A mixed-methods approach to conduct program evaluation and monitor social indicators of behavioral change over time in the Western Lake Erie Basin

A report by the WLEB 2025 Social Science Panel and the University of Michigan Water Center

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Glossary

- **audience segmentation**: the process of dividing a target audience into smaller, more specific groups based on characteristics like demographics, behaviors, or needs to allow for more personalized and effective messaging
- **commodity row crop**: annual crop grown on a large, often in parallel rows for ease of mechanical planting and harvesting
- **“good farmer” identity**: social, cultural concept representing an idealized vision of a farmer’s role that guides their actions and decisions beyond just economic goals; defined by specific social, cultural, and environmental context, linked to farmer’s sense of skilled role performance and symbolic capital
- **legacy/land ethic:** principle that farmers and landowners should view the land as a community to which they belong and have a responsibility to maintain its long-term health for future generations, not just as an economic commodity
- **Norm Activation Theory**: explores the conditions under which personal norms affect behavior; personal norms are activated when two conditions are met:
    - 1. Individuals are aware of the consequences their behavior has on others
    - 2. Individuals ascribe responsibility for their actions to themselves
    - These conditions influence how situations are evaluated, the extent of norm activation, and whether behavior will change.
- **nudging**: non-regulatory encouragement; involves interventions that guide a target group toward a desired behavior without restricting their options or changing their economic incentives
- **participatory action learning**: collaborative process where stakeholders work together to solve problems through a cycle of learning and action; combines research and practice, focusing on collective self-reflection and experimentation to create change and build knowledge within a community
- **Precision-agriculture**: component of smart farming; farming strategy that employs technology and data analytics to manage within-field variations with high accuracy
    - uses technology including sensors, GPS, drones, computers, and other tools to manage variations across field characteristics
- **Quality of Life Agencies**: government and non-profit organizations focused on improving community well-being through services for various groups
- **segmented digital communication**: process of delivering tailored messages to a target audience which has been divided into smaller groups based on shared characteristics (i.e. demographics, behavior, interests)
- **smart farming**: integration of data and information technologies (i.e. AI, robotics, computers) to optimize all aspects of a farming system with data-driven decisions, including labor, efficiency, crop quality, and yield

- **Technical Service Providers (TSPs)**: individual or entity certified by the Natural Resources Conservation Service to provide a range of technical assistance to producers; includes NRCS TSPs, CSPs, Agronomists, Retailers/Input Providers
- **two-dimensional interest-influence matrix**: graphical tool used to analyze relationships and influence, typically representing stakeholders on a grid with two axes like impact vs. influence; helps visualize the influence of different actors and how interested they are in an issue to inform strategy
- **value chains**: the entire series of activities, from farm production to the final consumer, in which each step adds value to an agricultural product
- **value-trait markets**: market where specific traits or characteristics of a product (rather than its status as a generic commodity) determine its value; in this system, farmers focus on differentiating their products to meet targeted consumer preferences (i.e. certified organic, locally produced)

1) Introduction

This report outlines an approach for the Western Lake Erie Basin Watershed in Michigan to evaluate its producer outreach and best management practice implementation programs over the next 5-10 years. The goal is to collect the data necessary to answer the questions outlined below in Section 2 and adaptively manage funding and programs that aim to reduce phosphorus pollution into Lake Erie's western basin.

This report can be used to choose appropriate evaluation tools for existing programs, design and evaluate new programs, and conduct basin-wide reviews. It draws from the wealth of information available in peer-reviewed literature from academic studies and gray literature produced by non-profit and governmental organizations. While we can learn a great deal from the literature, to adaptively manage our programs here in Michigan, it is also important to evaluate programming iteratively, learning from each cycle and improving over time.

In doing this work, it is important to move beyond the assumption that information provision by experts will automatically lead to the desired changes in behavior. This report encourages the use of comparative and controlled methodologies to measure the true efficacy of interventions and land-use change associated with formal program support. It outlines checklists based on the literature, which can inform the design of evaluation tools.

A key insight from the WLEB Social Science Panel is that project design, evaluation, and monitoring is most effective when (a) there are clear goals and ideas about the intermediate steps required to achieve these goals, (b) the evaluation methods are tailored to test whether progress is being made on these specific steps, and (c) there are strong collaborative partnerships. The Panel recommends that any Requests for Proposals (RFPs) include a clause requiring applicants to demonstrate meaningful collaboration across various organizations, such as non-governmental, academic, and private sector partners. This collaboration is key to designing and implementing initiatives (evaluations, programs, etc.) that are both credible and actionable across the basin. Collaboration will also lead to more efficient evaluation tools that reduce survey fatigue by reducing redundant data collection.

Navigating this Report

This report is organized to guide users through the process of evaluating and improving producer outreach and best management practice (BMP) adoption programs in the Western Lake Erie Basin (WLEB). Structured with a mix of core guidance and practical resources, the sections and appendices are designed to be used collectively or independently, depending on your program needs. Collectively, these sections and appendices provide a flexible but comprehensive evaluation framework—blending best practices from the social science literature and on-the-ground experience in the WLEB. This guide provides practical, evidence-based tools for adaptive management of outreach and BMP implementation programs across the WLEB.

Section 2: *Objectives and Questions*
Outlines the overarching objectives underpinning this work and the specific social and programmatic questions outlined by Michigan's Quality of Life Agencies that this evaluation framework seeks to answer.

Section 3: *Key Recommendations to Michigan's Domestic Action Plan (DAP) Team*
Summarizes actionable, high-level recommendations for the DAP Team and other WLEB leaders, emphasizing the importance of collaboration to avoid survey fatigue, a strategic, mixed-methods approach to monitoring change over time, and expanded internal capacity to evaluate programs.

Section 4: *Develop a Roadmap to Connect Actions to Outcomes*
Guides teams in designing a Theory of Change for BMP adoption, linking program actions to measurable outcomes through collaborative, participatory planning.

Section 5: *Stakeholder Mapping and Tailoring Communication*
Provides detailed guidance on stakeholder mapping, analysis, and audience segmentation—as well as best practices for tailoring outreach and communication strategies to diverse audiences.

Section 6: *Guide to Program Design and Evaluation*
Offers a step-by-step "how-to" for identifying barriers to BMP adoption, setting goals, choosing interventions, and selecting appropriate evaluation tools. This section is intended as a practical resource for current and future program design.

Section 8: *Managing Survey Data*
Recommends frameworks and software for survey data collection, management, and analysis, with user-friendly references to support robust, standardized data practices.

Section 9: *Citations*
Provides a comprehensive list of peer-reviewed sources and gray literature informing this report, serving as a foundation for evaluation approaches and evidence for recommendations.

Appendix A: *Program Design and Evaluation Methods*
An in-depth reference organized by key barriers to BMP adoption, with targeted goals, intervention strategies, and example evaluation methods for each barrier.

Appendix B: *Types of Assessments*
Presents a toolkit of assessment methods, from low-burden secondary data reviews to high-rigor mixed-methods studies, including considerations for selecting and implementing each approach.

Appendix C: *Python Web Scraping Instructions*
Practical instructions for using Python to gather information from online sources, including technical guidelines and ethical considerations relevant to program evaluation.

Appendix D: *Stakeholder Mapping*
Offers examples from a participatory stakeholder mapping activity at the 2025 WLEB Conference, illustrating how influence-interest matrices can inform ongoing engagement and outreach efforts.

Appendix E: *Annotated Bibliography*
Short descriptions of over 50 peer-reviewed papers supporting the content in this report. This section is to help you get information on the best science available in a quick, accessible format.

2) Objectives and Questions

These objectives and related questions were identified by the Science Panel based on questions the WLEB community and the Quality of Life Agencies shared earlier in the process. This report provides a set of recommendations for how the WLEB community could collect the information necessary to answer these questions.

Overall Objective: Reduce phosphorus loading to Lake Erie through the following:

1. **Improve and increase outreach to producers** to promote understanding of the WLEB and good conservation practices.
    - Who is engaged? Are we engaging new audiences; broadening participation?
    - What strategies have been deployed/tried? Do these include innovative outreach events and other outreach/communication tools?
    - Is outreach improving awareness and understanding of the benefits of conservation practices in the WLEB? Are producers gaining confidence in their ability to implement conservation practices that would protect the WLEB?
    - Is outreach and engagement supporting two-way conversations with producers? Has producer feedback/input changed the content or approach to outreach programming?
2. **Maintain and expand partnerships to provide valuable technical and financial assistance** to producers
    - How well coordinated are efforts across agencies/programs?
    - What is the level of participation from Technical Service Providers (TSPs)?
    - Are TSPs finding the programs to be able to provide valuable info/resources to producers?
    - What other creative ways to provide technical services can the community harness? (e.g. online decision support tools)
3. **Implement more long-term best management practices** / increase broad and sustained adoption (for diverse list of BMPs)
    - Why are some producers implementing these practices but not others?
    - What is the role of outreach, extension, engagement programs in adoption decisions?
4. **Improve and increase outreach to the public** to promote understanding of challenges in agriculture and difficult tradeoffs farmers/producers must make.
    - Do we need public buy-in for farmer/producer behavior to change?

3)Key recommendations to the DAP Team

Develop and Institutionalize a Roadmap to Connect Goals to Outcomes: Convene broad, cross-sectoral stakeholder groups (farmers/producers, technical staff, advisors, local government, non-profits, academics) to collaboratively establish a roadmap to connect BMP adoption goals to outcomes. Clearly define program goals, planned activities informed by data or theory, measurable outcomes, and key assumptions.

Adopt Tailored Evaluation Approaches for Individual Programs: Include quantitative and/or qualitative tools, ranging from literature reviews, web scraping, and remote sensing to annual and longitudinal surveys, panel studies, and specific program or population-wide assessments. Best practices include tailoring approaches to individual programs, staggering assessments over time, and minimizing participant burden by coordinating these efforts across programs to reduce survey fatigue. This multi-faceted approach enables robust, adaptive management and continuous learning for effective conservation efforts in the WLEB.

Conduct Ongoing, Participatory Stakeholder and Audience Analysis to Tailor Communication and Outreach: Use up-to-date collaborative stakeholder mapping to inform and adapt outreach and engagement strategies, ensuring that communication is a) delivered through locally trusted messengers (e.g., crop advisors, farmer “champions”) and b) tailored to the audience context and needs using multiple communication modalities. Revisit and revise these analyses and strategies annually and following major regulatory or scientific changes.

Ensure Long-Term Data Collection and Adaptive Management: Invest in coordinated, long-term monitoring of BMP adoption and related water quality outcomes, integrating biophysical, social, and economic data. Schedule periodic (3–5 year) reviews and updates to adaptively manage programs, inform stakeholders, and ensure regular touch points in the adaptive management cycle.

Invest in Evaluation Capacity: Support evaluation skills training for technical and advisory staff, internships/apprenticeships, and continuous professional development to expand evaluation capacity.

4) Develop an Evaluation Roadmap to Connect Goals and Activities to Outcomes

(aka Theory of Change or Logic Model)

Why Develop an Evaluation Roadmap?

This is a powerful tool for planning how you will reach your desired outcomes. Think of it as a **"roadmap" for getting from your starting point to your desired outcome,** showing each important step along the way. It's a logical story of how and why what you are doing will create the changes you hope to see.

An Evaluation Roadmap will help you meet goals that require broad community buy-in and participation and will support your process through:

- **Clarity:** Everyone knows the steps, and why each one matters.
- **Accountability:** You can check if your actions are actually leading to change.
- **Communication:** It's an easy way to explain your plan to funders, partners, or community members.

How to Develop an Evaluation Roadmap:

Over the course of 3-12 months, hire a facilitator to work with local social scientists and a broad cross section of the agricultural and conservation communities (see full list below) in the WLEB to develop and write down an Evaluation Roadmap for BMP adoption in the WLEB. This facilitated group will work together to:

- **Set Goals:**
  - Cleary state the goal you want to achieve.
  - Your end goal could be: sustained adoption of BMPs to improve water quality in the WLEB even after initial incentive programs end.
- **Identify what needs to change to meet your goal:**
  - Short term: What is required for initial implementation of BMPs?
  - Long term: What is required for farmers/producers to continue to implement BMPs after initial funding programs end?
- **Identify underlying assumptions**:
  - What is required for practices to continue after initial incentive funding ends?
  - An assumption could be that farmers/producers will continue to use BMPs after initial funding runs out if a peer group or local trusted advisor holds them accountable.
- **Identify measurable intermediate goals:**

    - Align these with your assumptions.
    - One of your intermediate goals could be: 20 new edge-of-field practices in the WLEB over the next 2 years.
- **List your activities:**
    - What steps will you take to achieve your intermediate goals?
    - An activity could be to fund dedicated staff at Conservation Districts whose job is to work one-on-one with farmers/producers to keep practices on the ground after initial cost-share or pay-for-performance programs end.
- **Map out how your activities will lead to your goals:**
    - Draw diagrams connecting activities to goals
    - BMP incentive program → Increased acres under BMPs
    - Personal accountability → Sustained adoption of BMPs
- **Check your assumptions**
    - Will farmers/producers respond to outreach from trusted advisors or colleagues after funding runs out?
- **Draw a logic model**
    - Use a flowchart or diagram to demonstrate how activities connect to intermediate and long-term goals.

<u>Meeting Process:</u>

- Start with remote data collection using an online survey or solicitation to respond to an email to gather information about key assumptions before meeting in person.
- Multiple meetings to determine a series of causal processes that lead to identified outcomes (one 2-hour meeting per week for 3-4 months or so).
- Sit down with like-minded groups for an hour and ask what matters when making decisions, then map it behind the scenes.
- Bring together a diverse group of key stakeholders and discuss paths for approaching farmer/producer behavior change in the WLEB.
- Fold into WLEB's annual adaptive management process (help formalize the adaptive management process).
- Make the time to come together every year and synthesize evaluation across projects.

<u>Who should be invited to contribute to the Evaluation Roadmap?</u>

- Conservation Districts
- The Nature Conservancy Farmer Advocates

- Farmer-led Watershed Conservation Group(s) in WLEB and local farmers/producers
- Michigan Department of Agriculture and Rural Development (MDARD) WLEB and Regenerative Agriculture Program staff
- Environment, Great Lakes, and Energy (EGLE) Nonpoint Source Program staff
- Department of Natural Resources (DNR) wetland staff
- Local social scientists (MI, OH)
- MSU Extension
- Farmer/producer advocacy groups including Farm Bureau and Michigan Corn
- Non-profits such as National Wildlife Federation (NWF) and The Nature Conservancy (TNC)
- Middle and late adopters (farmers/producers)
- Certified Crop Advisors and other trusted advisors

What next?

- Co-designing a collective Evaluation Roadmap and generating a series of "If…Then" assumptions will allow intervention programs to define areas of exploration within their program. Each program could design evaluation tools using tailored questions designed to assess each program's objectives.
- Researchers could design studies to test assumptions by evaluating the outcome of an intervention. For example, Houser et al.'s 2025 study tests the assumption that offering a "yield warranty" will increase participation in BMP adoption programs.

What resources are available to get started?

Dr. Adam Reimer, NWF, developed a logic model of conservation adoption outcomes and activities in the WLEB collaboratively with MDARD staff and local Conservation District staff in 2024 through a series of meetings. The community who developed this model should be expanded beyond the public sector into the private and nonprofit sectors to expand on this existing work to develop a Theory of Change model.

You can read more about the potential pitfalls of the Theory of Change process and how to overcome them in Davies 2018.

This has been done before in the Chesapeake Bay:

- Dr. Martin facilitated a similar exercise in the Chesapeake Bay (Martin et al 2025) in which they co-developed seven causal assumptions related to human behavior. Here is one example of a causal assumption:

    - "If farmers try and experience the agronomic and economic benefit of a conservation practice on their farm, then they will implement the practice without continued need for incentives because the practice saves them money and/or time and/or makes management easier."

Learn more about logic models:

- University of Wisconsin Extension's course
- University of Kentucky's community toolbox "Developing a Logic Model or Theory of Change" guidelines
- Watershed specific example in Minnesota

Example of the process:

Lawson, A. J., Kalasz, K., Runge, M. C., Schwarzer, A. C., Stantial, M. L., Woodrey, M., & Lyons, J. E. (2022). Application of qualitative value of information to prioritize uncertainties about eastern black rail population recovery. Conservation Science and Practice, 4(7), e12732.

- Lawson et al. 2022 demonstrate a facilitated, collaborative process for identifying and prioritizing causal assumptions in conservation decision making, an approach that aligns strongly with the Theory of Change roadmap proposed for the WLEB. In this study, stakeholders participated in a structured workshop to co-develop conceptual models, define explicit "if-then" relationships between management actions and expected outcomes, and prioritize uncertainties through a qualitative Value of Information framework. This approach reflects the process of developing a Theory of Change- clarifying assumptions, mapping pathways, and identifying which indicators to measure.
- The study demonstrates how group facilitation and structured reasoning make assumptions visible and testable, allowing for organizations to focus monitoring on the information that will actually improve decisions. The authors show that collaboratively outlining these assumptions increases transparency and accountability and aids adaptive management by guiding where investments in new data or evaluation are most valuable. This study provides a precedent for a process with emphasis on co-production, stakeholder engagement, and the linkage of action to measurable outcomes. Although the study centers on ecological change rather than behavioral change, the facilitation model and logic provide a successful example of Theory of Change process development.

5) Map Stakeholders and Tailor Communication

Before we can answer these questions in the WLEB or develop an Evaluation Roadmap, we must first understand “who are the key stakeholders?” To develop communication strategies, we must further understand which messengers communities trust, and how best to engage diverse audiences. To lay this foundation, we can start by identifying trusted messengers and target audiences and organize these groups along interest versus influence continuums.

This approach helps determine who should deliver messages to different types of producers and other stakeholders. As a first step, we conducted a participatory stakeholder mapping activity during the 2025 WLEB Conference. This exercise established baseline data to clarify the complex relationships, authority structures, and knowledge networks that shape conservation efforts in the WLEB. See **Appendix D** for an example of this process, conducted at the June 2025 State of the WLEB Conference in Adrian, MI.

Use a Multi-Stage, Flexible Approach to Stakeholder Analysis

Using a multi-stage, flexible approach to stakeholder analysis helps ensure that decisions are informed by those most affected. By combining collaborative mapping, ongoing updates, and adaptable tools like the influence-interest matrix, teams can create responsive strategies that truly reflect community needs and evolving circumstances. This process can feed into an annual adaptive management cycle:

Collaborative Mapping and Reflective Learning

- Start with group activities to map out who the key stakeholders are and what their roles and interests might be.
- Use follow-up discussions and surveys to gather additional thoughts and local insights.
- This approach values everyone’s perspective, making sure solutions are shaped by those most involved.

Using the Influence-Interest Matrix

- Organize stakeholders on a simple chart (matrix) showing their level of interest and influence.

- This tool helps compare perspectives and decide who should be involved in decision-making, while leaving space for local realities to be heard.

Keep Stakeholder Analysis Up to Date

- Treat the stakeholder matrix as a “living document” that is updated as new people or groups become important.
- Review and update the matrix regularly—set a clear schedule (e.g., annually or after important changes).
- Revisit the matrix whenever new policies, regulations, or scientific findings come out, or when major events affect the community.

Tailor Analyses to Projects and Timing

- Create different matrices for different goals or projects.
- Adjust and tailor your approach based on the season or timing, since water quality concerns can change over the year.

Work as a Team and Document Changes:

- Collaborate in groups (across agencies and with key local stakeholders) to make sure the analysis reflects a variety of perspectives.
- Keep notes and rationale for any updates to the matrix so the process remains transparent and understandable.
- Remember, because these matrices are subjective, they’re best used by planning and outreach teams, not as public-facing tools.

Use Best Practices for Messaging and Communicating with Different Audiences

Successfully engaging agricultural producers to adopt conservation practices requires more than a “one-size-fits-all” approach. Different producers, landowners, and operators bring unique perspectives, goals, and circumstances to each decision. To maximize the effectiveness of outreach and extension efforts, it is essential to systematically define and understand your audience using a variety of characteristics and behavioral typologies. This section provides a step-by-step framework for audience segmentation and message design, drawing on both operation-specific attributes and farmer/producer identity.

As you work through each task in this section—defining your audience, identifying messengers, tailoring messaging, and selecting communication methods—consider not only who you’re hoping to reach but also how their perspectives, peer networks, and operational realities shape their openness to change.

Task 1 - Define your audience based on these category types:

Consider this first: The following categories may apply to different farmers/producers with respect to different behaviors - for some practices, (e.g., adoption of precision-agriculture or cover crops), the innovators and early adopters might operate large row crop farms with corn, soy, wheat rotations, while for other practices (e.g., intensive rotational grazing, diversified crop rotations) the innovators may be on small farms with access to alternative grain markets.

Know operation characteristics:

- Commodity type: vegetable vs. commodity row crop vs. dairy/livestock
- Tenure: owner-operator vs. renter
- Age: note generational perspectives and intergenerational power dynamics
- Size/scale of farm
- Market orientation: mainstream commodity markets, value-trait markets (e.g., organic, GMO-free), and local/direct markets

Behavioral/identity typologies (Upadhaya et al. 2023)

- **Conservationist** - place high value on conservation, identifying strongly with non-economic conservation motivations and maintaining a willingness to employ innovative approaches.
- **Traditionalist** - high concern for economic and agronomic barriers and less concern for soil health. Employs traditional practices and is distrustful of new approaches. Local expectations and fear of future regulations are the most effective conservation incentives for traditionalists.
- **Productivist** - align with the “highest yield possible” perspective of “good farmer” identity, placing their value in the latest technology and seed. Motivated by economics and show concern for the effects of farm policy on input prices.
- **Deliberative** - “early majority adopters” - Rogers 2003. Maintain diverse conservation motivations but fall behind in trust of innovative approaches due to uncertainty in the efficacy of practices and economic and agronomic barriers. Value local conservation benefits for their fields and place trust in agribusiness advisers, family and friends, conservation groups, and commodity groups equally.

Diffusion of Innovation categories:

- **Innovators and early adopters:** tend to have a conservation-oriented mindset and are not primarily driven by financial incentives (Dunn et al. 2016, Ma et al. 2012, Ryan et al. 2003).
    - venturesome, have relationships with many different types of individuals across the world, and communicate within a clique of other innovators (Padel 2001).
    - can cope with a high level of uncertainty and are willing to take risks (Padel 2001).
    - may not be accepted at first but are still integrated into their local communities, are opinion leaders, and have intensive contact with information sources (Padel 2001).
- **Early majority:** adopt before the late majority. They require evidence and success stories that the innovation works before they will adopt it (LaMorte 2019 Summary of Rogers 1962).
- **Late majority:** remain uncertain of change and will only adopt after more than half of their peers have (LaMorte 2019 Summary of Rogers 1962).
- **Skeptics:** They adopt common innovations such as reduced tillage last, in response to peer pressure and compliance such as regulations that require innovator behaviors.

Task 2 - Identify trusted messengers for your audience:

- **Leverage locally trusted sources**: crop advisors, respected peer farmers, local extension agents, agribusiness professionals.
- **Utilize peer-led networks and diverse farmer "champions" who fit different typologies:** champion-led events, informal peer Q&A, practical mentorship, and demonstration days.
- **Focus on building and sustaining long-term relationships:** prioritize trust, credibility, and empathy over organizational affiliation.
- **Listen**: when soliciting feedback on farmer/producer needs, perceptions of conservation practices, or program design - be open to ideas and input that might not align with your own understanding of the situation.

Task 3 - Tailor messaging to your intended audience:

- **Align with Audience Values, Identity, and Motivations:** Connect practices with stewardship, legacy/land ethic, profitability, or "good farmer" identity according to which type of farmer/producer you are trying to reach.

- **Balance Intrinsic and Extrinsic Motivations:** Don't undercut intrinsic motivations with narrowly financial appeals; foster internalized motivations.
- **Highlight Social Norms:** Emphasize descriptive (what others are doing) and injunctive (what is valued/expected) norms. Use stories, testimonials, and visible proof of social/peer adoption ("Most farmers in your county ...").
- **Appeal to Responsibility:** Use the Norm Activation Theory – make outcomes and personal responsibility explicit.
- **Avoid One-Size-Fits-All Messaging:** Generic mass outreach is less effective than segmented, targeted messaging.
- **Use Multi-Modal Approaches:** Combine print, digital, face-to-face, peer-to-peer, and demonstration-based outreach.
- **Use positive, practical, and clear language:** Avoid jargon, be concise, and emphasize actionable steps.
- **Highlight practical benefits:** profitability, operational efficiency, risk reduction, visible outcomes, "see it to believe it."
- **Acknowledge and empathize with risk:** communicate about economic stability, safety nets, and risk reduction mechanisms.
- **Emphasize flexibility, autonomy, and choice** in programs or BMP adoption ("multiple cost-share options," "your plan, your timeline").

Task 4 - Identify appropriate communication methods based on the stage and mode of outreach

- **Personalized Mass Outreach** - personalized mail, segmented digital comms
- **Group Events/Demos** - field days, peer meetings
- **One-on-One Meetings** - advisor visits, technical consults
- **Farm Visit & Demonstration** - visuals, peer success stories
- **Plan Development** - custom implementation plan, flexible options
- **Implementation Support** - technical/peer support during practice change
- **Post-implementation** - maintenance, recognition, peer-to-peer sharing

Task 5 - Consider these outreach strategies

- **Facilitated Farmer Groups:** peer-to-peer learning, facilitated groups, participatory action learning
- **Technological Development (multi-actor approach):** smart farming, multi-actor approaches combined with training, precision agriculture
- **Information Provision:** Brochures and newsletters, BMP guides, tailored information, digital tools (e.g., decision support tools) and smart-farming

technologies, topic-specific information for targeted agricultural practices, science communication.
- **Consulting:** One-on-one advice, coaching models (work in local context with farmers' extant body of knowledge while supporting farmer autonomy)
- **E-extension:** webinars, podcasts, apps, virtual experiences
- **Co-Innovation:** collaborative problem-solving between farmers/producers, researchers, and others to develop new models, value chains, products, or practices.
- **Social Marketing**: long-term nudging, social comparison/peer influence, participation rewards

Task 6 - Tie it all together

Once you identify who you are trying to reach, identifying the appropriate communication tools can be challenging. Here are some examples based on common types of farmers/producers you may be trying to reach.

This group has potential to serve as the messenger: A long-term cover-cropper on a large-scale row crop farm with conservationist values would benefit from:
- encouragement from local conservation district/organization to communicate conservation success stories with their peers,
- via one-on-one recruitment to a farmer advocate/leader role and training on how to communicate with middle adopters.

These groups are more likely to change their behavior in response to effective communication tools:
- A mid-career, large-scale, commodity row crop producer with traditional values would benefit from:
    - messaging aligned with profitability and reducing risk of additional regulations through proactive conservation behaviors,
    - via one-on-one meetings with a local, trusted source focused on operation economics (i.e., crop advisor, fertilizer dealer).
- An early-career, small-scale, organic dairy farmer with conservationist values would benefit from:
    - messaging aligned with land ethic values describing what peers are doing on neighboring farms and that appeal to personal responsibility to steward the land,
    - via a peer-led network group hosting hands on, demonstration field days.

This group is more likely to be resistant to change no matter what you try:

- A skeptic with productivist values who is close to retirement and resistant to change would benefit from:
    - messaging that emphasizes that conservation practices make other local producers more profitable, which will allow them to expand and plan for succession to the next generation,
    - via one-on-one discussions with peers about benefits of conservation practices to farm viability and succession planning.
    - Note that finding the right messenger for each individual is important and conservation oriented messaging may not be appropriate.

6) Guide to Program Design and Evaluation

This section acts as a mock guidebook for individual programs to develop robust evaluation tools for a range of programs implemented by organizations in the WLEB. We recommend that this guidebook be used as the building blocks for designing an online decision support tool for individuals designing, implementing, and evaluating conservation adoption programs to use for developing more scientifically robust programs with evaluation processes. The web tool that we propose will be designed as an end-to-end decision support tool.

This section provides a starting point with examples of how the tool could flow from selecting local barrier(s) to stepwise options to choose from to develop strategies for overcoming the barrier, design and implementation tools, and then a method for evaluating the outcomes including a tool to support the development of survey/interview questions and data analysis. Local conservation practitioners will be included in the design and pilot testing of this decision support tool.

This section is intended to be a mockup of the tool with tables representing different steps in the tool with an appendix that includes detailed information that would be provided to users based on their choices. The information provided here in this report should be adapted based on what is discovered by the community through the Evaluation Roadmap development process and then further reviewed by social scientists to ensure robust inputs to the tool and work with MDARD, EGLE, DNR, MSU Extension, and the Conservation Districts to ensure this material is scientifically robust and is relevant and useful to their programming needs.

Instructions for using the information provided in this section

- Identify a key barrier in Task 1
- Once you identify the barrier, find the corresponding chart below in Task 2
- Choose the goal that aligns best with your objectives.
- You'll find each goal represented on the chart as a code. Use Command + F to search **Appendix A** for that code and read the full goal description.
- After you select your goal, follow the chart to identify potential interventions.
- Finally, review the list of evaluation tools for suggestions for assessing the effectiveness of your chosen intervention.
- Find detailed descriptions for evaluation tools in **Appendix B** by searching the name of the tool

Task 1: Start by identifying a key barrier, or barriers, that your community has identified as limiting sustained BMP adoption.

Ten Barriers to Program Participation and Practice Adoption:

1) Structural/Systemic Constraints
    a) Strategy 1: Incentives and support to enable diversification
    b) Strategy 2: Robust, cross-jurisdictional coordination
    c) Strategy 3: Public-private partnerships for capacity building and innovation
2) Value Alignment and Program Mismatch
    a) Strategy 1: Recognize diverse conservation motivations and value systems in your community
    b) Strategy 2: Adapt programs to match with farmer/producer values
    c) Strategy 3: Create flexible programs to appeal to a range of value systems
3) Time, Labor, Equipment, and Information Constraints
    a) Strategy 1: Experienced workforce with low turnover and high technical assistance capacity
    b) Strategy 2: Increased access to equipment, technology, and financial aid
    c) Strategy 3: Streamlined technical assistance and program navigation tools
4) Risk Aversion and Safety Net Mindset
    a) Strategy 1: Overcome misconceptions about risk
    b) Strategy 2: Restructure program incentives and participation models to remove barriers for risk-averse and tenant farmers
5) Inflexibility and Lack of Customization
    a) Strategy 1: Flexible programs that accommodate farm and field variability, allowing for mix / match practice adoption instead of all or nothing packages
    b) Strategy 2: Program alignment and stackability across multiple initiatives
6) Perception and Belief in Practice Benefits

a) Strategy 1: Strengthened farmer/producer conservation identity, connected to BMP adoption
b) Strategy 2: Improved trust in practice efficacy through transparent, field-based feedback loops
c) Strategy 3: Increased awareness of collective responsibility for nutrient pollution reduction at the watershed scale

7) Economic Incentives and Financial Constraints
   a) Strategy 1: Long-term, flexible funding programs to provide consistent support for producers, allowing sufficient time to realize benefits from conservation practices
   b) Strategy 2: Financial incentives and risk-sharing mechanisms that offset the costs, profit risks, and logistical barriers associated with adopting nutrient reduction practices in the WLEB
8) Distrust of Government and Regulations
   a) Strategy 1: Enhanced trust through farmer-led and peer-based outreach
   b) Strategy 2: Program transparency and farmer control in design and delivery
9) Administrative Burden and Program Complexity
   a) Strategy 1: Simplified and streamlined administrative requirements
   b) Strategy 2: Enhanced support and navigation for farmers/producers
   c) Strategy 3: Improved transparency, communication, and feedback loops
10) Unsettled Science and Data Gaps
   a) Strategy 1: Develop a multi-decadal water quality and agronomic dataset to detect change
   b) Strategy 2: Improve confidence in practice selection and effectiveness

Task 2: Identify goals, potential interventions, and evaluation tools

Barrier (B1): Structural /Systemic Constraints		
Strategy	Implementation	Evaluate Outcomes of interventions
Incentives and Support to Enable Diversification (B1 G1)	Provide funding, equipment, and technical assistance (B1 I1)	**Low Cost:** Literature Review (B1 E1a)
		Medium Cost: Pre/Post Participation Surveys (B1 E1b)
		Medium Cost: Remote Sensing Combined with Administrative Data (B1 E1c)
Robust, Cross-Jurisdictional Coordination (B1 G2)	Enhance collaboration among technical assistance staff at all government levels. (B1 I2)	**Low Cost:** Web Scraping/Program Inventory (B1 E2a)
		Medium Cost: Qualitative Interviews with Key Staff (B1 E2b)
		High Cost: Synthetic Reviews/Annual Multi-stakeholder Meetings (B1 E2c)
Public-Private Partnerships for Capacity and Innovation (B1 G3)	Develop a public-private partnership (B1 I3)	**Medium Cost:** Focus Groups (B1 E3a)
		Medium to High Cost: Agronomic and Economic Impact Assessments (B1 E3b)
		High Cost: Tracking Behavioral Changes/Longitudinal Surveys (B1 E3c)

Barrier (B2): Value Alignment and Program Mismatch		
Strategy	Implementation	Evaluate Outcomes of interventions
Acknowledge diverse conservation motivations (B2 G1)	Conduct value Mapping Exercises to Identify Value Systems in Community (B2 I1)	**Low to Medium Cost**: Qualitative Interviews (B2 E1a)
		Low to Medium Cost: Surveys with Value/Attitude Scales (B2 E1b)
		Medium Cost: Focus Groups (B2 E1c)
Programs aligned with Farmers Values (B2 G2)	Co-Design Programs with Farmers (B2 I2)	**Low to Medium Cost**: Focus Groups (B2 E2a)
		Medium Cost: Feedback Forms/Surveys (B2 E2b)
		Medium Cost: Qualitative Interviews/Post-Implementation Interviews (B2 E2c)
Flexible Programs for Diverse Values (B2 G3)	Make Customizable Program Criteria (B2 I3)	**Low to Moderate Cost**: Surveys (Pre/Post & Comparison of Program Options) (B2 E3a)
		Medium Cost: Persistence Assessments (Panel or Follow-Up Surveys) (B2 E3b)
		Low to Medium Cost: Literature Review (B2 E3c)

Barrier (B3): Time, Labor, Equipment, and Information Constraints		
Strategy	Implementation	Evaluate Outcomes of interventions
Experienced workforce (B3 G1)	Promote stable workforce and technical capacity development (B3 I1)	**Low Cost**: HR Data Reviews (B3 E1a)
		Low to Medium Cost: Literature Review (B3 E1b)
		Medium Cost: Survey Staff (B3 E1c)
Access to equipment, technology, and financial support (B3 G2)	Create conservation technology and equipment hubs and/or bundled cost-share programs (B3 I2)	**Low to Medium Cost**: Surveys/ Feedback Forms (B3 E2a)
		Medium Cost: Remote Sensing and Admin Data Review (B3 E2b)
		Medium to High Cost: Agronomic and Economic Impact Assessments (B3 E2c)
Streamlined technical assistance and program navigation tools (B3 G3)	Establish a coordinated method for delivering conservation support (B3 I3)	**Low to Moderate Cost**: Web Scraping and Inventory (B3 E3a)
		Medium Cost: User Experience Surveys and Focus Groups (B3 E3b)
		Medium Cost: Synthetic Review/Multi-Stakeholder Evaluation: (B3 E3c)

Barrier (B4): Risk Aversion and Safety Net Mindset		
Strategy	Implementation	Evaluate Outcomes of interventions
Overcome misperceptions about risk (B4 G1)	Create targeted outreach efforts, accessible tools, and reframed incentive structures to correct misconceptions (B4 I1)	**Low to Medium Cost**: Web Scraping (B4 E1a)
		Medium to High Cost: Pre- and Post-Surveys with Control Group (B4 E1b)
		Medium to High Cost: Qualitative Interviews and Focus Groups (B4 E1c)
Remove barriers for risk-averse farmers (B4 G2)	Structure programs to retain farmer participation and attract risk-adverse farmers (B4 I2)	**Low Cost**: Literature Review of Program Structures and Incentives (B4 E2a)
		Low to Medium Cost: Targeted Surveys on Participation and Retention (B4 E2b)
		Medium to High Cost: Qualitative Interviews and Focus Groups (B4 E2c)

Barrier (B5): Inflexibility and Lack of Customization		
Strategy	Implementation	Evaluate Outcomes of interventions
Flexible programs that accommodate variability, allowing for mix / match practice adoption (B5 G1)	Enable flexible, tailored designs and reform payment structures (B5 I1)	**Low to Medium Cost**: Remote Sensing & Secondary Data Analysis (B5 E1a)
		Medium Cost: Qualitative Interviews & Focus Groups (B5 E1b)
		Medium Cost: Surveys with Pre- and Post-Participation Evaluation (B5 E1c)
Program alignment and stackability (B5 G2)	Improve administrative flexibility (B5 I2)	**Low to Medium Cost**: Web Scraping & Literature Review (B5 E2a)
		Medium Cost: Focus Groups (B5 E2b)
		Medium to High Cost: Targeted Interviews and Persistence Assessment(B5 E2c)

Barrier (B6): Perception and Belief in Practice Benefits		
Strategy	Implementation	Evaluate Outcomes of interventions
Strengthened farmer conservation identity (B6 G1)	Build conservation identity and encourage peer leadership (B6 I1)	**Low Cost**: Case Study (B6 E1a)
		Medium Cost: Surveys (B6 E1b)
		Medium to High Cost: Longitudinal Focus Groups (B6 E1c)
Improved trust in practice efficacy (B6 G2)	Develop visible, credible feedback mechanisms (B6 I2)	**Low to Medium Cost**: Feedback form assessments (B6 E2a)
		Medium Cost: Qualitative Interviews (B6 E2b)
Increased awareness of collective responsibility (B6 G3)	Normalized shared responsibility through communication, education, and engagement across silos (B6 I3)	**Low Cost**: Outreach Material Review (B6 E3a)
		Low to Medium Cost: Literature Reviews (B6 E3b)
		Low to Medium Cost: Surveys (B6 E3c)

Barrier (B7): Economic Incentives and Financial Constraints		
Strategy	Implementation	Evaluate Outcomes of interventions
Long-term, flexible funding programs (B7 G1)	Multi-year one-on-one advisor support (B7 I1a)	**Low Cost**: Participant Surveys (B7 E1a-a)
		Moderate Cost: Qualitative Post-Program Interviews (B7 E1a-b)
	Long-term, facilitated, farmer-led peer networks (B7 I1b)	**Moderate Cost**: Surveys (B7 E1b-a)
		Moderate-High Cost: Biannual Panel Survey & Social Network Analysis (B7 E1b-b)
		Moderate/High Cost: Qualitative Retrospective Study (B7 E1b-c)
Incentives and risk-sharing to offset costs and risks (B7 G2)	Long-term, flexible performance-based incentives (B7 I2)	**Low Cost:** Pre- and Post-Practice Implementation Survey (B7 E2a)
		Moderate/High Cost: Remote Sensing and Field Audit Assessment (B7 E2b)

Barrier (B8): Distrust of Government and Regulations		
Strategy	Implementation	Evaluate Outcomes of interventions
Enhanced Trust Through Farmer-Led and Peer-Based Outreach (B8 G1)	peer-to-peer learning groups and local "champion" networks (B8 I1)	**Low Cost**: Short, focused participant post meeting surveys (B8 E1)
		Low - Medium Cost: Behavioral and administrative data tracking (B8 E2)
Program Transparency and Farmer Control in Design and Delivery (B8 G2)	advisory councils and collaborative program design (B8 I2)	**Medium Cost**: Qualitative Interviews and Focus Groups (B8 E3)

Barrier (B9): Administrative Burden and Program Complexity		
Strategy	Implementation	Evaluate Outcomes of interventions
Simplified and streamlined administrative requirements (B9 G1)	Multi-actor Technology Development Approach: "one-stop-shop" online portal/app (B9 I1)	**Low to Medium Cost**: Structured usability tests (B9 E1a)
		Medium Cost: User Surveys (B9 E1b)
		Medium Cost: Focus Groups (B9 E1c)
Enhanced Support and Navigation for Farmers (B9 G2)	One-on-one Consulting with Trusted Advisors (B9 I2)	**Low Cost**: Behavioral Tracking (B9 E2a):
		Medium Cost: Pre-post surveys (B9 E2b)
		Medium - High Cost: Qualitative Interviews (B9 E2c)
Improved Transparency, Communication, and Feedback Loops (B9 G3)	Transform communication materials and processes to reduce ambiguity and invite ongoing feedback (B9 I3)	**Low-Medium Cost**: User Feedback Form (B9 E3a)
		Medium Cost: Focus Groups and Interviews(B9 E3b)
		Medium Cost: Pre-post Survey (B9 E3c)

Barrier (B10): Unsettled Science and Data Gaps		
Strategy	Implementation	Evaluate Outcomes of interventions
Develop a multi-decadal water quality and agronomic dataset to detect change (B10 G1)	Expand long-term (decadal), coordinated data collection and monitoring (B10 I1)	**Low Cost**: Web Scraping (B10 E1a)
		Low Cost: Literature Review (B10 E1b)
Improve confidence in practice selection and effectiveness (B10 G2)	Co-create and co-manage on-farm experiments with farmers (B10 I2a)	**Medium Cost**: Remote Sensing (B10 E2a)
	Develop transparent, farmer-focused risk communication tools (B10 I2b)	**High Cost**: Mixed-Methods Qualitative Case Studies and Focus Groups (B10 E2b)

8) Managing Survey Data

Consider using **SIDMA/SIPES**:

- SIPES is a framework developed for measuring social indicators (awareness, attitudes, behaviors, values, constraints, capacity) tied to non-point source (NPS) water pollution projects
    - Provides standardized questionnaires, protocols for pre- and post-project measurement, and core vs. supplemental indicators
- SIDMA is a web-based tool that supports the SIPES process: building/adapting surveys, data entry, data storage, basic statistical analysis, visualizations, comparison of survey rounds (pre vs post), exporting data
    - Includes a bank of questions to choose from

- Software for survey data collection and analysis
    - Google Forms
    - Qualtrics Surveys and Results
    - Microsoft Forms
    - SPSS

- **Book resources:**
    - Brinkerhoff, R. O. (2003). The Success Case Method: Find Out Quickly What's Working and What's Not. Berrett-Koehler.
        - Evaluation technique that is easier, faster, and cheaper than competing approaches, and produces compelling evidence decision-makers can actually use.
    - Patton, M. Q. (2015). Qualitative Research and Program Evaluation. (4th ed.) SAGE.
        - Qualitative research and evaluation methods, inquiry frameworks, and analysis options available today
    - Patton, M. Q. (2022). Utilization-Focused Evaluation. (5th ed.) SAGE.
        - Detailed advice on conducting evaluations that promote effective use of the findings
    - Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method. Wiley.
        - Good for survey design, reducing bias, modes of administration
    - Groves, R. M., et al. (2009). Survey Methodology. (2nd ed.). Wiley.
        - Text on sampling, non-response, measurement error
    - Fowler, F. J. Jr. (2014). Survey Research Methods. (5th ed.). SAGE.
        - Covers question wording, pilot testing, ethics, respondent burden

- Fowler, F. J. Jr. (1995). Improving Survey Questions: Design and Evaluation (Applied Social Research Methods). SAGE
    - How to word and format a question, write questions that will evoke the kind of answers for which they were designed, and empirically evaluate survey questions

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Appendix A: Program Design and Evaluation Methods

Barrier: Structural/Systemic Constraints (B1)

Description from the Research:

- Current markets, infrastructure, technology, and policies create path dependency around the production of simplified corn-based cropping systems in the Upper Midwest, limiting farmers' willingness and ability to diversify (Roesch-McNally, 2018)

WLEB Specific Constraints:

- Lack of centralized, basin-wide coordination; each state pursues its own approach, hoping results add up to meet targets.
- Natural Resources Conservation Services (NRCS) technical assistance delivery not functioning as it could; limited collaboration across agencies and jurisdictions.
- Insufficient reliance on public/private partnerships to supplement staff and expertise (e.g., conservation agronomists).

Examples related to short term/initial adoption:

- Limited upfront incentives make it difficult for farmers to offset transition costs or risk experimenting with new practices
- Insufficient early-stage technical assistance
- Lack of demonstration projects or visible peer success stories decreases early confidence and perceived feasibility
- Administrative complexity in navigating multiple agencies and cost-share options

Examples related to long term/continued adoption:

- Expiration of short-term cost-share programs leads to disadoption once incentives end
- Inconsistent long-term funding and shifting policy priorities decrease stability and trust among producers
- High staff turnover, weak coordination between agencies reduce continuity of technical assistance
- Programs remain siloed, preventing landscape-scale or basin-wide progress.

- Without sustained engagement and durable market or policy incentives, adoption remains isolated rather than systemic

Strategy:

1. Incentives and Support to Enable Diversification: Realign financial and institutional incentives to support and reward diverse, conservation-oriented practices (B1 G1)
2. Robust, Cross-Jurisdictional Coordination: Foster centralized, basin-wide planning and implementation to break down silos between agencies and states (B1 G2)
3. Public-Private Partnerships for Capacity and Innovation: Expand and diversify funding, expertise, and delivery networks by actively involving private-sector and nonprofit partners (B1 G3)

Implementation:

1. Provide funding, equipment, and technical assistance to implement more complex crop rotations and conservation practices (B1 I1)
    a. Set up an insurance structure to reward growers who experiment with conservation
    b. Directly fund equipment and technical assistance for farmers shifting to diversified systems
2. Increase collaboration between federal, state, and county technical assistance delivery staff (B1 I2)
    a. Create/support regional task force representing all partners
    b. Standardize practices for data collection and sharing across state lines in the WLEB
    c. Facilitate joint training events for everyone providing technical assistance in the WLEB
3. Develop a public-private partnership to fund and staff new conservation programs (B1 I3)
    a. Pilot private-sector agronomy advisors deployed alongside NRCS staff
    b. Seek support and co-investment from food processors, retailers, and environmental organizations to scale up outreach and incentives
    c. Offer shared grants for collaborative projects between farm groups, companies, and agencies

Evaluate outcomes:

Implementation # 1

- **Low Cost:** Literature Review: Synthesizes best practices, lessons learned, and cost-share program effectiveness in similar contexts. Can guide design and tweak Michigan's incentive programs based on peer-reviewed and gray literature.
    - *Who can do this:* university students, state agency analysts
    - *Skills required:* research and synthesis skills (B1 E1a)

- **Medium Cost:** Pre/Post Participation Surveys (with quasi-experimental or control group designs): Directly measure changes in farmer behavior, motivation, and attitudes before and after receiving funding/support; can identify if and why incentives shift management choices.
    - *Who can do this:* graduate students[1], research firms
    - *Skills required:* survey design, data analysis, statistics (B1 E1b)

- **Medium Cost:** Remote Sensing Combined with Administrative Data: Objectively assesses landscape-level changes in crop diversity, cover cropping, or tillage practices before and after program implementation in supported vs. non-supported counties/areas.
    - *Who can do this:* Anyone with coding/GIS skills
    - *Information Required:* publicly available data for state/county, purchased data for finer scale (B1 E1c)

Implementation # 2

- **Low Cost:** Web Scraping/Program Inventory: Maps who is offering technical assistance, what kinds of programs exist, and identifies gaps, overlaps, or redundancies in service delivery. Useful for benchmarking improved coordination.
    - *Who can do this:* undergraduate or graduate students
    - *Skills required:* basic Python/web data collection skills (B1 E2a)

- **Medium Cost:** Qualitative Interviews with Key Staff: In-depth interviews with agency or extension staff at multiple levels to reveal barriers to coordination, perceptions of effectiveness, and suggestions for improvement. Identifies where implementation deviates from plans.
    - *Who can do this:* university-based researchers, independent evaluators
    - *Skills required*: qualitative interview/conversational skills, thematic analysis (B1 E2b)

- **High Cost:** Synthetic Reviews/Annual Multi-stakeholder Meetings: Organizes annual reviews with partners to assess progress, address bottlenecks, and

[1] Graduate students must be mentored by a principal investigator at a university.

document process outcomes, using evaluation data and stakeholder experiences to enhance buy-in and adaptive management.
    - *Who can do this:* researchers, extension staff, agency program managers
    - *Skills required:* facilitation, synthesis, reporting (B1 E2c)

Implementation # 3

- **Medium Cost:** Focus Groups (with private sector, agency, and farmer participants): Facilitates small-group discussions to surface diverse perspectives on partnership effectiveness, emerging needs, and unintended outcomes. Helps adapt partnership models to maximize participation and reach.
    - *Who can do this:* trained facilitators from universities, non-profits, state agency staff
    - *Skills required:* group facilitation, qualitative research design, thematic analysis (B1 E3a)

- **Medium to High Cost:** Agronomic and Economic Impact Assessments: Directly measures on-the-ground outcomes (yield, profitability, risk reduction) and whether public-private involvement leads to successful, durable BMP adoption or co-benefits.
    - *Who can do this:* social scientists, agronomists, university researchers
    - *Skills required:* survey development, field data collection, economic/agronomic analysis (B1 E3b)

- **High Cost:** Tracking Behavioral Changes/Longitudinal Surveys: Conducts repeated random-sample or panel surveys to track changes in knowledge, adoption, and persistence among farmers engaged by public-private partnerships. Captures trends, program reach, and behavioral impacts over time.
    - *Who can do this:* social science researchers, university/state research staff, survey firms
    - *Skills required:* survey design and administration, longitudinal data analysis, social statistics (B1 E3c)

Barrier: Value Alignment and Program Mismatch (B2)

Description from the Research:

- Conservation programs often fail to align with farmers' values, which can hinder participation. Mis-alignment can occur if programs “promote monetary benefits over locally salient stewardship values.” Aligning can look like framing ecosystem services as a product that farmers produce and could be proud of to align with

productionist values (Chapman et al. 2019). Examples of misalignment consequences include:
    - lack of flexibility / personalization limits the perceived agency of farmers (Chapman et al. 2019)
    - ‘No-touch’ (meaning no ag activities in that zone) requirements for buffers and other conservation installments can conflict with farmer values of active management and keeping a tidy landscape (Chapman et al. 2019)
- Combined with administrative difficulties, these issues can contribute to “voluntary program bias” in which voluntary programs only attract conservation-minded producers and fail to secure participation from non-adopters (Stuart et al. 2014). Michigan Agriculture, Environmental Assurance Program (MAEAP) certification provides an example of this: the program has often served as a symbolic act for conservation-minded stewards rather than a tool to engage skeptical producers.
- Community and peer norms are critical factors of adoption: participating is much less likely in areas where few farmers adopt BMPs (Baumgart-Getz et al. 2012, Bressler et al. 2021).

WLEB Specific Constraints:

- Federal program priorities (EQIP ranking/screening) often misaligned with local priorities—limited partner input.
- Federal programs focus on one-off BMPs due to funding design, lacking support for integrated, systems-based conservation.
- Practices may be targeted incorrectly (e.g., in-field practices for operators, permanent practices for landowners), with limited mechanism for tailored recruitment.

Application to short term/initial adoption:

- Conservation programs often emphasize environmental compliance over producer-driven values like profitability/autonomy
- Rigid, prescriptive requirements, like no-touch buffers, conflict with cultural norms of active land management
- Messaging that fails to connect with local identity or stewardship traditions limits buy-in

Application to long term/continued adoption:

- Programs that remain inflexible lose relevance

- Lack of ongoing communication or co-design opportunities decreases ownership and motivation to continue
- Lacking peer adoption prevents normalization of conservation practices within local communities
- Without mechanisms to reinforce pride, stewardship, or productivity benefits, long-term adoption decreases once incentives fade

Strategies:

1. Recognize diverse conservation motivations and value systems in your community (B2 G1)
2. Adapt programs to match with farmer values (B2 G2)
3. Create flexible programs to appeal to a range of value systems (B2 G3)

Implementation:

1. Conduct value mapping to identify value systems in your community (B2 I1)
    a. Organize participatory workshops or peer groups where farmers discuss what conservation means to them, their motivations for stewardship, and their perceptions of different practices.
    b. Conduct “values sorting” exercises (e.g., asking what they most value about their land: productivity, family legacy, environmental stewardship, economic security, etc.).
    c. Conduct structured interviews or “listening tours” with a variety of producers (early adopters to skeptics) to uncover deeper value systems and perceived barriers.
2. Co-design programs with farmers seeking iterative feedback (B2 I2)
    a. Establish a farmer advisory board or co-design committee that meets throughout the program lifecycle—reviewing draft guidelines, messaging, eligibility criteria, and incentive structures.
    b. Hold joint field days or on-farm trials where program tweaks are tested and evaluated together.
    c. For programs involving technology adoption or precision ag practices, bring together farmers, advisors, scientists, and tech developers from the earliest stages. Involve them in decision-support tool design or BMP toolkits to promote buy-in.
    d. Run iterative webinars, online feedback forms, and periodic field days where farmers can review and comment on program updates, guidelines, or tools.

3. Provide customizable options within program criteria to allow more individuals to feel comfortable participating (B2 I3)
    a. Provide one-on-one technical assistance where trusted advisors tailor program requirements to individual farm operations.
    b. Use personalized communication to present flexible program pathways. Highlight stories/testimonials from farmers who have customized their adoption path, reinforcing that the program welcomes adaptation to different production systems and value sets. Employ “nudge” strategies, such as letting farmers compare their progress to peers but in a supportive, non-coercive way.
    c. Develop conservation program frameworks that describe a range of acceptable BMPs or practice bundles, rather than prescriptive one-size-fits-all requirements. Include “pick-and-mix” options, alternative compliance pathways, or locally-tailored incentives. Enable passing on certain program elements when justified and offer alternatives.

Evaluate outcomes:

Implementation # 1
Low to Medium Cost: Qualitative Interviews: In-depth, one-on-one interviews with farmers and local stakeholders can help program managers understand the diverse motivations, stewardship values, and perspectives that underpin adoption or resistance to conservation.

Who can do this: University-based researchers, Extension staff, independent evaluators
Skills required: Interview design, coding, thematic analysis, local agricultural knowledge (B2 E1a)

Low to Medium Cost: Surveys with Value/Attitude Scales: Surveys developed with attitudinal/value-based questions (e.g., stewardship, pride in land, productivity beliefs) can map the prevalence of different value systems among the population.

Who can do this: Graduate students, research firms, agency staff
Skills required: Survey design, data analysis, statistics (B2 E1b)

Medium Cost: Focus Groups: Group discussions bring together a cross-section of farmers to openly discuss their conservation values, stewardship beliefs, and what motivates action. Also surfaces local language and salient metaphors.

Who can do this: Trained facilitators, Extension, non-profits
Skills required: Group facilitation, qualitative methods, agricultural context (B2 E1c)

Implementation # 2

Low to Medium Cost: Focus Groups: Iterative focus groups with farmer-participants at each stage of program development ensure continuous alignment and promote adaptive management of program structure, messaging, and delivery.

- *Who can do this:* Trained facilitators, Extension, state staff, consultants
- *Skills required:* Facilitation, qualitative analysis, agricultural context (B2 E2a)

Medium Cost: Specific Program Assessments (customized feedback forms, mini-surveys post-enrollment or post-pilot): Brief, targeted surveys or feedback instruments after participation easily capture farmer satisfaction, sense of agency, and value alignment with program modifications made through co-design.

- *Who can do this:* Graduate students, research staff
- *Skills required:* Survey design, basic data analysis (B2 E2b)

Medium Cost: Qualitative Interviews/Post-Implementation Interviews: Post-implementation interviews capture participant experiences, perceived value-alignment, and recommendations for further adaptation. This method also uncovers unintended outcomes.

- *Who can do this:* University-based researchers, Extension, independent evaluators
- *Skills required:* Interviewing, thematic analysis, context knowledge (B2 E2c)

Implementation # 3

Low to Moderate Cost: Surveys (Pre/Post & Comparison of Program Options): Gauge which options are most and least attractive to farmers, track changes in participation among diverse value groups, and measure persistence of participation with flexible programming.

- *Who can do this:* Graduate students, agency staff, social science researchers
- *Skills required:* Survey development, data analysis, statistics (B2 E3a)

Medium Cost: Persistence Assessments (Panel or Follow-Up Surveys): Track whether farmers who participated in customizable/flexible programs remain engaged longer or disadopt less often, relative to those in less flexible programs.

- *Who can do this:* Social scientists at universities, agencies
- *Skills required:* Survey panel management, longitudinal analysis, data management (B2 E3b)

Low to Medium Cost: Literature Review: Systematic review of flexibility in conservation program design can identify best practices, unintended consequences, and design elements that improve participation across value systems; helps inform further adaptation.

- *Who can do this:* University students, agency analysts
- *Skills required:* Synthesis of research, familiarity with programs and cultural context (B2 E3c)

Barrier: Time, Labor, Equipment, and Information Constraints (B3)

Description from the Research:

- Producers often face labor and time constraints, and the added time and labor mandated by program participation may not align with producers' seasonal calendars (Guo et al. 2023, Bressler et al. 2021).
- Per acreage payments and expensive equipment costs are barriers to smaller operations and those without adequate access to equipment that may make these producers less likely to adopt nutrient BMPs (Ulrich-Schad et al. 2017).
- Barriers to adoption of 4R include perceived efficacy and structural barriers including a lack of equipment access, lack of time, and potential uncertainty in weather forecast (Zhang et al. 2016).
- Programs and BMPs can often be information intensive (Ulrich-Schad et al. 2017)

WLEB Specific Constraints:

- Staffing resources are insufficient to meet technical assistance requests from landowners.
- Producers lack access to affordable technology and equipment to improve nutrient precision.
- Farmers face challenges navigating multiple programs/funding sources, unsure of where to go for support.

Application to short term/initial adoption:

- Labor is always an issue when implementing more complex practices

- Upfront equipment costs

Application to long term/continued adoption:

- Labor continues to make continued adoption of annual practices such as cover crops or diverse crop rotations difficult
- Annual data collection and reporting can discourage participation long-term

Strategies:

1. Experienced workforce with low turnover and high technical assistance capacity (B3 G1)
2. Increased access to equipment, technology, and financial aid (B3 G2)
3. Streamlined technical assistance and program navigation tools (B3 G2)

Implementation:

1. Promote stable workforce and technical capacity development (B3 I1)
    a. Advocate for sustained funding beyond 1-3 years at a time to increase the number of conservation/agronomic advisors
    b. Support internship/apprenticeship programs to build a pipeline of technical staff
    c. Develop a structured, region-wide program to train experienced farmers, crop consultants, and early adopters as “champions” or mentors in conservation practices. This leverages highly trusted community messengers, while providing opportunities for ongoing professional and skills development.
2. Create conservation technology and equipment hubs and bundled cost-share programs (B3 I2)
    a. Local or regional cooperative including farmers, private sector, universities, and ag consultants that pools resources to give producers affordable access to precision ag equipment, conservation seeders, and other emerging technology.
    b. Pair funds for implementing conservation practices with access to appropriate technical assistance, equipment rentals, and hands-on skill-building sessions.
3. Establish a coordinated method for delivering conservation support (B3 I3)
    a. Develop an online navigation hub with MSU Extension, U of M Water Center, NRCS, Michigan Association of Conservation Districts (MACD),

TNC, NWF, Ducks Unlimited, Pheasants Forever, watershed councils, and other local conservation organizations.

b. Supplement digital offerings with printed materials for under-connected producers and in-person funding and resource navigation events.
c. Standardize messaging through a cross-organizational training to keep all staff up-to-date.

Evaluate outcomes:

Implementation # 1

Low Cost: Persistence Assessments/HR Data Reviews: Analyze HR or organizational data to track retention rates, staff turnover, advancement to higher-skilled roles, and coverage of technical assistance needs over time

- *Who can do this:* HR staff, program administrators with analytics support
- *Skills required:* Data analysis, familiarity with HR information systems, basic statistics (B3 E1a)

Low to Medium Cost: Literature Review: Systematically search and synthesize existing research and program evaluations to identify best practices for technical advisor retention, effective mentorship, and workforce development.

- *Who can do this:* University students, agency analysts, independent consultants
- *Skills required:* Academic research, literature synthesis, knowledge of conservation workforce issues (B3 E1b)

Medium Cost: Tracking Behavioral Changes/Surveys of Technical Staff: Conduct annual surveys with technical advisors and program staff to assess job satisfaction, retention, perceived support, professional development needs, and impacts of mentorship.

- *Who can do this:* University researchers, Extension HR, or third-party evaluators
- *Skills required:* Survey design, questionnaire development, data analysis, workforce context (B3 E1c)

Implementation # 2

Low to Medium Cost: Specific Program Assessments: Implement targeted short surveys and feedback forms for participants of equipment hubs or cost-share programs to assess usage rates, satisfaction, barriers to access, and perceived impact.

- *Who can do this:* Graduate students, cooperative partners, Extension staff
- *Skills required:* Survey design, data collection, descriptive analysis (B3 E2a)

Medium Cost: Remote Sensing & Administrative Data Review: Use satellite data, conservation program records, and GIS to track adoption of precision equipment and conservation practices where access/equipment hubs are available, and compare to regions without such programs.

- *Who can do this:* Staff or students with GIS/coding skills
- *Skills required:* GIS analysis, coding, interpretation of remotely sensed and admin data (B3 E2b)

Medium to High Cost: Agronomic and Economic Impact Assessment: Evaluate the impact of equipment access and bundled programs on yield, input costs, labor/time savings, and rates of BMP adoption.

- *Who can do this:* University or agency economists/agronomists
- *Skills required:* Economic analysis, field data collection, agronomy expertise (B3 E2c)

Implementation # 3

Low to Medium Cost: Web Scraping and Program Inventory: Systematically gather data on available technical assistance programs and navigation tools, mapping who offers what, accessibility, and information clarity.

- *Who can do this:* Undergraduate or graduate students with Python/data skills
- *Skills required:* Basic web scraping coding, data curation, digital literacy (B3 E3a)

Medium Cost: User Experience (UX) Surveys & Focus Groups: Conduct surveys and group discussions with producers to capture feedback on ease of navigating the online hub, accessibility of information, and satisfaction with in-person or printed support.

- *Who can do this:* Survey specialists, Extension staff, nonprofit partners
- *Skills required:* Survey/focus group design, qualitative analysis, agricultural context (B3 E3b)

Medium Cost: Synthetic Review/Annual Multi-Stakeholder Evaluation: Hold regular review sessions with program partners and stakeholders using quantitative and qualitative data to assess success, identify gaps, and coordinate improvements across organizations.

- *Who can do this:* Program leads, evaluators, advisory board members
- *Skills required:* Facilitation, reporting, quantitative and qualitative synthesis (B3 E3c)

Barrier: Risk Aversion and Safety Net Mindset (B4)

Description from the Research:

- Risk aversion - producers often follow a “safety net” mindset (Chai et al. 2023)
    - Farmers may over-apply fertilizer as a “risk-reducing” strategy; this is a common misconception which does not reflect economic findings demonstrating that the relationship between fertilizer application and profit is relatively flat near the economic optimum. This means that farmers can actually reduce their fertilizer use significantly without suffering profit loss.

WLEB Specific Constraints:

- Many producers are hesitant to implement new practices due to fear of sacrificing yield or profit.
- Rented land and short-term contracts discourage long-term conservation investments.
- Perception that manure/nutrient management changes are risky without guaranteed financial or technical backup.

Application to short term/initial adoption:

- Perceptions of new nutrient management practices as financially risky - yield loss
- Over-application of fertilizer is viewed as a “safety net,” making it difficult to convince farmers that optimization does not hurt profits
- Rented land and short-term lease agreements discourage tenants from making multi-year conservation investments
- Limited availability of simple, low-barrier pilot programs prevents risk-averse farmers from experimenting

Application to long term/continued adoption:

- Farmers may revert to prior practices if risk perceptions are not continually addressed or reinforced through trusted data
- Expiration of short-term incentives or pilot programs can lead to discontinuation once safety nets disappear
- Tenant farmers remain constrained by unstable leasing arrangements that hurt multi-year planning
- Need risk-sharing frameworks and consistent, trust-based communication reinforcing long-term profitability and stability

Strategies:

1. Overcome misconceptions about risk: Increase Farmer Confidence and Willingness to Adopt Nutrient-Management Practices by Reducing Perceived Risk (B4 G1)
2. Restructure Program Incentives and Participation Models to Remove Barriers for Risk-Averse and Tenant Farmers (B4 G2)

Implementations:

1. Targeted outreach efforts, accessible tools, and reframed incentive structures to correct misconceptions (B4 I1)
    a. Message framing centered around legacy and risk aversion: emotional appeal communication centered around identity, loss, and/or community;
        i. Generate and promote educational and outreach materials to clearly explain that over-application of fertilizer does not significantly increase yield or profits and that excessive fertilizer can actually increase risk to farmers and their land. Messages should be framed to appeal to farmer ties to land and identity/role.
        ii. Education and outreach materials should reframe the conversation around fertilizer reduction to “increasing profits” rather than “cutting back.” Shift environmental protection/stewardship narratives to focus instead on higher profit margins due to reduced input costs.
    b. Utilize local demonstration farms to convey side-by-side comparisons of fields with excessive application versus optimal application; this can help provide concrete evidence that over-application does not provide a safety net against poor yield.
    c. Leverage local farmers testimonials to share their specific experiences of reducing fertilizer application without increasing risk.
    d. Provide accessible, simple decision-support tools (like apps or other digital tools) for farmers to learn the optimal fertilizer application rates for their specific practices and see the minimal impact reducing application will have on profits.
2. Structure programs to retain farmer participation and attract risk-adverse farmers (B4 I2)
    a. Default enrollment and opt-out models - program participation is framed as a “safety net;” this means that farmers have to actively “opt out” to apply higher rates of fertilizer, making the optimum the default

b. Default inclusion in pilot trials, nutrient audits, or low barrier/risk trials all maintaining the option to deliberately exit the program
c. Structure programs to focus on small, easy steps that are less intimidating- promote smaller reductions in application initially, highlighting that it poses no financial risk, to pull risk adverse farmers
d. Link programs to fertilizer optimization rather than just practice implementation to help farmers achieve measurable nutrient reductions that also favor them financially
e. For rented farmland, encourage multi-year contracts as opposed to informal or annual contracts, which will boost tenants' confidence that they will farm the land long enough to see a good return on their investment for implementing practices. The incorporation of conservation practices into contracts can provide an opportunity for the two parties to review and revise contracts.

Evaluate outcomes:

Implementation # 1
Low to Medium Cost: Web Scraping and Communication Analysis: Scrape online sources (agricultural websites, social media, newsletters) to inventory the spread and framing of fertilizer-related outreach, uptake and promotion of educational tools, testimonials, and messaging strategies; benchmark against external practices.

- *Who can do this:* Undergraduate or graduate students with Python/data analysis skills
- *Skills required:* Basic Python/web scraping, digital content analysis, data curation (B4 E1a)

Medium - High Cost: Pre- and Post-Surveys with Control Group: Conduct baseline and follow-up surveys with both intervention participants and a control group to measure changes in farmer knowledge, attitudes, and fertilizer application behaviors, as well as recall and perception of educational messages, demonstration sites, and decision-support tools.

- *Who can do this:* Graduate students, university researchers, or evaluation staff familiar with survey methods
- *Skills required:* Survey design, data collection, basic statistics or econometrics, and an understanding of agricultural contexts (B4 E1b)

Medium - High Cost: Qualitative Interviews and Focus Groups: Conduct in-depth interviews and small group discussions with participating and non-participating farmers to understand how targeted messaging, reframed incentives, and tools influenced

decisions, surface barriers, and evaluate narrative resonance around profit, legacy, and risk.

- *Who can do this:* University-based researchers, Extension staff, trained evaluators, or graduate students with qualitative research experience
- *Skills required:* Interview/focus group facilitation, qualitative research methods, knowledge of agriculture and BMPs, qualitative coding/analysis (B4 E1c)

Implementation # 2

Low Cost: Literature Review of Program Structures and Incentives: Systematically review academic, technical, and government literature to identify best practices and past results regarding default enrollment, risk-reduction framing (opt-out models), pilot participation, and conservation leasing strategies. Extract lessons on optimum contract lengths, small-step behavioral nudges, and approaches for engaging risk-adverse or tenant farmers.

- *Who can do this:* University students, state agency evaluation specialists, or independent consultants
- *Skills required:* Literature search and synthesis, BMP/program knowledge, citation management, critical appraisal of evidence (B4 E2a)

Low to Medium Cost: Targeted Surveys on Participation and Retention: Develop and administer brief baseline, interim, and/or follow-up surveys targeting farmers in default-enrolled or opt-out programs, as well as those in pilot trials and multi-year contracts. Track program retention, ease-of-enrollment, risk perceptions, and satisfaction with stepwise participation or contract changes. Include targeted questions for both participating and non-participating (opt-out) farmers to inform refinement.

- *Who can do this:* Graduate students, university researchers, extension specialists, or survey research firms
- *Skills required:* Survey design, understanding of ag program design, data management and statistical analysis (B4 E2b)

Medium to High Cost: Qualitative Interviews and Focus Groups on Opt-Out Models and Contract Experiences: Conduct one-on-one interviews and small-group discussions with farmers in default-enrollment programs, pilot trials, and those on rented land with conservation contracts. Elicit detailed feedback on comfort with default options, perceived barriers, participation drivers, and contract experiences. Focus on understanding the perspectives of risk-averse farmers and tenants faced with multi-year agreements.

- *Who can do this:* University-based researchers, trained extension staff, or social scientists with agricultural experience

- *Skills required:* Qualitative interviewing/focus group facilitation, familiarity with conservation contracts/programs, qualitative coding/analysis (B4 E2c)

Barrier: Inflexibility and Lack of Customization (B5)

Description from the Research:

- Program complexity or inflexibility can lead to confusion and decreased participation (Palm-Forster et al. 2017, Espenshade et al. 2022, Stuart et al. 2014, Luther et al. 2020) Inflexibility can look like prescriptive BMP plans that lack room for customization, rigid timelines that don't align with the seasons, "all-or-nothing" contracts, verification systems that don't consider field and situational context, and uniform payment structures that don't consider field variation.
- Enrollment in other programs may bar producers from enrolling and participating in new programs- whether or not they can stack credits or payments is often unclear (Vegh and Murray 2020).

WLEB Specific Constraints:

- Federal conservation program requirements offer little room for tailoring to local agronomic or hydrologic conditions.
- Inability to contract out for engineering design work for tailored practice solutions.
- Limited flexibility to implement innovative approaches due to rigid permitting/regulatory constraints.

Application to short term/initial adoption:

- Rigid program requirements and "all-or-nothing" contracts deter participation from farmers needing tailored solutions.
- Prescriptive BMPs that do not account for local field, weather, or equipment conditions create confusion and perceived infeasibility.
- Uniform payment structures reduce appeal for diverse operations with varying costs and risk profiles.
- Inability to stack payments or participate in multiple programs discourages early interest.
- Slow or restrictive approval processes delay implementation, especially during key planting or harvest windows

Application to long term/continued adoption:

- Farmers may abandon practices if programs fail to accommodate operational changes, crop rotations, or shifting market conditions
- Inflexible verification and reporting systems lead to administrative fatigue
- Sustainable, long-term adoption depends on flexible frameworks that reward adaptation and continuous improvement rather than rigid compliance

Strategies:

1. Flexible programs that accommodate farm and field variability, allowing for mix / match practice adoption instead of all or nothing packages (B5 G1)
2. Program alignment and stackability across multiple initiatives (B5 G2)

Implementation:

1. Enable flexible, tailored designs and reform payment structures (B5 I1)
    a. Use modular options to allow farmers to adopt practices incrementally or in combinations tailored to their operations
    b. Develop adaptive contracting frameworks that allowed for adjustments when poor weather conditions, cropping systems, or market shifts occur
    c. Instead of flat-rate payments, develop outcome-based or field-sensitive payment systems- for example, systems linked to risk reduction, field vulnerability, or practice performance
2. Improve administrative flexibility (B5 I2)
    a. Provide clear guidance on stacking payments across initiatives
    b. Work across agencies / policy stakeholders to harmonize requirements across different WLEB programs
    c. Implement safety measures for new adopters so that those testing customized approaches are not penalized if early outcomes fall short of expectations

Evaluate outcomes:

Implementation # 1
Low - Medium: Remote Sensing & Secondary Data Analysis of Practice Adoption and Payment Effectiveness: Analyze remotely sensed data and secondary datasets (e.g., payment records, field-level practice adoption, weather events) across pilot and non-participating areas to compare rates/patterns of incremental and modular BMP adoption

under redesigned payment frameworks (flat-rate vs. outcome-based). Assess correlations between payment type, field vulnerability, and adoption outcomes.

- *Who can do this:* Graduate students with skills in GIS/data analysis, state agency analysts
- *Skills required:* Basic GIS, statistical analysis, working with large datasets, knowledge of BMPs, familiarity with payment program structures (B5 E1a)

Medium - Qualitative Interviews & Focus Groups: Conduct interviews and/or small focus groups (in-person or phone) with farmers in pilot/adaptive payment programs to elicit experiences with modular options and incremental adoption, perceived fairness/flexibility of new contracts, reactions to field-sensitive/outcome-based payments, specific adaptations made due to weather/market/cropping shifts, and challenges encountered or suggestions for improvement.

- *Who can do this:*University extension staff, agricultural social scientists, trained independent evaluators
- *Skills required*: Qualitative interviewing/focus group moderation, basic coding/thematic analysis, program context knowledge (B5 E1b)

Medium: Surveys with Pre- and Post-Participation Evaluation: Deliver brief surveys at three timepoints (start, midpoint, 2-3 years post) to program participants and a sample of non-participants in the region. Track which modular BMPs were adopted, satisfaction with payment structures, barriers encountered in customizing combinations and observed agronomic/economic results. Collect basic demographic/farm data to control for confounding. Use pre-post comparison to assess if practice adoption, satisfaction, and yield/risk outcomes differ by payment scheme (flat vs. field-sensitive).

- *Who can do this:* Graduate research assistants, evaluation consultants, agency staff
- *Skills required:* Survey development/administration, data management, quantitative analysis (B5 E1c)

Implementation # 2

Low to Medium: Web Scraping & Literature Review of Payment Stacking/ Harmonization Guidance: Systematically scrape websites and aggregate documents from agencies/program websites to inventory and compare current guidance about stacking payments or harmonizing requirements across agencies. Review peer-reviewed and gray literature on best practices, challenges, and outcomes of payment stacking/safety measures for new adopters across states/watersheds.

- *Who can do this:* Undergraduate/graduate students, agency analysts with basic coding skills

- *Skills required:* Python for scraping, literature review synthesis, basic database/search (B5 E2a)

Medium: Focus Groups with Cross-Program Participants & Staff: Facilitate small group discussions with farmers who've participated in multiple WLEB-related programs and program administrators from collaborating agencies. Discuss clarity/sufficiency of stacking guidance, experiences navigating multiple requirements, perceptions/impacts of safety protections for early/custom adopters, and suggestions for harmonizing programs.

- *Who can do this:* University/Extension facilitators, neutral evaluation staff
- *Skills required:* Group moderation, stakeholder engagement, knowledge of federal/state agricultural conservation programs (B5 E2b)

Medium to High: Targeted Interviews and Persistence Assessment for New Adopters: Track a panel of farmers who are piloting new approaches with administrative safeguards. Interview annually for 2-3 years about experiences with program safety nets, barriers/challenges in customizing practices, incidents of programmatic penalties or supports, and whether flexibility enabled continued adoption or innovation after initial setbacks.

- *Who can do this*: PhD/MSc students, technical evaluation staff
- *Skills required:* Panel/longitudinal research design, interviewing, qualitative tracking (B5 E2c)

Barrier: Perception and Belief in Practice Benefits (B6)

Description from the Research:

- Lack of belief in a practice's benefits
- Producers often prefer visible, short-term outcomes- inability to "see" direct results of BMPs can hinder adoption (Luther et al. 2020).
- A lack of feedback mechanisms to demonstrate the efficacy of BMP adoption on field outcomes can hinder sustained adoption (Jackson-Smith et al. 2018).
- Risk perception of nutrient loss is not driven by the physical vulnerability of the land to erosion but rather by conservation identity (Schwab, Wilson, and Kalcic, 2021).

WLEB Specific Constraints:

- Substantial sociological barriers—many farmers do not believe they contribute to HAB issues or lack awareness of lake impacts.
- Misunderstanding about effectiveness of certain practices, and widespread plausible deniability regarding farm vs. urban phosphorus sources.
- Need for more research and outreach on human dimensions and positive educational influences.

Application to short term/initial adoption:

- Farmers are hesitant to adopt practices whose benefits are not immediately visible
- Skepticism toward conservation messaging can reduce trust
- Misconceptions about BMP effectiveness due to lack of local data, visible results, or credible messengers
- Early outreach efforts often fail to connect with farmers' lived experiences

Application to long term/continued adoption:

- Lacking consistent feedback loops like soil health metrics, nutrient loss reports means farmers struggle to see ongoing value and may stop practices
- Shifts in conservation identity fade over time if peer recognition or visible reinforcement is lacking
- Continued uncertainty about practice performance under changing weather or market conditions
- Need transparent, participatory feedback mechanisms and peer-driven reinforcement that make conservation outcomes visible and credible

Strategies:

1. Strengthened farmer conservation identity, connected to BMP adoption (B6 G1)
2. Improved trust in practice efficacy through transparent, field-based feedback loops (B6 G2)
3. Increased awareness of collective responsibility for nutrient pollution reduction at the watershed scale (B6 G3)

I**mplementation:**

1. Build conservation identity and encourage peer leadership (B6 I1)

    a. Community / farmer-to-farmer conservation recognition programs to highlight the success of trusted local producers in implementing practices
    b. Collaborate with commodity groups to develop conservation messaging that aligns practice adoption with productivity and stewardship
    c. Develop participatory research projects in which farmers' input is involved in the design (including assessment and identified solutions of problems), implementation, interpretation, and communication of trials
2. Develop visible, credible feedback mechanisms (B6 I2)
    a. Develop support systems for on-farm monitoring and "report cards" to provide individual feedback on nutrient loss risk and soil health improvements
    b. Support and advertise field days to allow for farmers to directly observe practice outcomes under real-world conditions
3. Normalized shared responsibility through communication, education, and engagement across silos (B6 I3)
    a. Hold community forums / engagement events for agricultural and non-agricultural stakeholders to jointly discuss nutrient resources to reduce space for blame-shifting
    b. Support extension-led workshops and outreach that emphasize conservation practices as risk reducing strategies; reframe adoption as protecting farm profitability and yield, as well as water health
    c. Develop standardized outreach materials that connect farm-level practices to water quality impacts

Evaluate outcomes:

Implementation # 1
Low Cost: Evaluate Successful Case Studies: From the literature, analyze qualitative case studies of "conservation champions" getting recognized annually and investigate their influence on peer adoption. Identify effective recognition criteria, types of incentives, peer leadership best practices, messaging frames, and program outcomes.

- *Who can do this:* University students, agency analysts, independent consultants
- *Skills required:* Conservation/BMP literacy (B6 E1a)

Medium Cost: Farmer-to-Farmer Influence Surveys: Use short surveys or interviews with program participants to assess credibility of practices and the influence of peer leaders on adoption decisions

- *Who can do this:* Graduate research assistants, evaluation consultants, agency staff
- *Skills required:* Survey development/administration, data management, quantitative analysis (B6 E1b)

Medium to high cost: Longitudinal focus groups: Survey the same farmers over 3-5 years to track changes in conservation identity and practice adoption, investigate links to exposure to peer leaders

- *Who can do this*: PhD/MSc students, Extension facilitators, agricultural social scientists, trained evaluators
- *Skills required:* Longitudinal research design, interviewing, qualitative research (B6 E1c)

Implementation # 2

Low to medium cost: Feedback form assessments: Develop a standardized rapid feedback tool (paper/digital) for use at field days and demonstration sites. Attendees quickly rate usefulness, credibility, and clarity of observed practices; indicate likelihood to adopt; and describe remaining barriers.

- *Who can do this:* Extension/event staff, grad students
- *Skills required:* Basic survey/feedback tool management, data compilation, event logistics (B6 E2a)

Medium: Qualitative Interviews With Farmer-Collaborators: Conduct semi-structured interviews with farmers involved in participatory trials, on-farm monitoring, and "report card" programs. Explore motivations for participation, value of visible feedback, changes in practice based on trial outcomes, barriers, and perceived credibility of participatory research vs. traditional extension. Include follow-up at different project phases to capture evolving perspectives.

- *Who can do this:* Extension educators, university researchers, consultants
- *Skills required:* Interviewing, qualitative analysis, familiarity with research trials and nutrients/BMP context (B6 E2b)

Implementation # 3

Low Cost: Outreach Material Review: systematically review outreach materials to improve consistency of communication regarding the link between agriculture and HABs

Who can do this: Program staff and MS or PhD evaluation/research students
Skills required: Content analysis, qualitative coding, knowledge of effective communication principles (B6 E3a)

Low to Medium Cost: Literature Review of Collaborative Communication and Outreach**:** Compile and synthesize evidence from previous cross-sector nutrient management forums, water quality outreach campaigns, and shared responsibility models in other regions. Identify effective frames, stakeholder engagement approaches, and lessons regarding blame-shifting and collaborative action.

- *Who can do this:* MS or PhD evaluation/research students, agency analysts
- *Skills required:* Literature/database review, program evaluation (B6 E3b)

Low to Medium Cost: Surveys to Assess Shifts in Attitudes Toward Shared Responsibility and Practice Adoption: Include questions in extension workshop/post-outreach surveys to track: changes in perceived collective responsibility, concerns about water quality/farm profitability tradeoffs, intent to discuss/act on nutrient management with off-farm community, and awareness/use of standardized outreach materials. Aggregate across program efforts to track shifts over time.

- *Who can do this:* Evaluation staff, grad students
- *Skills required:* Survey instrument design, basic statistics (B6 E3c)

Barrier: Economic Incentives and Financial Constraints (B7)

Description from the Research:

- Economic incentives alone are insufficient (Ogieriakhi and Woodward 2022).
- Agricultural commodity price volatility and profit margins leave little room for trial-and-error with BMPs that are not clearly confirmed to have positive effects on yield (Shortle et al. 2021).
- Lack of equipment access and technical assistance can limit implementation (Zhang et al. 2016)
- Land tenure and rental arrangements can hinder long-term planning and limit ability to participate in incentive programs (Sawadgo et al. 2021).

WLEB Specific Constraints:

- Program funding is often too short-term for producers to realize and sustain agronomic or economic benefits.
- Producers need stronger financial incentives to adopt phosphorus/nitrogen reduction practices.
- Heavy manure management imposes costs and logistical barriers that current programs do not address.

Application to short term/initial adoption:

- High upfront costs, uncertain returns discourage farmers from experimenting with new conservation practices
- Short-term funding cycles fail to align with multi-year timelines needed to see agronomic or financial benefits
- Cost-share or incentive programs often do not help with equipment, labor, or input costs, especially for small and mid-sized farms
- Market volatility, small profit margins make producers risk-averse and hesitant to reallocate resources to unproven practices

Application to long term/continued adoption:

- When financial support ends, producers may revert to conventional practices if conservation methods do not show reliable economic payoffs
- Programs lacking adaptive or performance-based funding
- Lack of long-term technical and financial support prevents continuous improvement or expansion of BMPs
- Ongoing costs like maintenance, seed, equipment upgrades become unsustainable without renewed funding or market-based returns.
- Sustained adoption requires durable, flexible funding mechanisms, risk-sharing frameworks, and consistent technical assistance

Strategies:

1. Long-term, flexible funding programs to provide consistent support for producers, allowing sufficient time to realize benefits from conservation practices. (B7 G1)
2. Financial incentives and risk-sharing mechanisms that offset the costs, profit risks, and logistical barriers associated with adopting nutrient reduction practices in the WLEB. (B7 G2)

Implementation:

1. Assign dedicated technical advisors to work directly with producers over multiple years. Advisors will assist with individualized conservation plans, conduct regular on-farm visits, and help producers adaptively manage practices to maximize long-term success and ensure continued funding eligibility. (B7 I1a)
1. Long-term, facilitated, farmer-led peer networks to help sustain participation and problem-solving beyond the limits of one-off or short-term grants. (B7 I1b)

    a. Groups of WLEB farmers meet regularly for 5+ years with consistent funding and technical support allowing group members to openly discuss results, obstacles, and modifications, while normalizing “trial and error” and building multi-year trust.
    b. “Farmer Champions” Mentorship Model with Staggered Entry: evolving mentorship network where experienced adopters coach new adopters, supported by staggered 3-year term funding for both mentors and mentees.
2. Long-term, flexible incentives to individual producers based on verified improvements in nutrient reduction or soil/water quality over time (not just upfront adoption of BMPs). Payments adapt based on measured results—rewarding both persistence and documented improvements, and sharing financial risk if weather or initial implementation is challenging. (B7 I2)

Evaluate outcomes:

For long-term evaluation, these approaches should occur iteratively through regular (e.g., 3-5 year) synthetic reviews, integrated with secondary data (e.g., remote sensing, web-scraped adoption statistics), and cross-validated with population-wide or panel surveys as funding allows.

Implementation # 1a
Low Cost: Participant Surveys: Administer brief, targeted surveys at set intervals (e.g., annually or post-visit) to producers working with technical advisors to assess satisfaction with advisory services, changes in management practices, barriers experienced, and continued eligibility for funding.

- *Who can do this:* Extension staff, agency or university evaluation staff, program administrators
- *Skills required:* Survey design, data collection, basic data analysis (B7 E1a-a)

Moderate Cost: Qualitative Post-Program Interviews: Conduct in-depth, semi-structured interviews with a subset of producers at the end of advisor engagement (or every 2-3 years for long-term programs) to gather rich detail on practice changes, the perceived value of technical advice, barriers, adaptations, and lasting agronomic or financial impacts.

- *Who can do this:* University researchers, program evaluation consultants, experienced Extension staff
- *Skills required:* Interviewing, qualitative research, agricultural context knowledge, qualitative data analysis (B7 E1a-b)

Implementation # 1b

Medium Cost: Surveys: Distribute very brief surveys immediately after each peer group meeting to capture trust, group cohesion, satisfaction, perceived value, and intended next steps. Send out short surveys to mentors and mentees at the conclusion of each mentorship cycle (or annually, if staggered entry), focusing on skill/knowledge gained, confidence in BMPs, perceived support, and intent to continue or mentor others. Collect follow-up data annually on BMP adoption, problem-solving, and collaborative action.

- *Who can do this:* Peer group facilitators, Extension staff, trained program volunteers or students
- *Skills required:* Survey design, in-person or digital data collection, summary analysis (B7 E1b-a)

Moderate-High Cost: Biannual Panel Survey & Social Network Analysis: Conduct a more detailed, biannual survey (paper, phone, or web) with all group members and a small panel of non-participants to track changes in practices, persistence of adoption, group member relationships, diffusion of innovation, and barriers faced across years. Use social network mapping to assess flow of knowledge and influence.

- *Who can do this:* University research teams, grad students with agricultural background, agency research staff
- *Skills required:* Survey design, data management, social network analysis, longitudinal data analysis (B7 E1b-b)

Moderate/High Cost: Qualitative Retrospective Study: conduct semi-structured interviews and focus groups with both mentors and mentees across several cohorts, synthesizing detailed data on learning pathways, program impacts, unforeseen obstacles, and network effects.

- *Who can do this:* Independent evaluators, university-based research teams, postdocs
- *Skills required:* Qualitative research methods, facilitation, data transcription/coding, evaluation reporting (B7 E1b-c)

Implementation # 2

Low Cost: Pre- and Post-Practice Implementation Survey: Require all participants to complete a short survey at program enrollment (baseline) and after measurable BMP results (e.g., at payout or after each growing season) to capture self-reported changes in practices, yields, input usage, and perceptions of incentive fairness and risk-sharing.

- *Who can do this:* State agency staff, university research teams, data managers
- *Skills required:* Survey/questionnaire design, data entry, descriptive statistics (B8 E2a)

Moderate/High Cost: Remote Sensing and Field Audit Assessment: Leverage commercially available or publicly funded remote sensing data (e.g., satellite or drone) and/or field visits to verify BMP implementation, track ecological changes (cover crop acreage, reduction in bare ground, buffer strips), and compare incentivized to non-incentivized fields. Supplement with an annual phone survey on economic and management impacts.

- *Who can do this:* Research staff skilled in GIS/remote sensing, environmental consultants, trained agency staff
- *Skills required:* GIS/remote sensing, field data collection, basic agronomic and economic assessment, mixed-methods data analysis (B8 E2b)

Barrier: Distrust of Government and Regulations (B8)

Description from the Research:

- Government distrust and wariness of regulations may discourage participation in voluntary programs like MAEAP, especially for more conservative farmers (Stuart et al. 2014).
- Farmers maintain fear and distrust of agencies and regulations- they exhibit discomfort with monitoring and worry about misrepresentation or being "put on a list" for future consequences or regulations (Stuart et al. 2014, Conservation Practitioner Poll 2021).

WLEB Specific Constraints:

- Loss of trust among local farmer "influencer" clusters due to negative experiences with federal/state programs.
- General skepticism toward government programs and reluctance to engage with technical agencies.
- Difficulty recruiting disengaged producers back into conservation programs.

Application to short term/initial adoption:

- Many producers avoid voluntary programs due to fears of monitoring, data misuse, or future regulation

- Negative past experiences with agencies or perceived government overreach discourage early engagement
- Farmers may view conservation programs as bureaucratic or politically motivated rather than farmer-driven
- Lack of transparency about how farm data are collected, stored, or shared only increases skepticism
- Initial outreach by agency staff, rather than trusted peers, often fails to overcome rooted distrust

Application to long term/continued adoption:

- Distrust can resurface if communication is inconsistent or data transparency lapses
- Farmers may disengage when they feel their input does not meaningfully influence program design or delivery
- Perceived loss of control over monitoring or verification processes discourages ongoing involvement
- Failure to maintain open, two-way feedback loops
- Sustained adoption depends on building durable peer-led structures and clear, continuous communication about program purpose, data use, and outcomes

Strategies:

1. Enhanced Trust Through Farmer-Led and Peer-Based Outreach: Peer networks and local champions are more trusted than agency representatives. Empowering influential local farmers to lead outreach increases credibility and reduces skepticism. (B8 G1)
2. Program Transparency and Farmer Control in Design and Delivery: Greater clarity and opportunities for farmer input reduce fear of monitoring, misrepresentation, and regulatory risk, particularly for those with prior negative experiences. (B8 G2)

Implementation:

1. Organize and support peer-to-peer learning groups and local "champion" networks where trusted farmers—rather than agency staff—lead discussions, demonstrations, and program outreach. (B8 I1)

    a. Farmer-Led Discussion Circles: Organize regular, farmer-moderated meetings (on-farm or virtually) where participants discuss pros/cons of MAEAP or NRCS programs, ask questions, and share honest experiences—facilitated by respected local champions, not agency staff. This method is demonstrated to boost trust, normalize participation, and provide local-scale social proof.
    b. Peer Mentor/Champion Visit Program: Deploy a network of "farmer champions" who make on-farm visits to hesitant or disengaged producers, offering informal one-on-one guidance, sharing their personal journey, and providing practical tips for participation. This method builds trust by showing real, local success and reduces fears through peer validation.
2. Create ongoing advisory councils and collaborative program design sessions where farmers have real decision-making power in how protocols, monitoring, and communications are structured—and how data are used. (B8 I2)
    a. Farmer Advisory Committees for Program Design: Form formal advisory boards or councils composed primarily of local producers to review, refine, and help co-create the rules, paperwork, and privacy policies for conservation programs. Ensure their decisions visibly shape program delivery and communication. This method increases legitimacy, accountability, and reduces top-down decision-making.
    b. Transparent Program Dashboards and Open Feedback Loops: Launch online and printed dashboards (co-developed with farmer input) that show, in plain language, where applications stand in the process, who sees their data, what it's used for, and provide clear "feedback buttons/phone numbers" for complaints or suggestions. This method provides continuous transparency and affirms the farmer's right to feedback and input.

Evaluate outcomes:

Implementation # 1 and 2

Low Cost: Short, Focused Participant Surveys: Administer brief, targeted surveys to participants immediately following peer group meetings, champion farm visits, or advisory council sessions to assess trust, satisfaction, and program clarity, and to collect follow-up data on participation and practice change after program activities.

- *Who can do this:* University evaluation staff, agency research teams, program staff, or trained Extension educators
  Skills required: Survey design, data collection, basic data analysis (B8 E1)

Low-Medium Cost: Behavioral & Administrative Data Tracking: Track participation metrics using existing administrative records (e.g., enrollment rates, application completion times, repeated program modifications based on dashboard feedback) and supplement with secondary data (e.g., remote sensing for BMP adoption, counts of feedback submitted via dashboards).

- *Who can do this:* Agency staff, university analysts, or data scientists
- *Skills required:* Data management, basic quantitative analysis, ability to interpret administrative records (B8 E2)

Medium Cost: Qualitative Interviews and Focus Groups: Conduct semi-structured interviews or small focus groups with a selected subset of participants (e.g., farmer champions, advisory committee members) and non-participants to gather in-depth insights into trust building, transparency, perceived influence, program barriers, and unintended impacts.

- *Who can do this:* University researchers, evaluation specialists, Extension professionals, or independent consultants
  Skills required: Interview/focus group facilitation, qualitative research methods, transcription, thematic coding (B8 E3)

Barrier: Administrative Burden and Program Complexity (B9)

Description from the Research:

- Administrative burden can reduce participation, especially for medium and small farms (Stuart et al. 2014, Conservation Practitioner Poll 2021)
- Time and cognitive effort required to understand a program's rules, eligibility, technical standards, and application process may overwhelm farmers.(Stuart et al. 2014, Conservation Practitioner Poll 2021)
- Paperwork and monitoring (e.g. maintaining records, completing field inspections, undergoing audits, submitting annual reports) may feel too intrusive or confusing. (Stuart et al. 2014, Conservation Practitioner Poll 2021)
- Jargon-heavy language in outreach, unclear benefits or trade-offs, long and confusing program applications, and poor communication systems bar producers from effectively participating in programs.
- Lack of program transparency and clarity in timeline and delivery, particularly when it comes to reimbursements or payments, can discourage participation and trust due to fear of risk.(Stuart et al. 2014, Conservation Practitioner Poll 2021).

WLEB Specific Constraints:

- Overly complex and slow NRCS/FSA paperwork; programs not streamlined for timely farmer participation.
- Ranking/prioritization processes result in rejections, causing frustration and deterring applicants.
- Need for process improvements—delays, heavy paperwork, and complex approvals burden producers and staff alike.
- Lack of guaranteed funding year to year.

Application to short term/initial adoption:

- Time-consuming paperwork, complex eligibility requirements, long approval processes
- Unclear language, inconsistent guidance, and technical jargon
- Confusion about payment timelines, ranking systems, and trade-offs reduces motivation to apply
- Limited staff capacity and poor communication channels lead to slow or incomplete responses to farmer requests

Application to long term/continued adoption:

- Ongoing monitoring and compliance reporting can feel intrusive or overly bureaucratic
- Lack of streamlined renewal processes discourages repeat enrollment after initial contract expiration
- Persistent delays or reimbursement uncertainty decrease trust in the program's reliability
- Sustained adoption requires simplified digital systems, responsive advisory support, and transparent, predictable communication throughout the participation cycle

Strategies:

1. Simplified and streamlined administrative requirements: reduce cognitive overload and increase participation rates, especially among small-medium-scale producers. (B9 G1)

2. Enhanced Support and Navigation for Farmers: reduce time and cognitive burdens, increase understanding, and provide continuous access to guidance—addressing confusion and building trust. (B9 G2)
3. Improved Transparency, Communication, and Feedback Loops: Improving transparency and communication builds trust, reduces discouragement due to uncertainty or delays, and signals a more farmer-centered program approach. (B9 G3)

Implementation:

1. Technological Development (multi-actor approach): Co-develop digital tools that simplify conservation program administration and paperwork, involving farmers, advisors, agency staff, and tech developers to address real-world bottlenecks and usability from the ground up (B9 I1)
    a. Collaborate with producers and agency staff to co-design an online “one-stop-shop” portal where farmers can fill out a single application for multiple conservation programs.
    b. Design a user-friendly mobile app for maintaining required records, with automated reminders, easy field data input, and example audit checklists.
2. Consulting (trusted, one-on-one advice): Embed advisors in existing farmer networks or peer groups to offer tailored, ongoing hands-on assistance. (B9 I2)
    a. Fund positions for Conservation Navigators through local Extension or Conservation Districts. These advisors would provide step-by-step, “high-touch” support to walk farmers through applications, eligibility, technical standards, and ongoing compliance.
    b. Pair new or hesitant applicants with experienced peer mentors who have completed programs. Mentors provide real-world perspectives, problem-solving support, and confidence-building throughout the process.
3. Transform communication materials and processes to reduce ambiguity, make timelines and tradeoffs visible, and invite ongoing feedback from producers. (B9 I3)
    a. Co-create guidance materials (print and digital) featuring flowcharts, FAQs, and timelines for each program stage—including deadlines, payment schedules, and who to contact at each step.
    b. Launch a feedback platform to collect and act on user suggestions/ complaints in real time. Regularly update program FAQs and communication channels based on this feedback.

Evaluate outcomes:

Implementation # 1

Low to Medium Cost: Usability Testing: Conduct structured usability tests where farmers, advisors, and agency staff interact with digital tools or the “one-stop-shop” portal. Measure how easily and quickly users complete core tasks (e.g., submitting an application, entering records, receiving reminders).

- *Who can do this*: University or agency researchers, user experience specialists, or tech development teams
- *Skills required:* Usability research, digital platform testing, data collection and analysis (B9 E1a)

Medium Cost: Post-Launch User Surveys: Deploy surveys and in-app feedback forms to users after tool rollout. Gather data on satisfaction, ease of use, remaining pain points, and impact on time saved or paperwork completion. Supplement survey data with usage analytics (login frequency, task completion rates, common errors).

- *Who can do this:* Digital tool developers, evaluation staff, student research assistants
- *Skills required:* Survey design, data analysis, familiarity with web/app analytics tools (B9 E1b)

Medium Cost: Focus Groups for Co-Design and Iterative Refinement: Organize multi-actor focus groups throughout the development and launch process to capture feedback on prototypes and deployed tools, ensuring continued fit with field needs.

- *Who can do this:* Extension staff, university facilitators, product designers
- *Skills required:* Group facilitation, qualitative analysis, iterative design thinking (B9 E1c)

Implementation # 2

Low Cost: Behavioral Tracking of Program Progress and Completion Rates: Track and compare completion rates, approval rates, and compliance milestones for farmers who receive navigator or peer mentor support versus those who do not.

- *Who can do this:* Data analysts in agencies or partnering universities, Conservation District administrative staff
- *Skills required:* Data management, quantitative analysis, familiarity with program databases (B9 E2a)

Medium Cost: Pre/Post Surveys: Survey farmers before and after receiving advisor support to measure changes in program understanding, application confidence, and successful enrollment. Follow-up on satisfaction and likelihood to recommend peer support.

- *Who can do this:* Extension staff, university researchers, graduate students

- *Skills required:* Survey creation, data analysis (B9 E2b)

Medium - High Cost: Qualitative Interviews: Conduct in-depth interviews with advisors, mentors, and farmers to capture stories and specific challenges overcome via individualized consulting support, gather suggestions for system improvement, and identify barriers for hesitant adopters.

- *Who can do this:* social science researchers, Extension staff
- *Skills required:* Qualitative interviewing and coding, agricultural systems knowledge (B9 E2c)

Implementation # 3

Low to Medium Cost: User Feedback: Provide opportunity for real-time feedback through an online form. Regularly analyze submitted feedback, FAQ engagement, and help desk logs to identify common confusion points and monitor improvement after materials are updated.

- *Who can do this:* Agency communication staff, student analysts
- *Skills required:* Feedback system management, content analysis, response coordination (B9 E3a)

Medium Cost: Focus groups and Interviews: Test new guidance materials using farmer focus groups or cognitive interviews. Assess clarity, perceived usefulness, and identify sections needing further simplification or detail. Monitor improvements in self-reported understanding of program timelines and steps.

- *Who can do this:* Communication specialists, Extension educators, third-party evaluators
- *Skills required:* Facilitation, education assessment, document design and literacy testing (B9 E3b)

Medium Cost: Pre-post Survey: Survey participants at launch and after updates to measure changes in awareness of deadlines, confidence navigating the process, and satisfaction with communication and transparency.

- *Who can do this:* Extension communications staff, university partners
- *Skills required:* Survey development, evaluation design, communication program knowledge (B9 E3c)

Barrier: Unsettled Science and Data Gaps (B10)

WLEB Specific Constraints:

- Lack of long-term water quality and agronomic data to assess practice effectiveness and environmental/agronomic response.
- Uncertainty about phosphorus loss drivers, fertilizer/manure management, and best test methods (Mehlich-3 vs. BrayP1).
- Insufficient research quantifying ROI, behavioral change verification, and challenges monitoring results of conservation adoption.

Application to short term/initial adoption:

- Farmers hesitate to adopt practices when evidence of agronomic or economic benefit is unclear or conflicting
- Lack of localized, field-scale data creates uncertainty about what works under specific soil and weather conditions
- Limited feedback from early adopters reduces confidence in riskier or less visible conservation measures
- Farmers may delay adoption until more concrete, trusted results are available from local research trials

Application to long term/continued adoption:

- Without consistent monitoring and transparent data-sharing, farmers cannot verify progress or justify continued effort
- Incomplete or inaccessible data prevent adaptive management and long-term refinement of practices
- Failure to link on-farm results to larger watershed outcomes decreases perceived impact and motivation to persist
- Sustained adoption relies on long-term, co-managed monitoring networks, participatory field research, and clear communication of evolving evidence

Strategies:

1. Develop a multi-decadal water quality and agronomic dataset to detect and attribute improvements (or challenges) over time to specific conservation practices (B10 G1)
2. Improve confidence in practice selection and effectiveness. (B10 G2)

Implementation:

1. Expand long-term (decadal), coordinated data collection and monitoring (B10 I1)

    a. Co-develop monitoring protocols with scientists, technology developers, farmers, and ag consultants to design, deploy, and maintain the monitoring infrastructure (such as smart sensors, automated sampling, and integrated databases).
    b. Create shared data platforms that guide decision making without exposing personal landowner information.
2. Co-create and co-manage on-farm experiments with farmers (B10 I2a)
    a. Support targeted, collaborative field-scale research with farmers to close key practice and outcome knowledge gaps including phosphorus loss dynamics, fertilizer/manure management, and optimal testing methods.
    b. Develop a farmer-led research network across the WLEB and host farmer-led field days showcasing the results.
2. Develop transparent, farmer-focused risk communication information demonstrating the agronomic and environmental ROI (return on investment) of practices—and assurance that behavioral changes will be verified and recognized, even amid some scientific uncertainty. (B10 I2b)

Evaluate outcomes:

Implementation # 1

Low cost: Web Scraping: Use Python or similar tools to build an inventory of existing regional and national digital monitoring platforms, field experiment networks, risk communication dashboards, and online databases for conservation. Monitor what types of metrics, communication methods, and data privacy practices are in use. Analyze frequency of updates, coverage, and presence/absence of key ROI information.

- Who can do this: undergraduate or graduate students
- Skills required: basic coding, web data collection, digital literacy (B10 E1a)

Low cost: Literature Reviews: Conduct systematic reviews of published peer-reviewed and gray literature, technical reports, and existing program documentation on large-scale, long-term monitoring projects, collaborative field trials, and digital data-sharing platforms. Assess known best practices, pitfalls, and outcomes from regional, national, or global efforts. Synthesize findings to benchmark Michigan's interventions and refine protocols.

- Who can do this: university students, agency analysts, independent consultants
- Skills required: research synthesis, database searching, knowledge of BMPs and agricultural monitoring (B10 E1b)

Implementation # 2:

Medium cost: Remote Sensing: Leverage publicly available or purchased remote sensing data at the county or watershed level (e.g., cover crop acreage, no-till adoption) to assess trends in land management over time. Compare conservation adoption patterns in areas with robust monitoring/research networks to those without. Use spatial data to infer where field research and knowledge-sharing may be driving visible management change.

- *Who can do this*: anyone with basic coding or GIS skills
- *Skills required:* GIS/remote sensing, analysis, knowledge of agricultural conservation (B10 E2a)

High cost: Mixed-Methods Qualitative Case Studies and Focus Groups: Complement broad surveys with targeted qualitative interviews and focus groups (including program participants and non-participants) to deepen understanding of trust, data transparency, and lived experiences with verification and recognition processes.

- *Who can do this:* Graduate students or university-based researchers with qualitative expertise; Independent evaluators or consultants.
- *Skills required:* qualitative research design, interviewing, and facilitation; thematic coding and analysis; deep understanding of agricultural context/bmps; ability to recruit and incentivize farmer participation.

Appendix B: Types of Assessments

A few notes when designing your evaluation tools:

- Aim to extract the least amount of new data necessary from farmers to prevent survey fatigue.
- Consider the size of the population–interviews are better for smaller groups or "pilot" programs (> 30), while surveys may be better suited for larger projects.

Lower-Medium Effort Assessments using Secondary Data

- **Pros:** Does not require primary data collection directly from farmers
- **Cons:** Limited by the quality and extent of available data

Literature reviews: The State of Michigan can learn from what has and hasn't worked in other places as documented in both the peer-reviewed literature and gray literature reports. This method involves systematically searching, synthesizing, and analyzing existing research studies, evaluations, technical reports, government publications, and program documentation relevant to the program or area of interest. Literature reviews can help identify best practices, common challenges, unintended consequences, and conditions for success or failure in different contexts.

- Example application to program evaluation:
    - For example, a literature review could shed light on past evaluations of pay-for-performance programs in the adoption of best management practices (BMPs) in agriculture. For instance, Michigan could review studies assessing how financial incentives have influenced farmer behavior related to soil health, nutrient runoff reduction, or climate resilience. The review could also identify which program designs (e.g., tiered payments, technical assistance, contract length) have proven most effective in increasing adoption and environmental outcomes, especially in states with similar agricultural profiles. This evidence could guide the refinement of Michigan's own conservation programs.
- Skillsets necessary to conduct method:
    - Understanding of academic research and methods
    - Familiarity with BMPs in Michigan, etc.
    - Proficiency in database searching and citation management
    - Ability to extract and summarize key information
    - Ability to critically appraise study quality and relevance
- Who could conduct this method?
    - University students
    - Analysts of evaluation specialists in state agencies

    - Independent consultants
- How much would this method cost?
    - Low to moderate

Web scraping: Scraping the web for data can answer a range of questions for the State including identifying existing communication tools and messengers. For example, it could be used to conduct an inventory of engagement efforts and/or incentive programs, as well as identify who is offering them. It would then be possible to evaluate if these efforts are being done right (e.g., based on best practice, offered by trusted sources, etc.). If these sources offer metrics of success online (or if those can be tracked down), then you can also see if the programs being done "right" are actually more effective. This is both a way to build an evidence base of what is being done (or not) and a way to track impacts over time. Another more specific example would be to use the data collected to summarize the ways that conservation is being messaged, again as a way to inform new efforts in Michigan or beyond and to ensure that we are building on best practice and not re-inventing the wheel. Web scraping can be done using python based on the instructions in **Appendix C**.

- Skillsets necessary to conduct method:
    - Basic Python skills
- Who could conduct this method?
    - Undergraduate or graduate students
- How much would this method cost?
    - Cost to pay student

Remote Sensing: This method can be used to understand land-use change with vs. without formal program support in different parts of the watershed to assess impact on land use change.

- Example application to program evaluation:
    - Remotely sensed data on conservation adoption (e.g., cover crops, no-till and small grains) is available at the county level over time and can be purchased at the field level. These observations of practices at various scales can be used to track the extent to which practices are increasing in a particular area compared to another without the same additional program support. For example, if additional technical assistance was being offered in one county to help tailor recommendations for farmers and/or assist in program enrollment, one could compare how adoption in that county changes from the baseline to the end of the program relative to other randomly selected counties without that extra assistance.

- Skillsets necessary to conduct method:
    - This data is available at the county scale for free and only required basic coding and/or GIS skills to analyze it over time.
- Who could conduct this method?
    - Anyone can conduct this method as the data is publicly available over time and is updated annually to reflect the current year.
- How much would this method cost?
    - If field level data for a larger area (e.g., watershed) is required it will cost money, but for example, an entire state's worth of field level data over time can be purchased for ~$20,000.

Higher Effort Repeated Evaluation Tools for Long-term Data

- Skillsets necessary to conduct these methods:
    - Masters or PhD in social science research field.
- Who could conduct this method?
    - PhD-level student or technical staff with guidance from Faculty or Post-doctoral researcher
- Estimated costs
    - High

Synthetic reviews: There should be time made on an annual and 3-5 year basis for a synthetic review and reporting out on evaluation results. This reporting out should include private sector and farm organization partners, especially to get their input for why programs are working or not, based on results, plus to increase buy in.

Tracking behavioral changes: Conduct coordinated and efficient random-sample cross-sectional surveys of farmers in the WLEB every 3 years to track population-scale changes in perceptions, attitudes, and behaviors over time.

Persistence assessments: Include smaller panel survey design where the same individuals are resurveyed at each wave to see changes at individual level, including measurements of disadoption.

Specific Program Assessments: While the periodic random-sample or panel surveys can assess change over time among farmers in the region, the sampling and questions can be designed to capture and compare impact of individual programs over time (to whatever extent is feasible). This could also be a systematic approach to a brief follow up survey for participants sometime in the 3-5 year post participation period to capture

persistence of program intervention benefits. This will be critical to understanding intervention program impact over time.

Ecological and social assessment: BMP adoption is not the same as BMP "use" or implementation. We too often assume that because a farmer is soil testing that they are following those test results. We often assume that all cover crop plantings achieve the same ecological benefits. Or we assume that split fertilizer application is being used to reduce N rate relative to corn yield (Houser et al. 2022). These assumptions are consistently proven wrong. The ecological impact of a BMP depends on how or to what end it is used (Sanderson and Hughes 2019). I strongly recommend incorporating agronomic and social data into the evaluation process to assess not just if and why an intervention program led to a BMP, but how was that BMP put to use and did it lead to ecological benefits. In short, we need to evaluate in order to assess the potential for rebound effects. See here for example:

Agronomic and economic impact assessment: What is evidence that adoption of BMPs can provide agronomic and/or economic benefits to farmers? Are they realizing yield gains, yield stability, reduced input costs, better weed control, or resilience in the face of extreme weather?

Population-wide survey every 5 years: Evaluation of BMP implementation over time at the state level. Leverage the Panel Farmer Survey (PFS) out of Michigan State University. This survey should consider BMP adoption and views of BMP overtime, with a specific focus on assessing the "indirect" impacts of intervention programs. Use remotely sensed data (multiple datasets if possible) to compare the total number of BMPs being implemented vs. the BMPs implemented as a part of specific programs (SHIP, PfP) that will be monitoring implementation in the GLWMS. The survey goes beyond tracking adoption to track perceptions and experiences with BMPs (including disadoption).

- Example application to program evaluation:
    - Houser et al. 2025 found evidence of diffuse adoption–ie, adoption of BMPs by farmers not enrolled in an intervention program, but that were directly led to adopt as a result of the intervention program being offered. There is a need to track how intervention programs are having a wider impact on the non-participating population, as well as to assess potential sub-population segments to target to adapt future interventions to. High enough incentives can lead to good participation, partnering with the private sector can further increase participation.
- Skillsets necessary to conduct method:

    - Social statistics for conducting analysis
    - Social survey expertise, ideally experience surveying rural and/or agricultural populations
- Knowledge of BMP terminology and agronomic informationWho could conduct this method?
    - Social scientists affiliated with universities, non-profits, or private companies
- How much would this method cost?
    - High $100,000–$300,000 annually

Methods for Collecting New Data

Surveys

A note on when to administer surveys:
A short survey could be delivered across all intervention program types, ideally at three points in time:

1. Beginning: Outset of program and/or initiation of participation (why did you get involved?),
2. Middle: After 1-3 years of working with the program depending on duration (how did it go?)
3. End: ~3 years later to explore persistence of impacts (what stuck?).

Surveys can assess participant perceptions of programs and self-reported outcomes along key dimensions of the theory of change. This tool should be used if you are interested in a high percentage of participant views on a program's strengths and weaknesses, reported behavioral impacts, future intentions as a result of program, information on how the participant heard about the program and why they decided to enroll, as well as enrollee demographic information (who is participating).

Pre and Post Surveys: Quasi-Between Group Experimental Design: Assigning different groups of farmers with substantial distance between groups "treatment" or cost share and another group as a "control" that is not offered cost share. A pre survey should be administered to both groups before receiving cost share, ideally as a sign-up requirement to collect baseline data. Questions can be added to the bottom of existing forms that are mandatory for funding. This survey should measure the farmers current use of BMP practices as well as demographic and farm characteristics that can be used

as controls in statistical analysis. The same survey should be administered after a set amount of time sufficient for practice adoption. Groups should be similar in the ways in which we can measure (i.e., demographics, farm type, geography etc.). The US Census of Agriculture can be used to identify similar counties for analysis. Use statistical analysis (i.e., difference in difference modeling) to understand whether and to what extent cost share drove BMP adoption.

Surveys: Quasi-experimental without control groups: Surveys can be delivered to assess the impact of an incentive program in a variety of ways. Ideally, a pre and post-intervention survey (i.e. 2 surveys) would be delivered to assess behaviors and views before and after the delivery of an incentive program. Administer a pre survey before cost share is delivered to measure BMP practice use to collect baseline data. This should ideally be a requirement for program participation to ensure high response rates. Administer the same survey after a period of time sufficient for adoption of the BMPs as an exit program requirement. However, in resource limited scenarios, a single-post incentive survey can be effective. The survey should be delivered shortly after a farmer is able to evaluate the impact of an intervention induced behavior change (e.g. post harvest after a new BMP is adopted that may impact yields or profits).
If sample size is sufficient, use statistical analysis (i.e., binary or ordinal regression) to understand the relationship between cost share participation and BMP adoption, while holding demographic and farm characteristic variables constant. For small sample sizes, more basic statistical tests or descriptive accounts can be insightful.

Surveys with non-participants - As resources and capacity allow, it can also be helpful to collect some program feedback from farmers (or other target audiences) in the area who were likely aware of but opted not to participate in the program. A special survey instrument and/or interview questions could be developed to better understand why people did not participate, and what kind of programming might entice them to get more involved.

- Example application to program evaluation:
    - Some interest examples are listed here: https://www.sciencedirect.com/science/article/abs/pii/S0306919223001239
    - Could be used to evaluate the effectiveness of a cost-share program promoting cover crops. Farmers would complete a baseline survey at enrollment, reporting on their current use of cover crops, barriers to adoption, and attitudes toward conservation practices. A follow-up survey 1–2 years later would capture changes in cover crop use, motivations for adoption, and any operational or financial impacts. The data could help

determine whether the cost-share payments influenced adoption rates and identify factors associated with higher or lower uptake.

- Skillsets necessary to conduct method:
    - Survey design and questionnaire development
    - Understanding of BMPs and farming systems
      Data management and analysis
    - Statistical analysis (e.g., regression modeling, matching techniques)
- Who could conduct this method?
    - Graduate students
    - University researchers
    - Survey research firms with agricultural experience
    - State agency evaluation or research staff
- How much would this method cost?
    - Varies based on size of intervention program, but could be accomplished relatively cheaply (<$100,000, assuming labor costs) for smaller pilot programs of 30-50 farmers or less.
    - Moderate to high cost, depending on sample size, number of survey waves, and data analysis complexity.

Qualitative Interviews - These are best collected at times when farmers are already gathered, or one-on-one during “off-times” of the year, such as the winter. Interviews with a select percent of participants can be used to identify more detailed information about outcomes (including unexpected impacts of interventions), and/or as a means to better interpret survey-based findings. Interviews should be semi-structured, and aim to last around 45 minutes on average (though individual interview lengths will vary). Interviews can be performed over the phone or in person. Zoom is not recommended given the average age of producers and variable internet quality in rural areas. Qualitative data can help uncover nuanced insights, unexpected outcomes, or contextual factors that influence adoption, especially those not easily captured through surveys (Prokopy 2011). Additional incentives for participation should be offered to farmers.

Interviews with a select percent of participants should be used to identify more detailed information about outcomes (including unexpected impacts of interventions), and as a means to better interpret survey-based findings. In-person interviews should be strongly recommended as an evaluation tool for this work, and additional incentives for participation should be offered to farmers.

- Example application to program evaluation:
    - Mixed method application: Houser et al. 2025

    - Fleming et al. 2025
- Skillsets necessary to conduct method:
    - Strong interpersonal and interviewing skills
    - Qualitative research design and question development
    - Knowledge of agricultural context and BMP terminology
    - Ability to conduct qualitative coding and thematic analysis
- Who could conduct this method?
    - University-based researchers or Extension staff
    - Independent evaluators or consultants with qualitative expertise
    - Program staff (with proper training and neutrality)
      Graduate students
- How much would this method cost?
    - Moderate cost, depending on the number of interviews and depth of analysis.

Focus Groups: Focus groups are small-scale group interviews or guided discussions (i.e., 3-6 participants). Participants are usually selected through purposive sampling (researcher selects participants based on specific characteristics, i.e., all participants are dairy farmers) or snowball sampling (asking existing participants to help recruit future participants from among their acquaintances). Focus groups can reveal barriers to BMP adoption, perceived program effectiveness, and unintended consequences not easily captured through surveys or quantitative data. These discussions can provide valuable context to help refine program design and outreach strategies. Recruiting farmers to attend focus groups is always difficult, additional incentives for participation should be offered to farmers.

- Example application to program evaluation:
    - Focus groups could be used to explore how farmers/producers perceive **cover crop incentive programs** or **pay-for-performance models** aimed at reducing nutrient runoff into the Great Lakes. For example, a series of focus groups could bring together conventional and organic farmers from different regions (e.g., the Saginaw Bay watershed, Western Lake Erie Basin) to discuss what motivates or discourages adoption of BMPs such as reduced tillage, nutrient management planning, or buffer strips. Insights could help identify adjustments to payment structures, communication strategies, or technical assistance offerings.
- Skillsets necessary to conduct method:
    - Qualitative research design and facilitation skills
    - Experience in moderating group discussions with diverse stakeholders
    - Knowledge of agricultural context and BMP terminology

    - Ability to conduct qualitative coding and thematic analysis
- Who could conduct this method?
    - Trained facilitators from Michigan-based universities (e.g., MSU Extension)
    - Independent contractors or social scientists with agricultural experience
    - Non-profit organizations with ties to farming communities
    - State agency staff with training in stakeholder engagement
- How much would this method cost?
    - Moderate cost, depending on scale, location, and whether facilitation and analysis are done in-house or contracted externally.

Appendix C: Python web scraping instructions:

Tools You'll Need

1. **Python** – Popular language for web scraping.
2. **Libraries**:
    - requests – to fetch web pages.
    - BeautifulSoup – to parse HTML.
    - Optionally: pandas – to organize data into tables.

🕸️ **Step-by-Step Guide**

✅ **Step 1: Install Required Libraries**

If you haven't already, install these using pip:

bash🧰

CopyEdit

```
pip install requests beautifulsoup4 pandas
```

✅ **Step 2: Inspect the Website**

Go to the website you want to scrape. Right-click an element (e.g., a headline, price, etc.) and choose **"Inspect"**. You'll see the HTML structure—this helps you target the data you want.

✅ **Step 3: Basic Scraping Example**

Let's say you want to scrape article headlines from a news website like https://quotes.toscrape.com (a site made for practice).

python

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```
import requests
from bs4 import BeautifulSoup

# Step 1: Get the page
url = "https://quotes.toscrape.com"
response = requests.get(url)

# Step 2: Parse the HTML
soup = BeautifulSoup(response.text, 'html.parser')

# Step 3: Extract data
quotes = soup.find_all('span', class_='text')
authors = soup.find_all('small', class_='author')

# Step 4: Print results
for quote, author in zip(quotes, authors):
        print(f"{quote.text} — {author.text}")
```

✅ **Step 4: Save Data to CSV (Optional)**

python
CopyEdit

```
import pandas as pd

data = [{'quote': q.text, 'author': a.text} for q, a in zip(quotes, authors)]
df = pd.DataFrame(data)
df.to_csv('quotes.csv', index=False)
```

⚠️ **Legal and Ethical Considerations**

- Always check a site's **robots.txt** file (https://example.com/robots.txt) to see if scraping is allowed.
- Don't overload servers—respect request limits.
- Avoid scraping sites that require login or contain copyrighted content unless you have permission.

🧠 **Want to Try With a Specific Site?**

If you tell me what kind of data you want and from what site, I can walk you through a tailored example!

Would you like to try scraping a specific site or keep learning more techniques (e.g., pagination, using Selenium for JavaScript-heavy pages, etc.)?

Appendix D: Stakeholder Mapping

Example: Stakeholder Mapping at the 2025 WLEB Conference: To better understand the stakeholder landscape surrounding water quality issues in the Western Lake Erie Basin (WLEB), we conducted a participatory stakeholder mapping activity during the 2025 WLEB Conference. This session served as a baseline data collection effort to identify key stakeholders and interested parties relevant to water quality planning and implementation efforts across the region.

What we did: The activity took place during a facilitated breakout session with a subgroup of approximately 40 conference participants including water quality advocates, local residents impacted by HABs, staff from local conservation non-profits including watershed councils, Conservation District staff, Quality of Life Agency staff, science panelists, and local philanthropies. Participants were divided into six small groups of 5–7 people to encourage meaningful discussion and consensus-building.

Each group was provided a set of pre-identified stakeholders and interested parties represented on individual sticky notes. These included individuals, organizations, or institutions known to be affected by, to influence, to resist, or to hold relevant knowledge concerning WLEB water quality outcomes. This is the full list of pre-identified stakeholders that were given to the larger group:

- Agricultural retailers
- Local agricultural organizations (e.g., farmer-led groups)
- Drain Commissioners
- Road Commissioners
- Township Planning and Zoning Committees
- Zoning Boards
- Conservation Districts
- MSU Extension
- Farm Bureau
- Lake Associations
- Watershed groups/councils
- River groups
- 4-H/FFA
- Vocational/technical schools
- Colleges & universities
- Hunt and angler organizations (e.g., local hunt and fish clubs)
- Angler organizations (e.g., local fish clubs)
- Conservation organizations (e.g., TNC, Ducks Unlimited, Pheasants Forever)
- Lake Erie/Lake St. Claire Citizens Fishery Advisory Committee
- Great Lakes Fish & Wildlife Indian Commission
- Tribal communities in the WLEB
- Agricultural landowners/producers (small/family)
- Agricultural landowners/producers (large/commercial)
- Private landowners (non-agricultural)
- Nature Centers
- Land conservancies

The groups were instructed to use these sticky notes to populate a two-dimensional interest-influence matrix, a tool commonly used in participatory stakeholder analysis to visually categorize stakeholders based on their relative levels of interest in and influence over a particular issue (Reed et al 2009). Participants ranked each stakeholder on two axes:

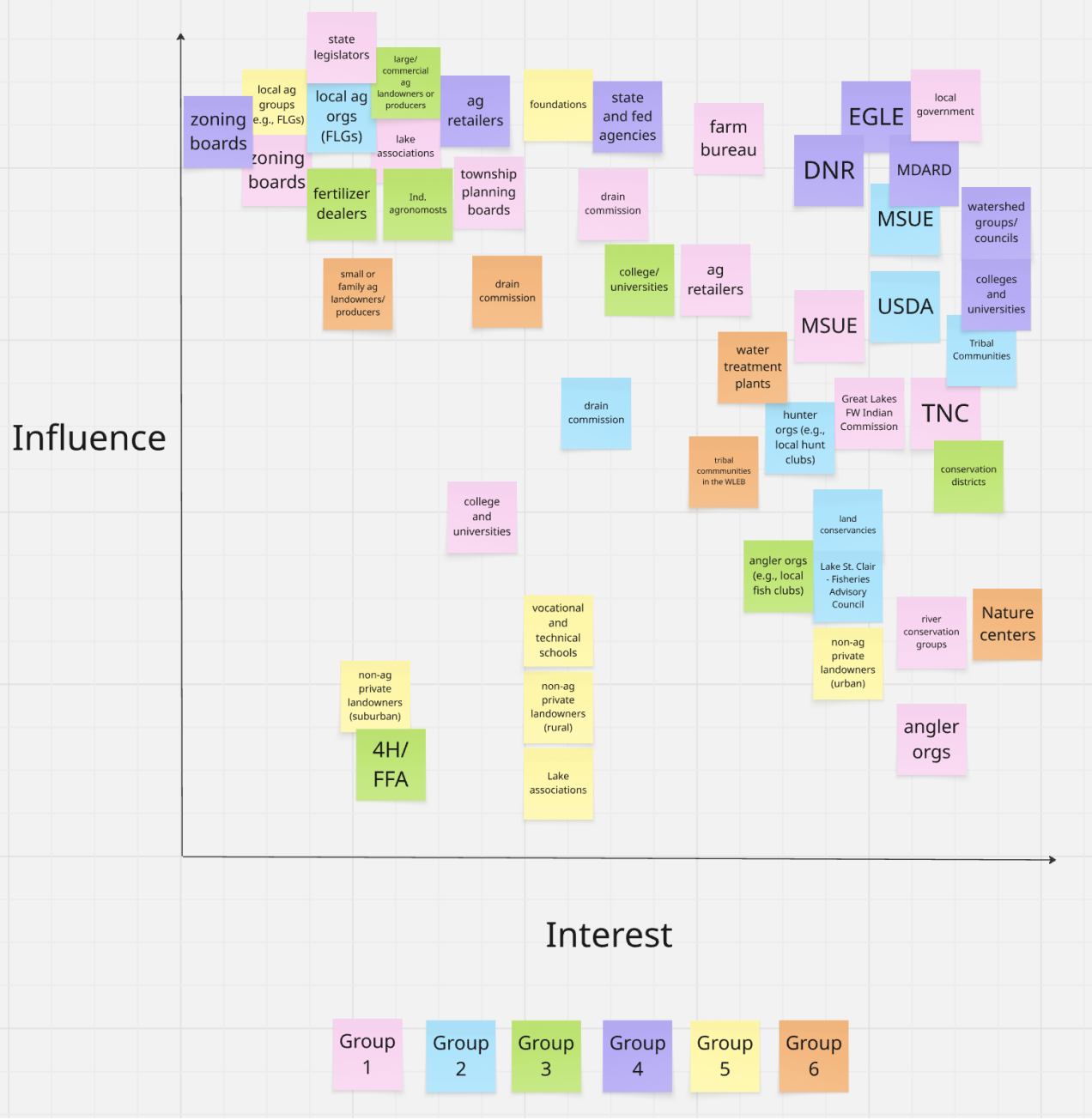
1) interest, ranging from “Unknown” to “Significant Interest” in water quality outcomes, and
2) influence, ranging from “Unknown” to “Significant Influence” over those outcomes.

To guide placement within the matrix, participants were asked to consider factors:

- control over financial or other resources,
- legal authority or formal decision-making power,
- relevant technical knowledge or skills,
- social or political status,
- informal or relational influence, and
- historical involvement in water quality work in the WLEB.

Groups were also encouraged to add missing stakeholders to their matrices if relevant actors were not already represented. Each group constructed its own influence-interest matrix using the sticky notes and a large flip chart, allowing for hands-on deliberation and refinement. The results are displayed in Figure 1.

Figure 1: Influence, interest matrix developed at the 2025 WLEB Conference. Each set of colored sticky notes represents a different group's perception of how stakeholders fall in the matrix.



Follow-up Survey: One month after the event, we distributed a follow-up Qualtrics survey via email to complement the matrix activity and clarify insights into stakeholder dynamics. The survey prompted them to reflect on the stakeholders they had identified and to expand on several themes through the following questions:

- *Who are the trusted messengers? Please describe the community who trusts them.*
- *What are the topical, geographic scope/location, context, personality conditions that help them fit within this?*
- *Who are the key stakeholders who should be involved in different phases of a project? (i.e., planning, implementing, reporting)*
- *Is there anything else you would like to share about why this group belongs in the interest/influence matrix?*
- *What key stakeholders did we miss during the conference breakout session activity?*

Survey respondents suggested adding two stakeholder groups to the interest/influence matrix:

1) local government, villages, and townships are highly interested and have great influence over local ordinances, and
2) state legislators have low interest but high influence over funding and state functions.

This multi-stage approach to stakeholder analysis—beginning with collaborative mapping and followed by reflective elaboration—draws from social learning and systems thinking approaches in natural resource management, which emphasize inclusive, iterative, and context-aware forms of knowledge generation (Prell et al 2009). The use of the influence-interest matrix enables structured comparison of stakeholder perspectives, while still allowing room for locally grounded insights to emerge from participants' experience.

To keep stakeholder analyses and associated matrices up to date, **it's essential to approach it as an ongoing, iterative process.** Stakeholder matrices should be treated as living documents that may require updating as new stakeholders emerge over time. As the context of water quality efforts in the WLEB evolves, it's crucial to revisit stakeholder matrices to ensure they reflect the current situation and needs. We recommend regularly reviewing your stakeholder analyses, adjusting your engagement strategy and associated goals based on new insights or the discovery of additional stakeholders. Specifically, we recommend setting regular, clear intervals for reviewing stakeholder matrices. Matrices should also be revisited in light of new regulatory changes, policies, scientific findings, or other major changes that affect the social and ecological WLEB context.

To effectively update stakeholder analyses, particularly in the context of the WLEB, consider developing different matrices for specific water quality goals, projects, and programs. By tailoring matrices to specific goals, projects, and programs, agencies can ensure a more tailored and relevant outreach, engagement, and/or education approach. For example, one might create separate matrices for agricultural stakeholders regarding nutrient runoff, for local municipalities regarding wastewater management, and for environmental groups focused on aquatic ecosystem health.

Additionally, consider the temporal nature of water quality concerns in the WLEB. Some issues may be more relevant at certain times of the year, while others may require more ongoing attention. The seasonal and contextual variability should be reflected in stakeholder matrices and associated outreach, education, and engagement strategies.

While matrices are a valuable tool for informing outreach, engagement, and planning, they are not ideal for public use, as they can be subjective based on the perspectives of those completing the associated analysis and mapping. However, recognizing the potential subjectivity of matrix development, we recommend working collaboratively on stakeholder analysis efforts in a team/group setting. This may include cross-agency collaboration but it may also involve collaborating with key stakeholders. Rationale for changes to matrices should be documented over time.

Appendix E: Annotated Bibliography

Asprooth L., Arbuckle J.G., Traldi R., Church S.P., Floress K., Gramig B.M., Margenot A.J., Maynard E.T., Thompson A.W., Torres A.P., Usher E.M., Awashra I., Pivaral K., Woodings F.S., and Prokopy L.S. 2025. To diversify or not to diversify: a preliminary report on farmers' perspectives on diversification in the U.S. Midwest. Renewable Agriculture and Food Systems, 40, e14, 1–15 https://doi.org/10.1017/S1742170525000043

This study examines survey data from 725 farmers in the Corn Belt region (Illinois, Indiana, Iowa) to understand farmer perspectives on diversification, including benefits, barriers, and opportunities. Farmers cited economic factors as the key barriers to diversification, including low availability or high cost of land, low short-term returns on investments, and, most critically, low availability of labor. Diversified farmers overall noted a lack of access to credit for diversification, while non-diversified farmers pointed to long distances to diversified markets, restrictive lease agreements, lack of access to buyers, and short term returns on investments as barriers. The top-ranked opportunities for supporting diversification included developing processing capacity for specialty crops and livestock, increasing market demand, and providing information on the return on investment for diversification.
Based on these findings, the authors indicate that **diversification in the Corn Belt could be increased through two key avenues: financial support to provide a safety net for farmers trying new practices and increased investment in and strong supply chains for diversified markets**. They also highlight the need for **different interventions between diversified farmers**, who would benefit most from increased access to credit, and non-diversified farmers, who may benefit more from the building of markets for alternative crops.

Beethem, K., Marquart-Pyatt, S. T., Lai, J., & Guo, T. (2023). Navigating the information landscape: public and private information source access by midwest farmers. *Agriculture and Human Values*, *40*(3), 1117-1135.

The authors of this study utilize data from a 2018 survey of Corn Belt farmers to investigate the agricultural information landscape, focusing on the shift from public to private information sources and the implications for agronomic and conservation decision making. They found that while farmers still use both public and private sources, private sources are consulted more frequently, often through in-person on-farm meetings, whereas public sources are contacted less often and largely through remote channels like phone or online platforms. Public sources were most frequently accessed by farmers with stronger environmental concerns, whereas younger farmers tended to rely more heavily on private sources, raising concerns about the long-term erosion of public influence over conservation messaging.

These findings reveal a mixed-source information ecosystem where mode of contact and farmer characteristics determine access and trust, highlighting the importance of farmer-farmer communication and suggesting that peer networks are central to information dissemination. The authors indicate that public information providers (like extension services) can improve

relevance by increasing on-farm, face-to-face engagement and tailoring content to diverse farmer attitudes, particularly targeting younger producers and those with lower conservation concern.

Bennett, E. A., Burnham, M., Ulrich-Schad, J. D., Arbuckle, J. G., Eaton, W. M., Church, S. P., ... & Williamson, M. A. (2023). Testing the Effect of Modified Sense of Place, Conservation Ethic, and Good Farmer Identity Measures on Predicting the Adoption of Cover Crops in Working Landscapes in Iowa. Society & Natural Resources, 36(5), 513-533.

This study examines the sense of place (SOP) in working landscapes, focusing on how it relates to Iowa farmers' adoption of cover crops. Findings reveal that **physical and dependence are key dimensions of SOP,** and that **understanding farmers' social responsibilities** enhances insights into their conservation decisions.

Bressler, A., Plumhoff, M., Hoey, L., & Blesh, J. (2021). Cover crop champions: linking strategic communication approaches with farmer networks to support cover crop adoption. Society & Natural Resources, 34(12), 1602-1619.

The authors evaluated the Cover Crop Champions program, a peer-to-peer outreach initiative that recruits respected local farmers to promote cover crop use, finding that participants exposed to champion-led events were more likely to report increased conservation knowledge, motivation, and behavioral intent. Champions were perceived as more trustworthy and relatable than agency staff, and their influence helped normalize BMP adoption within local social networks. The findings of this study offer a concrete example of **effective and ethical conservation messaging, demonstrating that peer identity, local credibility, and shared agronomic experience build relational trust.** The authors validate **investments in relationship-based outreach models** over top-down information delivery, an approach that agencies and stakeholders can use to train and support “champions” and involve them in the creation of engagement strategies that address local values and constraints.

Carter, M.R. 2016. What farmers want: the “gustibus multiplier” and other behavioral insights on agricultural development. *Agricultural Economics.* https://doi.org/10.1111/agec.12312

The article highlights recent studies on technology use among farmers who face risks and uncertainties, as well as how hope and aspirations influence their goals. It discusses important new questions in agricultural development economics, emphasizing how insights from behavioral economics can provide fresh understanding in this field. **Behavioral economic experiments have shown that people often don't act the way traditional economic models predict.** These experiments have also found ways to measure what individuals truly prefer when it comes to taking risks and making decisions over time. By understanding these preferences, researchers can explore why people make certain decisions about saving and investing and how changes in preferences can explain why some policies work while others don’t. This new approach allows economists to look beyond just pricing and income as explanations for economic behavior.

Chai, Y., Pannell, D. J., & Pardey, P. G. (2023). Nudging farmers to reduce water pollution from nitrogen fertilizer. Food Policy, 120, 102525.

In this article, the authors integrate **behavioral economics and production theory** to propose novel, low-cost strategies for reducing nitrogen fertilizer application by farmers. They identify three key insights from production economics:

1) many farmers apply fertilizer at rates exceeding what would maximize expected profits
2) nitrogen fertilizer is not a risk-reducing input (contrary to popular belief among producers), and
3) the profit curve around the optimal nitrogen rate is flat, meaning that rate reductions often impose little financial penalty.

The authors maintain that the application of these facts provides opportunities for **practice-shifting behavioral nudges;** they explore the potential of informational interventions, peer comparison, social norm appeals, and insurance instruments as means to shift behavior.

Nudges can be used to reframe nitrogen overuse as a costly misperception (regarding yield response to fertilizer), particularly when the flat profit curve is emphasized to ease perceived tradeoffs and behavioral prompts are tested to leverage social comparison and loss aversion. The authors' findings support revisiting past failures (like BMP insurance) to refine program design, emphasizing reduced transaction costs and improved clarity.

Chapman, M., Satterfield, T., & Chan, K. M. (2019). When value conflicts are barriers: Can relational values help explain farmer participation in conservation incentive programs?. Land use policy, 82, 464-475.

Drawing from farmer interviews conducted in the Puget Sound region, the authors emphasize the importance of incorporating farmers' expertise and preferences, such as considering aesthetic values for tidy landscapes or the use of local knowledge for specific farm management decisions, into agri-environmental incentive programs. They find that **conservation programs often fail to align with farmers' values, which can hinder participation.** Understanding and integrating **relational values** - such as the farmers' connection to their land, community, and landscape - can help design more effective programs that increase participation and reinforce stewardship values.

Duke, J. M., Liu, H., Monteith, T., McGrath, J., & Fiorellino, N. M. (2020). A method for predicting participation in a performance-based water quality trading program. Ecological Economics, 177, 106762.

In this article, the authors develop a predictive framework for estimating farmer participation in water quality trading programs using performance-based payments, accounting for field-level heterogeneity, transaction costs, and behavioral responses to policy design. The authors identify the impacts of price sensitivity, practice compatibility, and expected transaction costs on willingness to participate, offering insight into how programs can be better structured and

communicated to encourage wider farmer engagement. **Their findings demonstrate the use of modeling tools in understanding economics behavior and the influence of transaction costs and administrative issues on participation,** insights which are useful to the design of messages and tools for non-adopters.

Eanes, F. R., Singh, A. S., Bulla, B. R., Ranjan, P., Prokopy, L. S., Fales, M., ... & Doran, P. J. (2017). Midwestern US farmers perceive crop advisers as conduits of information on agricultural conservation practices. Environmental Management, 60, 974-988.

In this study, the authors analyzed farmers' perceptions of crop advisers through surveys, examining CAs' credibility and impact on decision-making in the context of conservation adoption through the **Trust & Influence Framework.** The authors analyze farmers' perception of crop advisors, finding that **CAs are** credible and influential sources of conservation information and as trusted as NRCS, SWCDs, and Extension services. **CA influence is stronger with production-related practices** with conservation benefits (especially when practices align with their production-focused services and offer financial or operational benefits, such as soil health improvements), than with purely conservation-oriented practices. Furthermore, while farmers are open to receiving conservation advice from CAs, they are generally unwilling to pay them for this role.

The CAs' role is hindered by public-private sectoral barriers (e.g. perceived and operational differences, territory) and challenges in collaboration with government agencies, limiting their impact. Some private-sector advisors view public entities like NRCS and Extension as inefficient, bureaucratic, and disconnected from farmers' needs, complicating joint efforts on regional conservation initiatives. Authors suggest incentivizing CAs' role in increasing conservation adoption and improving trust between public and private conservation entities. **CAs have potential to serve as valuable intermediaries by providing farm-specific conservation guidance.** Incentives for CAs to engage more deeply in conservation include entrepreneurial opportunities, billable services tied to conservation practices, and growing farmer receptiveness to their advice. However, deeper involvement is limited by public-private sector tensions, unclear roles, and a lack of formal compensation schemes, pointing to the need for policy reform, trust-building, and clearly defined complementary roles between CAs and traditional conservation agencies. The authors suggest that **CAs should be formally integrated into conservation initiatives**, but highlight the need for clarifying their role, aligning messaging, and incentivizing participation.

Eaton, W. M., Brasier, K. J., Whitley, H., Bausch, J. C., Hinrichs, C. C., Quimby, B., ... & Williams, C. (2022). Farmer perspectives on collaboration: Evidence from agricultural landscapes in Arizona, Nebraska, and Pennsylvania. Journal of Rural Studies, 94, 1-12.

Authors segment producers into different typologies based on their **regard for collaboration and conservation**, mapping out variables like openness to new ideas, level of independence in decision making, and willingness to engage. The authors apply Diffusion of Innovations to highlight the potential of more collaborative early adopters to serve as bridges to middle and late adopters.

Espenshade, J., Reimer, A., & Knuffman, L. (2022). Increasing agricultural conservation outreach through social science. Journal of Soil and Water Conservation, 77(4), 56A-59A.

Synthesizing literature from communication studies, behavioral science, and agricultural extension, the authors **argue against the "deficit model"** (which assumes that farmers just need more information to change). They demonstrate support for **embedding social science into the full cycle of outreach- audience segmentation, co-design, message framing, delivery, and evaluation.** The authors advocate for participatory approaches, theory-informed design, and tracking behavioral outcomes beyond attendance or compliance. Their work calls for outreach that **centers farmer autonomy, social identity, and learning** rather than compliance or persuasion emphasizing that conservation communication must be paired with segmentation tools or developmental evaluation methods. **Outreach must adapt to match audience needs, technology, and trust dynamics.**

Gao, L., & Arbuckle, J. (2022). Examining farmers' adoption of nutrient management best management practices: A social cognitive framework. Agriculture and Human Values, 39(2), 535-553.

This study evaluates factors influencing Iowa farmers' adoption of nutrient management practices to support the Iowa Nutrient Reduction Strategy, which aims to reduce nutrient runoff from agricultural fields. Utilizing social cognitive theory, the research identifies key predictors of adoption, including **self-efficacy, stewardship motivation, and economic pressures,** based on data from the Iowa Farm and Rural Life Poll. The findings offer valuable insights for policymakers and extension agencies to enhance outreach and encourage conservation practices among farmers.

Guo, T., Marquart-Pyatt, S. T., Beethem, K., Denny, R., & Lai, J. (2023). Scaling up agricultural conservation: Predictors of cover crop use across time and space in the US upper Midwest. Journal of Soil and Water Conservation, 78(4), 335-346.

Adoption literature lacks attention to the spatial and temporal precision of practice measures and misses opportunities to identify consistent or diverse mechanisms for scaling up conservation practices. The authors collected data from 1,724 corn and soybean farms in Illinois, Indiana, Michigan,and Ohio to study three measures of cover crop usage: the use of cover crops in a single year on a specific field, % acres planted to cover crops on a farm in a single-year,and years of cover crop use. The models included key biophysical, operational, policy, social,and psychological factors. Five factors performed consistently across measures**: Psychological factors: perceived soil health benefits of cover crops, knowledge about cover crops, profitability farming goals and Operational factors: no-till operation, rotational diversity.**
The effects of the other factors were only associated with the longevity of use: **Psychological factor: sustainability farming goals; Policy factor: have crop insurance; Operational factor: more than 10% of revenue from livestock; Biophysical factor: field classified as**

erodible. Study concluded that policy programs should consider which aspect of scaling-up is being targeted, then focus on corresponding factors that can better tailor policy and education programs to farmer motivations and decision-making contexts.

Ha, T. M., Manevska-Tasevska, G., Weih, M., & Hansson, H. (2024). Heterogeneity in farmers' stage of behavioural change in intercropping adoption: an application of the Transtheoretical Model. Agricultural and Food Economics, 12(1), 12.

The authors apply a behavioral change model (Transtheoretical Model - TTM) to intercropping adoption, identifying key socioeconomic and policy factors influencing different adoption stages. While this study was conducted in the context of European farmers, the authors provide valuable insights into improving adoption. They found that policy support was not significantly associated with the stage of adoption- rather, farmers with increased [conversation practice] knowledge, perceived financial benefits, and ease of implementation were more likely to progress to higher adoption stages. Furthermore, the article identifies heterogeneity in adoption behavior rather than assuming a binary adopter/non-adopter model; the authors emphasize that **outreach should be stage-specific, targeting knowledge gaps and perceived economic/technical barriers to encourage progression toward adoption.** They propose that educational programs should focus on early-stage adopters to correct misconceptions and highlight financial/environmental benefits targeted support for older or less-educated farmers could help bridge knowledge gaps.

Han, G., Schoolman, E. D., Arbuckle Jr, J. G., & Morton, L. W. (2022). Weather, values, capacity and concern: Toward a social-cognitive model of specialty crop farmers' perceptions of climate change risk. Environment and Behavior, 54(2), 327-362.

This study investigates specialty crop farmers' perceptions of climate change risks through a survey, analyzing cognitive, experiential, and socio-cultural influences using structural equation modeling. Findings indicate that while farmers show moderate concern about climatic risks, those feeling more capable and prepared tend to be less worried, whereas **recent experiences with extreme weather increase perceived risks,** highlighting the need for tailored outreach and further research.

Han, G., Grudens-Schuck, N., Arbuckle, J. G., & Martin, R. A. (2022). Adoption challenges, needs for extension programming, and program delivery formats for organic grain producers in the US Corn Belt. Agroecology and Sustainable Food Systems, 46(2), 200-233.

This study surveyed 258 organic grain farmers in Iowa to identify challenges in organic farming adoption, highlighting issues related to **operations, marketing, policy, finance, and social pressures.** Farmers expressed a need for extension programs focused on education, research, and technical services, preferring outreach formats that feature peer leadership, such as field days and mentor programs.

Houser, M., Marquart-Pyatt, S. T., Denny, R. C., Reimer, A., & Stuart, D. (2019). Farmers, information, and nutrient management in the US Midwest. *Journal of Soil and Water Conservation*, *74*(3), 269-280.

In this study, the authors evaluate data from a 2014 Corn Belt Survey to understand which information sources Midwest corn farmers rely on for nitrogen fertilizer management and how those sources influence decision making. They find that most farmers use multiple information sources, including fertilizer dealers, crop consultants, seed suppliers, and university extension. Education and farm size strongly predict diversity of information use. Most importantly, the authors identify a shift away from university extension toward private-sector advisors, raising questions about how commercial interests may influence fertilizer recommendations. They emphasize that understanding information networks is critical to improving nutrient management outreach and targeting messaging toward groups most influenced by non-university actors.

Houser, M., Denny, R. C., Reimer, A., & Marquart-Pyatt, S. T. (2018). Strategies for enhancing University Extension's role as an agricultural information source. *The Journal of Extension*, *56*(6), 19.

This study examines why Midwestern farmers increasingly favor private sector sources over university extension for nutrient management guidance. Through mixed-methods surveys and interviews with over 1200 farmers from Indiana, Iowa, and Michigan, the authors identify the key reasons for low use as declining public funding, conservative recommendations, and perceptions that extension is less cutting-edge than the private sector. They argue that extension must modernize by strengthening partnerships, improving on-farm engagement, and enhancing visibility in order to remain relevant. The authors recommend both structural reforms, like great investment and improved communication strategies, and changes on the ground, like relationship building and tailoring advice to farmer needs, to reestablish trust and influence in extension.

Houser, M. (2022). Does adopting a nitrogen best management practice reduce nitrogen fertilizer rates?. Agriculture and Human Values, 39(1), 79-94.

The author examines whether adopting nitrogen best management practices like split or multiple applications actually reduces fertilizer use among Midwestern corn farmers. Using structural equation modeling of data from over 2500 farmers, the author finds that each additional growing season application of nitrogen is associated with an average increase of 2.4 kg N/ha in total fertilizer rate. This suggests that farmers employ technical BMPs not to conserve nitrogen but to ensure high yields and profitability. The author posits that these results demonstrate how voluntary, within-system approaches may be limited by political and economic constraints.

Houser, M., Campbell, B., Jacobs, A., Fanok, S., & Johnson, S. E. (2024). Farmers' participation in incentivized conservation programs: Exploring barriers and opportunities for innovative designs. Journal of Soil and Water Conservation, 79(1), 20-30.

In this study, the authors explore barriers and opportunities in incentivized conservation programs through their analysis of interviews with ten dairy farmers in Pennsylvania. They find that current programs often enable rather than motivate behavior change; farmers typically adopt practices they were already interested in, using incentives to offset costs. **Key barriers to program success include complex enrollment processes, long approval timelines, and the need for upfront investments**. Farmers also expressed frustration with the blame for environmental degradation being placed on agriculture. Participants suggested that **simplifying applications, partnering with trusted private-sector actors, and publicly recognizing farmers' conservation efforts** could boost program participation and success. Many also suggested **linking incentives** to milk premiums or other **market-based rewards**. The study highlights that, rather than a one-size-fits-all federal model, an approach tailored to local context and farm type could increase adoption rates.

Jackson-Smith, D., Ewing, S., Jones, C., Sigler, A., & Armstrong, A. (2018). The road less traveled: Assessing the impacts of farmer and stakeholder participation in groundwater nitrate pollution research. Journal of Soil and Water Conservation, 73(6), 610-622.

In this study, the authors evaluate the social effects of participatory modeling by comparing stakeholder trust, understanding, and attitudes before and after participation in **collaborative nitrogen modeling.** Their findings demonstrate **significant increases in trust in science and shared understanding,** particularly among individuals that were initially skeptical. These results offer a validated approach to assessing outreach beyond technical outputs, supporting the development of inclusive, transparent stakeholder engagement and how it can generate buy-in, social capital development, and trust.

Lavoie, A., & Wardropper, C. B. (2021). Engagement with conservation tillage shaped by "good farmer" identity. Agriculture and Human Values, 38(4), 975-985.

Transitioning to conservation tillage (CT) systems requires new equipment and changes to management practices. However, **improved technology** (e.g., drills, precise seed and fertilizer placement, fewer passes) **and equipment, technical and financial incentives, reduced input costs (e.g., fuel, labor, time), increased soil organic carbon, and improved water holding capacity** have supported farmers' transition to CT systems (Bista et al. 2017; USDA-NRCS 2016). These factors may allow farmers to demonstrate **cultural capital in the physical and embodied form of new equipment, increased efficiency, and reduced soil erosion.** Engagement with CT systems has been shown to influence how farmers **balance short-term productivist goals with long-term stewardship goals,** as they build both economic and cultural capital (Coughenour 2003; Roesch-McNally et al. 2018).

Lu, J., Ranjan, P., Floress, K., Arbuckle, J. G., Church, S. P., Eanes, F. R., ... & Prokopy, L. S. (2022). A meta-analysis of agricultural conservation intentions, behaviors, and practices: Insights from 35 years of quantitative literature in the United States. Journal of Environmental Management, 323, 116240.

This study reviews 35 years of quantitative literature on conservation practice (CP) adoption in the U.S. to identify factors influencing farmers' behaviors and intentions. The analysis reveals that while **attitudinal factors predict both conservation intentions and actual behaviors**, previous practice use only affects actions, not intentions. Key predictors of actual adoption include **positive attitudes and knowledge about specific CPs, the adoption of other practices, information-seeking behavior, larger farm size, and the presence of vulnerable land**, with notable differences based on the characteristics of the CPs.

Luther, Z. R., Swinton, S. M., & Van Deynze, B. (2020). What drives voluntary adoption of farming practices that can abate nutrient pollution?. Journal of Soil and Water Conservation, 75(5), 640-650.

The authors use a discrete choice experiment to explore how farmers in the WLEB make tradeoffs when considering voluntary nutrient-reducing practices. Factors tested include **program payment size, contract length, BMP flexibility, and expected environmental outcomes.** The results demonstrate that adoption barriers vary by audience segment and depend on perceived risk, complexity, and outcome visibility, suggesting that conservation programs should offer diverse contract options and messaging tailored to different behavioral profiles.

Macrae, M., Jarvie, H., Brouwer, R., Gunn, G., Reid, K., Joosse, P., ... & Zwonitzer, M. (2021). One size does not fit all: Toward regional conservation practice guidance to reduce phosphorus loss risk in the Lake Erie watershed. Journal of Environmental Quality, 50(3), 529-546.

Authors recommend a 5-step plan to approach reducing P in Lake Erie watersheds:

1. **Refine P management regions:** The authors propose the initial delineation of P management regions within large, heterogeneous watersheds (like Lake Erie) as a starting point. This involves better understanding the interactions and heterogeneity of landscape and climate factors that affect P losses at a watershed scale.
2. **Develop region-specific guidance:** Create tailored conservation practice catalogs and fertilizer recommendations for different regions, accounting for their unique conditions.
3. **Refine guidance with region-specific field trials:** Conduct field trials and monitoring programs in different regions to quantify the effectiveness of conservation practices and ensure recommendations are grounded in local data.
4. **Incorporate cost-effectiveness analysis:** Integrate economic evaluations into the recommendations to ensure conservation practices are both environmentally effective and financially viable for farmers.
5. **Engage stakeholders:** Work collaboratively with farmers, scientists, and policymakers to develop practical solutions that balance environmental and economic priorities.

Mase, A. S., Babin, N. L., Prokopy, L. S., & Genskow, K. D. (2015). Trust in sources of soil and water quality information: Implications for environmental outreach and education. JAWRA Journal of the American Water Resources Association, 51(6), 1656-1666.

The authors conclude that agricultural respondents tend to trust organizations they are more familiar with, such as University Extension and NRCS, while nonagricultural respondents show less clarity in the relationship between familiarity and trust. **Trust in local and regional organizations** is highlighted as a key component of effective outreach and engagement. This finding suggests that organizations should focus on building familiarity to increase trust and promote the adoption of BMPs.

Mitchell, J. P., Jackson, L. E., Reicosky, D. C., Kassam, A., Shrestha, A., Harben, R., ... & Branco, R. F. (2025). The key role of local and global farmer networks in the development of conservation agriculture in California. Journal of Environmental Quality.

In this article, the authors examine how farmer participation in local and global networks shapes conservation knowledge exchange and adoption. Drawing on interviews and survey data from producers, they find that i**nformation spread through peer networks, trusted advisors, and online forums influences experimentation with new practices more effectively than top-down outreach**. **Local networks help to foster relational trust and context-specific learning, while global connections can introduce new ideas and technological innovations that farmers adapt to local contexts**. The article highlights that conservation adoption is a social process **driven by farmer identity, credibility of messengers, and feedback within communities**. The authors demonstrate how leveraging **both peer and expert learning pathways** increases the resilience and expansion of regional conservation behavior.

Ogieriakhi, M. O., & Woodward, R. T. (2022). Understanding why farmers adopt soil conservation tillage: a systematic review. Soil Secur 9: 100077.

This article synthesizes a broad range of research and identifies gaps in knowledge, such as the mixed perceptions of soil health improvements and the role of risk aversion in adoption decisions. They find that multiple factors, such as **perceived benefits to soil health, government payments, and social relationships, impact farmers' adoption of conservation tillage.** While adoption may be driven by perceived profitability and stewardship, there are **persistent barriers like risk aversion and lack of belief in the practice's soil benefits.** The authors emphasize the importance of agricultural extension and social interactions in facilitating adoption; they note that economic incentives alone are insufficient, suggesting that policies should include education and social network engagement to promote broader adoption. The authors suggest that **government payments be coupled with the agricultural extension activity and outreach** to spread conservation practice benefits to the farming community. Finally, the authors propose **share-leasing** as a viable route to encourage adoption on rented land, and they demonstrate support for the educational narrative that yield maximization does not necessarily represent profitability nor sustainability.

Palm-Forster, L. H., Swinton, S. M., & Shupp, R. S. (2017). Farmer preferences for conservation incentives that promote voluntary phosphorus abatement in agricultural watersheds. Journal of Soil and Water Conservation, 72(5), 493-505.

The authors analyze the effects of different contract characteristics on willingness to adopt through a choice experiment with WLEB farmers, testing relevant variables including payment type (fixed vs. performance-based), environmental outcomes, and program flexibility. They find that **while performance-based payments theoretically improve efficiency, many farmers prefer fixed payments due to risk aversion;** furthermore, flexibility and transparency in BMP selection significantly increase the appeal of programs as well. The results of this study validate the use of behavioral economic tools to refine program delivery before large-scale rollouts and support the design of BMP programs that align with farmer risk profiles and preferences.

Popovici, R., Ranjan, P., Bernard, M., Usher, E. M., Johnson, K., & Prokopy, L. S. (2023). The social factors influencing cover crop adoption in the Midwest: A controlled comparison. *Environmental Management*, *72*(3), 614-629.

In this article, the authors compare neighboring Midwestern counties with similar climate conditions but different cover crop adoption rates to identify why some localities experienced higher adoption rates while others fell behind. Through focus groups and interviews with farmers, crop advisors, and agency staff, they find that high-adopting counties demonstrate **strong collaboration networks** between agency staff and local "cover crop champions," a label which includes farmers, seed dealers, or advisors who actively experiment and help others troubleshoot. These localities normalize cover crops as part of local identity and agronomic strategy, whereas lower-adopting counties may have champions but lack the cross-organizational collaboration and information exchange needed to diffuse practices. The authors find that **economic framing is more effective than soil-health messaging**; farmers already believe in stewardship, but adoption only expands when they see how practices fit within their management system and bottom line.

Prokopy, L. S., Floress, K., Arbuckle, J. G., Church, S. P., Eanes, F. R., Gao, Y., ... & Singh, A. S. (2019). Adoption of agricultural conservation practices in the United States: Evidence from 35 years of quantitative literature. Journal of Soil and Water Conservation, 74(5), 520-534.

This comprehensive review analyzes quantitative studies on the adoption of agricultural conservation practices in the U.S. from 1982 to 2017, revealing that few independent variables consistently influence adoption. Key positive predictors include farmers' **stewardship motivations, environmental attitudes, previous adoption of practices, and awareness of programs**, while variables like land tenure appeared less significant. The review highlights the need for further research on the roles of farmer identity, structural factors, and effective outreach strategies to enhance conservation adoption.

Read, D. J., Blair, E., & Wainger, L. (2024). Effective Engagement Techniques Across the Agricultural Conservation Practice Adoption Process. Environmental Management, 1-17.

This paper reports on two case studies, the first focusing on interviews with conservation practitioners in the Chesapeake Bay watershed, and the second detailing the results of an online experiment aimed to gauge the effectiveness of a visualization intervention across two sequential outcomes in the adoption process.

- Study 1: interviews with conservation practitioners in the Chesapeake Bay watershed, USA, yielded a preliminary model of the different stages in the adoption process and what techniques practitioners find effective at each stage
    - Conservation practitioners suggest clearly explaining the steps in the adoption process, reducing transaction costs, and leveraging practitioner and farmer networks were effective
    - Focus on stages of adoption
- Study 2: online experiment examined the effectiveness of a visualization intervention across two sequential outcomes in the adoption process, seeking further information and contacting a practitioner

Stage-based approach boosts adoption. Conservation is not a one time decision, but rather a process that occurs in stages with different techniques being most effective at different points in that process- need tailored engagement - using the right technique at the right stage, like using visual aids early on and financial incentives at later stages. CPs can improve their strategies by **tailoring engagement techniques to the specific stage in the adoption process** they are addressing, leading to more effective outreach and higher adoption rates

Reimer, A. P., Denny, R. C., & Stuart, D. (2018). The impact of federal and state conservation programs on farmer nitrogen management. Environmental management, 62, 694-708.

Through the analysis of interviews with Midwestern corn producers the authors highlight the importance of program design in influencing farmer participation and conservation outcomes. They discuss how policy shifts have moved emphasis from land retirement to working-lands programs for better conservation outcomes, noting that **working-lands conservation programs (e.g., CSP)** are more effective at shifting nitrogen management practices than land retirement, certification, or outreach-based programs. These programs influence behavior by **engaging farmers with conservation agencies, incentivizing trials, and reducing risk through financial and technical support**. Finally, the authors note that farmer motivations for participation include **stewardship attitudes and avoiding future regulation,** and while conservation practices are generally viewed in a positive light, distrust of government remains a barrier for some producers.

Reimer, A., Doll, J. E., Boring, T. J., & Zimnicki, T. (2023). Scaling up conservation agriculture: An exploration of challenges and opportunities through a stakeholder engagement process. Journal of Environmental Quality, 52(3), 465-475.

This study uses participatory workshops and systems-level analysis to identify barriers and solutions to conservation agriculture adoption in Michigan. Through facilitated dialogue with farmers, conservation staff, and policymakers, the authors delineate economic, social, and institutional hurdles that prevent the scale-up of BMPs. The authors outline the need for **flexible program models, the importance of peer mentorship, and the role of technical assistance in adoption, emphasizing that trust, relevance, and consistency in program delivery matter just as much as if not more than financial incentives.** They demonstrate how adaptive program design and infrastructure, like conservation professionals and farmer

champions, are essential for adoption. In the WLEB, agency outreach must go beyond transactional relationships- **program coordination, consistent funding, and localized support** are important potential success factors in increasing adoption.

Roesch-McNally, G. E., Arbuckle, J. G., & Tyndall, J. C. (2018). Barriers to implementing climate resilient agricultural strategies: The case of crop diversification in the US Corn Belt. Global environmental change, 48, 206-215.

This study explores the barriers and motivations influencing the adoption of diversified crop rotations among farmers in the U.S. Corn Belt, using a combination of survey data and in-depth interviews. Findings indicate that the prevailing intensive corn-based cropping system creates path dependency, limiting farmers' willingness to diversify, although those in more varied watersheds or with livestock are more likely to adopt extended rotations. Additionally, farmers currently using diverse rotations are more inclined to consider them as a strategy for adapting to climate change, suggesting a **need for policy adjustments to promote cropping system diversity in the region.**

Sanderson, M. R., & Hughes, V. (2019). Race to the bottom (of the well): Groundwater in an agricultural production treadmill. Social Problems, 66(3), 392-410.

This study integrates the treadmill of production and ecological modernization theories to explain the persistence of groundwater depletion in the Ogallala Aquifer despite technological gains and increased conservation policy. They demonstrate how government subsidies and income supports reinforce a Jevon's Paradox cycle, in which irrigation technologies not only improve water use efficiency, they also expand irrigated acreage and intensify production. The authors' analysis critiques market and technology driven conservation models, highlighting how **efficiency improvements alone cannot lead to successful conservation outcomes without systemic policy reform. Interventions that focus too narrowly on technical innovation or voluntary incentives may unintentionally further environmental issues if underlying economic drivers remain unaddressed.**

Sawadgo, W. P., Zhang, W., & Plastina, A. (2021). What drives landowners' conservation decisions? Evidence from Iowa. Journal of Soil and Water Conservation, 76(3), 211-221.

Using survey data and probit regression modeling, the authors investigate the adoption of four conservation practices (cover crops, no-till, buffer strips, and sediment basins) by Iowa landowners. Their findings highlight the influence of land tenure on adoption, demonstrating that non-operating landowners often lack both awareness and incentive to prioritize conservation. However, many landowners surveyed expressed interest in supporting tenants if provided with appropriate tax credits or cost-sharing incentives. In the WLEB, where a significant portion of farmland is rented, **engaging absentee landowners and integrating flexible incentives to bridge the owner/operator barriers could help increase adoption.**

Schnitkey, G. D., Sellars, S. C., & Gentry, L. F. (2024). Cover crops, farm economics, and policy. *Applied Economic Perspectives and Policy*, *46*(2), 595-608.

In this study, the authors analyze the economic and policy dimensions of cover crop adoption in U.S. agriculture. They find that while cover crops yield substantial societal benefits, including carbon sequestration, reduced nitrogen and phosphorus runoff, and improved soil health, the private economic returns for farmers are often negative or uncertain due to added costs, yield reductions, and management complexity. The authors propose targeted federal incentives, including integration with crop insurance and carbon markets, to offset costs and expand adoption. The paper highlights the mismatch between private and public benefits, advocating for policy designs that make conservation practices economically viable for producers.

Schoolman, E. D., & Arbuckle, J. G. (2022). Cover crops and specialty crop agriculture: Exploring cover crop use among vegetable and fruit growers in Michigan and Ohio. Journal of Soil and Water Conservation, 77(4), 403-417.

This study examines cover crop adoption among specialty crop growers in Michigan and Ohio, using survey data from 881 farmers to identify patterns and influencing factors. Results show that cover cropping is more common among farmers managing certified organic farms, those influenced by private crop consultants, and those prioritizing agri-environmental goals, particularly vegetable growers. The findings suggest that **enhancing the organic food market and fostering partnerships with private consultants could effectively promote cover crop use in this sector.**

Schwab, E. R., Wilson, R. S., & Kalcic, M. M. (2021). Exploring the mechanisms behind farmers' perceptions of nutrient loss risk. Agriculture and Human Values, 38(3), 839-850.

Targeting communication or outreach efforts towards farmers who operate land with high physical vulnerability to nutrient loss is not a practical means of increasing farmer adoption; these farmers are less likely to be motivated and less likely to be influenced by education. A more effective approach would involve focusing on **formation and expansion of social networks among farmers**; go beyond standard forms like field days or demonstration farms- **Iowa Learning Farms** may provide a successful example.

Shortle, J., Ollikainen, M., Iho, A. (2021). Decision Making at the Farm Level. In: Water Quality and Agriculture. Palgrave Studies in Agricultural Economics and Food Policy. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-47087-6_4

In this chapter of *Water Quality and Agriculture* (2021), the authors explain why financial incentives and market signals alone often fail to yield environmentally optimal outcomes; they highlight that **even rational, profit-maximizing farmers will apply inputs at conservationally suboptimal levels unless externalities are priced or regulated.** They also demonstrate the importance of targeted messaging and policy, supporting the use of **spatially-informed economic models** to guide investment and tailor conservation outreach. The insights of this

chapter provide a framework to communicate economic and ecological trade-offs to skeptical or non-adopting farmers, particularly those influenced by cost-benefit reasoning.

Tong, J., Benning, J., DeLong, C., Schultz, M., & Zhang, W. (2024). What women landowners want to know about conservation. Renewable Agriculture and Food Systems, 39, e35.

Through survey analysis, the authors analyze conversation decision making and participation by women landowners. The authors suggest that policy support should better integrate women landowners into conservation initiatives by tailoring programs to their specific needs. In terms of outreach and communication, they find that **women landowners prefer virtual (e-newsletters, webinars) and printed materials (fact sheets, infographics) over traditional in-person meetings.** Furthermore, they suggest that **conservation messaging should be more inclusive** of non-operating landowners.

Upadhaya, S., Arbuckle, J. G., & Schulte, L. A. (2023). Individual-and county-level factors associated with farmers' use of 4R Plus nutrient management practices. Journal of Soil and Water Conservation, 78(5), 412-429.

The authors examine factors influencing adoption of 4R at an individual and county level. Barriers at the individual level include farmers' **perceived lack of agronomic capacity** to address nutrient losses, while county average **cover crop insurance rate** was negatively associated with adoption at the county level. The authors explore the factors and more, calling for conservation programs to address barriers at multiple levels.

Upadhaya, S., & Arbuckle, J. G. (2021). Examining factors associated with farmers' climate-adaptive and maladaptive actions in the US Midwest. Frontiers in Climate, 3, 677548.

This study analyzes a survey of 1,059 Iowa farmers to understand their responses to climate change-related extreme weather, focusing on adaptive and maladaptive actions in agriculture. Findings reveal that while many farmers adopt adaptive practices, such as using cover crops, **factors like reliance on crop insurance and farm scale can lead to maladaptive strategies**, underscoring the complexity of climate risk management in agricultural systems.

Upadhaya, S., Arbuckle, J. G., & Schulte, L. A. (2021). Developing farmer typologies to inform conservation outreach in agricultural landscapes. Land use policy, 101, 105157.

Through the application of cluster analysis to the results of a longitudinal survey of Iowa farmers, the authors determined four farmer typologies: **Conservationist, Deliberative, Productivist, and Traditionalist.** They define each category based on conservation motivations, barriers, and decision-making influences, noting the need for tailored outreach strategies. Conservationists are innovation-driven and environmentally motivated, while Productivists prioritize yield and profit but worry about policy and future quality of life. Deliberatives show potential for conservation but face perceived barriers, and Traditionalists are the least conservation-oriented, with low trust in conservation info and high perceived challenges. This study shows that audience segmentation using farmer typologies (based on

attitudes, motivations, and identities) can help tailor outreach strategies to improve conservation program effectiveness; however, because these typologies are based on unobservable traits, **more research is needed to link them to observable behaviors and characteristics to better target and engage specific farmer groups.**

Ulrich-Schad, J. D., De Jalón, S. G., Babin, N., Pape, A., & Prokopy, L. S. (2017). Measuring and understanding agricultural producers' adoption of nutrient best management practices. Journal of Soil and Water Conservation, 72(5), 506-518.

This study, drawing from empirical mail survey data from over 1000 farmers and agricultural landowners, found **low adoption rates of nutrient BMPs due to the information-intensive and expensive nature of these BMPs.** Focusing on four practices - NMPs, soil testing, variable rate application, and application timing - provided by crop and fertilizer consultants, the authors found that per acreage payments and expensive equipment costs proved to be barriers to different farmers - **smaller operations and those without adequate access to equipment were less likely to adopt.** The authors provide several suggestions to improve adoption, **including outreach engagement with crop advisors, advertising these BMPs as tools of risk management, improving producer access to necessary equipment, and holding more workshops to combat the information barrier.**

Vaske, J. J., Landon, A. C., & Miller, C. A. (2020). Normative influences on farmers' intentions to practice conservation without compensation. Environmental Management, 66, 191-201.

"The objective of this study was to explore how three normative concepts (i.e., awareness of consequences (AC), ascription of responsibility (AR), and subjective norms (SN)) affect Illinois farmers' intention to continue participation in conservation without compensation." Using conservation payments alone is costly and difficult to sustain. Regulations are unpopular, difficult to enact, and costs may outweigh the benefits. Conservation payments may undermine the ability to encourage farmers to take responsibility for their actions. Need least-cost alternatives to encourage a sense of social responsibility in farmers. Findings suggest that **farmers are willing to do the "right" thing without payment**, and that perceived social influence may underpin the development of moral normative beliefs that compel actions that benefit the environment.

Vegh, T., & Murray, B. (2020). Incentivizing the reduction of pollution at US dairies: Addressing additionality when multiple environmental credit payments are combined. Journal of Agriculture, Food Systems, and Community Development, 9(2), 123-139.

CAFO farmers can sell credits to environmental markets to mitigate environmental impacts of manure by investing in anaerobic digesters. **"Stacking" credits** to finance these operations may be "non-additional" or they do not produce incremental pollution reductions. Credits used for free benefits are problematic if they allow the CAFO to pollute more. Solutions to this include generating credits with **incremental effort and cost**, only allowing credit stacking **at the time of equipment installation**, and offering **partial credits**, or discounting.

Wilson, R. S., Schlea, D. A., Boles, C. M., & Redder, T. M. (2018). Using models of farmer behavior to inform eutrophication policy in the Great Lakes. Water research, 139, 38-46.

Applying Theory of Planned Behavior and SWAT modeling to survey data from farm households in the WLEB, the authors capture and analyze on perceived self-efficacy, or confidence in implementing practice, and response efficacy, or belief in the practice's effectiveness, factors which are critical for designing outreach programs. They highlight how **increasing the perceived efficacy of key in-field practices could boost adoption rates**, citing the need for **targeted outreach programs that enhance farmers' confidence in their ability to implement effective practices and their belief in the effectiveness of these practices in improving water quality.** Potential approaches to building efficacy span a wide range, including low-risk opportunities for producers to test out a practice at a small scale, peer-to-peer learning through field days and farm demonstrations, and discussion and planning engagement at outreach events.

Wuepper, D., Bukchin-Peles, S., Just, D., & Zilberman, D. (2023). Behavioral agricultural economics. Applied Economic Perspectives and Policy, 45(4), 2094-2105.

In this article, the authors present evidence that farmer behavior often **departs from rational profit-maximizing** assumptions due to **loss-aversion, short-term bias, social pressures, and cultural values.** For example, some farmers prefer lump-sum payments as commitment devices or respond more to social comparison nudges than financial incentives. These insights help explain why incentive schemes and programs often fail to attract non-adopters and how strategic, inexpensive nudges can prove more effective. The authors also outline a “behavioral toolbox” for policymakers, explaining how to use **field-tested nudges, adjust framing, and select trusted messengers to increase program efficacy.**

Zhang, W., Wilson, R. S., Burnett, E., Irwin, E. G., & Martin, J. F. (2016). What motivates farmers to apply phosphorus at the “right” time? Survey evidence from the Western Lake Erie Basin. Journal of Great Lakes Research, 42(6), 1343-1356.

This article emphasizes the **role of social norms and peer networks** in conservation practice adoption. The authors posit that farmers’ willingness to apply P at the "right" time is influenced by a mix of intrinsic motivations, like environmental stewardship, and extrinsic factors, such as financial incentives and peer influence. Barriers to adoption of 4R include perceived efficacy and structural barriers including a lack of equipment access, lack of time, and potential uncertainty in weather forecast. The authors suggest that **effective outreach strategies should target both social norms and practical, economic benefits.**

Zimmerman, E. K., Tyndall, J. C., Schulte, L. A., & Larsen, G. L. D. (2019). Farmer and farmland owner views on spatial targeting for soil conservation and water quality. Water Resources Research, 55(5), 3796-3814.

Using a watershed-scale biophysical targeting approach to identify conservation-priority fields, the authors conducted qualitative interviews with farmers and farmland owners to assess

willingness and barriers to BMP adoption. They found that while farmers and farmland owners acknowledge the importance of conservation, they lack sufficient context, certainty, and incentives to adopt BMPs. Farmers are open to spatial targeting but worry about cost, complexity, and loss of autonomy; government program distrust is a recurring theme, indicating that **engagement strategies must build trust and offer flexible, adaptive incentives.** Furthermore, farmers view non-agricultural sources as primary polluters, suggesting a need for **better communication and monitoring networks.** Successful adoption rates would require **trusted partnerships, tailored incentives, and improved technical services.**