

Take Me To The River: How do agricultural processes affect nutrient concentrations in the Kokosing River?

Will Laymon | Advisor: Carlo Moreno | Spring 2026

INTRODUCTION

Rivers are vital for both ecological health and human well-being. The Kokosing River in Knox County, Ohio is a 57-mile scenic tributary of the Walhonding River, supporting 74 fish species, 44 mammalian species, and 89 bird species across a 482 square-mile watershed.

Knox County is predominantly agricultural, with 121,291 acres of cropland (2022). Agricultural runoff is the leading driver of eutrophication: excess nutrient loading fuels algal blooms and oxygen dead zones, leading to aquatic biodiversity loss.

57 mi

Kokosing River Length

482 mi²

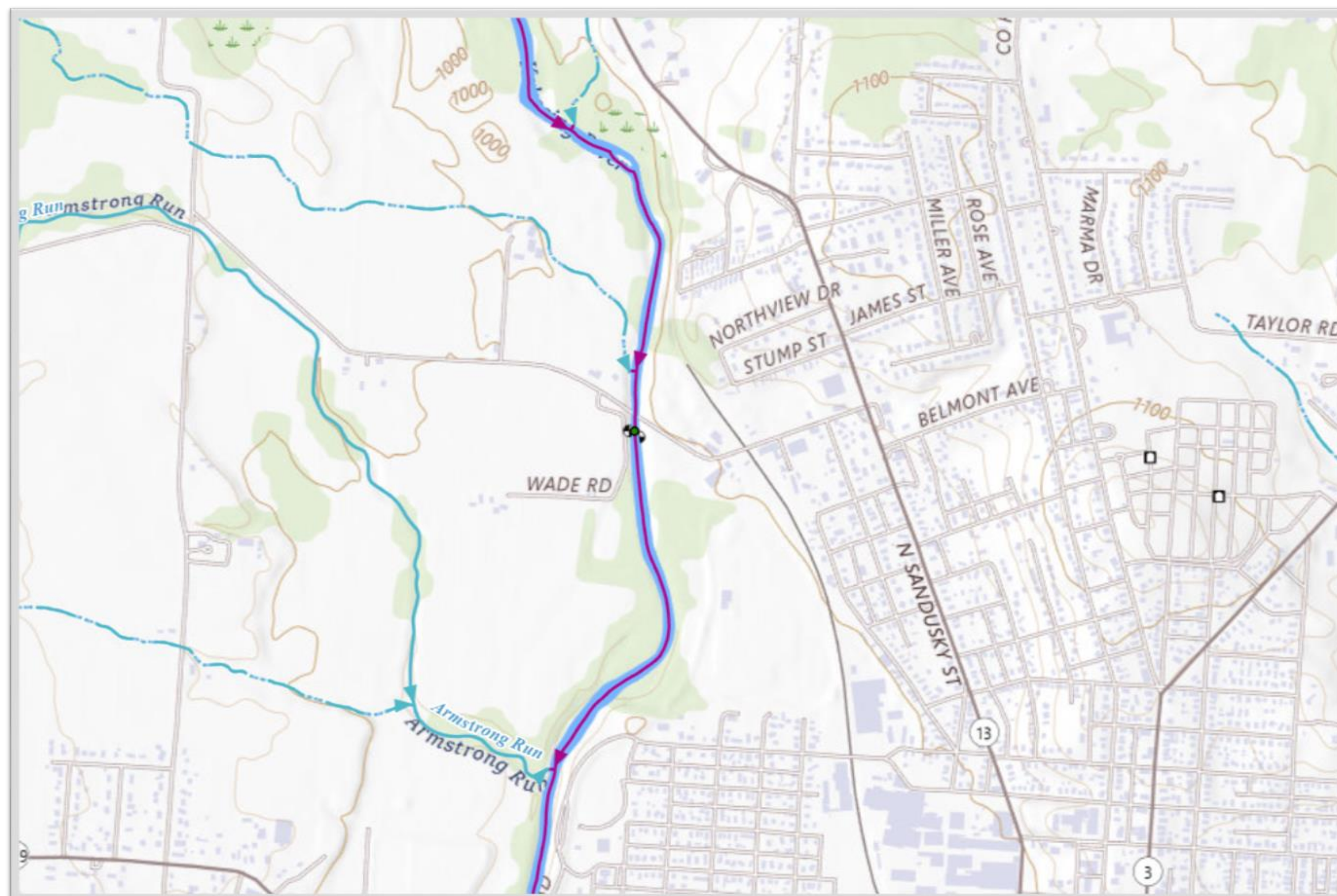
Watershed Area

121,291 ac²

Knox County Agricultural Acreage

STUDY SYSTEM

The study site is USGS gauge 03136500 (Kokosing River at Mount Vernon, OH) at Latitude 40°24'20", Longitude 82°30'00", river mile 28.61. Currently, this is the only long-term monitoring site in the area.



RESEARCH QUESTION

“How do nitrogen and phosphorus concentrations in the Kokosing River reflect landscape changes in Knox County, Ohio?”

METHODS

Ohio EPA monthly water samples (1999–2019) were analyzed for nitrogen and phosphorus. Annual means were calculated (N = 21 data points).

USDA QuickStats data provided annual corn and soybean acreage for Knox County.

A multiple linear regression in RStudio examined relationships between nutrient concentrations (N, P) and crop acreage (corn, soybeans).

RESULTS — PHOSPHORUS

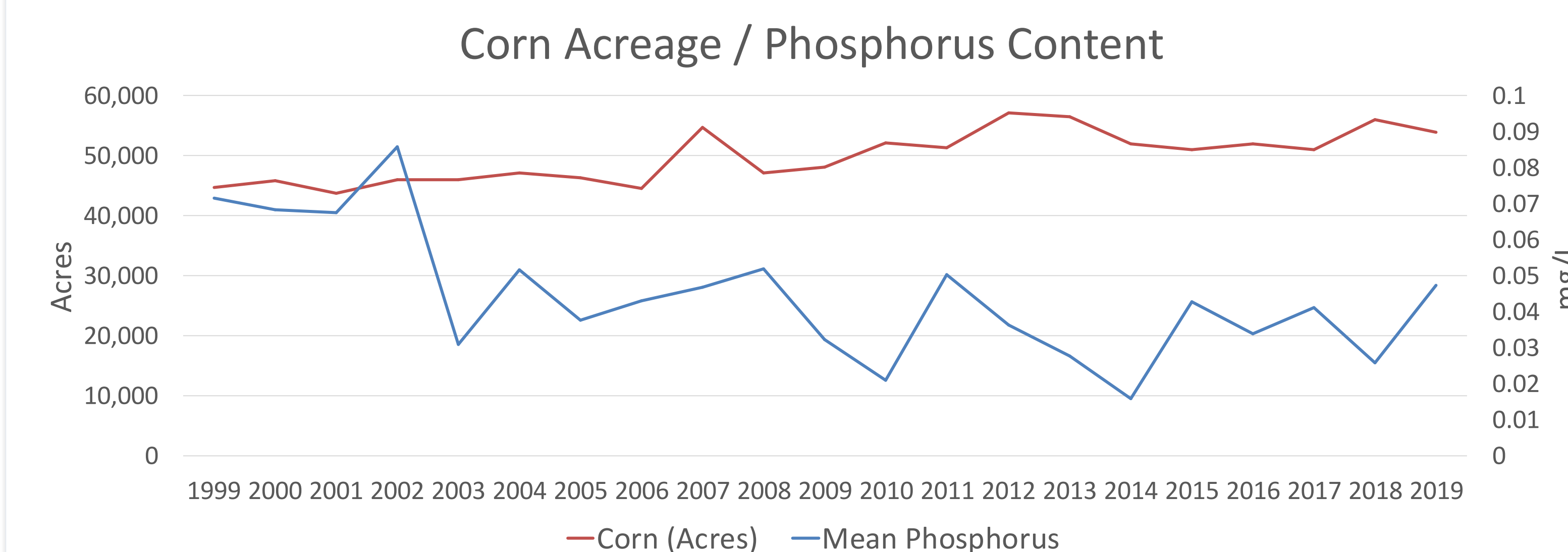
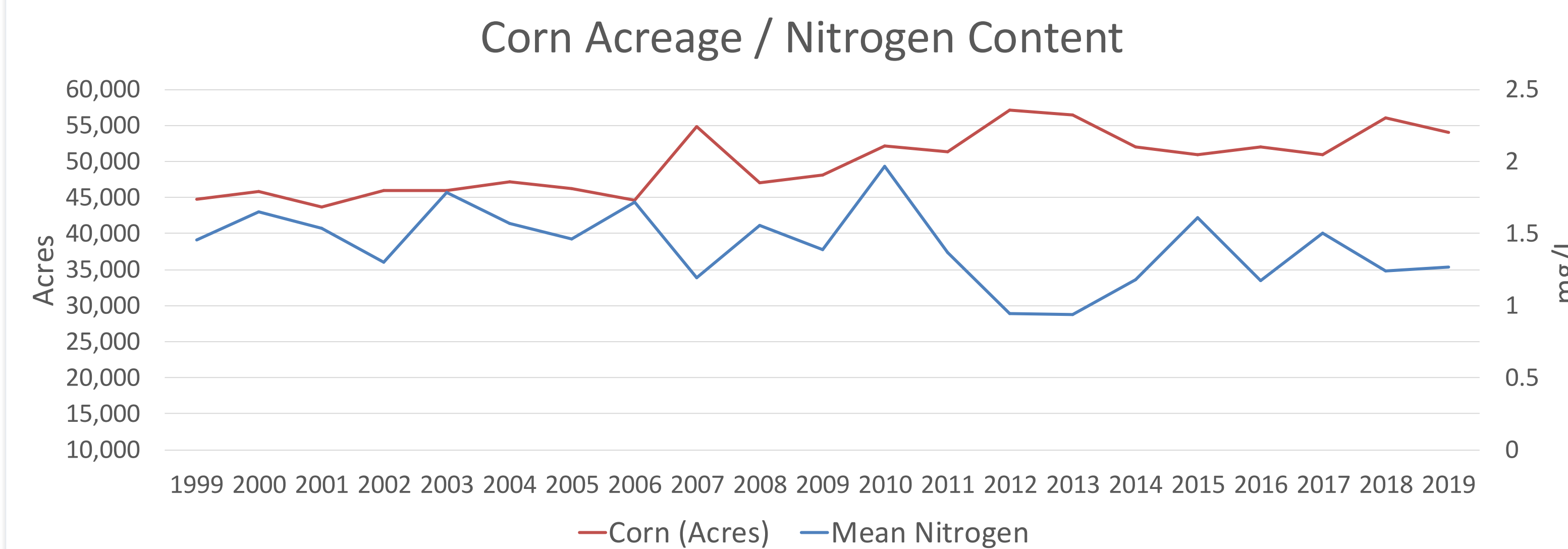
Variable	Estimate	t-value	p-value
Corn (Acres)	-2.00E-06	-2.357	0.030 *
Soybeans (Acres)	-1.12E-06	-1.106	0.283

Model $R^2 = 0.371$ | Adj. $R^2 = 0.301$ | $F = 5.304$ ($p = 0.015$)

RESULTS — NITROGEN

Variable	Estimate	t-value	p-value
Corn (Acres)	-4.05E-05	-3.319	0.004 **
Soybeans (Acres)	3.43E-06	0.235	0.817

Model $R^2 = 0.409$ | Adj. $R^2 = 0.344$ | $F = 6.237$ ($p = 0.009$)



DISCUSSION

Corn acreage showed a significant negative relationship with nitrogen and phosphorus ($p \approx 0.004-0.03$), while soybean acreage did not have a significant relationship with either, contradicting expected results for the study.

These results suggest that:

- Soybean crops have a different relationship with nutrient outflow, potentially due to their use in crop rotations and ability to fix nutrients such as nitrogen within soil.
- Alongside this, the negative relationship between corn and both nutrients shows that local practices may be working against nutrient outflow in positive ways.

Local Best Management Practices (BMPs), including nutrient management plans, reduced tillage, grassed waterways, and terraces, are likely responsible. These were planned for Knox County in the Kokosing Watershed Action Plan (2004) and could potentially account for nutrient reduction in the river.



CONCLUSIONS & FUTURE DIRECTIONS

- Corn acreage was a significant negative predictor of N & P in the Kokosing River ($R^2 \approx 0.37-0.41$).
- Water quality in small rural watersheds is shaped by complex, locally-specific management decisions that broad studies may not cover.
- Future work should use multiple sampling sites along the full 57-mile river, broader land-use categories (forest, pasture, urban), and farm-level BMP adoption data.
- Preemptive local-scale monitoring is essential for addressing eutrophication before it causes acute ecological harm.

REFERENCES

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