Precision Conservation in Corn and Soybean Production Systems using Geospatial Techniques

Digital Agriculture Research & Extension Center
University of Missouri

Anil Subedi [1], Asbin B K[1], Blessing Ademola[1], Jianfeng Zhou[1], Jasmine Neupane [1]

Division of Plant Science and Technology
College of Agriculture, Food and Natural Resources

College of Agriculture, Food & Natural Resources
University of Missouri

Introduction

- Precision conservation is the integration of cutting-edge spatial technologies including global positioning system (GPS), geographic information system (GIS), and remote sensing to develop and implement management practices that contribute to sustainable agriculture and natural ecosystems.
- In-field conservation practices such as grassed waterways can contribute to soil and water conservation by reducing erosion and the off-site transport of sediments and nutrients across watersheds.
- Moreover, grassed waterways can also help in increasing biodiversity in the field and support natural habitat of wild flora and fauna.
- However, limited studies have explored the opportunities of digital agriculture technology in delineating optimum areas in the field for precision conservation from both agronomic and economic perspectives.

Objectives

- To identify the impact of existing natural grassed waterways in the field
- To identify opportunities for precision input management at the agroecosystem nexus

Methodology

- This study is ongoing at MU Digital Farm which is approximately 50 acres with spatial variability in soil and topography and consist of natural grassed waterways.
- Drone flights have been conducted every week using multispectral and thermal cameras to detect differences in crop growth conditions during the season.
- Elevation map has been created from the drone images to map the topography of the field(Figure 2).
- Soil sampling was conducted to determine the variability in soil chemical properties across the field.

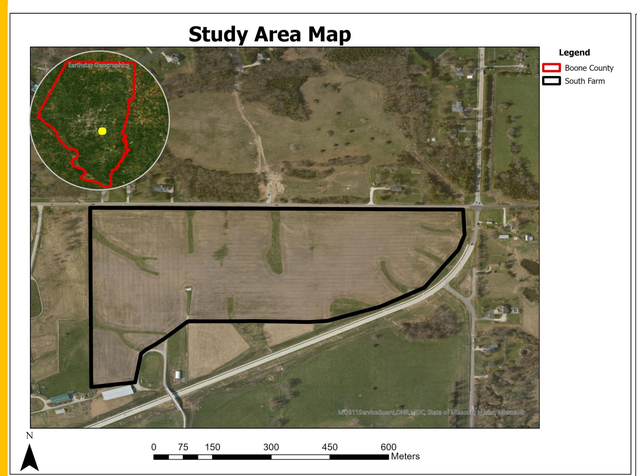

Figure 1. Research site 'MU Digital Farm'

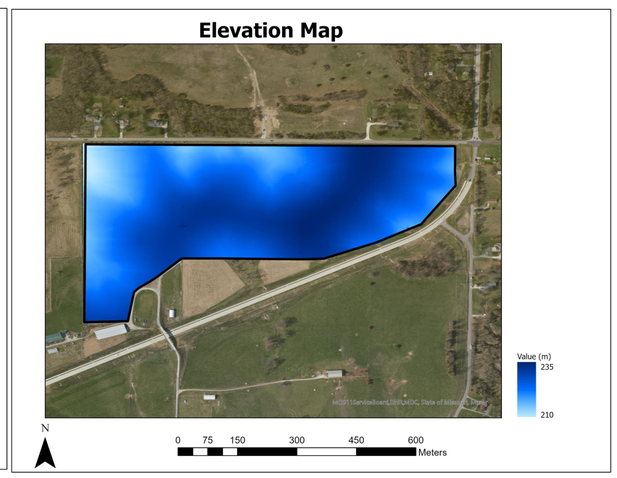

Figure 2. Digital Elevation model of the research site

Preliminary Analysis

- Preliminary analysis of historical yield data from this field has been done to identify variability across the border areas. As evident in Figure 3, yield is relatively lower at the areas bordering natural grassed waterway in the study area.
- Analyzing the relationship between yield and other variables such as elevation, slope, calcium, potassium, magnesium, pH, and EC using machine learning algorithms like random forest, it was found that yield is most strongly correlated with elevation.
- Temperature is lower within the grassed waterways, while areas near the waterways exhibit higher temperatures, likely due to bare soil and slope(Figure 6).
- As shown in Figures 2 and 3, yield tends to be higher in elevated areas and lower in low-lying areas, particularly near the grassed waterways, where yields are notably lower.

Preliminary Analysis

- Analysis of the soil chemical properties across the field reveals significant variability which highlights the complexity of field conditions and the importance of site-specific management(Figure 4).

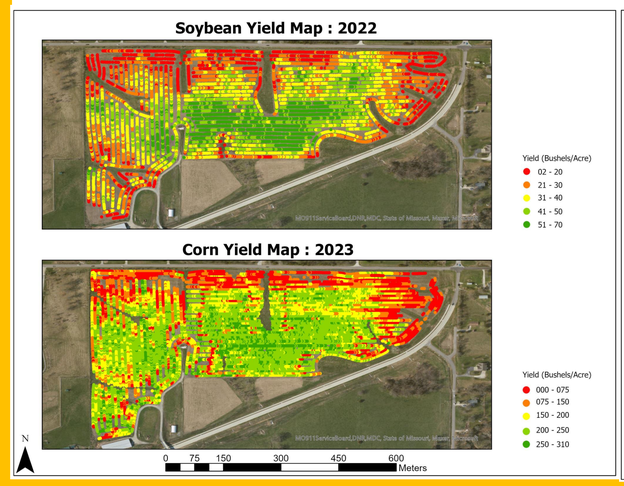

Figure 3. Yield maps showing low yields particularly near the grassed waterways

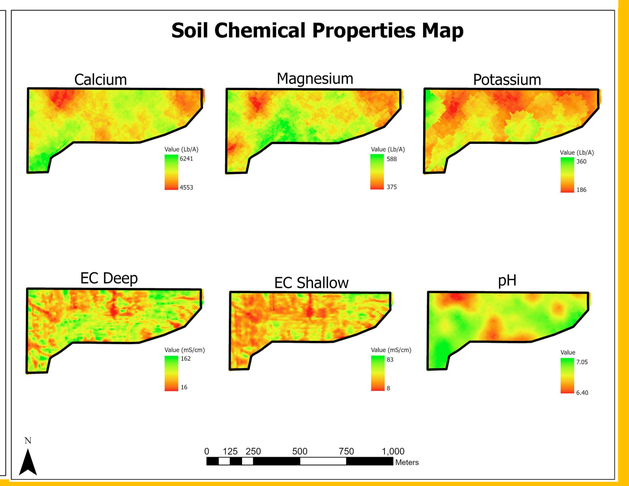

Figure 4. Soil chemical properties map showing variability in the field

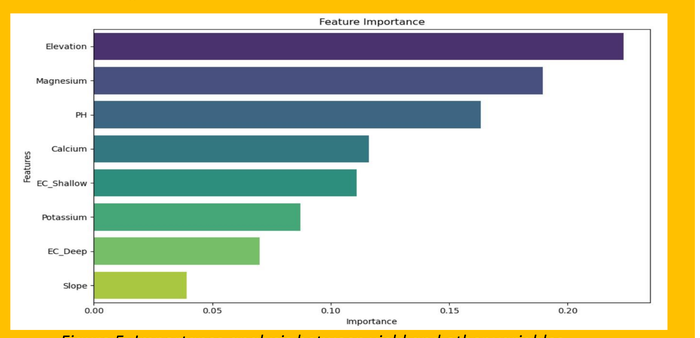

Figure 5. Importance analysis between yield and other variables

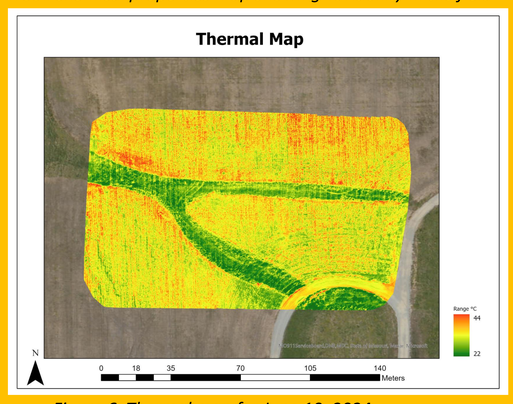

Figure 6. Thermal map for June 10, 2024

Summary

- The preliminary analysis of historical yield data and soil data from this field highlights spatial variability, particularly in areas near natural grassed waterways, emphasizing the potential of digital agriculture technologies to enhance precision conservation by accurately identifying areas that require special attention, improving both crop productivity and environmental sustainability.
- These results indicate that natural grassed waterways may provide new opportunities for precision input management to co-manage biodiversity conservation and food production objectives in agroecosystems.

Next Steps

- To identify the impact of grassed waterways on crop growth conditions, crop yield, and quality as the distance from the center of the grassed waterways increases.
- Conduct multiple year research to develop climate-smart agroecosystem management strategies that could enhance agroecosystem functionalities and production economics in the long run.

References

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