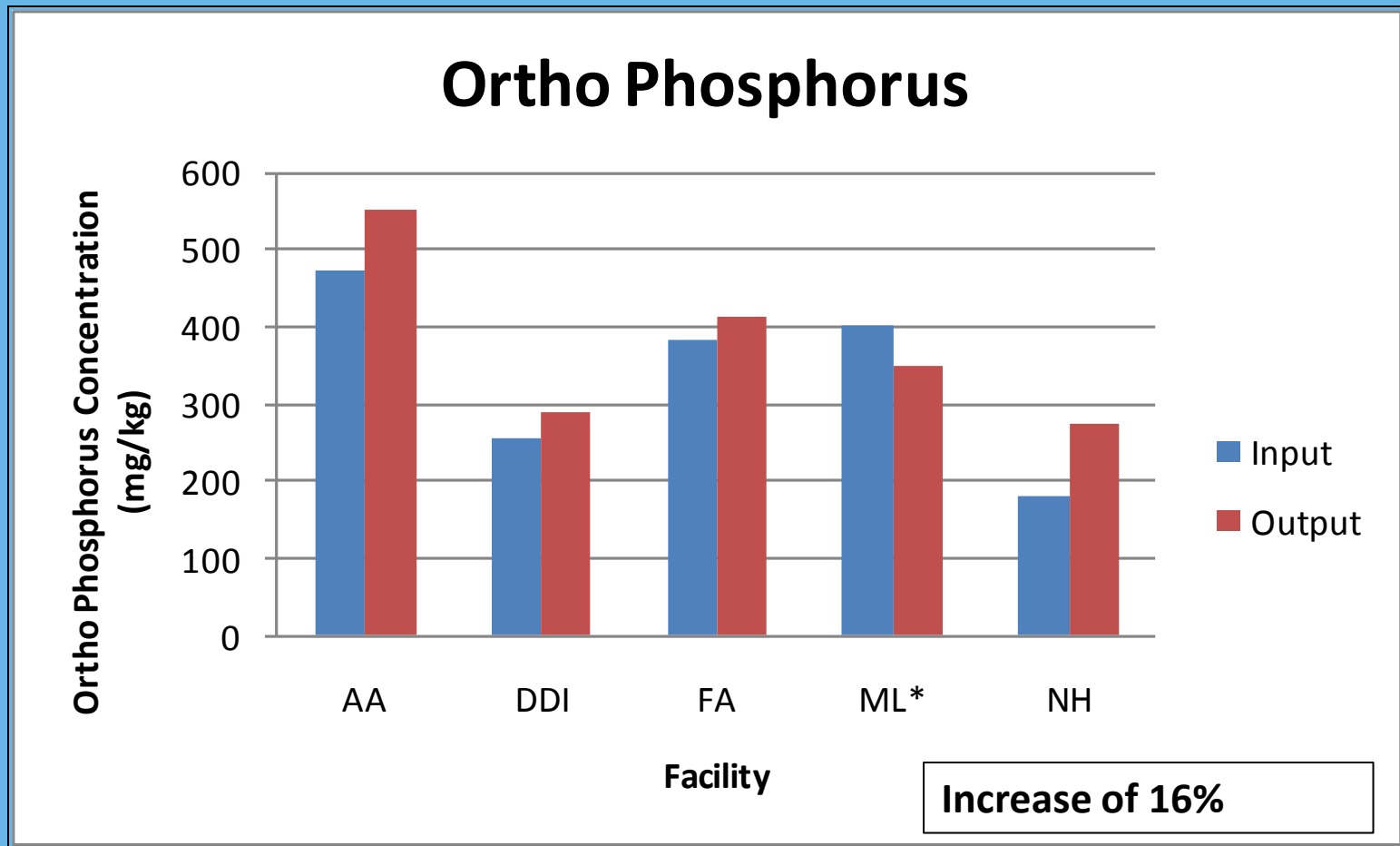
Nutrients & Anaerobic Digestion



Nutrients & Anaerobic Digestion



Nutrients & Anaerobic Digestion



Nutrient Management & Anaerobic Digestion

- Improved plant availability of nutrients
- Increased management during manure application
 - reduced risk of leaching, runoff or volatilization
- Total mass of nutrients remains relatively unchanged
 - Co-feeding may increase nutrient load
 - Post digester treatment
- Additional benefits include reduction in pathogens and odor

Solid/Liquid Separation Technologies

- Gravity settling (passive)
 - Settling basins
- Mechanical separation (active)
 - Screens
 - Stationary inclined (static) screens
 - Vibrating screens
 - Rotating screens
 - Presses
 - Roller presses
 - Belt presses
 - Screw presses
 - Centrifuges

Screw Press

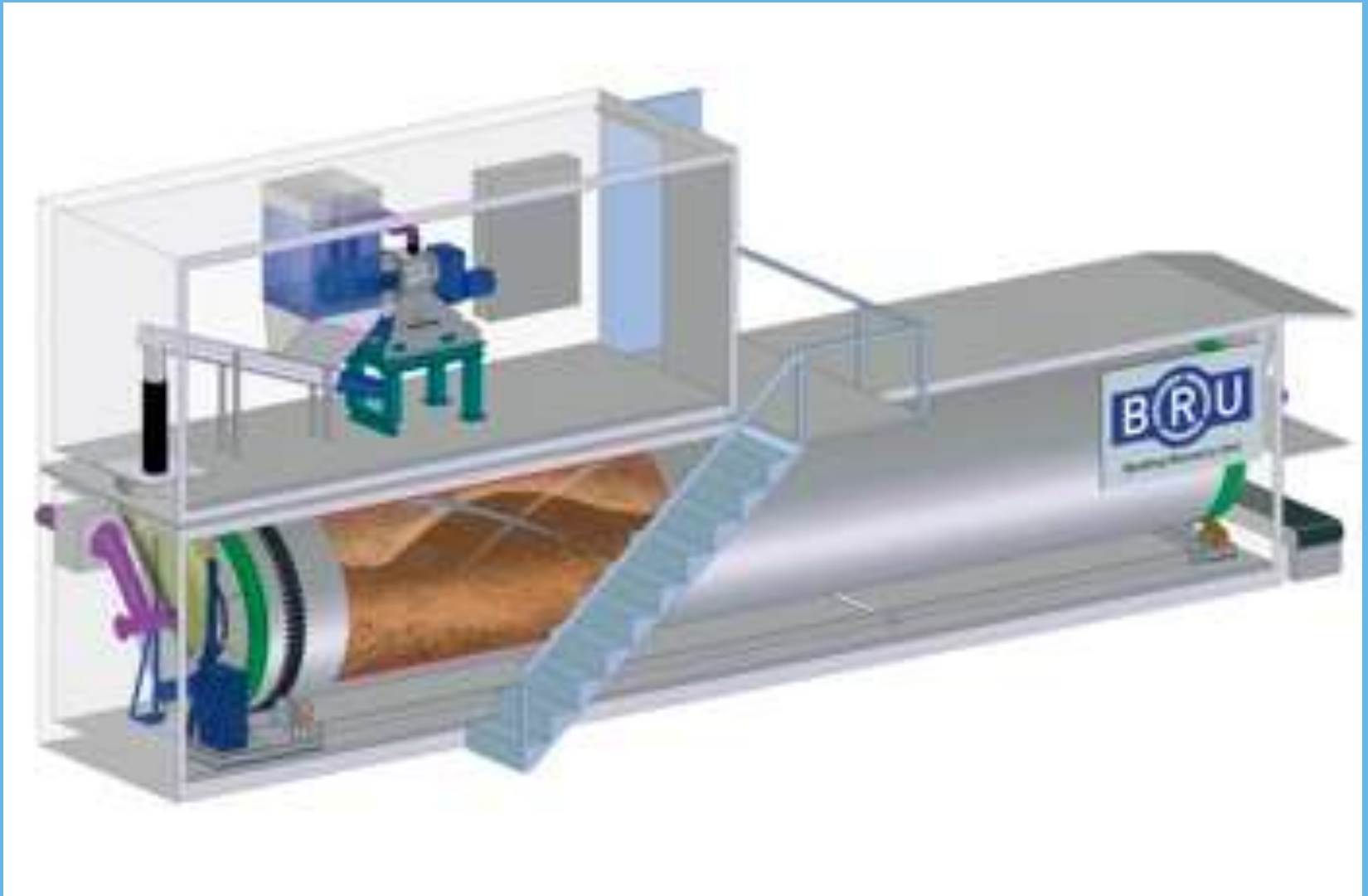


Centrifuge



Centrifuge at the Dane County Digester; Clear Horizon

Bedding Recovery Unit



Solid/Liquid Separation System Performance

- Separator efficiency; determines the amount of solids and nutrients that will be recovered
 - Solids capture rate rates range from less than 5% to higher than 70%
 - Can be increased significantly with the use of polymer
- Solids content of recovered solids; key to value-added products
 - Studies range from approximately 12% to 40% or higher

Characteristics of Separated Liquids

- Low solids content
- Contains significant portions of soluble nutrients



Characteristics of Separated Solids

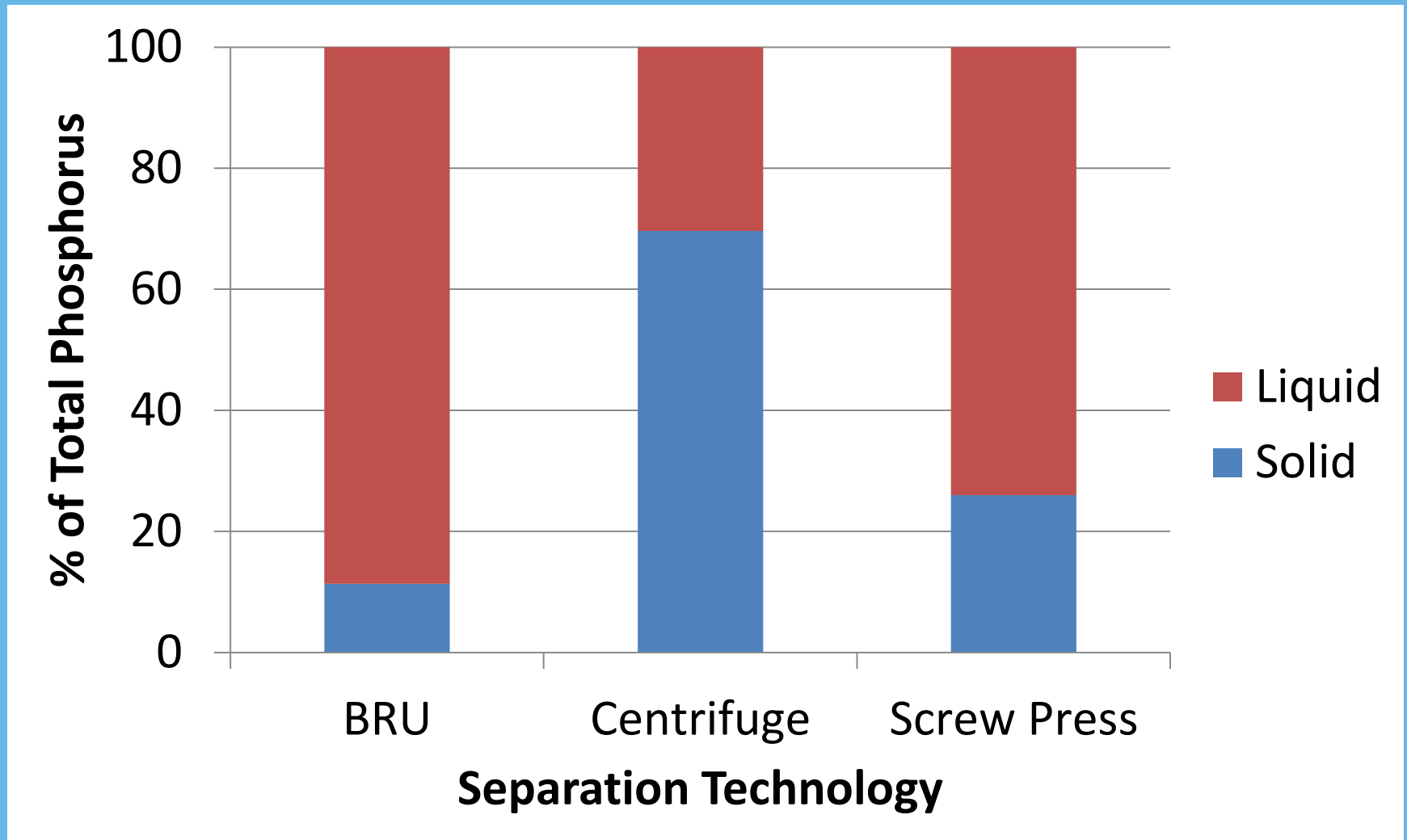
- Higher concentrations of N, P, K and trace elements than manure
- Organic nitrogen and phosphorus concentration higher in the separated solids than in the liquid digestate



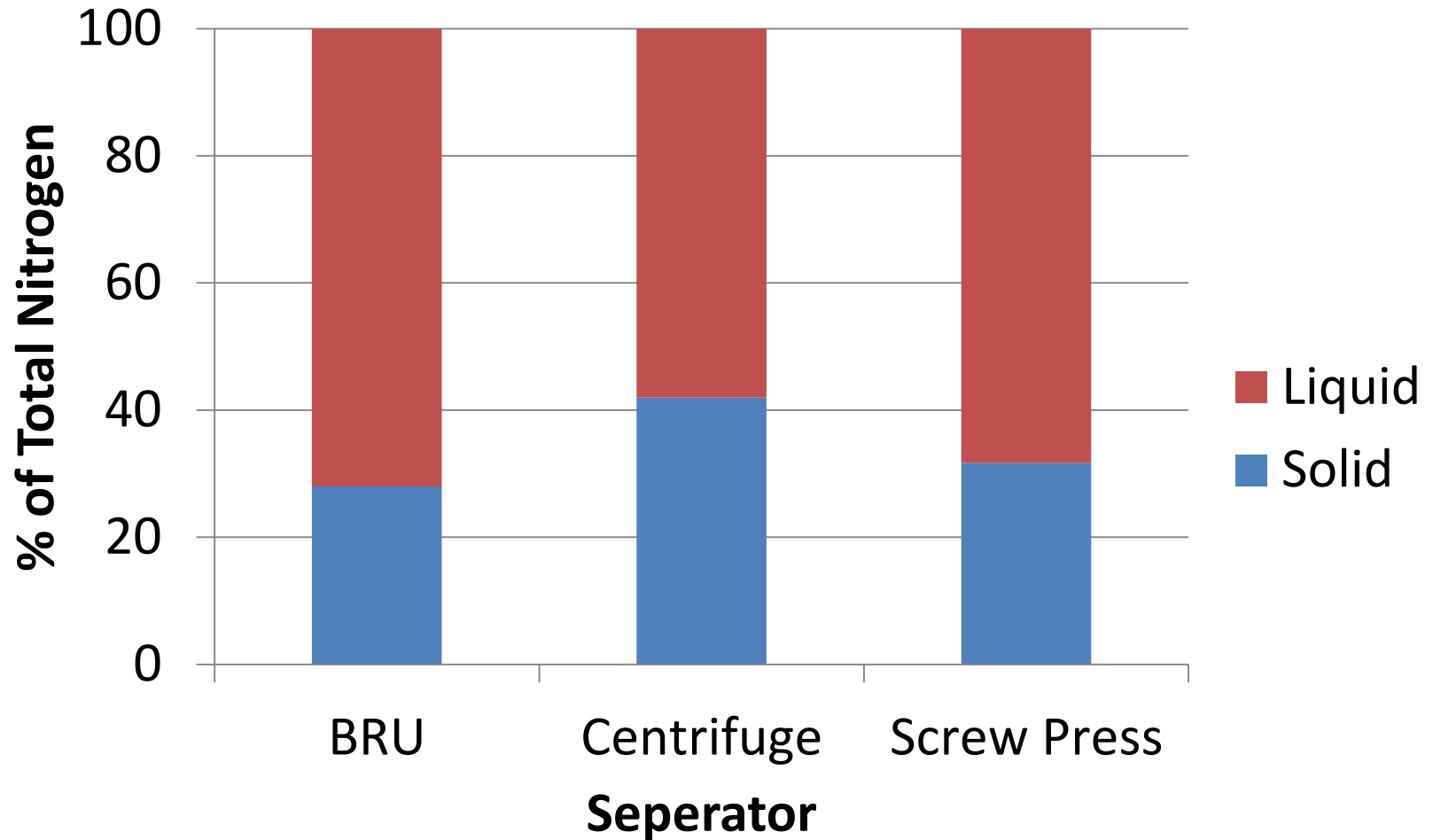
Sources

1. Frame et al. (2001).
2. Martin (2003)

Total Phosphorus Following Separation



Total Nitrogen Following Separation



Solids Separation – System Performance

- Screens
 - Perform better with low solids manures
 - Avoids clogging of screens
 - Less moisture will be found in the solids
 - Balancing act between screen size and separator efficiency
- Presses
 - Higher separator efficiency and solids content
 - Little data available on performance
 - Often used following screens

What is the “Right” Separation System

- Depends on the objectives of the facility
 - Capture as many solids as possible – high separator efficiency
 - High solids content product – separation efficiency may be lower and more solids will end up in the lagoons
- Cost can be a factor
 - The most expensive separator may not be best to meet the objectives
 - The least expensive separator may not be best to meet the objectives

Thank You

Continued analysis of data will be available at

<http://wimanuremgt.org/>

Under research results