

Co-Producing Community - An integrated approach to building smart and connected nutrient management communities in the US Corn Belt

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Our vision is to co-produce with Illinois farmers a community-based cyberinfrastructure that addresses an urgent need: providing famers direct access to high-quality and unbiased info on nutrient management

The (farmer community-identified) Problem

- Farmers tend to overapply N and P fertilizer due to concerns on unpredictable weather, yield loss risk, and a lack of reliable information
- This decreases farmers' profitability and compromises natural resources
- Yet, farmers' perceptions of nutrient management challenges vary widely as does their willingness to adopt novel nutrient management approaches
- There is an unmet need to provide farmers with, and help them adopt, nutrient management tools informed by advanced science, technology, and farmer expertise

Intellectual Merit

- Identify individual- and structural-level constraints to N and P management across farmer subgroups in Illinois to inform technology development
- Characterize soil N and P biogeochemistry to predict contribution of soil nutrient stocks to crop uptake, to deliver critical insights for management
- Integrate soil biogeochemistry and new satellite observations to improve process-based modeling of N and P cycling in Corn Belt agroecosystems
- With farmer insights, co-produce multi-tiered nutrient management tools that can accommodate diverse farmer needs and priorities
- Create a technological and community infrastructure to expand farmer access to state-of-the-art nutrient management tools

Overall, we employ cutting-edge science and technology (i.e., data-model fusion, cyberinfrastructure) to generate practical and customized nutrient management solutions for farmers in a **Nutrient Management Community (NuMC)** platform

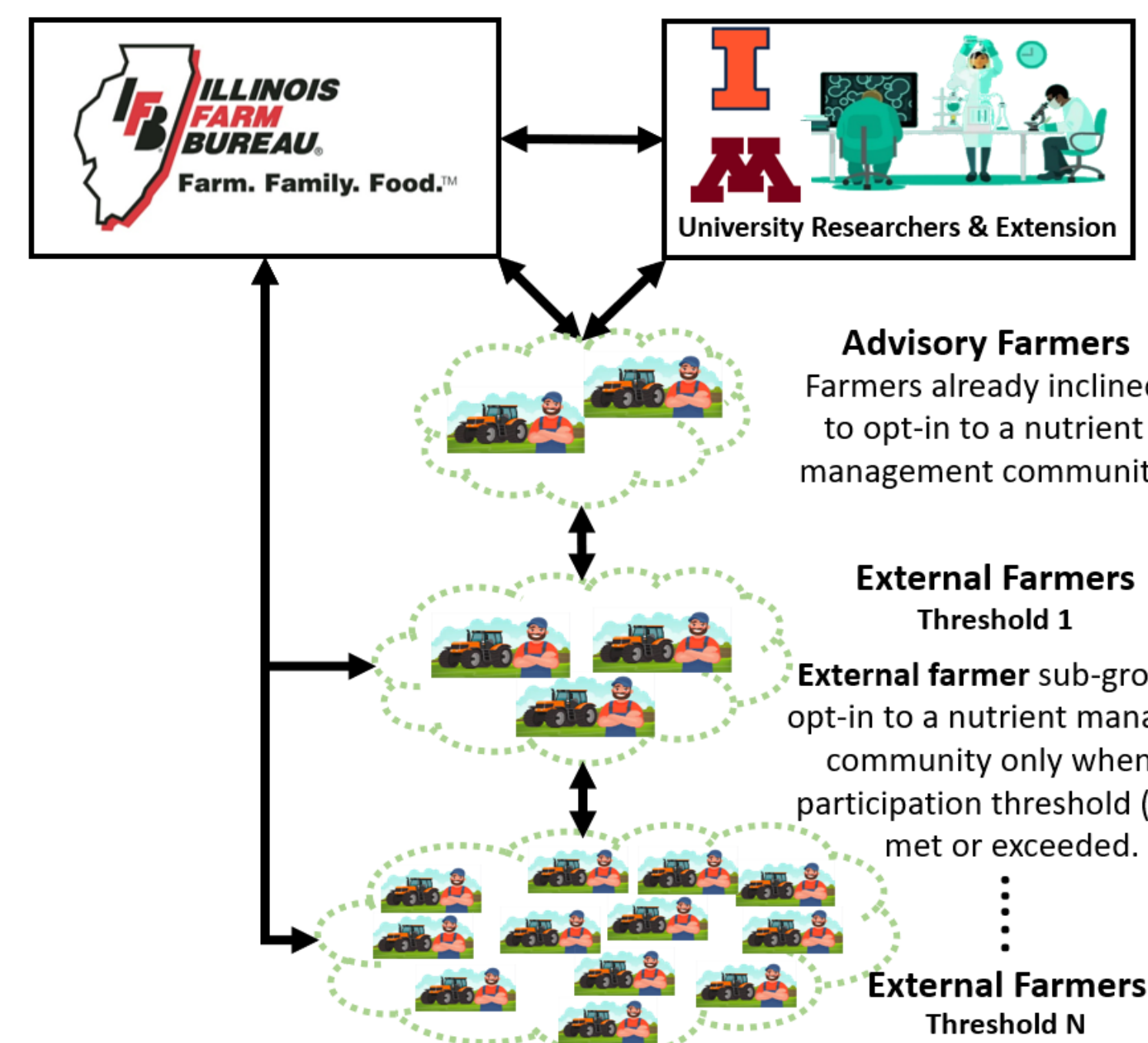
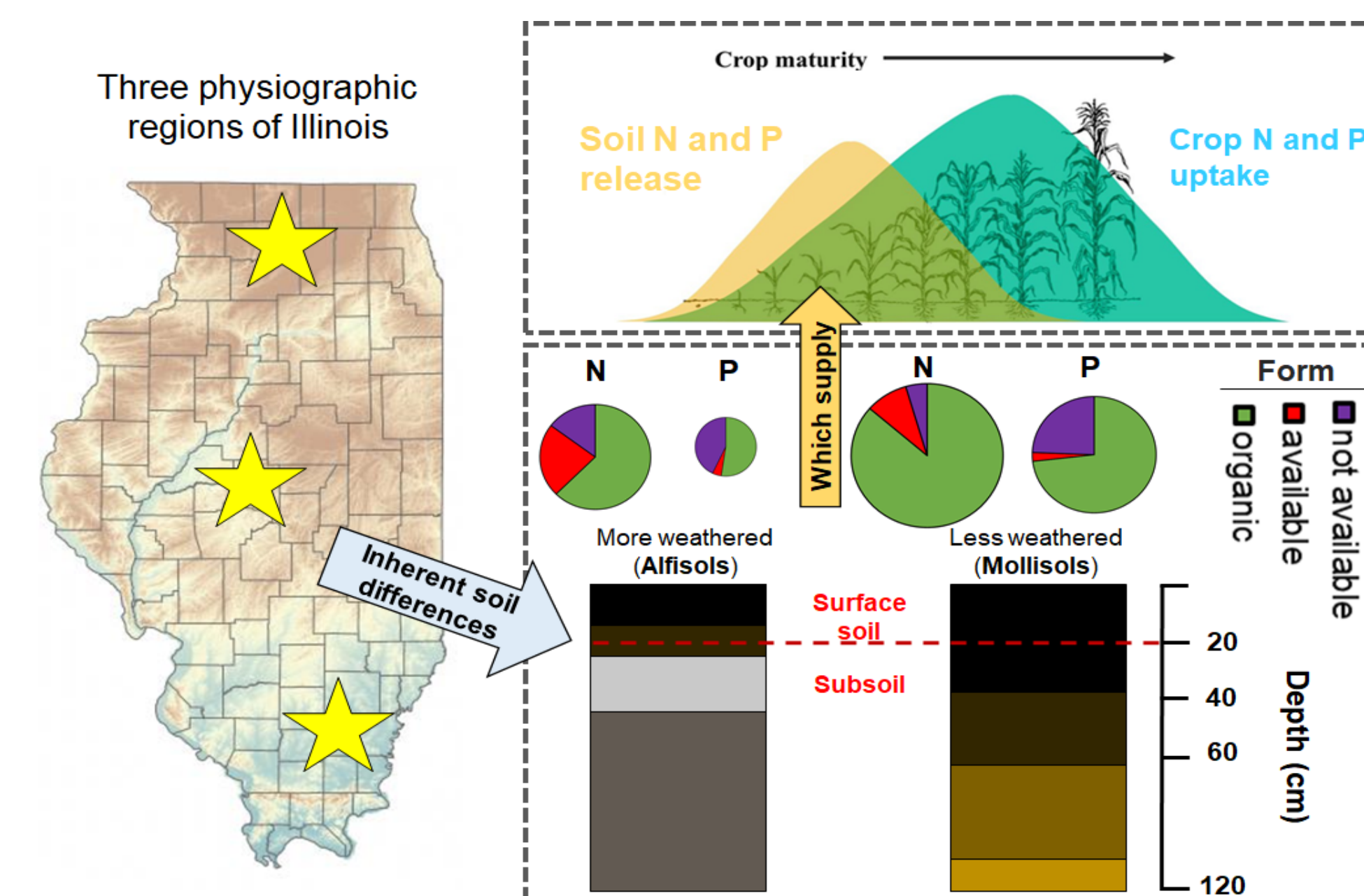


Illustration of the NuMC that connects researchers, Illinois Farm Bureau, and farmers to co-produce smart solutions for N & P management.

Activity: Farmer Focus Groups

- Farmers are skeptical about "new technology": technofatigue and oversimplification of complex challenges they face on nutrient management
- Concerns on data sharing, access and control
- Distrust with the University specifically and research in academia in general
- Want to be seen as individuals working context-dependent soils; no one-size-fits-all solution
- Farmers are caught between individual values (which may or may not be inclined toward conservation) and structural constraints



Quantifying how much N and P are 'banked' in soils, and in what form will enable testing hypothesized site-specific contribution of soil nutrients to crop uptake, thereby enabling improved fertilizer application decision-making

Activity: Quantifying soil nutrient capital

- Sampling soils at farmers' fields (n=60) differing in soil types and management
- 3x increase in proposed field sample set in response to community feedback via farmer focus groups
- Soil nitrogen (N) and phosphorus (P) stock quantification (total and speciation) to 120 cm depth
- Soil N and P inventories will be used to inform fertilizer experiments on-farm to model field-specific fertilizer requirements

Broader Impact – Immediate

- Provide Illinois farmers with direct access to high-quality and unbiased nutrient management information, especially critical given historically severe input costs and water quality impairment
- Advance understanding of nutrient management challenges facing agricultural communities in the Corn Belt while promoting teaching, training and learning
- Improve rural prosperity by decreasing agricultural input costs
- Promote environmental sustainability by reducing unnecessary application of fertilizers
- Increase visibility of nutrient management challenges and foster greater willingness to actively address them

Broader Impact – Sustainability & Transferability

- Generate knowledge on interactions of complex biogeochemical and social systems across researchers, agricultural organizations, and farmers that underpin agricultural and environmental sustainability
- Develop a community-based cyberinfrastructure for a sustained NuMC by virtue of being integrated into community partner (Farm Bureau) infrastructure
- High transferability to other agricultural states outside of Illinois by providing a blueprint based on Farm Bureau scaffold

Next steps

- Synthesize focus group and interview results to identify constraints and opportunities for farmers on nutrient management
- Finalize on-farm soil nutrient inventories
- Assemble farmer-led advisory board to initiate NuMC platform
- Identify sites for experimental trials