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4.1.2.11



ECOSYSTEM SERVICES AND FARM DECARBONIZATION ENTREPRENEURSHIP TECHNICAL ASSISTANCE



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PROJECT OVERVIEW



- This technical assistance (TA) project is an outreach project for farmers in Illinois
 - Access to unique, Argonne-developed tools and expertise
- Goals:
 - Provide farm holders and in particular disadvantaged ones the opportunity to be valued stakeholders in a bioeconomy that leverages marginal land for the creation of biomass and ecosystem services
 - Utilize the generated biomass to meet communities' energy needs and decarbonize agricultural practices
 - Create resilient rural communities by offering diversified opportunities for entrepreneurship, jobs, and a clean environment.

Overview

- The approach favors supporting disadvantaged rural communities with a means of preserving rural socioeconomics while improving environmental conditions both locally and globally.
- By providing TA to grow the bioeconomy, this effort seeks to
 - Reduce the \$/gge for producing biofuels
 - Diversify opportunities for entrepreneurship and jobs
 - Improve the environment



AREAS OF TECHNICAL ASSISTANCE

1. Perennial Bioenergy Crops

- Switchgrass varieties, Miscanthus, mixed prairie grasses, energy sorghum
- Short-rotation woody crops (SRWC) – willow, poplar
- Targeting economically and/or environmentally marginal farmland

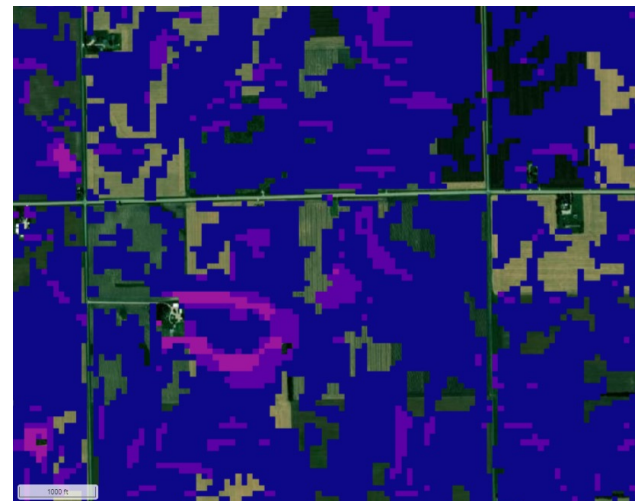
2. On-farm Energy Independence

- Explore off-grid propane use changed to biomass-based technologies
- Anaerobic digesters (AD) for combined heat and power production onsite
- Biochar production for heat generation, soil amendment, and carbon sequestration

AREAS OF TECHNICAL ASSISTANCE (CONT.)

3. The Scaling Up PERennial Bioenergy Economics and Ecosystem Services Tool (SUPERBEEEST)

- developing under another project, “Scaling Up Decarbonization and Sustainability” (4.2.2.12)
- An online geospatial tool
- SUPERBEEEST’s goal is to assist in decision-making regarding the adoption of perennial bioenergy crops to grow the bioeconomy
- Focus on current row crop land use in U.S. Midwest
- For use at essentially any scale and by a full range of stakeholders



Example of farm level analysis
(cumulative marginalities
shown over aerial photo)

APPROACH



- Collaborate with the American Farmland Trust (AFT) and University of Illinois Urbana-Champaign (UIUC) Extension on an outreach plan for a wide range of stakeholders
- Incorporate recommendations from outreach events into the current SUPERBEEST online geospatial tool and develop a plan for a future-state bioeconomy initiative
- Develop a Technical Assistance program to provide the farming community with training in relevant tools and technologies

Approach

- 1-3 team calls per month with AFT
- AFT subcontract held up until Sept. 2022
- DEI
 - We maintain a diverse team, as does AFT
 - Recent hire to staff from underrepresented group
 - AFT invited Argonne to participate in interviewing of candidates (from underrepresented groups) to support this project
 - Exposure of summer interns (underrepresented group) to project
 - Focus of project is outreach to underserved rural communities with an alternative cropping strategy

Argonne

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Rachel Dalke

Cristina Negri

Brad Kasberg

Colleen Zumpf

Nora Grasse

John Quinn

AFT

Marlee Giacometti

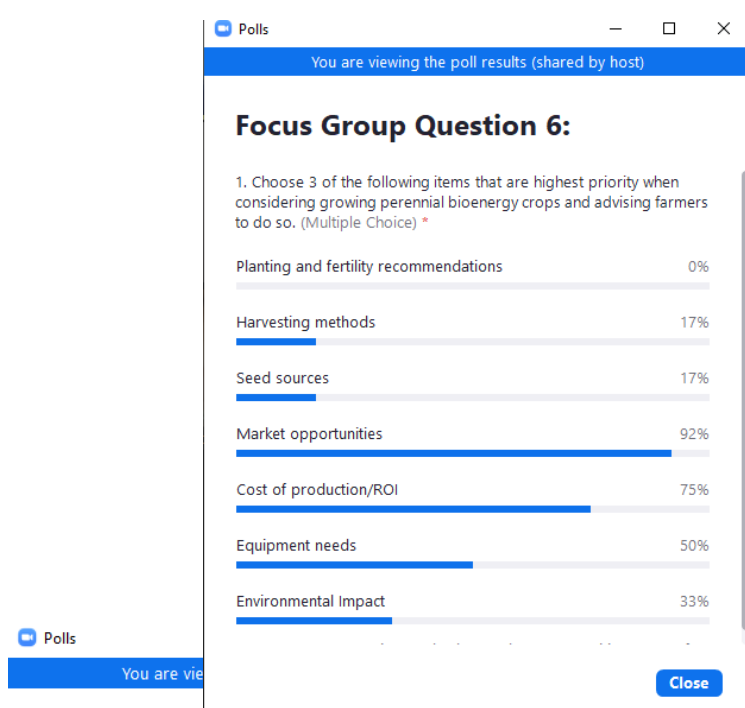
Shelby Best

Jean Brokish

Progress and Outcomes

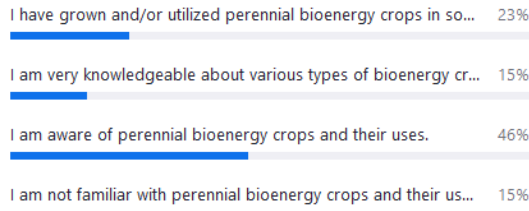
LISTENING SESSIONS

- 4 main Listening Sessions (virtual)
 - Association of Illinois Soil and Water Conservation Districts (9/27/22)
 - Industry Reps (wood chip, carbon credits, biochar, biofuels) (10/20/22)
 - Women Landowners (12/14/22)
 - Farmers and Landowners (1/26/23)
- Sessions included
 - Introduction to perennial bioenergy crops
 - SUPERBEEEST demo
 - Focus group discussions
 - Invitation to our Midwest Bioenergy Crop Coalition



Focus Group Questions 1:

1. Can you describe your overall comfort level and familiarity with perennial bioenergy crops? (Single Choice) *



OTHER ACTIVITIES

- Presented project at
 - Savannah Institute's Perennial Farm Gathering – approximately 60 participants with interest in perennials
 - Illinois Soil Health Week (Crop Diversification session)
- Conducting market analysis through subcontractor Sierraview Systems to analyze market opportunities
 - Particular interest in synthesizing market analysis with recent legislation in Illinois regarding SAF credits
- Met with University of Illinois Extension representatives to discuss the past experiences with biomass opportunities in Illinois from the Extension perspective

ENERGY CONSUMPTION SURVEY

- Energy Consumption Survey
 - 25 questions developed by AFT and Argonne
 - Administered by AFT at public events or online
 - 61 farmer respondents
 - Questions on
 - Energy types used on farm
 - Familiarity with renewables, including bioenergy crops

1. In what counties is your farmland located? (Please include all that apply.)
2. Please select the option that best describes your status.
 - I currently generate renewable energy on my farm property for on-farm and/or off-farm use.
 - I have considered installing renewable energy on my farm for on-farm and/or off farm use.
 - I am not considering installing renewable energy on my farm.
 - Renewable energy is not available near my farm.

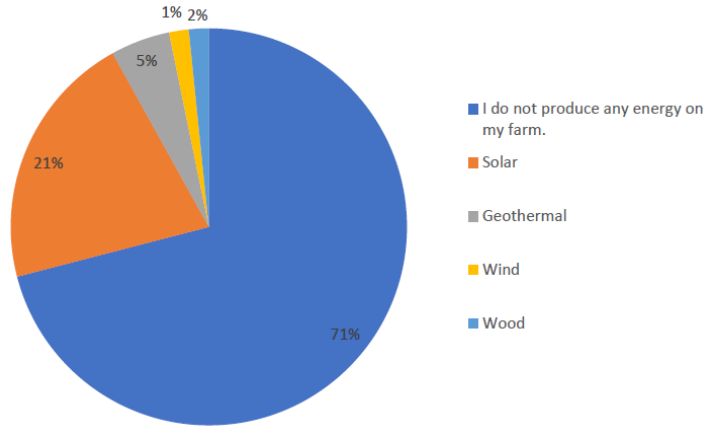
The following questions will ask you about energy consumption on your farm.

3. How do you use energy on your farm? Please select all that apply.
 - Personal use (home)
 - Grain Storage and Drying
 - Heating, cooling animal housing
 - Heating, cooling facilities other than animal housing facilities
 - Fuel for equipment (gas, diesel)
 - Irrigation
 - Other (please specify): _____

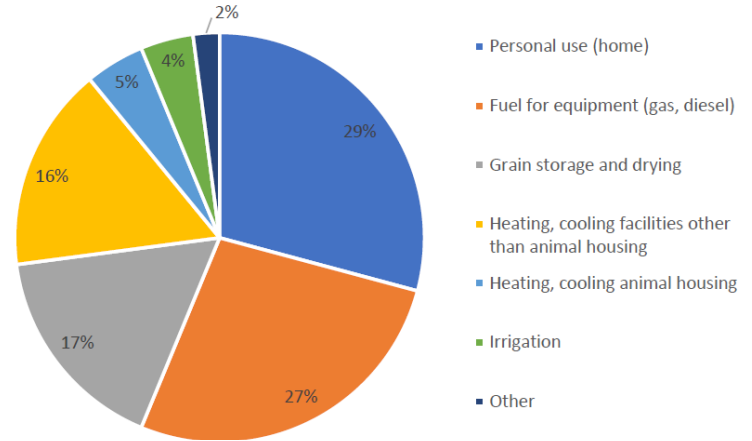
Progress and Outcomes

Some results of Energy Consumption Survey

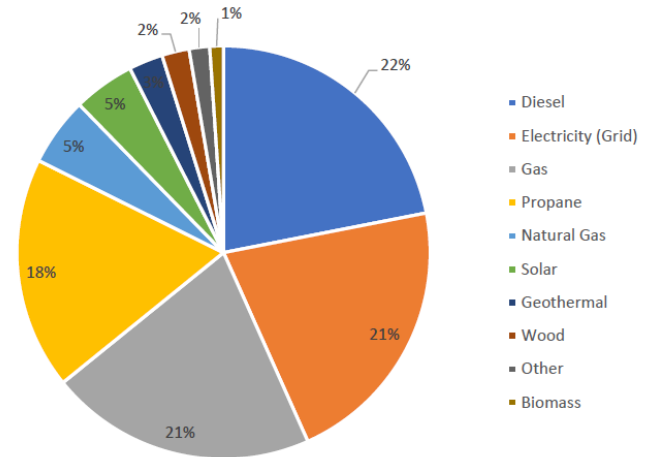
Do you generate any renewable energy on your farm? Please check all that apply.



How do you use energy on your farm? Please select all that apply.



What kind of energy do you consume on the farm? Please check all that apply.



SUMMARY OF ENERGY CONSUMPTION SURVEY

- 54% of respondents identified having marginal lands on their farms.
- Most respondents (71%) do not produce energy on their farm.
 - Of the 29% of farmers who claim to generate renewable energy on their farms, only 6% generate between 75-100% of the energy needed for their farm operations.
- Most farmers (73%) would prefer to sell their biomass harvest to a processor over using an anaerobic digester or biochar kiln.
- Primary barrier to the adoption of bioenergy crops is lack of biomass buyers.
- 44% of farmers indicated they would only consider siting renewable energies on land not suitable for crop production or pasture (i.e. on marginal fields).
 - The other 56% of respondents noted they would consider investing in renewable energy if it provided additional income or if it provided other benefits to their farms such as soil health and resiliency.

MIDWEST BIOENERGY CROP COALITION

- Midwest Bioenergy Crop Coalition
 - 11/30/22 (Kickoff), 2/22/23
 - Two dozen virtual participants: farmers, academia, industry
 - Breakout questions and key responses
 - #1 what are the barriers to a successful bioeconomy?
 - Equipment, growing practices, ES payments vs. existing corn/soybean markets
 - #2 what should coalition focus on?
 - TA support to farmers, long-term trials, small-scale adoption first and then market build up (“the chicken and the egg”)
 - #3 what should outcomes of coalition be?
 - Outreach and publicly available reports, including those on market drivers

SO WHAT HAVE WE LEARNED FROM ALL THESE EVENTS??

- Farmers want to **grow, harvest, and sell crops**
 - Infrastructure for biofuel market (directly to biorefineries? Biomass depots?)
 - Short-term steps to grow an initial market – for erosion socks, turkey bedding, boilers, anaerobic digester, biochar...
- Curiosity about how **payments for ecosystem services** and **nutrient trading schemes** may develop
- Interest and favorable comments about the TA's focus on perennials and the use of SUPERBEEST
 - **“SUPERBEEST is definite help for the bioeconomy, no doubt about it.”**
(Industry rep)

NEXT STEPS

- Continue interactions, including with women farmer/landowners, minority farmers, and disadvantaged farming groups
 - Feedback to inform type and style of Technical Assistance
- Provide Technical Assistance to interested parties of SUPERBEEEST results and on-farm energy technologies
- Desired additions to SUPERBEEEST
 - Biorefinery locations
 - Spatial Environmental Justice (EJ) information
 - USEPA's EJScreen for income data (do lower income levels in some rural areas relate to prevalence of marginal soil, and therefore an optimal place for perennials and a biorefinery?)

IMPACT

- **Biomass growth for the Bioeconomy** – increased adoption of perennials, increased availability of biomass feedstocks for bioeconomy, and reduced feedstock production cost
- **The Environment** – improved carbon sequestration, biodiversity, and water quality, and decreased greenhouse gas emissions and topsoil loss
- **Stakeholders** – farmers, landowners, and the bioenergy industry benefit from optimal cropping systems, low input (e.g. fertilizer) cost, and a resilient and stable rural economy including in underserved regions

The TA project contributes toward all these needs:

- Identifying perennial bioenergy crop alternatives for marginal lands
- Helping stakeholders to use SUPERBEEST to identify marginal land, ecosystem services, and net economics from a conversion to perennials
- On-farm energy independence through biomass as a means of avoiding or minimizing fossil fuel use

SUMMARY

- There is interest among stakeholders in perennial bioenergy crops, strategies for their placement (SUPERBEEEST), and their valuation (biomass value and payments for ecosystem services relative to value of row crops grown on marginal soil)
- American Farmland Trust has been the ideal partner in this project
- More to be learned as we conduct more outreach activities and provide TA (perennials, SUPERBEEEST, energy independence)



QUAD CHART OVERVIEW

Timeline

- *FY22 begin*
- *FY24 conclude*

	FY22 Costed	Total Award
DOE Funding	\$450K	\$450K per year for three years
Project Cost Share	n/a	n/a

TRL at Project Start: 3
TRL at Project End: 3

Project Goal

The goal is to offer farm holders, including those in disadvantaged farming communities, the opportunity to be stakeholders in a bioeconomy that leverages marginal land to create biomass and generate ecosystem services. This goal is to be achieved through outreach activities that include education regarding perennial bioenergy crops, training and application of SUPERBEEEST to aid in decision-making, and exploring on-farm energy independence and decarbonization of farms by relying on biomass.

End of Project Milestone

Creation of a plan for implementation of the bioeconomy vision, containing specifics and target goals

Funding Mechanism

2023 Lab Call, AOI 5-b4: Technical Assistance

Project Partners

- American Farmland Trust
- University of Illinois Extension

ADDITIONAL SLIDES

PROJECT NOTES

- Prior Peer Review
 - This project began after Peer Review 2021.
- Go/No-Go
 - Due in March 2023, the Go/No-Go concluded that “there is sufficient interest and opportunity for a TA program to be established” on the basis of the main listening sessions and other outreach activities.
- Publications
 - Due to the outreach nature of the project and its early phase, there are no formal publications yet.
- Presentations
 - As described above, numerous presentations have taken place with Argonne, AFT, and a wide range of stakeholders.
- Media
 - “Renewable Energy Production is Focus of New Collaboration Between AFT and Argonne National Laboratory”, press release issued by the American Farmland Trust, August 9, 2022.
<https://farmland.org/renewable-energy-production-is-focus-of-new-collaboration-between-aft-and-argonne-national-laboratory/>

SUPERBEEST SUMMARY

- Next 4 slides
- Taken from 4.2.2.12 presentation

SUPERBEEST PURPOSE: 3 CAPABILITIES

- Identification of marginal land (any scale) ideal for conversion from corn/soybean to perennial bioenergy crops
 - Marginality by economic and/or environmental measures
 - Identification of good candidate Saturated Bioenergy Buffer locations (for enhanced biomass production and reducing nitrate lost to surface water)
 - No land use change – productive farmland remain in row crop rotation
- Determination of ecosystem services to be realized from the crop change
 - Water quality (nitrate, sediment, water-based recreation) - SWAT model link
 - Carbon sequestration
 - Greenhouse gas
 - Biodiversity, hunting, pollinators, wildlife viewing
- Estimation of the net economic value of the change

SUPERBEEST Summary

SUPERBEEST



- Marginalities
 - National Commodity Crop Productivity Index (NCCPI)
 - Economic
 - Soil Survey Geographic Database (SSURGO)
 - Drainage
 - Flooding
 - Ponding
 - Runoff
 - U.S. Geological Survey
 - Nitrate leaching
 - Pesticide leaching

Marginal Lands

Layers

- NCCPI
- Drainage Class
- Flooding Frequency
- Ponding Frequency
- Runoff
- Nitrate Leaching
- Pesticide Leaching

Composite

- Heatmap Least  Most
- Cumulative 1  7

Analyze an area... →

Saturated Bioenergy Buffers

- Suitable

Analyze an area... →

Full Analysis

Analyze an area... →

SWAT

Upload your land use/land cover raster to have SUPERBEEST replace crop lands with bioenergy crops.

Raster

Reclass value

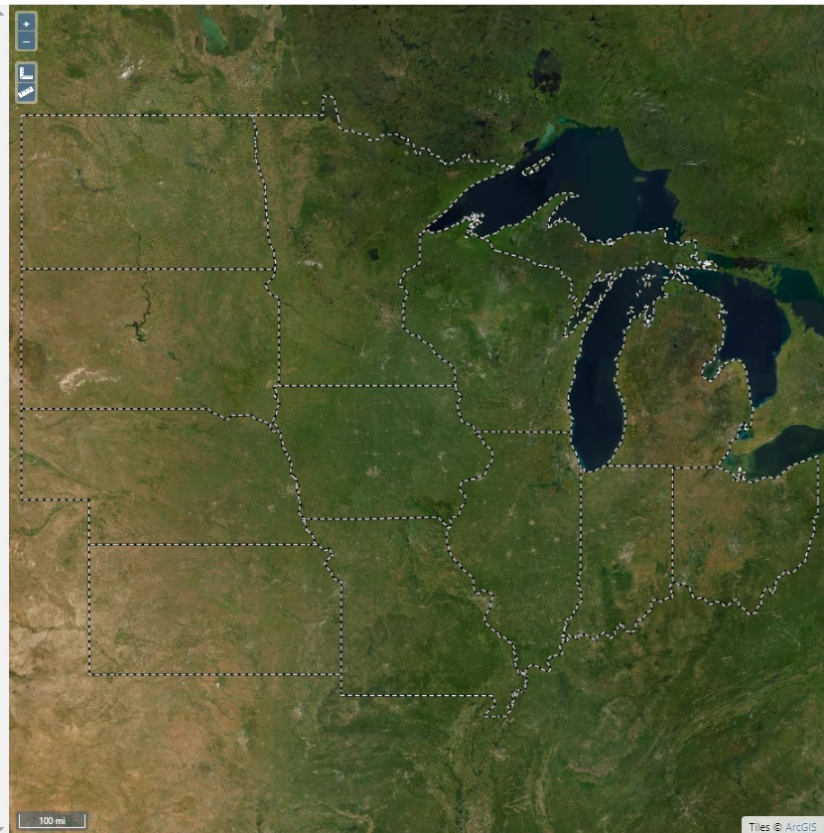
Reclassify raster ↕

Reference Layers

- State
- County
- HUC8
- HUC10
- HUC12

Base map

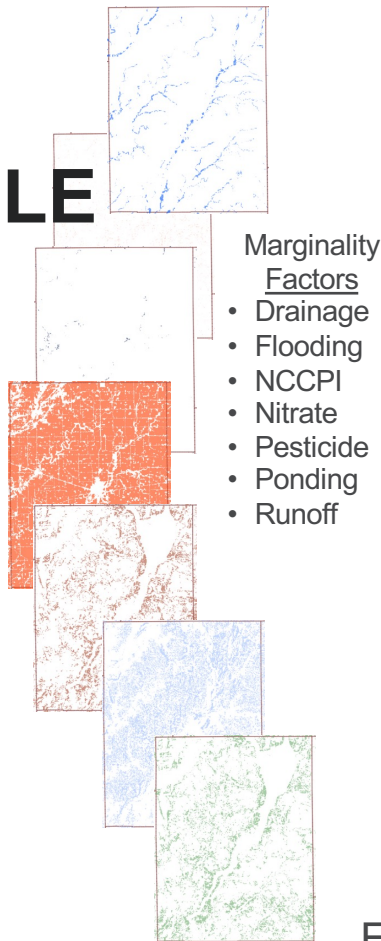
- Esri World Imagery
- Esri World Street Map
- Esri World Topo Map
- OpenStreetMap
- None



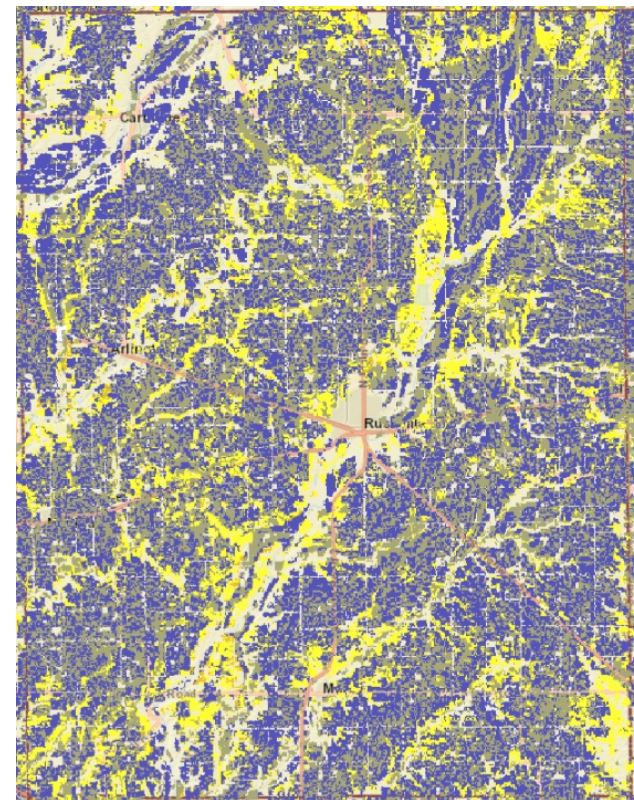
A COUNTY-SCALE EXAMPLE

Argonne's SUPERBEEST

Examples show an Indiana county's environmentally and economically marginal farmland and a combination of marginality factors to identify optimal locations for conversion to perennial bioenergy crops with environmental and economic benefits



Combined marginalities

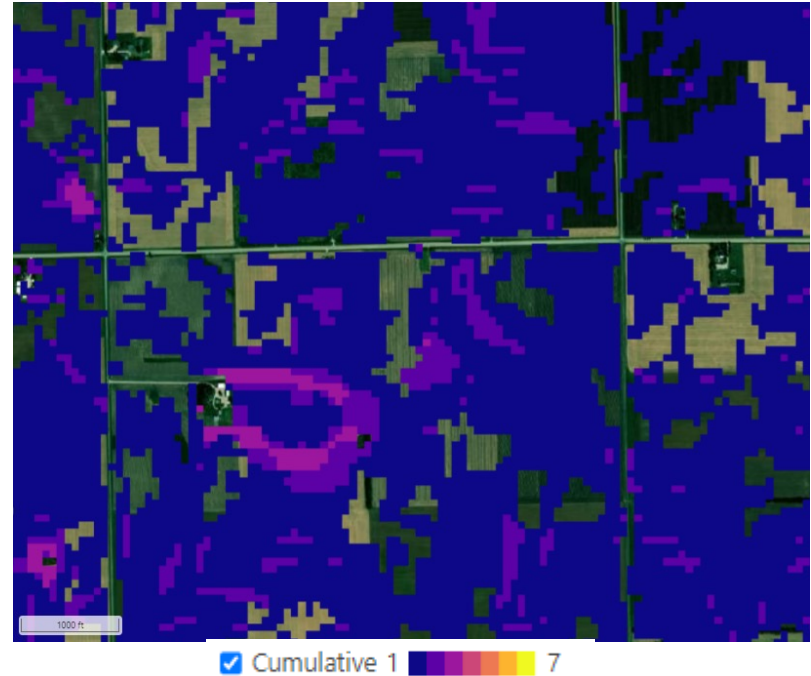


Suitability Least Most

Example: an Indiana county

FARM-SCALE EXAMPLE

- For multiple scales
 - a manual delineation of landowner's farmland
 - a county or group of counties
 - a watershed or group of watersheds (HUC-8 to HUC-12)
- Target users
 - Farmers and landowners
 - Agencies and regulators
 - Researchers
 - Biorefinery planners



Example of farm level analysis
(cumulative marginalities shown
over aerial photo)



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ENERGY

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