Resident preferences for landscape change in the Kaskaskia River Watershed

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UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Our Motivations

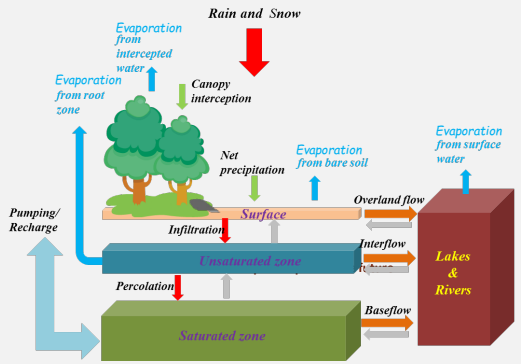
- Maintaining resilient and sustainable agricultural watersheds requires **diverse and interdisciplinary knowledge** from the sciences

- Farming and rural communities play a particularly important role in agro-ecosystem management
  - **82% of watershed devoted to farming**
  - **63% covered with crop agriculture**

We are part of a larger project entitled:

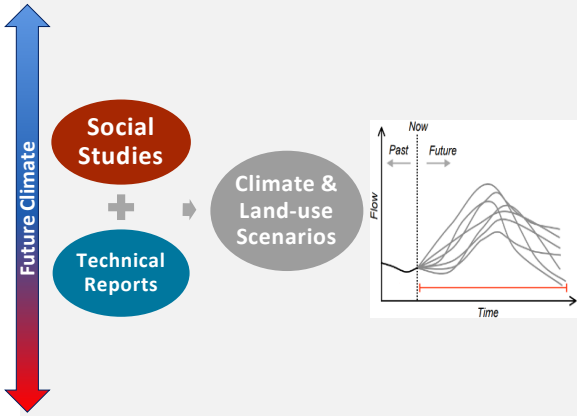
Enhancing agro-ecosystem services using integrated hydro-ecologic, socio-cultural, and decision analytic models

Develop a baseline hydro-ecologic model using SWAT



Part 1: Baseline hydrologic model – simulate historic values of environmental variables (e.g., streamflow, nutrient, and sediment)

Predict watershed response to selected scenarios

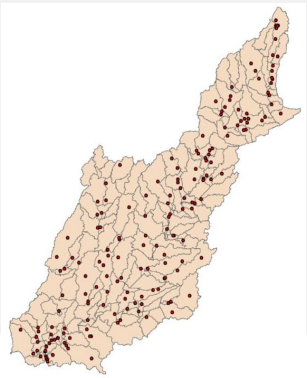


Part 2: Land use change scenarios and future climate (e.g., 50 years of projection 2020-2070, 32 climate models, 13 mgmt scenarios)

Fish richness model

Fish richness *vs* Environmental variables

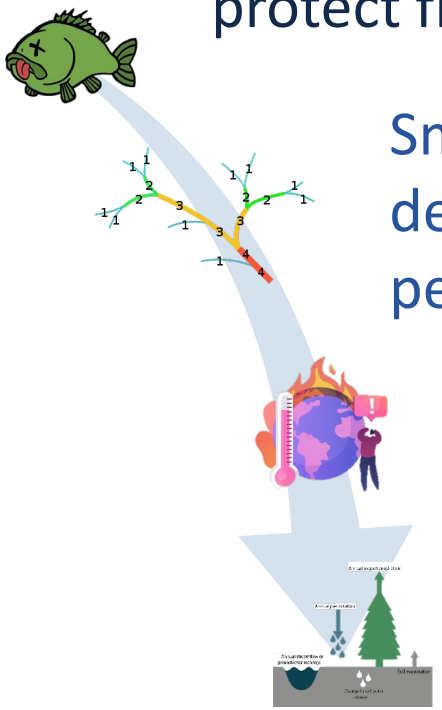
222 sites fish sampling sites



Part 3: Predict changes in fish richness due to changes in climate and management

Highlights from agro-ecosystem modeling

Inevitable impacts if additional measures not taken to protect freshwater biodiversity



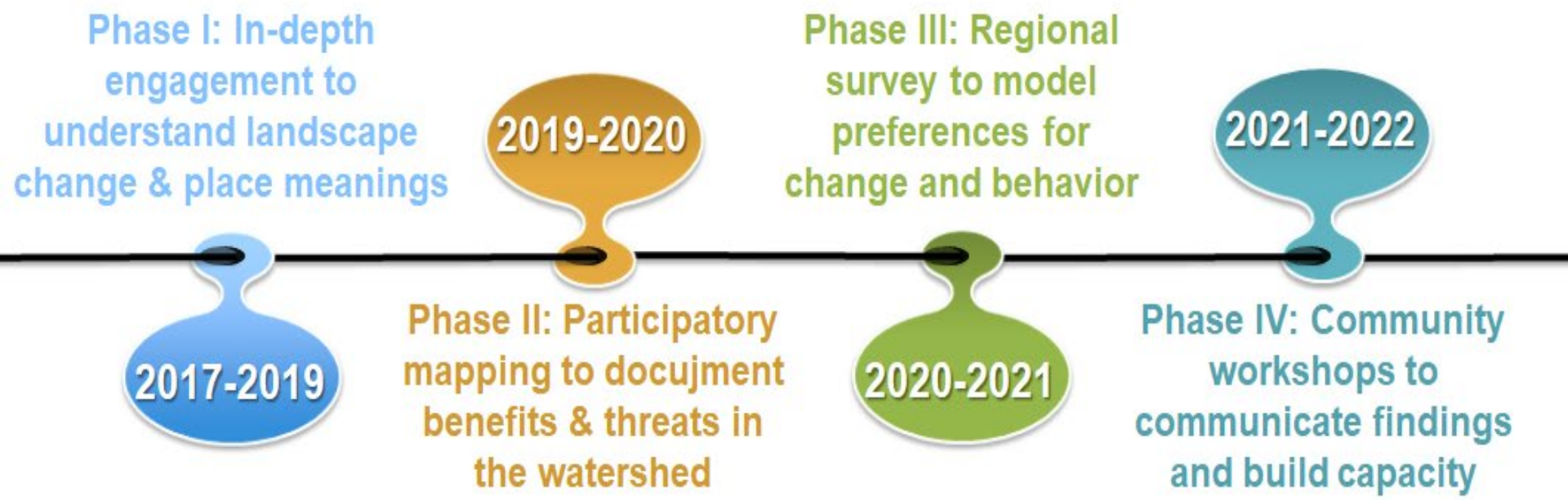
Small-size streams require priority strategies ~ highest decrease rates of fisheries biodiversity: -5% to -10% per decade

Implementation of monitoring networks that generate relevant data for aquatic life

Effects of climate-driven changes of riparian forest on fish riverine habitat

Our Learning Process

- Residents have been engaged in research since 2017 to **understand preferences for landscape change and build the capacity of rural communities in Illinois**
- Organized our efforts around **four phases** of engagement:



Summary of Findings: Phase 1

- In-depth interviews conducted in 2017 (n = 22) to discuss the meanings of places and farmer perspectives on sustainable land practices in the face of change
- Narrative analysis revealed two framings that drive farmer decision-making: efficiency and farm legacy

Narrative of Efficiency

- Orientation: Farming decisions driven by the "bottom line"
  - "It comes down to profitability. [Farmers] are all trying to maximize their profits and minimize their costs. That's the bottom line on it."

- Complication: Changes in markets, technology, and climate influence farmer decision-making for efficiency
  - "In profitable years you see [farmers] do things, more of those sustainable practices, when it gets leaner they kind of cut back. When you have $5 corn you can do a lot more than you can when it's $3 corn."
  - "They will bid up land. They need the volume and they will bid up the rent cost that most normal farmer they can't match it because it doesn't pencil out. The only way it pencils out is volume. That is what makes that work and that is why you see more of these bigger farms."

- Resolution: Explore solutions to maximize efficiency
  - "Corn on corn acres for several years because it was more profitable"

Narrative of Farm Legacy

- Orientation: Farming decisions driven by pride with viability of land and family farm
  - "If a farm has been in the family for generations, they're probably gonna be more likely to take care of it in one way or another, it's your way of life, it's your land, if it's been in the family for hundreds of years."
- Complication: Pressure from agricultural intensification, changes in rural populations, and resistance to change threaten legacy
  - "….bigger tenant farmers….do not have any ownership. They are farming for somebody else in Chicago. Economics is more important to them than conservation or the watershed."
- Resolution: Explore solutions to create opportunities through land stewardship for sustainable practices
  - "There needs to be a change in the way these leases are written. Leases that are written to include conservation. Not only profitability and sustainability, but use conservation to achieve these two things."

Summary of Findings: Phase 2

- Expert panel convened in 2018 (n = 27) and engaged in both a four-wave “Delphi study” and focus group
- Consideration given to four landscape types




Benefits, Threats, & Practices

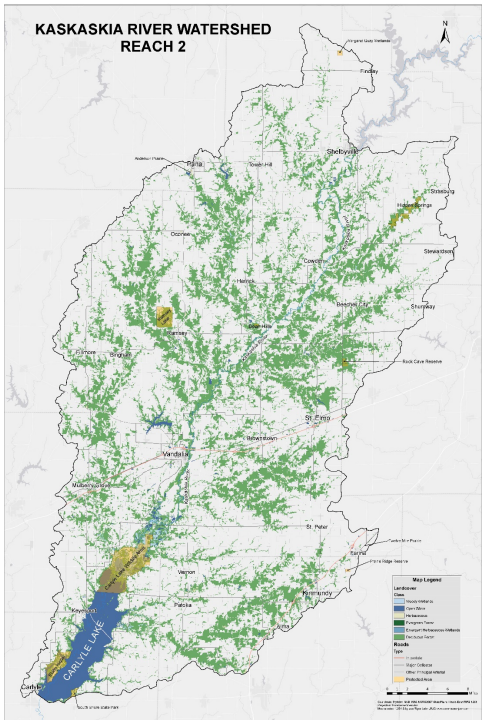
- Most important perceived benefits: Crop production, opportunities and access for recreation, wildlife habitat, water supply, and values associated with farming lifestyle and rural heritage

- Threats perceived to be most impactful: Erosion, run-off, siltation, habitat fragmentation, and invasive species

- Land use practices perceived to be most effective:
  - ***Agricultural landscapes:*** *R*educed or no-till practices, cover crops
  - ***Lakes & rivers:*** Best management practices for nutrients and chemicals
  - ***Built environments:*** Zoning plans, infrastructure improvements
  - ***Forest landscapes:*** Sustainable harvesting practices, invasive species removal and control

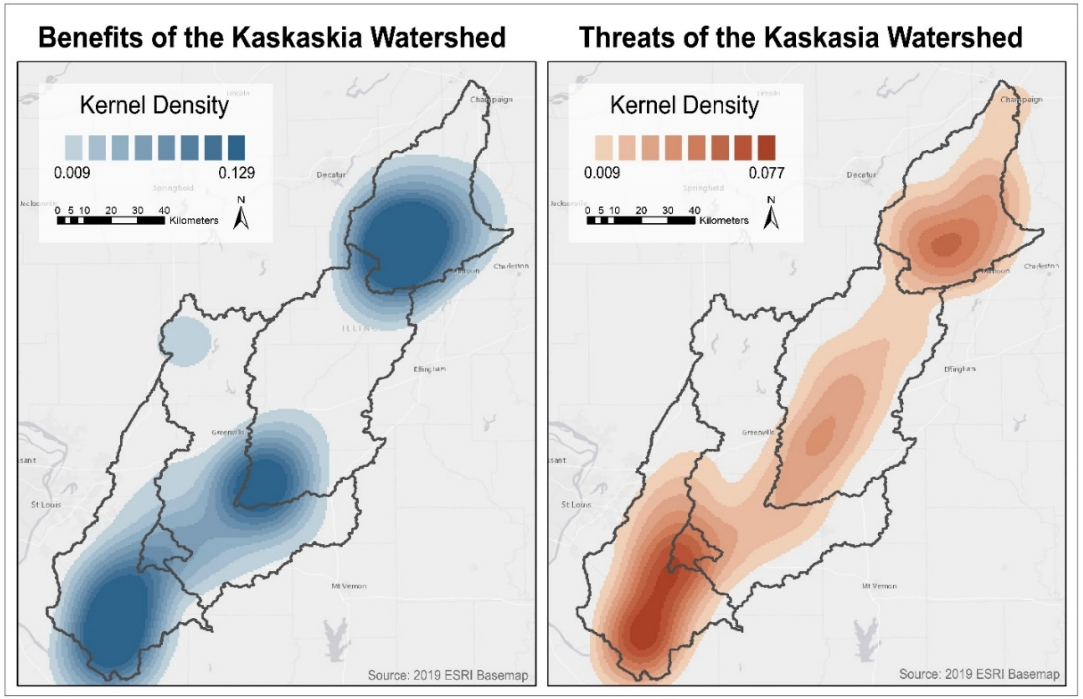
Benefits & Threats Mapped

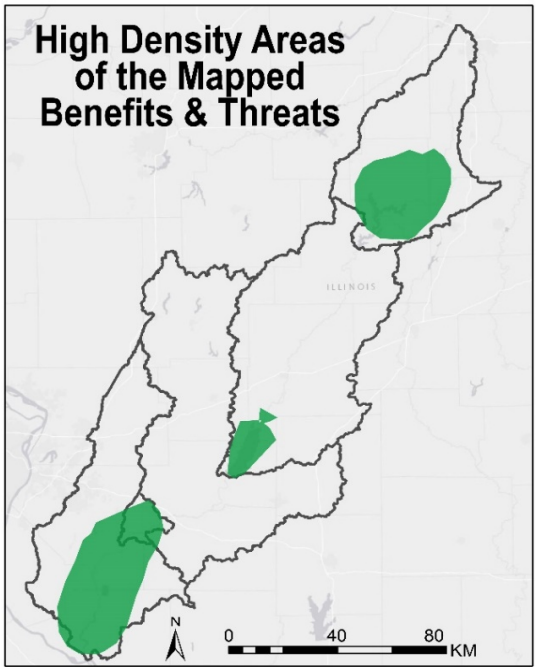
- Participatory mapping exercise conducted in 2019 (n = 52) to locate benefits and threats identified in phase 1
  - How would you spend $100 to preserve existing benefits?
  - Where are the sources of threats that would impact those benefits?



Benefits & Threats Mapped

- **High and low priority locations** were identified across the Kaskaskia River Watershed
  - **Threats were more spatially dispersed** but clustering occurred throughout
  - Both benefits and threats **clustered around the main stem** of the Kaskaskia River
  - **Areas of overlap** between benefits and threats located in Reaches 1, 2 and 4





Summary of Findings: Phase 3

- Regional survey of **residents in the watershed** conducted to examine generalizability of relationships found in phases 1 and 2
  - Purposes of survey
    - Understand experiences with the region
    - Examine intentions to engage in behaviors
    - Evaluate preferences for future growth
  - Qualtrics online panel (n = 786)
  - Demographic quotas set for age, gender, & race applied to help ensure sample aligned with demographics of the region

USDA NIFA

A study of residents surrounding the Kaskaskia River: Understanding your preferences for landscape change

You are one of a small number of people chosen to participate in this study because you live in one of 22 counties in Illinois that are part of the region surrounding the Kaskaskia River. This region is a great place to live, yet there are many changes influencing the landscape. To understand how residents like you are responding to these changes, the University of Illinois is partnering with local organizations to learn more about your opinions and experience. Your response is important to us. Results from this research will be made publicly available and shared with local residents, community leaders and decision-makers.

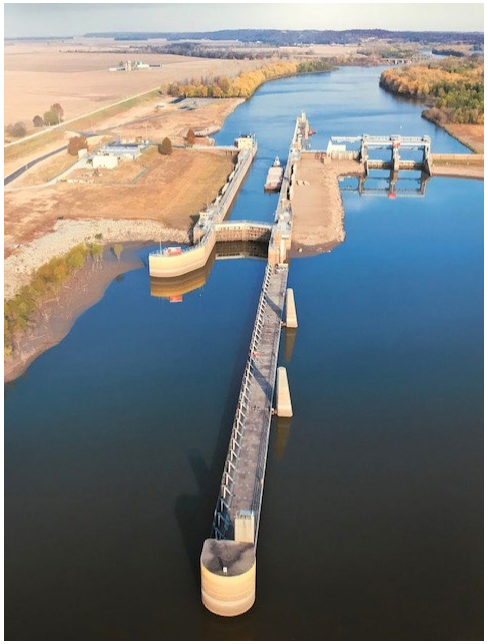
All personal information will be kept confidential and your participation is voluntary. If you decide to participate, you are free to withdraw at any time. If for any reason you prefer not to participate, you may exit now. By clicking "next," you are agreeing to participate in this study. Please answer each question carefully and save any additional comments for the final page. This questionnaire will take about 20 minutes to complete.

If you have questions or concerns about your rights as a participant please contact the University of Illinois at Urbana-Champaign Office for the Protection of Research Subjects at 217-333-2670 or via email at irb@illinois.edu. If you have any questions about the study, please contact the project leader, Carena van Riper at cvanripe@illinois.edu. You can find more information about the project at the website link below.

https://publish.illinois.edu/kaskaskia/

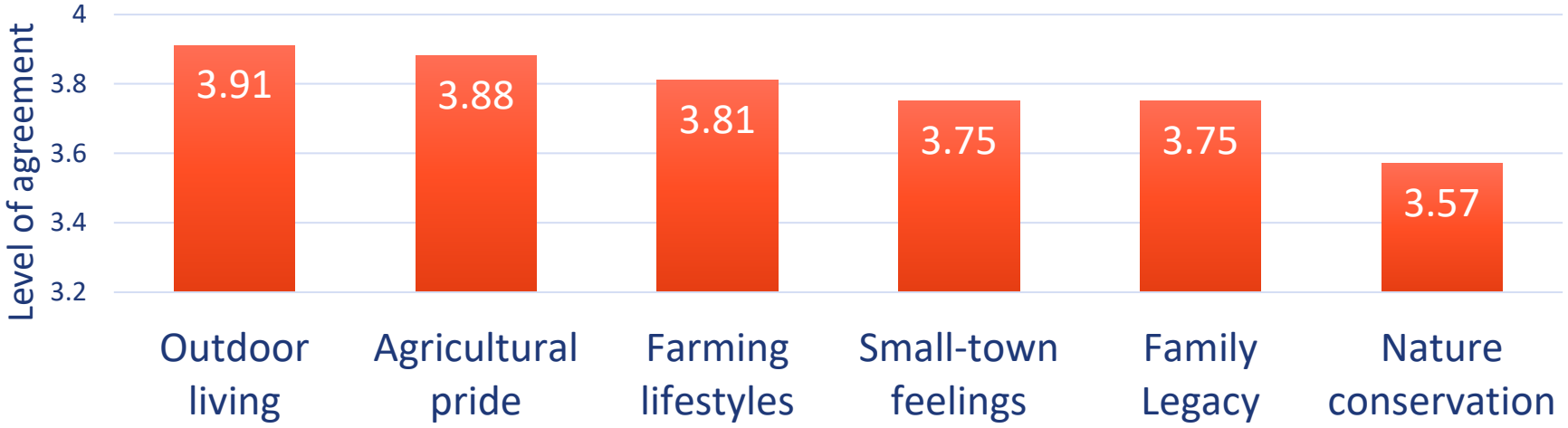
Sample characteristics

- Respondents were mainly White (83%), female (65%), with an average age of 41 years (*SD* = 15.6)
- Respondents who had an income less than $100,000 (78%) and some form of college education (71%)
- Over half considered their area of residence to be rural (61%) and some indicated they owned farmland in the watershed (13%)

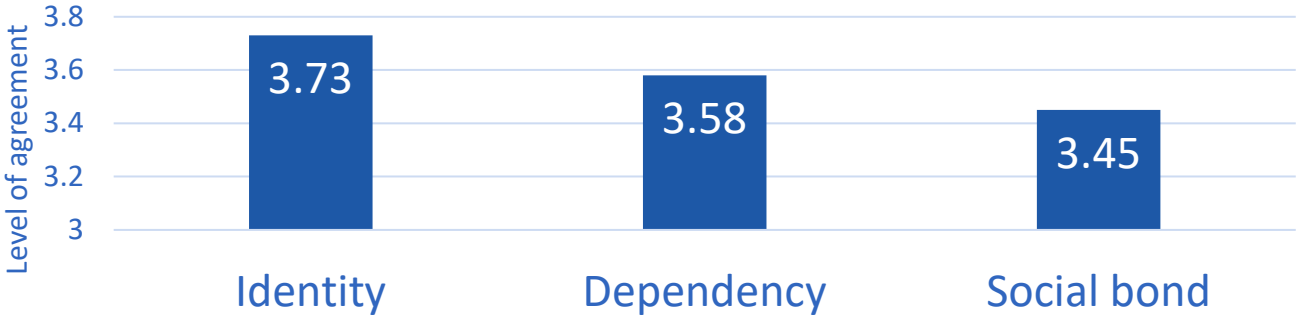


Connections to place

Why do you value your places?



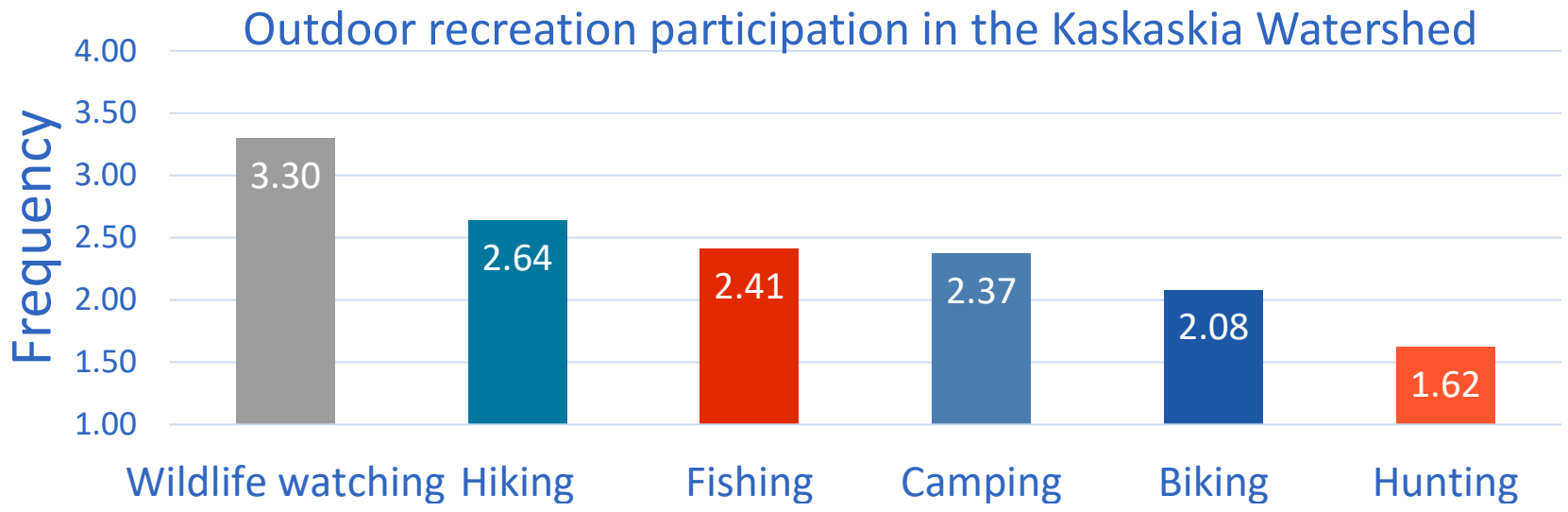
How are you connected to your places?



(1 = Strongly disagree;
5 = Strongly agree)

Recreation and behavior

- Respondents reported moderate to low levels of engagement in recreation (2019)

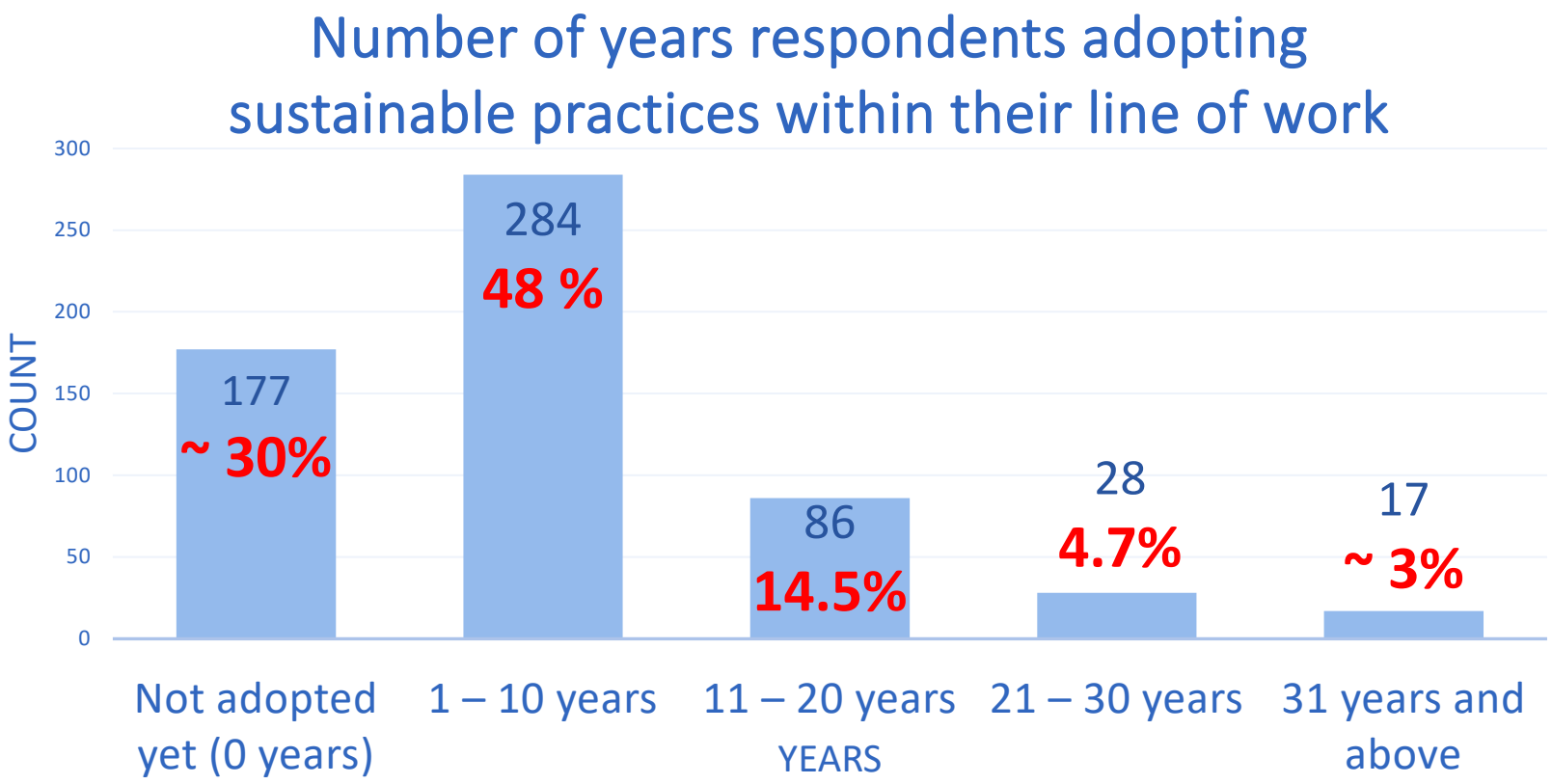


(1 = Very rarely; 3 = Occasionally; 5 = Very often)

- Respondents “occasionally” to “frequently” engaged in behaviors benefitting the environment (e.g., everyday actions tied to water conservation, recycling)

Adoption of sustainable practices

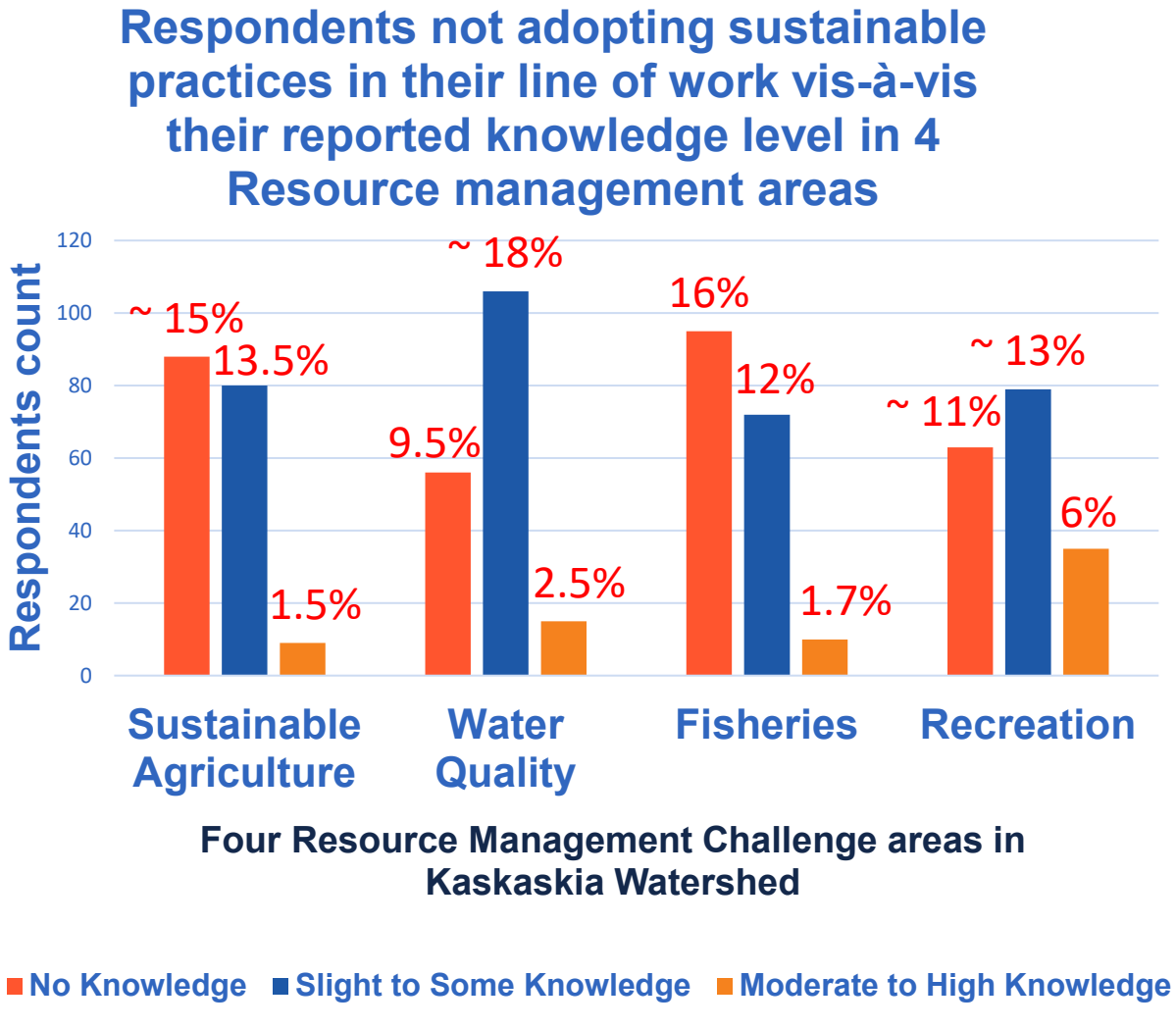
- Mean number of years adopting sustainable practices: 7 years
- Range: 0-65 years
- Not responded: 4%



Knowledge vs adoption of sustainable practices

Reported knowledge level of respondents in the 4 resource management challenge areas is positively associated with adoption of sustainable practices

Educational Attainment of Respondents not adopting sustainable practices	
Level of Educational attainment	**%**
No Formal Education	1%
High School Graduates	9.5%
Some College Education	12%
Bachelor's degree	5%
Post-Graduate degree	2.6%

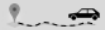


Preferences for Landscape Change

- Preferences for future landscape change evaluated through a series of hypothetical future scenarios.
- Within each scenario, five "features" represented possible changes to current landscape conditions.

Future Scenario 1

Suppose Option A and Option B were the *only* options available besides "No change" over **the next 30 years**. Which would you choose? *Please select the option that represents your choice.*

Attribute					$	I would choose 
Option A	25% Increase	25% Increase	50 Miles Away	15% Increase	$60	❒ A
Option B	0% Change	25% Increase	<1 Mile Away	15% Decrease	$0	❒ B
Option C	No change					❒ C

Choice model attributes and levels for the survey instrument

Attribute	Description	Levels
Acres of Sustainable Agriculture	Percentage change in acres of farmland plated using sustainable practices	25% decrease
		No change
		25% increase
Water Quality	Percentage change in water quality	No change
		25% increase
		50% increase
Distance to Public Recreation Areas	Distance to the nearest recreation area from the resident's home	Less than one mile
		Travel 25 miles
		Travel 50 miles
Fish Variety	Percentage change in native fish variety in the lakes and rivers	15% decrease
		No change
		15% increase
Conservation Fund	Annual contribution to a conservation fund that would improve all attributes	$0
		$5
		$15
		$30
		$60

Preferences for Landscape Change

- Changes in all five features significantly predicted choice

- Likelihood respondent selected an alternative choice increased with **more acres of sustainable agriculture** (β = 0.022), **higher water quality** (β = 0.014), **more native fish variety** (β = 0.025), and decreased as **distance to recreation increased** (β = -0.007)

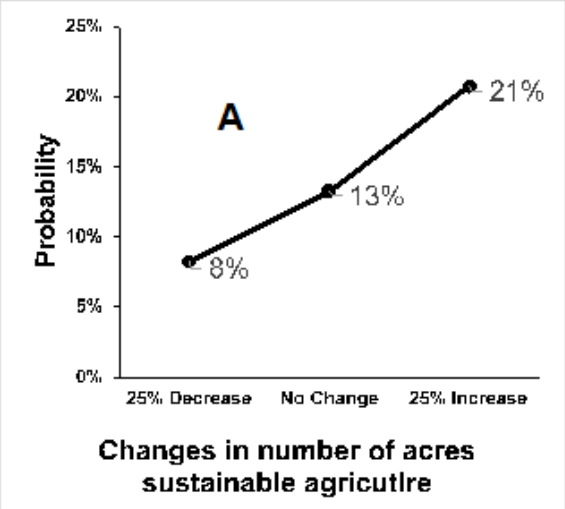
Attributes	Coefficients (SE)	Std. Deviation (SE)
Acres sustainable agriculture	0.022*** (0.002)	0.029*** (0.003)
Water quality	0.014*** (0.002)	0.017*** (0.003)
Distance to public recreation	-0.007*** (0.002)	0.017*** (0.013)
Fish variety	0.025*** (0.003)	0.028*** (0.004)
Conservation fund	-0.005** (0.002)	0.034*** (0.03)
Constant	-1.880*** (0.150)	1.509*** (0.146)

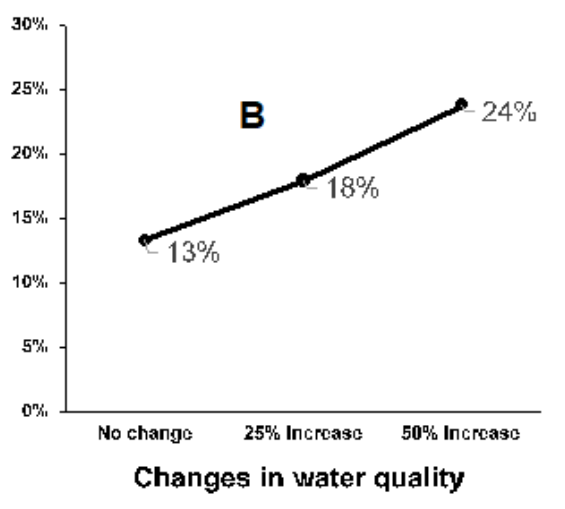
Log-likelihood = -2774.89; Akaike information criterion (AIC) = 5573.8; No. of observations = 3319; Pseudo R2 = 0.24

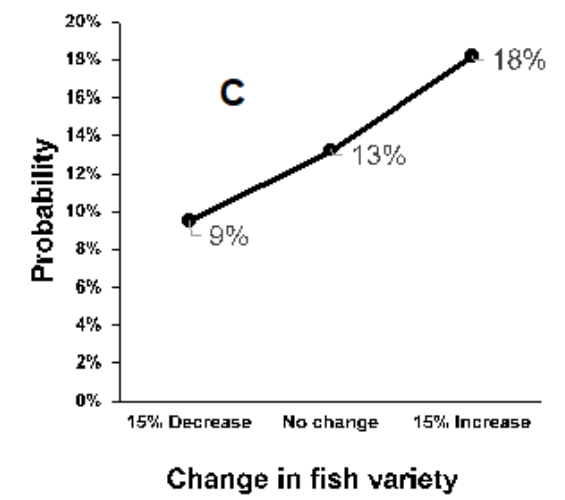
*p < .10, ** p < .05, *** p < .01

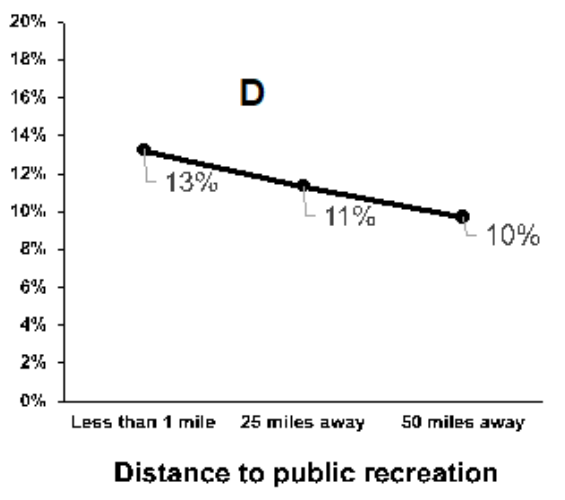
Preferences for Landscape Change

- Logit values converted to probabilities for ease of interpretation
- Figures show the probability that a respondent would choose an alternative scenario over no change at each feature level









Willingness to Pay

- Calculated a marginal willingness to pay for features based on contributions via a hypothetical conservation fund
- Values show the relative cost that respondents would be willing to pay for changes in each landscape feature
  - **Changes in fish variety and acres used for sustainable agriculture** were most valuable
  - **These values are close to double** what respondents would be willing to pay for changes in water quality and distance to public recreation

Variable	Willingness to Pay per unit change
Acres sustainable agriculture	$4.40
Water quality	$2.80
Distance to public recreation	$1.40
Fish variety	$5.00
Conservation fund	-

Community Engagement: Phase 4

- Current phase initiates community-based discussions about landscape change
- Two steps
  - Presentation of results through face-to-face meetings, technical report, and organizational networks
  - Meet with groups of stakeholders to facilitate planning workshops for landscape change

Conclusions & Funding

- Stakeholders and residents care about conservation and developing sustainable practices
- General agreement that strong agricultural industry compatible with healthy ecosystems that support fisheries biodiversity
- Farmer decision-making directed by efficiency in production and stewarding farm legacy
- Next two years to engage stakeholders in discussions about landscape change in Kaskaskia Watershed
- Grateful for support from funders of research:

The National Great Rivers Research & Education Center

ILLINOIS
Natural Resources & Environmental Sciences
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

Small group exercise

- Step 1: Review technical report in small groups
- Step 2: Identify results that are most and least important
  - What do you think is interesting?
  - What have you learned
  - What else would be helpful for you or your organization to understand?
- Step 3: Come together with larger group to share points of discussion

Mitigating Future Threats to Biodiversity: The Role of Headwater Streams and Land Management Practices in the Kaskaskia River Watershed

Joan M. Brehm, Professor and Department Chair, Department of Sociology and Anthropology, Illinois State University

Bill Stewart, Professor, Department of Recreation, Sport, and Tourism, University of Illinois

Cory Suski, Professor, Department of Natural Resources and Environmental Sciences, University of Illinois

Maria Librada Chu, Associate Professor, Department of Agricultural and Biological Engineering, University of Illinois

Jordan Buffington, Graduate Student, Department of Sociology and Anthropology, Illinois State University

Illinois State University

Illinois' first public university

Water, Agriculture, & Healthy Ecosystems

- Maintaining and protecting freshwater resources within Illinois has implications for a variety of sectors including agriculture and food security, energy, economic development, public health, and ecosystem services.
- Most notable is the link between land use, water and agriculture.
- Viable freshwater water ecosystems are essential to agricultural production.
- At the same time, agricultural production has some of the largest impacts on our freshwater systems.

Extending Existing Research

- Extends existing research project "*Enhancing agro-ecosystem services using integrated hydro-ecologic and socio-cultural models*" (USDA/NIFA funded).
- Preliminary findings indicate many fish populations in these headwater streams in the Kaskaskia watershed are at risk due to climate change, primarily as a result of rising temperatures.
  - Stakeholder priorities are not focused on these streams, but instead directed at the two reservoirs of the Kaskaskia River for threats and opportunities linked to water quality and fisheries biodiversity.
- **Elevating the importance of low order streams within the farm-based stakeholders of the Kaskaskia River watershed would enhance the sustainability of Illinois agro-ecosystems.**

ILLINOIS STATE UNIVERSITY
Illinois' first public university

Research Goals

- Stimulate active and ecological land management practices among agricultural landowners of the Kaskaskia River Watershed.
- Extend existing research to focus on the protection of vital headwater streams to mitigate the negative impacts from rising temperatures and increase the productivity of these waterways that are critical to native biodiversity.

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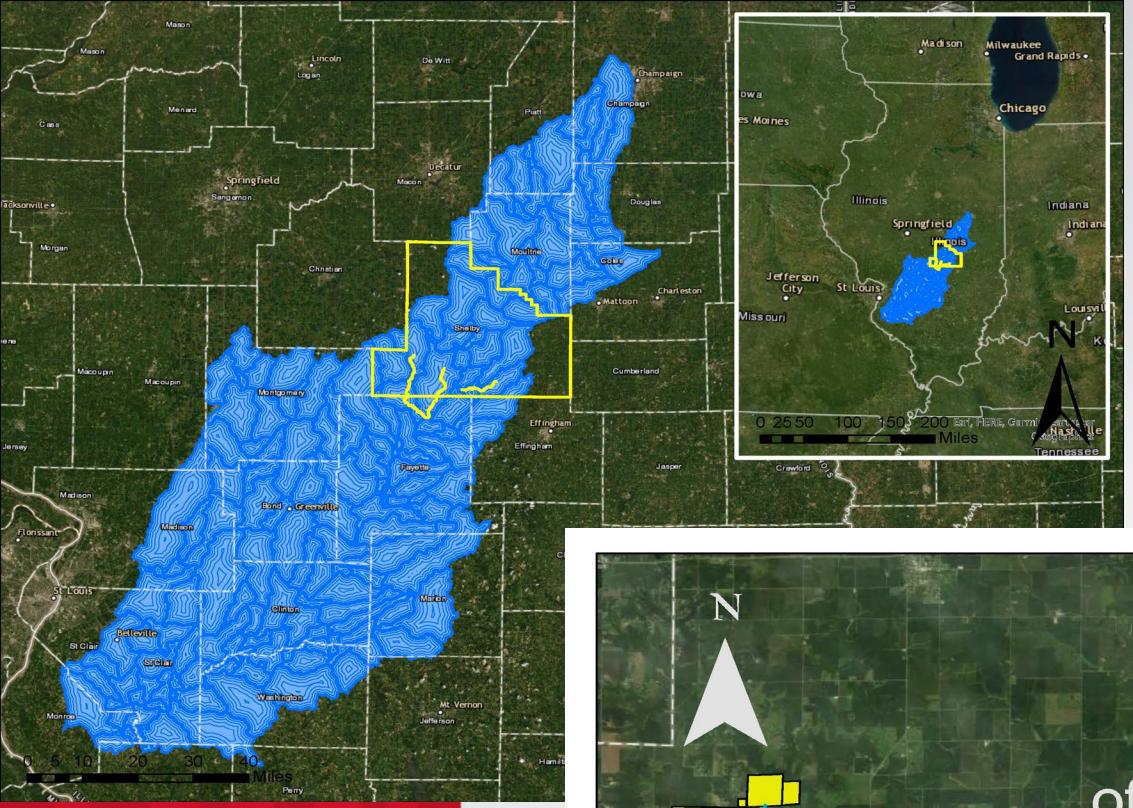
Research Questions

- Key Research Questions:
  - How do farmers view their identity in relationship to conservation practices?
  - How do farmers view their responsibility for conservation practices that extend beyond water quality to focus more directly on biodiversity and fish productivity?
  - What factors would positively influence farmer's engagement in conservation practices that enhance biodiversity and fish productivity in the small feeder streams on their land?

Study Sites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Charleston
Effingham
Fayette
Bond
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Madison
St Louis
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St Clair
Washington
Mt Vernon
Jefferson
Montgomery
Shelby
Cumberland
Jasper
Crawford
Douglas
Moultrie
Christian
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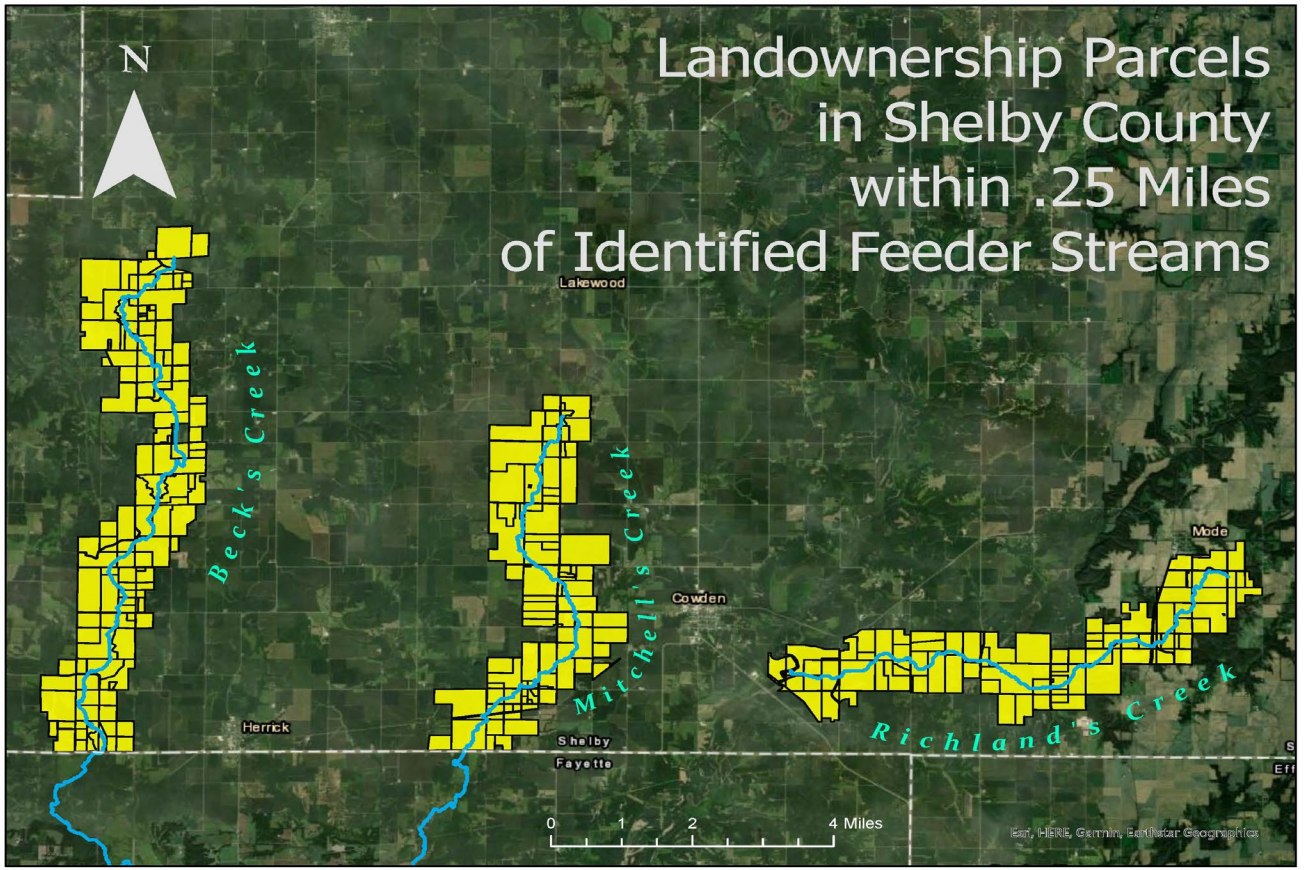
N
Landownership Parcels
in Shelby County
within .25 Miles
of Identified Feeder Streams
Lakewood
Beck's Creek
Mitchell's Creek
Richland's Creek
Cowden
Mode
Herrick
Shelby
Fayette
0 1 2 4 Miles
Esri, HERE, Garmin, Earthstar Geographics