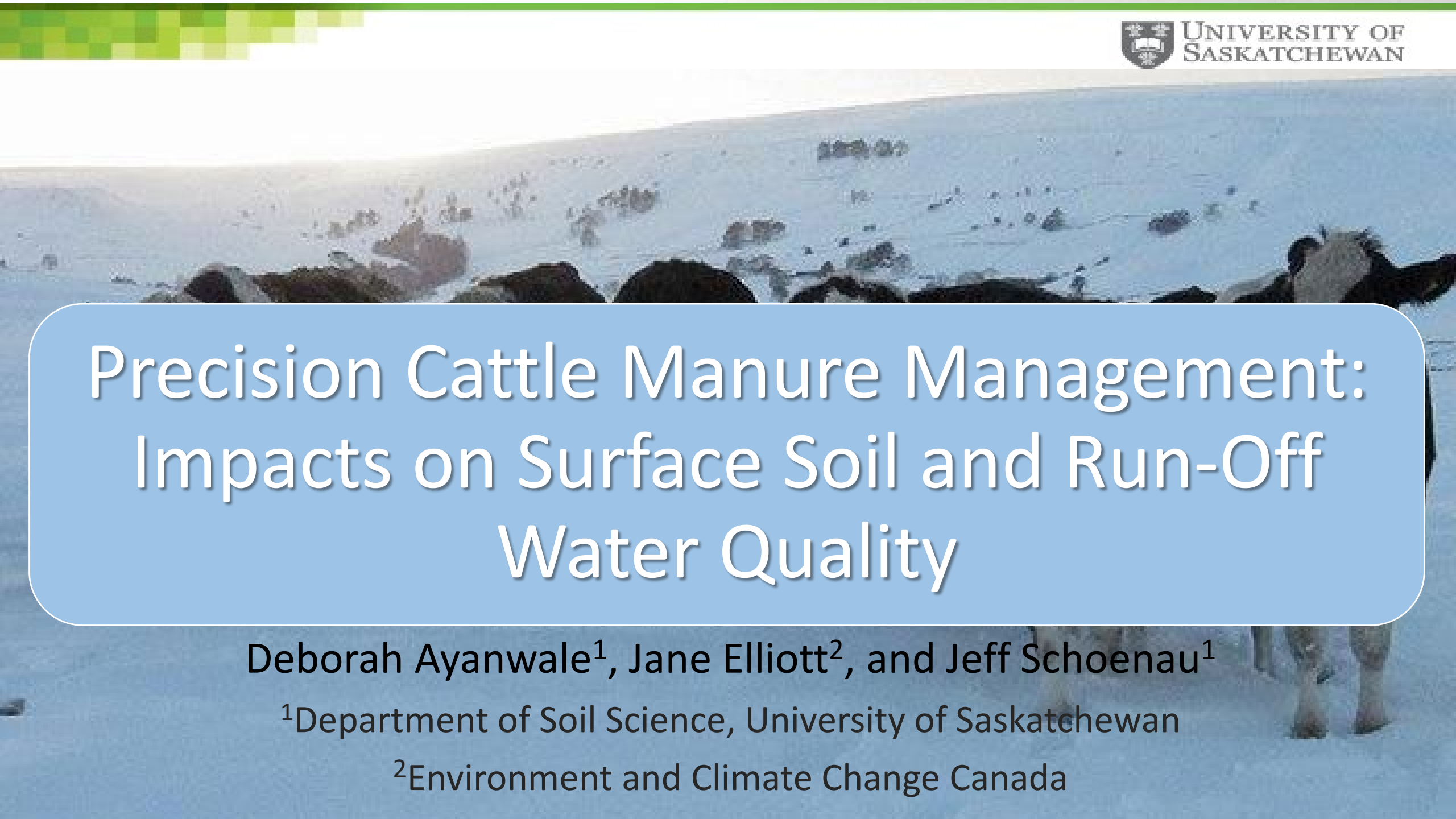

# Precision Cattle Manure Management: Impacts on Surface Soil and Run-Off Water Quality

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[1]Department of Soil Science, University of Saskatchewan

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# Cattle Manure

- Manure application is a sustainable agricultural practice.
  - Composed of feces, urine, uneaten feed and bedding materials.
  - Valuable for soil fertility (N, P, K, trace elements and organic matter).
  - Improves soil productivity.

# Cattle Manure Management

Despite the benefits of manure application, there are detrimental effects:

Agricultural/Environmental risks:

- Over-application and nutrient overloading and loss, leading to:
  - Surface water contamination
  - Fecal contamination- E.Coli, Total Coliforms
  - Groundwater contamination

# Manure Application Strategies

**Traditional Method:**

- Same application rate across land area
- No Setback from waterbody

**Precision Method:**

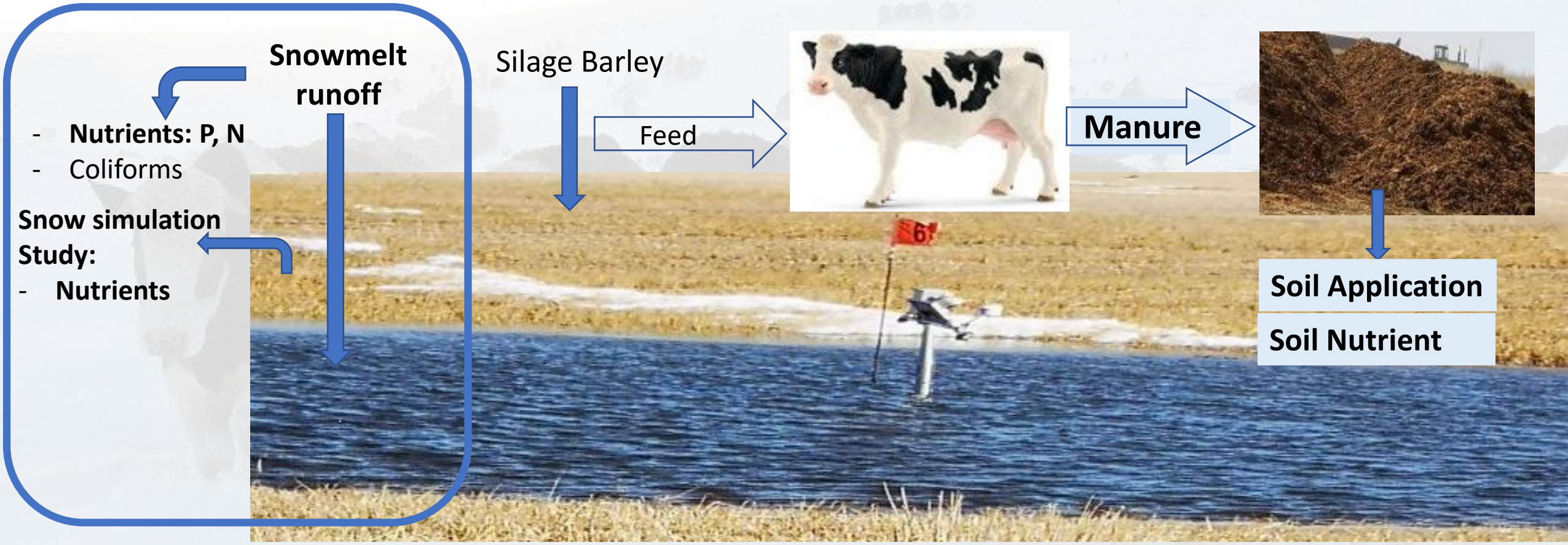
- Site-Specific variable rate of application
- Matches productivity
- Setback from waterbody

# Research Questions

How different are the **environmental** and **agronomic** impacts of these strategies?

Which method is the best?

# Precision Cattle Manure Management: Impacts on Surface Soil and Run-Off Water Quality




Compare: Precision manure application
Traditional /constant rate application
Commercial fertilizer application

# Nutrient export in run-off from commercial and manure-fertilized watersheds at the LFCE

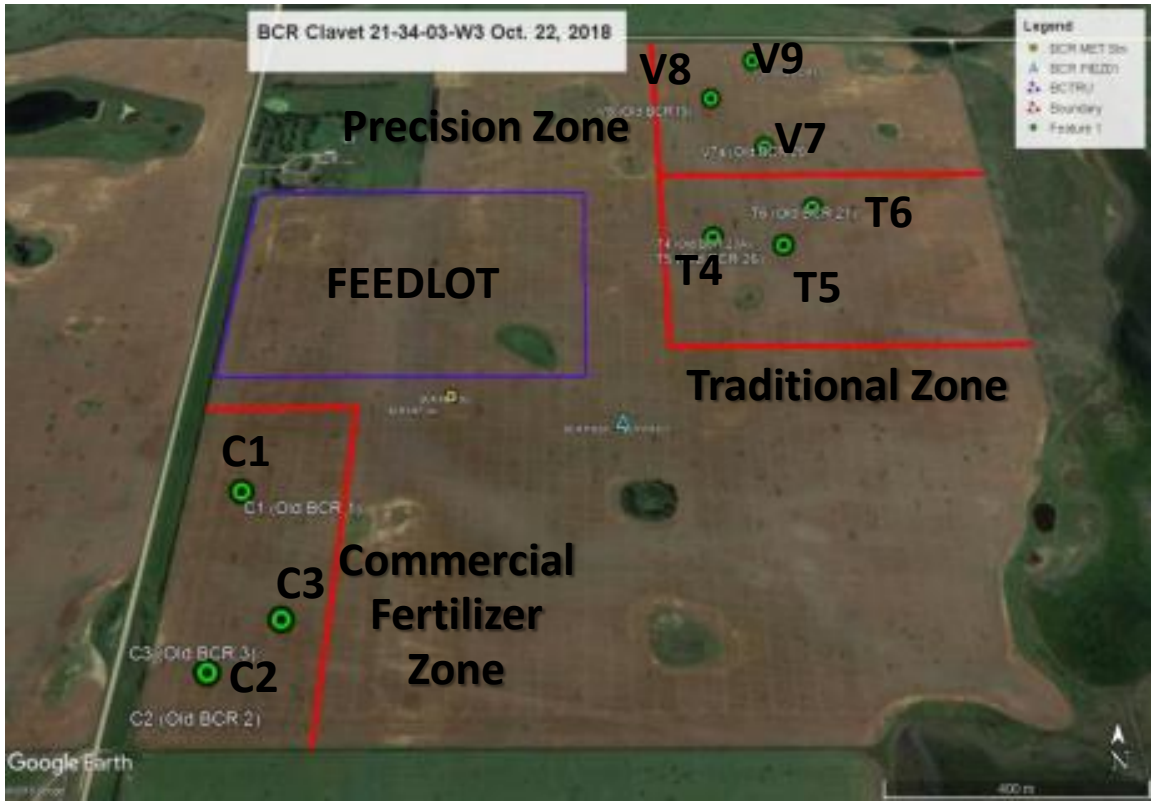
## Objective

To determine the concentration of soluble nutrients in water collected from the basins of each watershed.

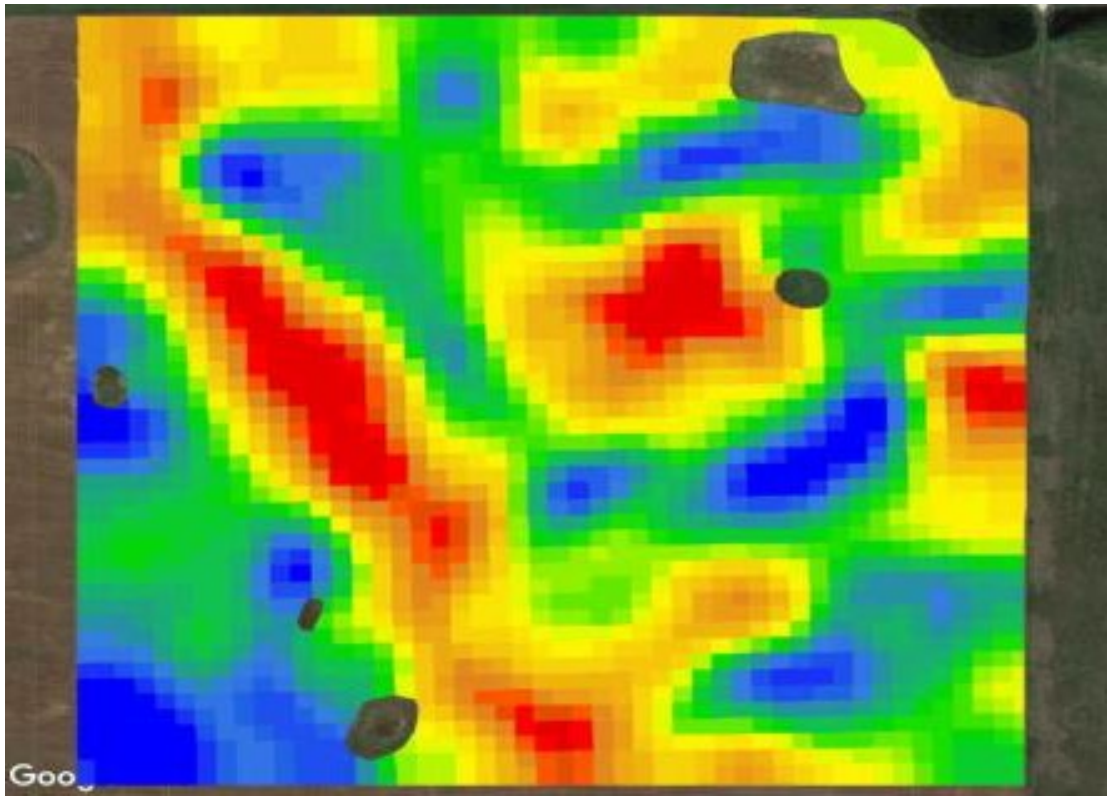
- Frozen soil influences water run-off due to reduced infiltration.
- Nutrients are transported in snowmelt runoff mainly in **dissolved**, also particulate forms.

# Study design

## Treatment Zones on Land around Feedlot



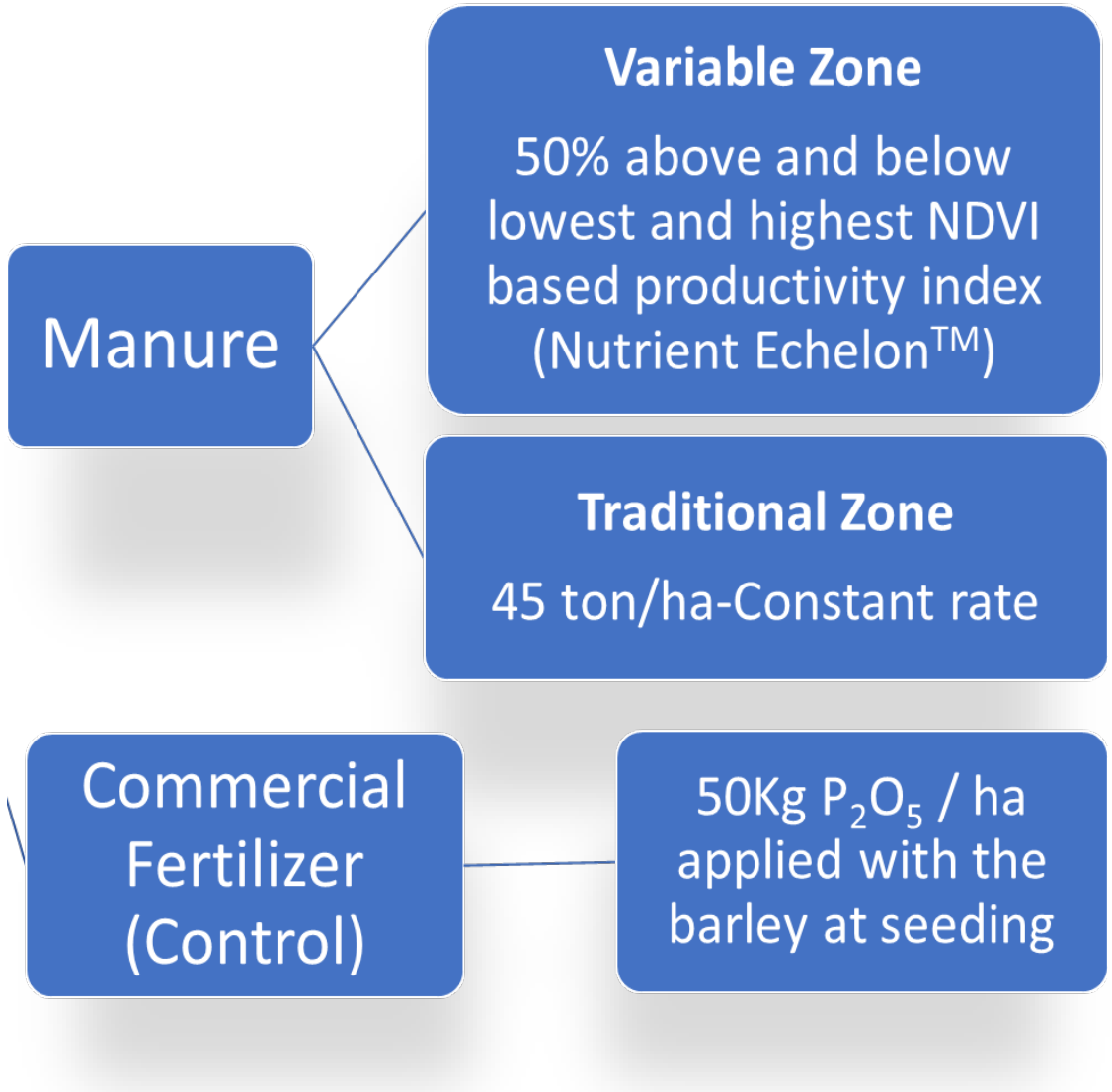

## NDVI Imaging of Variable Rate Zone



Low Productivity — High Productivity

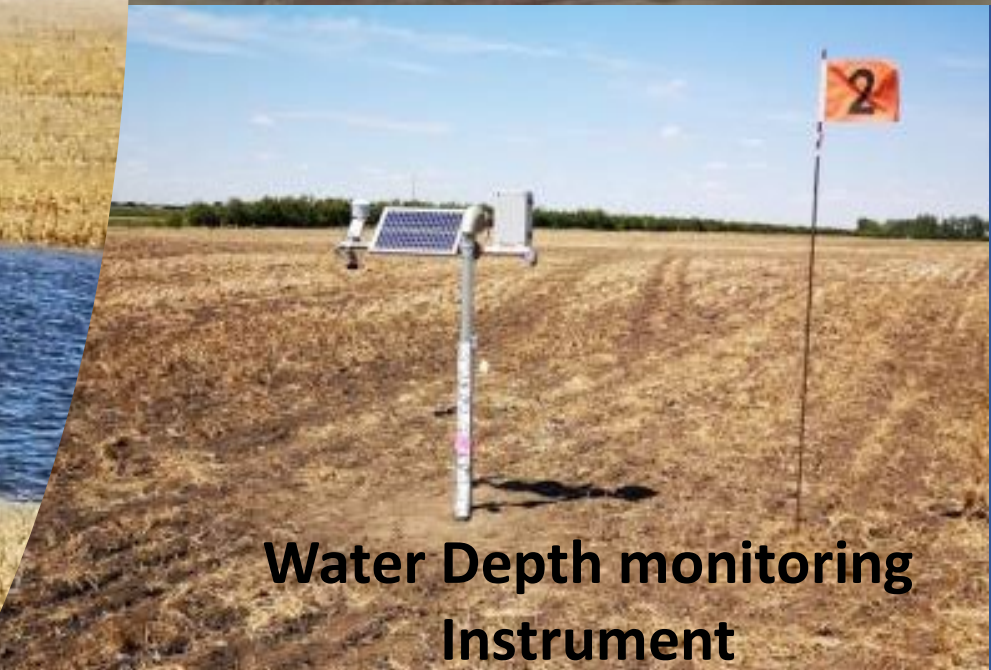
# Methodology

- Crop Grown: Silage Barley (Ranger)
- Manure will be applied every second year (2019 and 2021) based on $P_2O_5$ recommendation (broadcast and harrowed)
  - 0.6% N & 0.3% P concentration in manure
  - In 2019, 45 Ton/ha (i.e. 270 kg N/ha and 130 kg $P_2O_5$/ha) was applied
  - N supplement: 80 kg N/ha commercial fertilizer



# Methodology

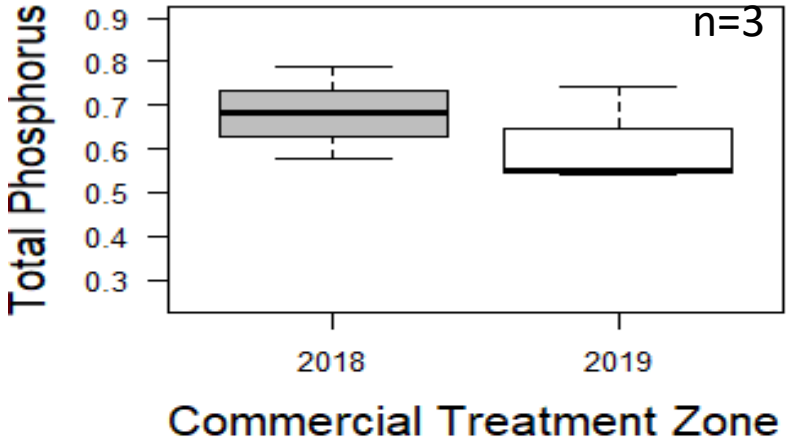
- Sampling in spring 2019
- Filter water through 0.45 µ membrane filter
- Total phosphorus
- Orthophosphate ($PO_4^{2-}$) soluble phosphorus
- Nitrate ($NO_3^-$-N)
- Ammonium ($NH_4^+$-N)

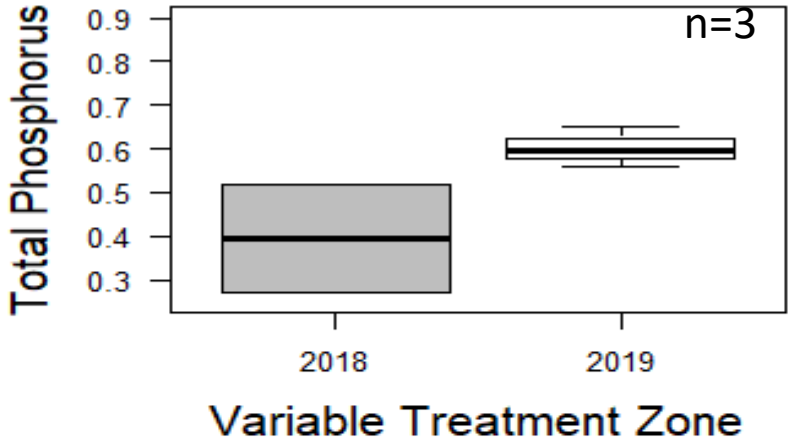



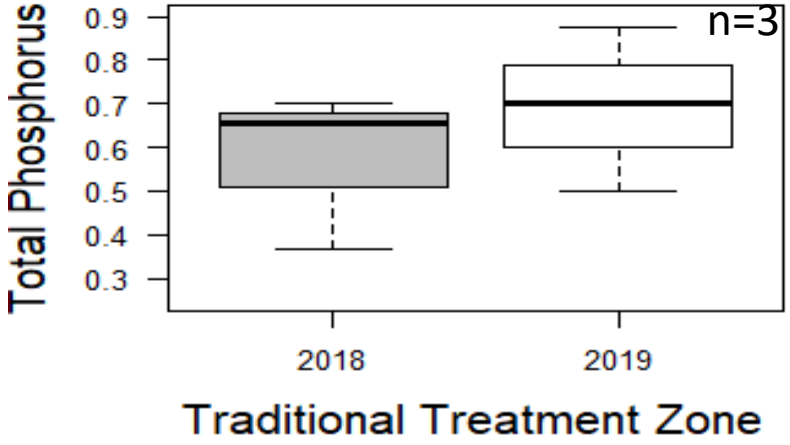

**Water Depth monitoring Instrument**

# RESULTS to Date

**Total P concentration (ug P / mL)** in run-off water in spring of 2018 (baseline) and spring of 2019 (before manure and fertilizer application)



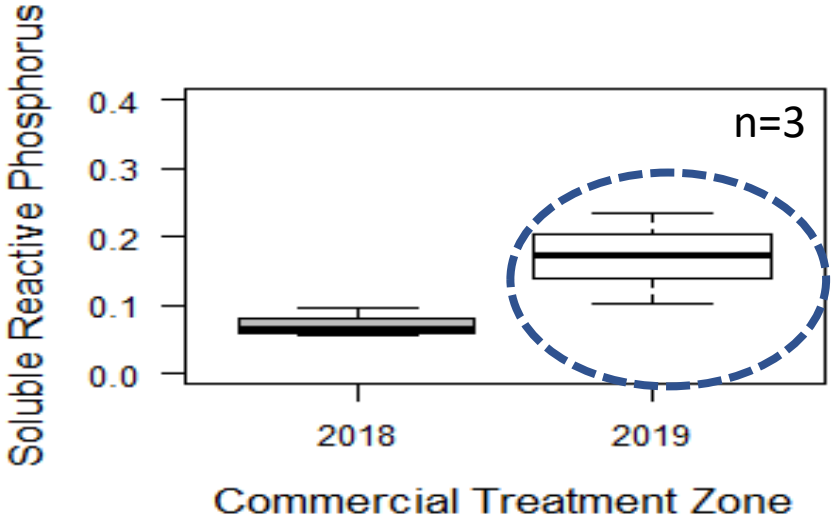



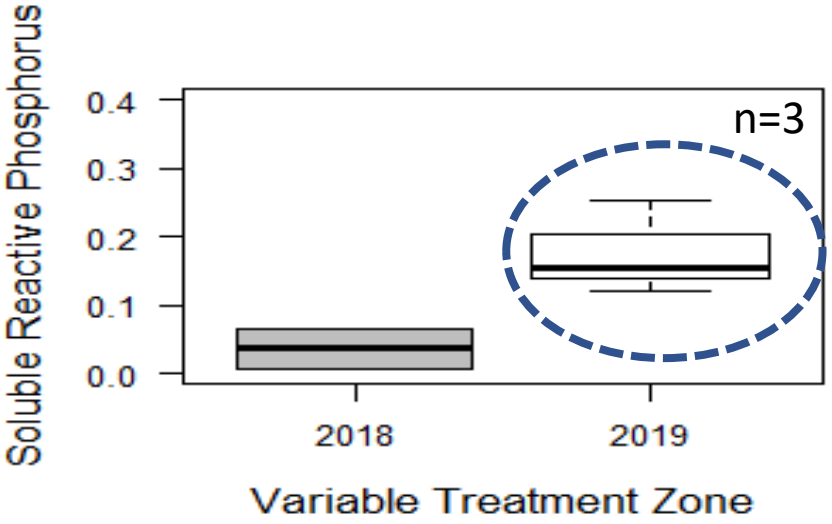



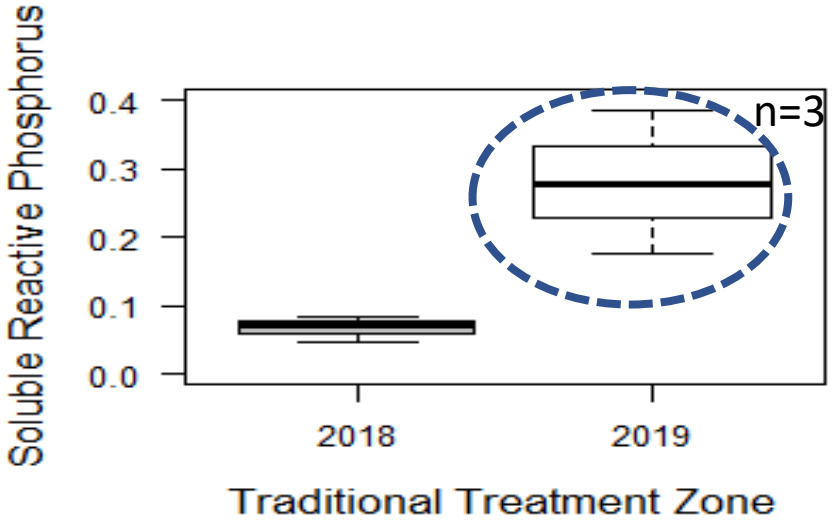

*All three zones have ~ 0.2 to 0.87 ug total P per mL in run-off water in spring 2019*

# RESULTS to date

**Soluble P concentration (ug P / mL)** in run-off water in spring of 2018 (baseline) and in spring of 2019 (before manure and fertilizer application)



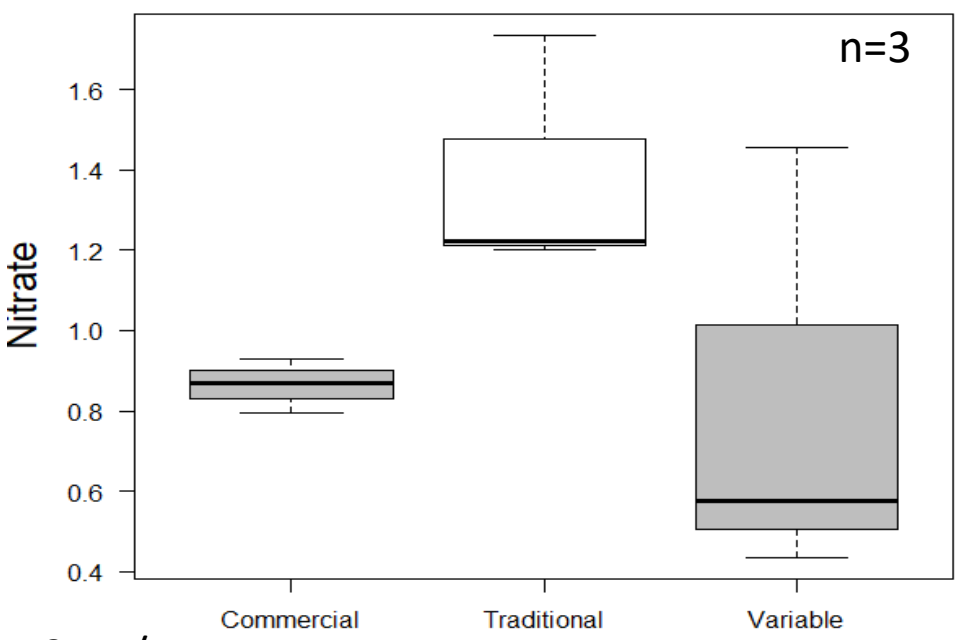




*All three zones have ~ 0.06 to 0.39 ug SRP per mL in run-off water in spring 2019*

# RESULTS to date

**Nitrate and Ammonium concentration (ug / mL)** in run-off water collected in spring of 2019 (before manure and fertilizer application)

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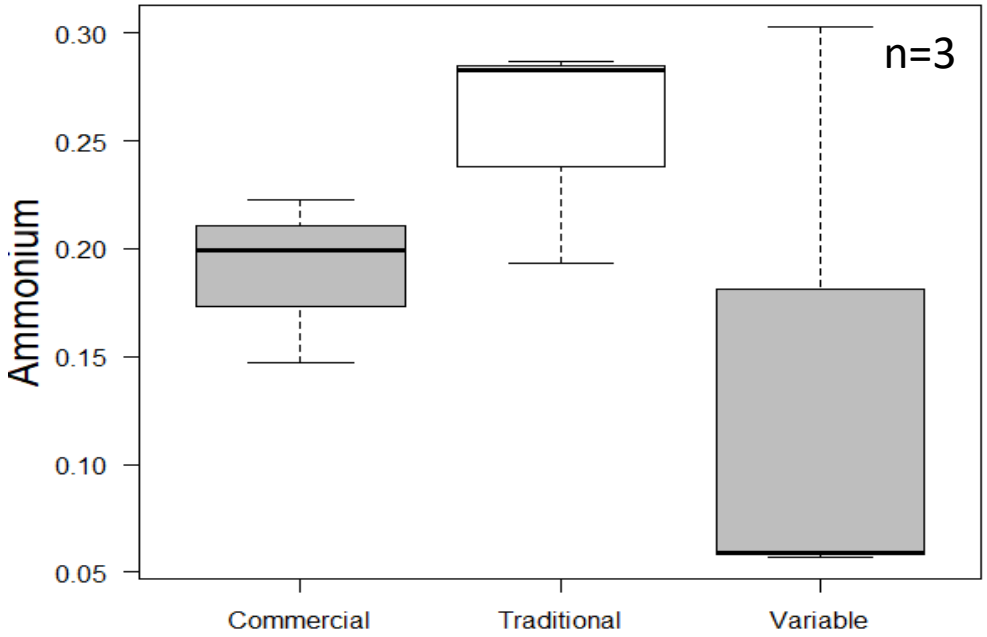
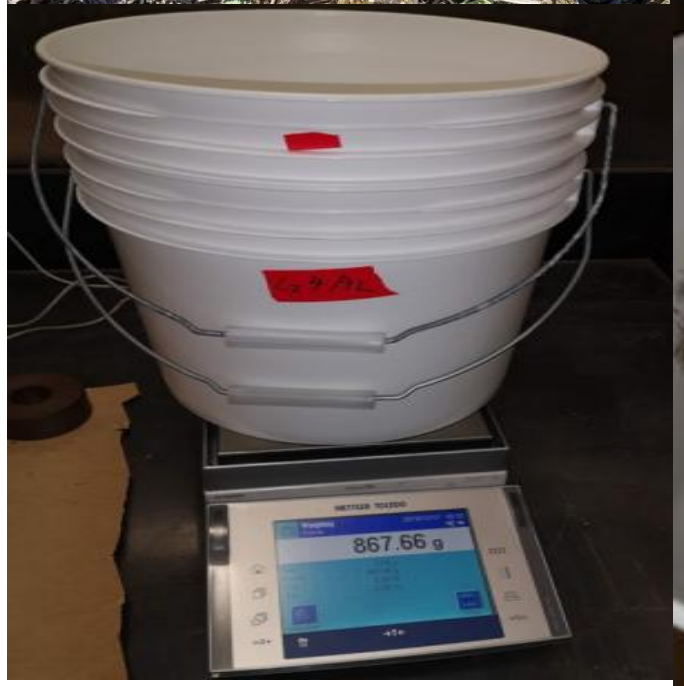



All Treatment zones

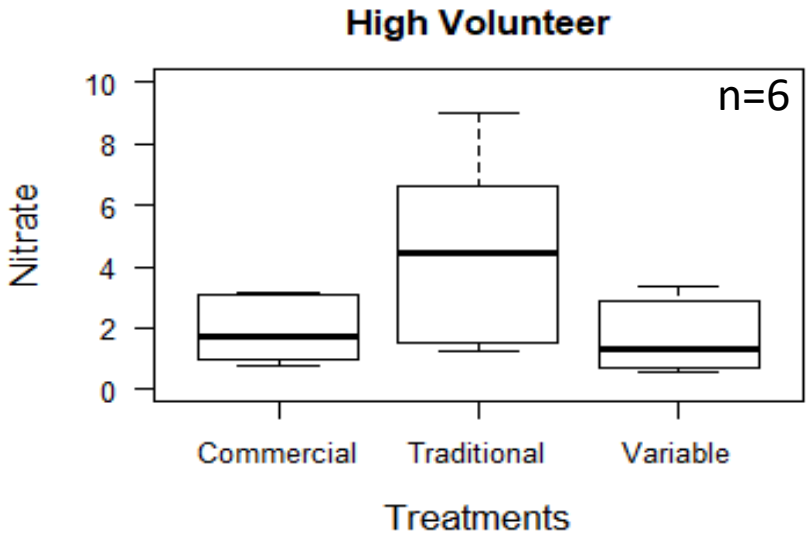
# Runoff Simulation Study

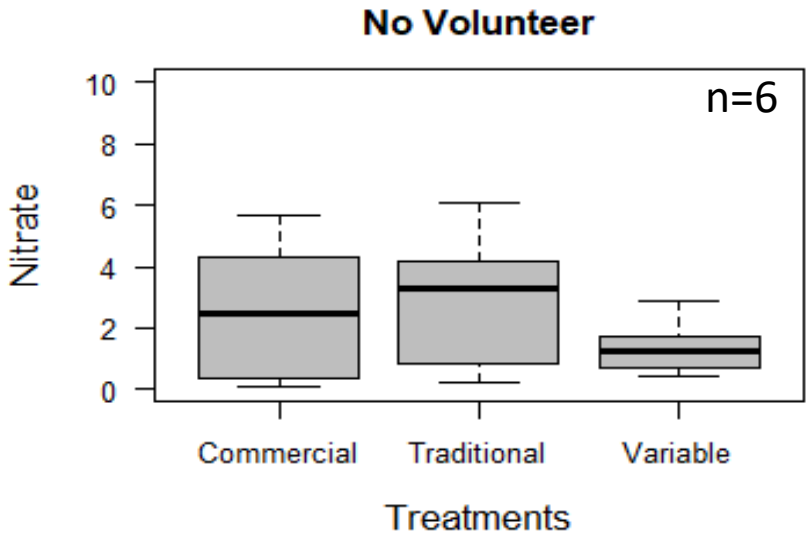
- Imitate the runoff event on the field.
- Sampling: Upper and Mid slope
- Sampling point:
  - High volunteer barley growth
  - No volunteer barley growth (Stubble)
- Samples: Residue and active layer soil
- October 2019 after harvest of silage barley.
- Nutrient in runoff water analysis

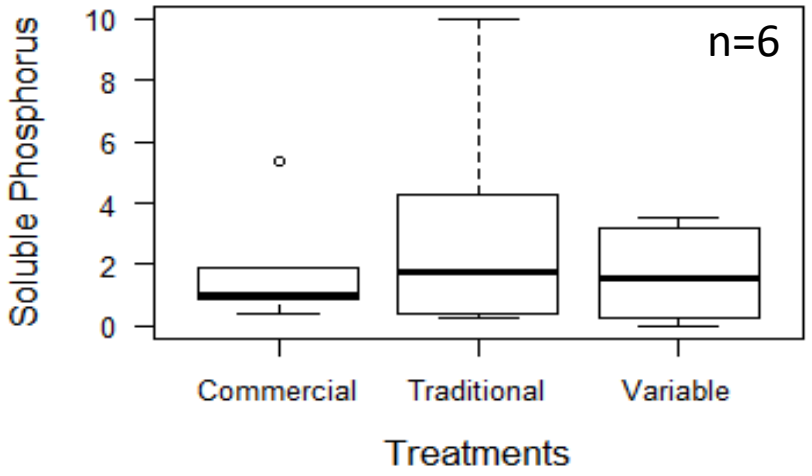


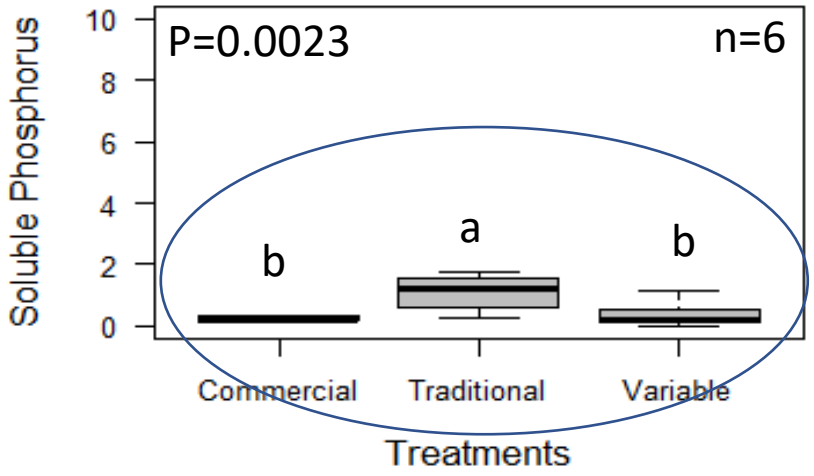

# RESULTS to date

## **Nitrate and Soluble Phosphorus concentration (ug / mL)** in run-off water collected from simulation study



# RESULTS to date

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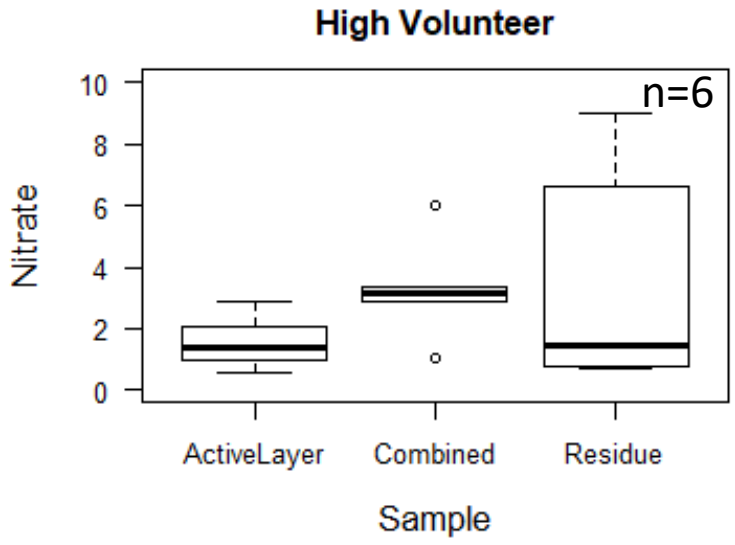


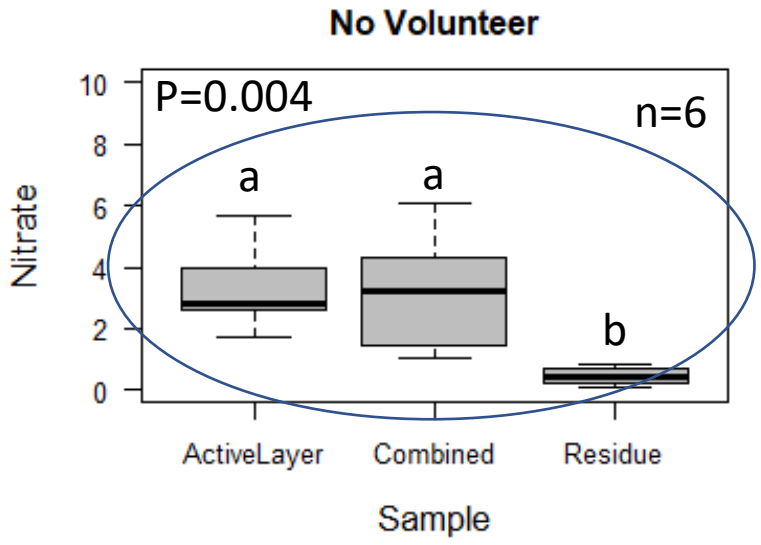


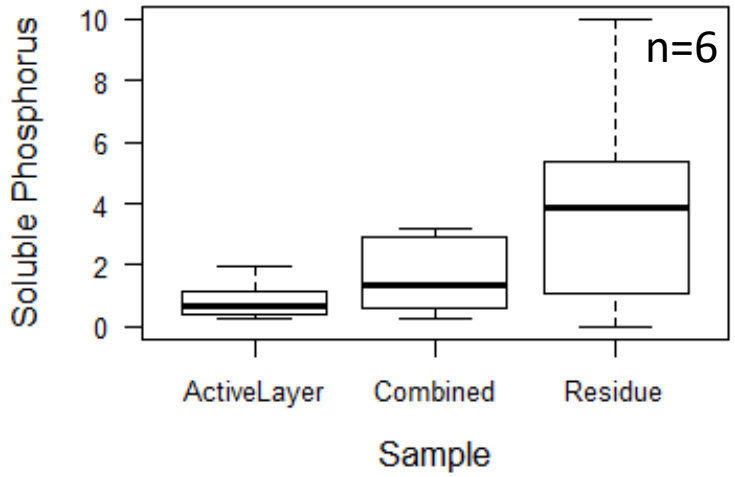


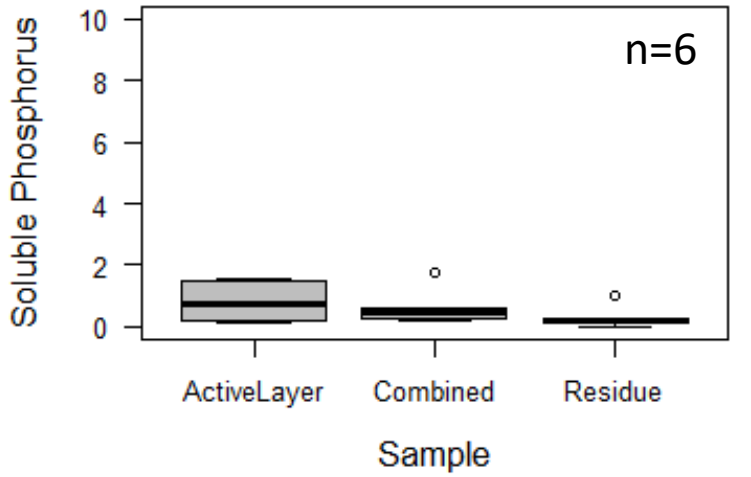

# THE TAKE-HOME MESSAGE

## ❖*After manure application*

**Traditional Method:**

✗ **Higher Soluble P concentration in runoff water**

**Precision Method:**

✓ **Low Soluble P concentration in runoff water**

## ❖Before manure application

- *Trend for P concentration in water higher in 2019 than 2018: less runoff in 2019.*

- *No significant difference in P and N concentrations in run-off water from the three different management zones*

# FUTURE RESEARCH

- Spring 2020 snowmelt run-off collection and analysis from manured and commercial fertilizer treatments that were applied in spring of 2019.
- Relate run-off to surface soil nutrient, barley yield and nutrient removal

# Acknowledgments

Special thanks to my Supervisors:

- **Dr. Jeff Schoenau**
- **Dr. Jane Elliott**

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The team Schoenau


# QUESTIONS ?