Water Nutrient Flux Across Lower Order Streams in Watersheds with Diverse Land Uses and Variable Saturation Levels

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Significance: In the face of global change, population growth and rapid urbanization, understanding the effect of nutrient pollution in small first and second order streams will be fundamental in conserving and protecting freshwater ecosystems and resources in the future.

Introduction

- Changes in natural and anthropogenic factors such as precipitation and land use cause many point source and nonpoint source pollution issues.[1,2,3]
- Previous research has focused on interactions of land use, water quality, and streamflow in higher order streams, while significant water pollutants could originate in lower order streams.
- Storms with increasing intensity over shorter periods is leading to increased rates of nutrient runoff, longer droughts, and streams with lower average flow throughout the year.[4,5]
- Our goal was to identify nitrogen and phosphorus concentrations in first and second order streams across different land use areas and investigate the effect of precipitation on nutrient concentrations in stream water.

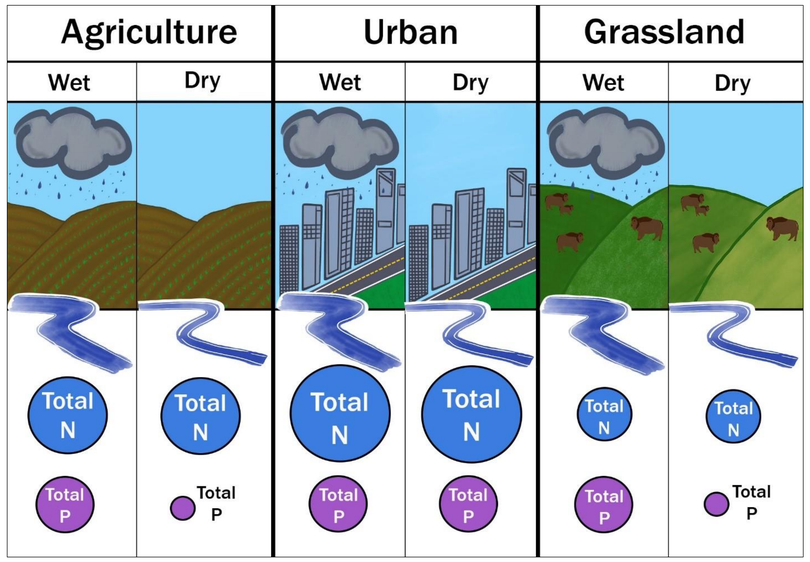

Figure 1: Conceptual model of experiment structure displaying total nitrogen and total phosphorus concentrations in first and second order streams in varying watersheds under different saturation levels.

Methods

- Watersheds were selected based on land use category (grassland, agricultural, and urban) across the state of Kansas.
- Dry sampling was conducted on March 19, 2024, and wet sampling was conducted on April 16, 2024, after a rain event.
- Daily streamflow measurements from all three watersheds were obtained from USGS for the past ten years.
- Samples were analyzed for nitrate (NO_3^-), orthophosphate (PO_4^{3-}), total nitrogen, and total phosphorous using potassium persulfate digestion.
- Stream water quality data and nutrient concentrations were analyzed using a two-way analysis of variance (ANOVA).

Sampling Area

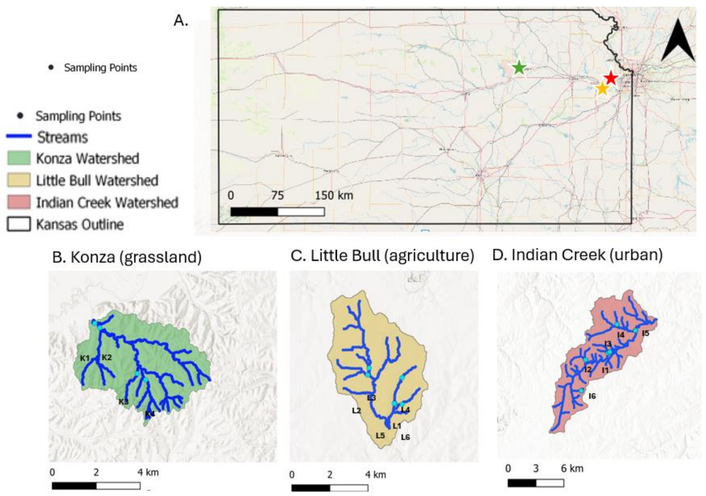

Figure 2: Map of all study site and the individual watershed areas with stream sampling sites.

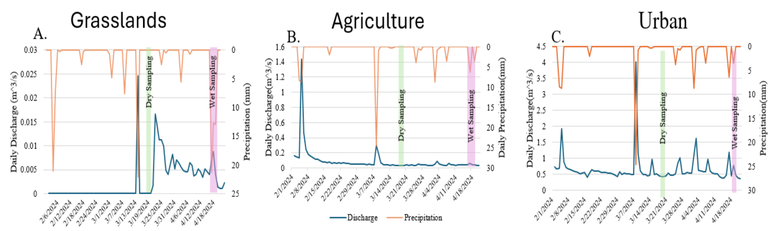

Figure 3: Displays sample timing relative to precipitation and discharge for three watersheds.

Results/Discussion

- There was a positive correlation between total nitrogen and nitrate across land use (Table 1).
- Total phosphorus and orthophosphate increased after the rain event, due to sediment mobilization.
- There were higher levels of area standardized stream flow in the urban and agricultural watersheds compared to grassland.
- Groundwater infiltration was highest in the grassland watershed, followed by agriculture and urban
- Land use is interconnected to both hydrology and stream nutrient concentrations, and monitoring first and second order streams will be fundamental for understanding changes due to changes in land cover.

Table 1: Summary table for nutrients using analysis of variance (ANOVA). Significance is identified with an asterisk (*).

Anova Association (p-value)	Total Nitrogen	Total Phosphorus	Nitrate	Orthophosphate
Watershed	0.0257*	0.551	0.0372*	0.578
Treatment	0.831	0.306	0.400	0.544
Watershed:Treatement	0.695	0.615	0.569	0.409
R^2	0.262	0.113	0.265	0.114

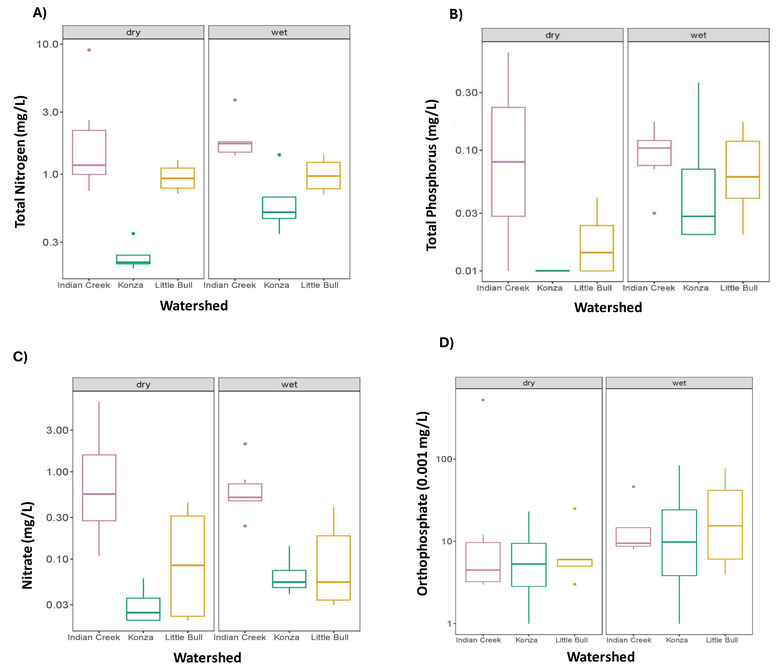

Figure 4: Graphs display changes in nutrient concentrations across land cover (red = urban, green = grassland, and yellow = agriculture) before and after a rain event.

Future Work

- Additional sampling locations with more intervals to create larger datasets for comparison.
- Determination of point sources for pollution into selected waterways and evaluating their overall effects.
- Sampling based on seasonal changes and weather events.

Acknowledgements

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References

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