Agricultural Land Use and Nitrate in the Kansas River Alluvial Aquifer: Patterns Across Time and Space

Layman, T., French, L., Hatley C., Seybold, E.

Kansas Geological Survey, University of Kansas

Introduction

The Kansas River Alluvial aquifer runs through the state of Kansas along the river basin. Western use is dominated by **agriculture** while Eastern is largely **municipal**. **Nitrate (NO3)** from agriculture "runs off" from farmland and enters the aquifer. This increases concentrations of nitrate in a system used for drinking water and irrigation. Excess nitrate can have **human health, environmental integrity, and agricultural sustainability** for the region. Because of this, we examined nitrate data in the aquifer across 40 years and asked how does nitrate change across time and space ?

Figure 1: Image of Sampling Well (C. Hatley 2025)

Methods

Kansas Department of Health and Environment **(KDHE),** Aquifer Water Quality Assessment for Kansas **(AWQUA),** and Kansas River Alluvial Aquifer **(KRAA)** sampled nitrate across time, KDHE data includes 120 machine detects and 22 non detects . **ROS** was used to **estimate non-detects** through a linear regression model. Across all samples, the median was 0.475 mg/L ranging from 0.003 to 54 mg/L. Outliers above 12 mg/L were excluded.

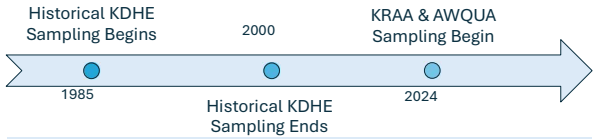

Figure 2: Timeline of Sampling for KDHE, KRAA, and AWQUA (1985 - 2025)

Results

Nitrate Concentrations Across Time

Nitrate Concentrations have a **negative correlation** in the 1990's. Modern data shows a positive correlation, though there are too few points for strong analysis

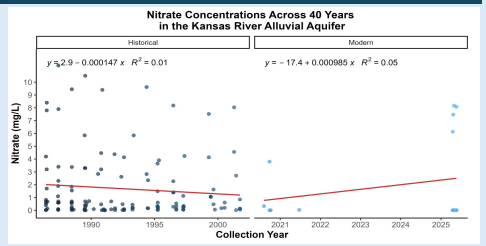

Figure 3: Nitrate through time, colored by sample date

Nitrate Concentrations and Agricultural Use

Nitrate has a **positive correlation** with the percent of **agricultural usage.** Agricultural in Figure 6 is colored brown and yellow. Distance (m) appears uniform across intervals

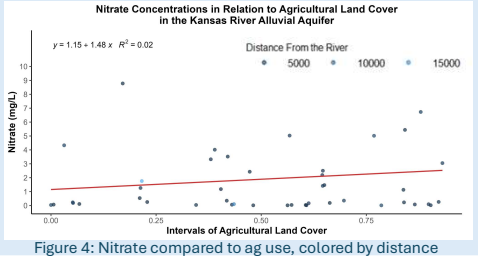

Figure 4: Nitrate compared to ag use, colored by distance

Nitrate Concentrations Across Space

Nitrate has a **positive correlation** with the distance from the river. We believe this is because the river has a diluting effect on concentrations throughout the aquifer

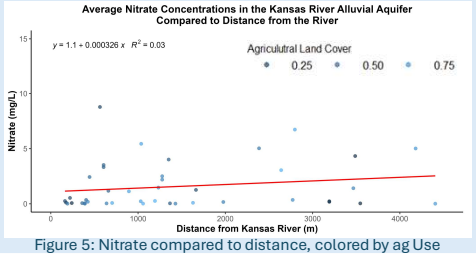

Figure 5: Nitrate compared to distance, colored by ag Use

Conclusions

Nitrate and **agricultural** use as well as **Time** and **Distance** are **not significant** predictors of each other. However, **Ag and Distance** are **significant** predictors when measured **before 2001**. We anticipate the lack of significance in modern data is from a **lack of sample points.** Nitrate and time are unlikely to change in significance with more sample points.

P = 0.337
Nitrate vs Time

P = 0.125
Nitrate vs Space

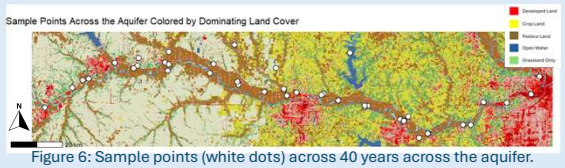

Figure 6: Sample points (white dots) across 40 years across the aquifer. Colors indicate dominant land usage (ag, barren, water, etc.)

Future Work

Through the future we hope to collect and analyze additional samples of AWQUA and KRAA data. We then want to use this data to compare this aquifer to other alluvial aquifers in the state of Kansas, analyze nitrate over time in relation to the distance of the sample from the Kansas river, and compare these results to other analyte samples we have collected.

References/Acknowledgments

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