Watershed Scale Response of Agricultural Systems to Drainage Water Management in Central Illinois

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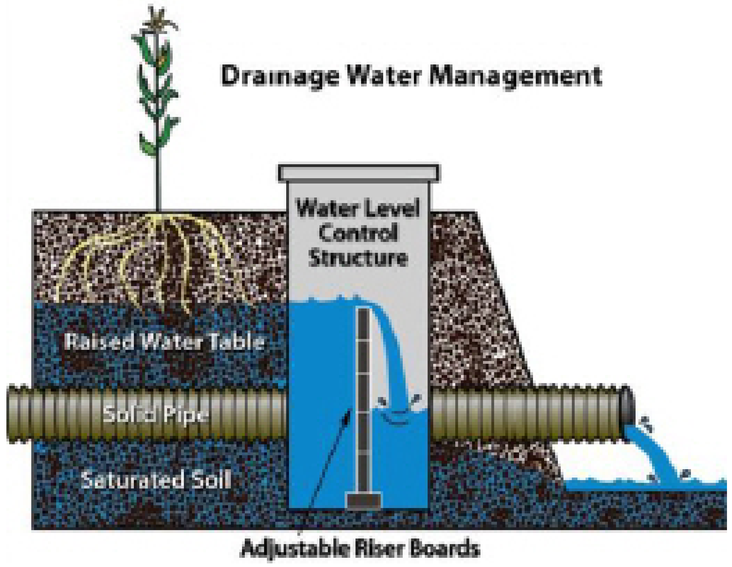
Background

- Nutrient loss from agricultural fields in Upper Mississippi River Basin has been attributed with the formation of hypoxic zone at the Gulf of Mexico every summer.
- Due to flat terrain and poorly drained soils, millions of acres of farmlands in the region are artificially drained using subsurface drainage system.
- Drainage water management (DWM) has been identified as one of the promising practices to reduce nutrient loss from agricultural fields with subsurface (tile) drainage.
- Drainage water management is the practice of using a water control structure in a main, sub-main, or later drain to vary the depth of the drainage outlet.



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- Although earlier studies have demonstrated that the system is able to reduce water and nutrient loss from tiled fields and may even boost the crop yield, there are very few studies that investigated the effectiveness of DWM in Illinois.
- Similarly, there are still questions regarding the fate of water and nutrient held by DWM.
- There is not a good understanding of its impacts on a larger spatial scale (i.e., watershed scale), which could limit the effectiveness of DWM.
- Furthermore, the impacts can vary depending on agricultural management practices (e.g., drainage design and fertilization) and weather conditions.
- This study seeks to fill these knowledge gaps to be able to provide farmers and other stakeholders with better understandings of DWM impacts at the watershed scale, by installing 4-year paired watershed experiment in Central Illinois.

Objective

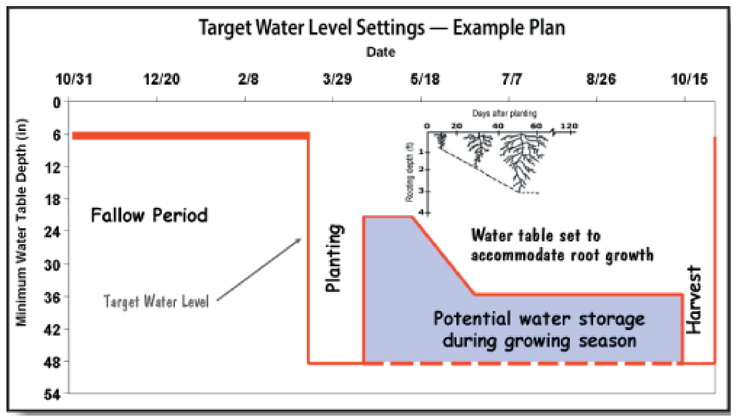
The overall goal of this project is to observe and communicate new information about the watershed-scale effects of drainage water management (DWM) on water and nitrogen (N) losses, and crop production in Central Illinois. This experiment is the first of its kind to answer the question: how does DWM affect water and N balances and crop production on a watershed scale? What are the long-term environmental and economic benefits of DWM? This project has the following specific objectives:

1) Monitor the watershed-scale effects of DWM on nutrient reductions, water and N balances, and crop production through a paired watershed experiment.
2) Estimate the long-term environmental and agricultural benefits of DWM through a watershed-scale modeling.
3) Communicate results to agricultural community stakeholders through field days and extension events.

Work Plan

In this project, we will quantify the effects of DWM on water and nutrient balances and crop production at the watershed scale through paired watershed study, explore the long-term environmental and agricultural benefits of DWM through a watershed-scale modeling, and initiate extension and outreach efforts to encourage participation in activities to share our findings on DWM. The specific activities planned for the project are as follows:

- Paired watershed study: Each watershed will be equipped with a weather station, a gauge station, and multiple control structures. A control structure equipped with a v-notch weir and pressure transducers will be installed at the outlet of each field in the study watersheds. Water samples will be collected weekly or more frequently (twice a week), depending on the weather and analyzed for nitrate and orthophosphate. Soil and Water Assessment Tool (SWAT) model, a watershed scale model that contain a tile drainage component, will be used for this study.



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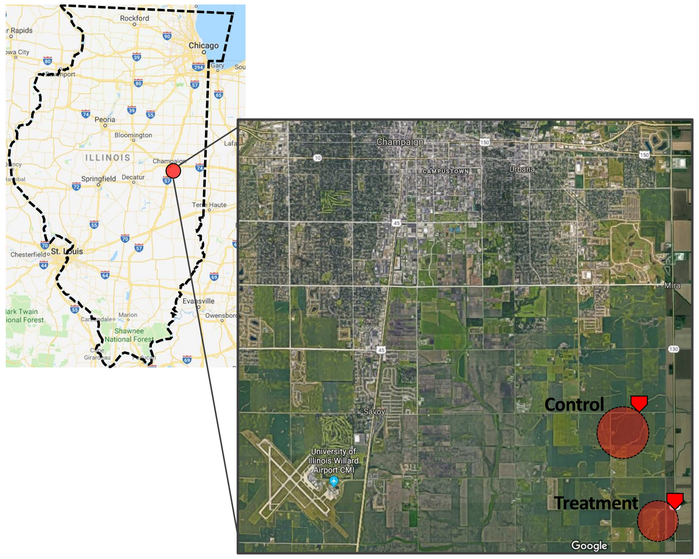

Future Impact

Results from this project will provide much-needed information on the potential agronomic and environmental impact from DWM. This experiment is the first of its kind including observations and simulations of the effects of DWM on agricultural systems at the watershed scale to provide an advanced understanding of promising pathways for reducing nutrient losses while maintaining crop production goals in Illinois.

1) This work will shed light on whether currently recommended DWM have the potential to achieve nutrient reduction and to increase crop productivity at a larger spatial scale beyond the field-scale.
2) This work will provide a clearer picture of how DWM affects water and nutrient balances and crop production at the watershed scale, which is not well understood.
3) Through a watershed scale modeling, this work will provide further insights into the long-term environmental and agricultural benefits of DWM considering different field management practices and weather conditions.
4) Outreach programs and activities will provide stakeholders with new findings on DWM derived from this work.

Acknowledgement

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