

Quantifying yield and water quality benefits of cover cropping at a landscape scale using satellite imagery

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INTRODUCTION



Figure 1: Environmental issues due to current agricultural practices

- Excess nutrients from intensive agricultural practices have led to serious environmental issues such as harmful algal blooms in the Great Lakes and around the world [1] (Fig 1).
- These agricultural practices have also led to loss in soil organic carbon and soil health degradation.
- Cover cropping is one of the conservation practices that help mitigate water quality and soil health problems due to intensive agricultural practices [2] (Fig 2).
- Several cover crop field trials evaluating the role of cover crops on yield and soil health exist but only few studies have investigated the effect of cover crops at a landscape scale.

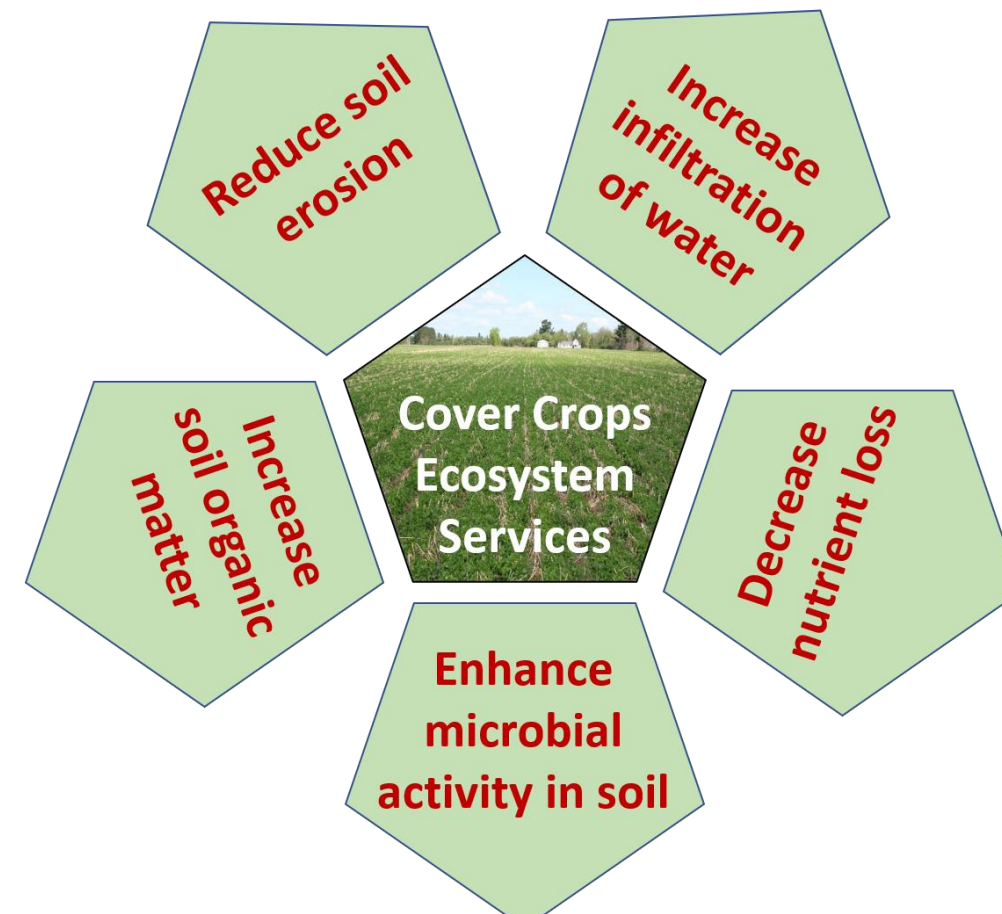


Figure 2: Benefits of cover cropping practice

OBJECTIVES

To assess the effect of cover cropping on crop yield and water quality at a landscape scale

Study Area

- Maumee River Watershed (Fig 3)
- 80% of the watershed is in corn and soybean production
- Agricultural production contributes to ~85% of the phosphorus load to the Maumee River which drains in the Lake Erie
- Only a small percentage of farmers in the watershed are adopting conservation practices including cover crops

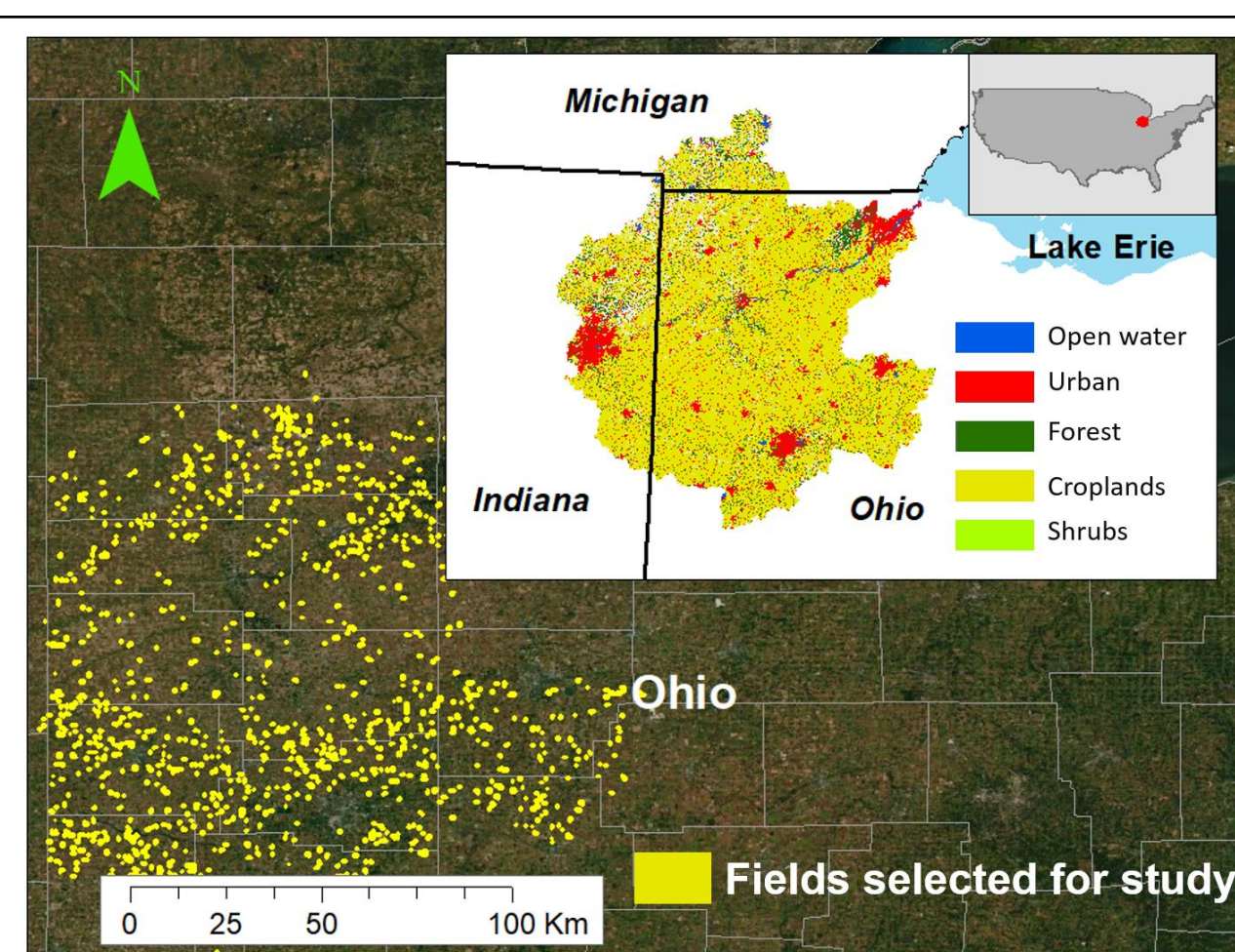


Figure 3: Maumee River watershed (17326 sq km)

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METHODS

Data

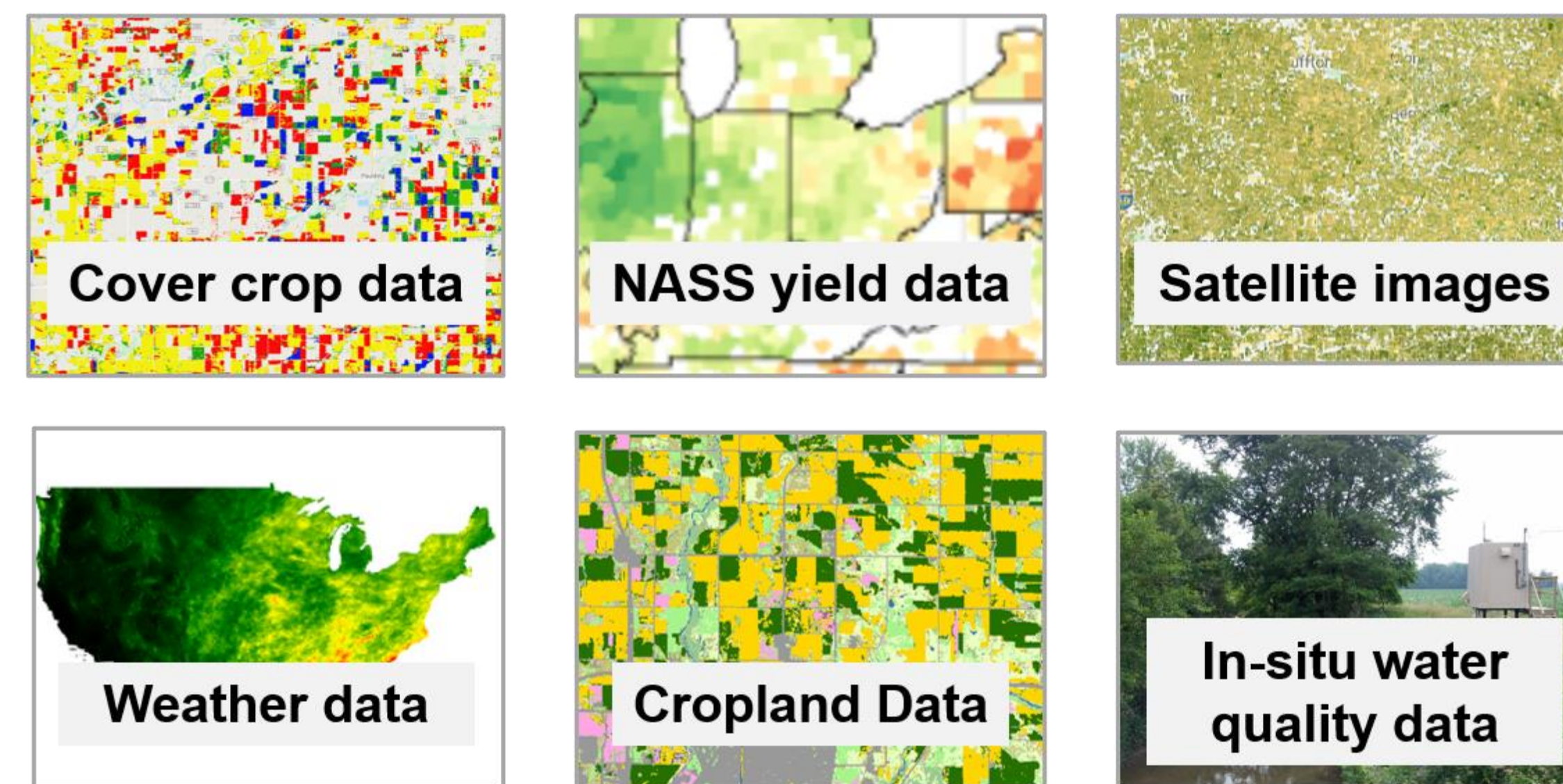


Figure 4: Data used in the study

- Cover crop data from 2008 to 2019 from our previous work focused on mapping cover crop practices using satellite imagery
- Landsat-MODIS fused satellite images at 30 m spatial resolution [3]
- PRISM Daily Spatial weather data at 4 km spatial resolution
- USDA annual Cropland Data Layer at 30 m spatial resolution
- County scale annual yield data from NASS were integrated with satellite imagery to develop high-resolution corn and soybean yield estimates
- In-situ water quality data at Maumee River from Heidelberg University's National Center for Water Quality Research

Workflow

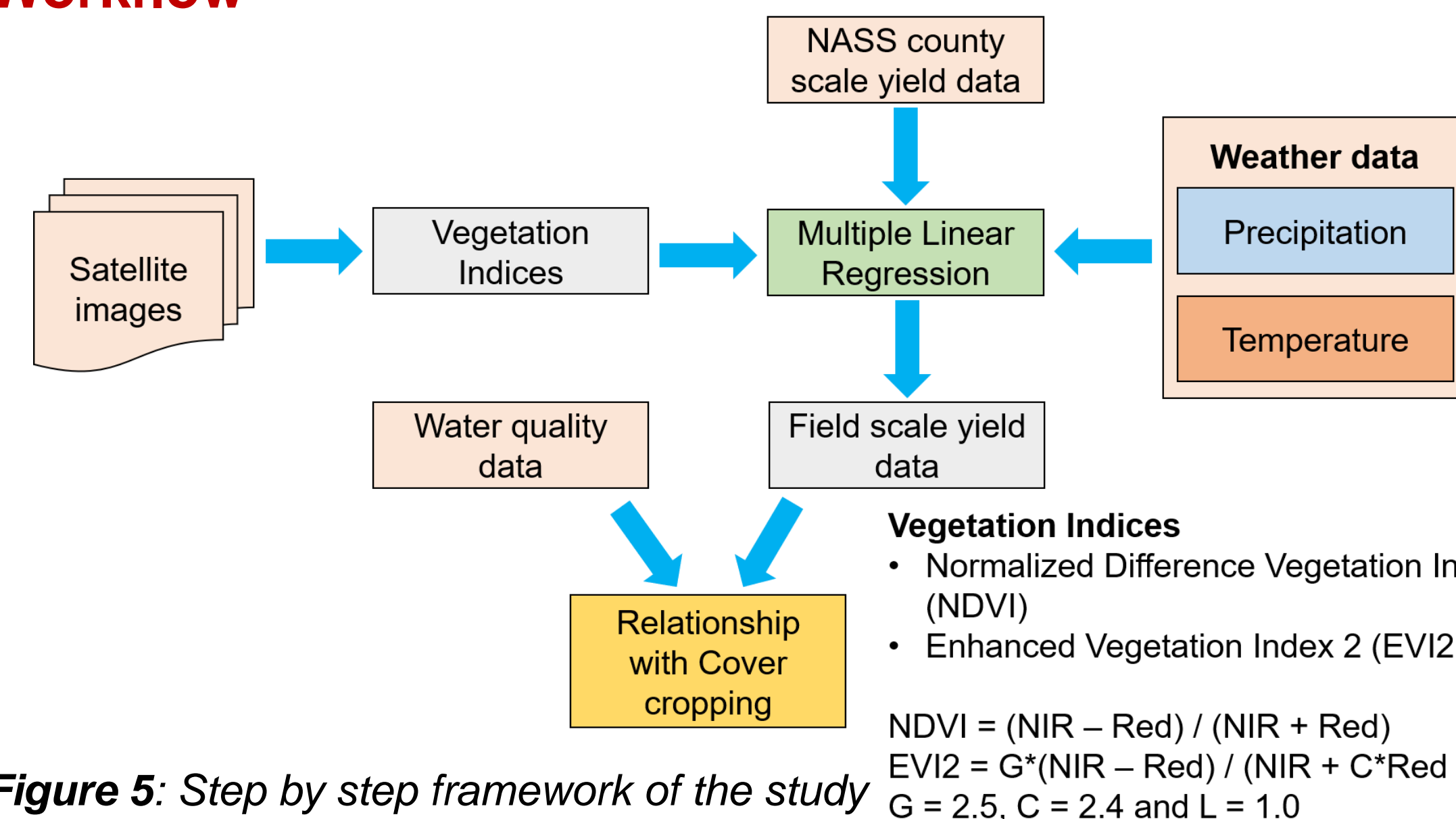


Figure 5: Step by step framework of the study

- Extracted corn and soybean areas using spatial and temporal cover crop maps
- Evaluated summer crop yield and nutrient load/concentration with the cover crop area in the corresponding winter season.

RESULTS

- On average, there were slight to negative advantages of cover crops on corn and soybean yields (Fig 7).
- The yield differences between field with and without cover crops however were not significant for soybean.
- These findings were found to be consistent with prior studies focused on field trials [4] [5].

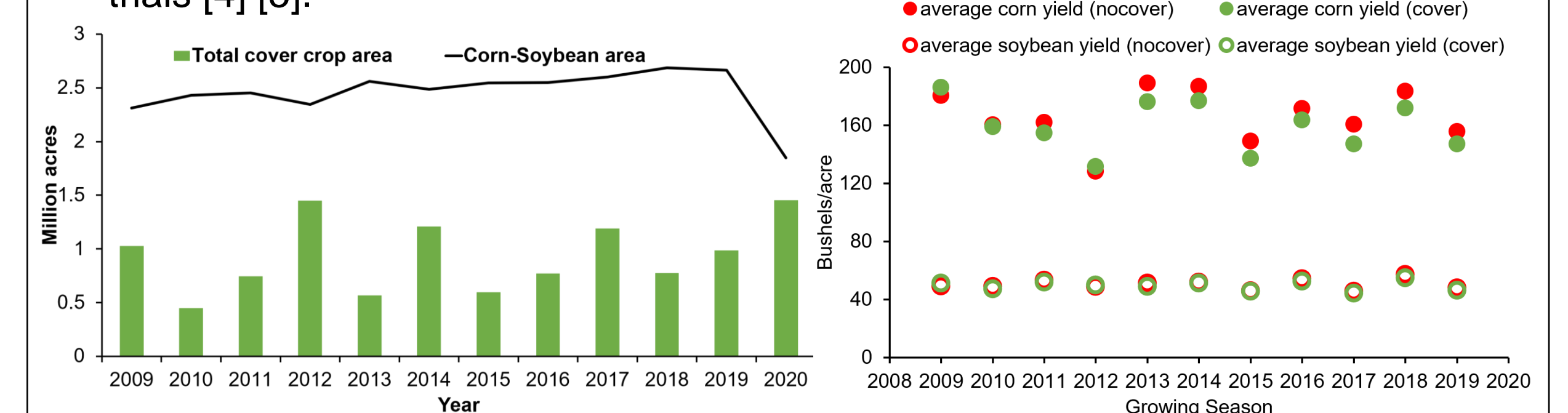


Figure 6: Cover crop areas in the Maumee River Watershed

Figure 7: Yield difference between fields with and without cover crops

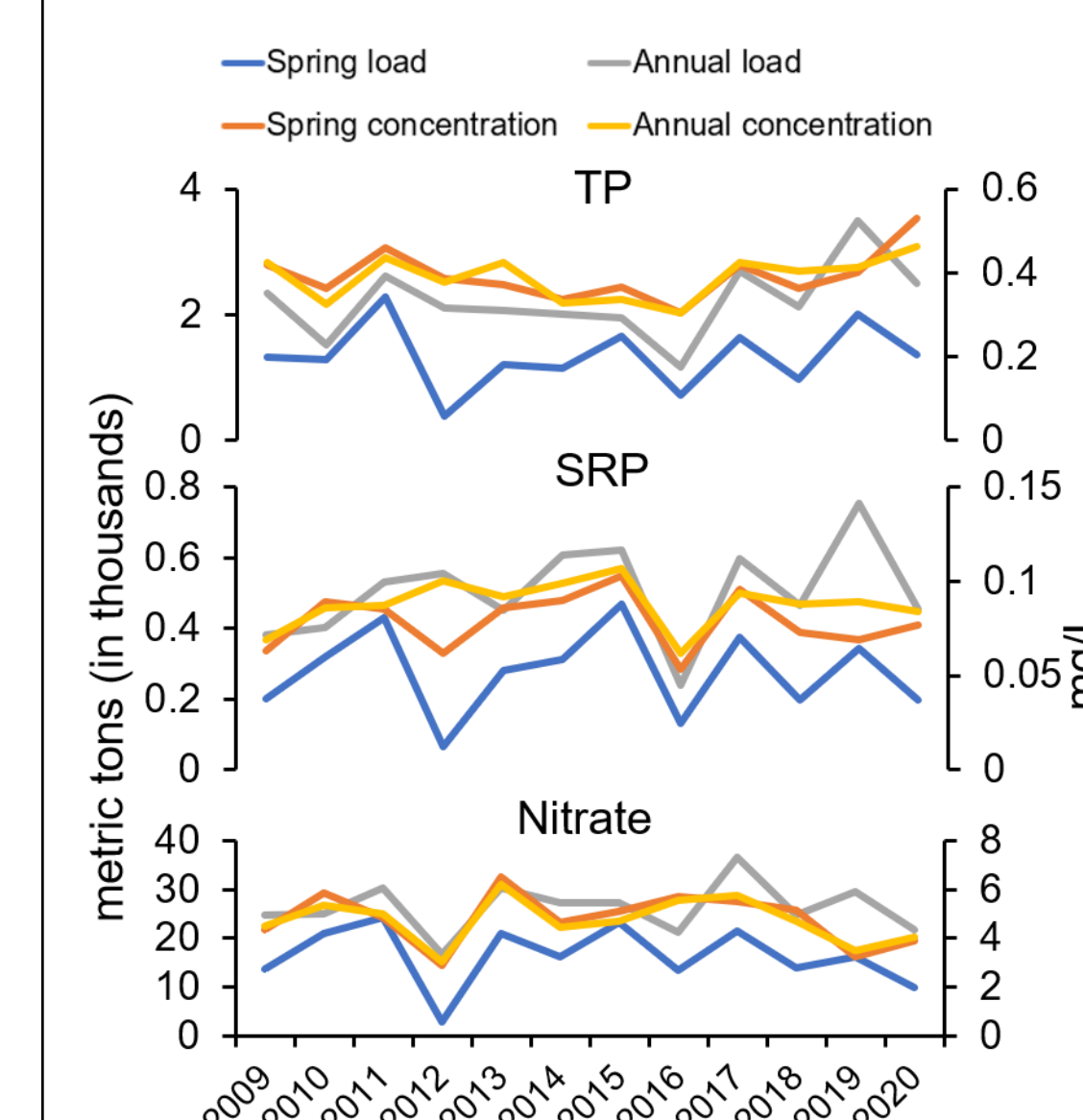


Figure 8: Annual and spring nutrient trend at Maumee River and relationship with cover cropping. Note: TP– Total Phosphorus, SRP– Soluble Reactive Phosphorus

- Spring load and concentration of nitrate show stronger negative correlation with cover cropping area than TP and SRP (Table 1).
- Annual nitrate concentration also decreased with cover crop area (not shown here)

Table 1: Correlation between cover crop area and nutrient load in Maumee River during 2009-2020.

Concentration/Load	Correlation (R) with Cover Crop Area
Spring Concentration (TP)	0.45
Spring Concentration (Nitrate)	-0.72
Spring Concentration (SRP)	-0.28
Spring Load (TP)	-0.25
Spring Load (Nitrate)	-0.70
Spring Load (SRP)	-0.44

Note: Spring load and concentration is for March – July. Annual load and concentration is for October – September.

CONCLUSIONS

- No significant to slightly negative change in yield on cover cropped fields.
- Cover cropping correlated with reduction of nitrate and SRP concentration and load showing implication of the practice in improving water quality.

FUTURE WORKS

- We will focus on assessing cover crop biomass and nutrient uptake efficiency using different remote sensing technologies (from Drones to satellite).

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