Research Agenda: Enabling a National Transition to Climate-Smart Agriculture

Contents

Overview and Purpose

As global climate change continues to cause disrupted weather patterns around the world, there is increased urgency for all sectors to both prepare for unavoidable changes and to do their part in mitigating the greenhouse gas emissions at the root of the climate crisis. In US agriculture, this response is often framed as “climate-smart” agriculture and encompasses a range of practices that include practices to reduce emissions – such as through increased fertilizer use efficiency – practices to increase carbon stored in soils – such as through reducing tillage – and practices to adapt to climate change – such as using cover crops to improve soil resilience to extreme precipitation.

Many of the practices considered part of the climate-smart response are not new – they are conservation practices that focus on reducing soil loss, improving soil quality and soil health, and improving efficiency of the use of fertilizer, crop chemicals, water and energy. These practices can also provide ecosystem services such as improved water quality and support of biodiversity, such as providing habitat through grass waterways, buffer strips and other integration of perennial vegetation into croplands and increasing crop diversity through complex rotations and integration of cover crops. Given that such practices have been promoted and supported for several decades by US government programs, environmental groups and the private sector, can this history inform greater adoption of practices for climate mitigation and adaptation? Or:

What conditions enable the success of voluntary conservation practice uptake in US agriculture?

Support from public and private sector incentive programs has helped many producers voluntarily adopt climate-smart practices. However, these early adopters still represent only a fraction of the total farmers across the country. The overarching research question becomes how far can voluntary conservation efforts go towards the objectives of widespread adoption of one or more climate smart practices?

While much social science research has focused on motivations of individual farm operators, here we take a step back to *examine what conditions they are operating in, and the diverse actors who shape those conditions*. A review of stakeholder reports and academic literature provides us with a range of hypotheses about what types of social, cultural, educational, technological and financial information and incentives lead to successful adoption and persistence of conservation practices. There is limited evidence about the effectiveness of different strategies and a need for rigorous testing of the hypotheses through structured research programs in order to answer the central question.

This document begins to articulate a series of hypotheses to guide research investment. Our goal is to catalyze research that can inform stakeholders on the most effective ways to create enabling conditions in US agricultural communities to accelerate the transition to widespread use of conservation practices, specifically those that have been identified as “climate-smart”.

This document will be shared with experts in the social sciences whose research intersects with the issues discussed here over the course of four short virtual workshops in December 2021. The hypotheses will be focused and refined, and a larger convening event including stakeholders and funding agencies will be held in the first half of 2022.

Category 1: Access to Information and Education

Hypothesis #1.1: Agronomic advisers need access to targeted training and resources on conservation practices

The current agriculture paradigm is optimized for efficiency and high productivity. Climate smart agricultural practices generally require additional labor time for planning and management to optimize across multiple objectives and balance productivity with resilience and environmental impacts. Knowledgeable advisers are a necessary resource to help educate and assist farmers in successful adoption (e.g. Certified Crop Advisers (CCAs), retail agronomists, Extension professionals, district conservationists). These trusted advisers need access to training resources and motivation in the form of demand from their farmer customers in order to spend time and resources developing their own capacity to provide such guidance. Conflicting information from different advisers can also be an impediment; united and consistent messaging is important.

Hypothesis #1.2: Market signals and customer demand can motivate ag retail companies to transition from a product model to a service model

Agricultural retailers serve their farmer-customers by supplying the goods and services necessary to farm successfully. Climate smart practices can be complex in both execution and impact and frequently personal experience using a practice on a farm is necessary for both an advisor and farmer to fully understand the benefits and trade-offs of a new practice. If farmers are not asking for climate smart services, the retailer is not incentivized to invest in the staff resources required to adapt their business model from only selling product to also selling services. Therefore, if the demand from farmer customers was sufficient, retailers would be more likely to pivot their business models in response. Retailers need to be equipped with realistic and accurate information to share with their farmer-customers about where climate smart practices will bring short- or long-term benefits, and where trade-offs are important to consider.

Hypothesis #1.3: Long-term relationships between farmers and knowledgeable advisors are important to ensure the persistence of climate-smart practices after adoption

Transitioning to new practices and understanding the benefits and trade-offs can be a multi-year effort for a farmer. Sustained relationships with knowledgeable, trusted advisers are important to support them in a successful transition that will persist over the long term. Where advisors are supported to engage with a community over the long term, they are able to build trust and speak to the unique circumstances of a community in a manner that successfully incentivizes climate-smart transitions. Adviser positions must be maintained long-term in target communities to build trust with farmers and develop sufficient understanding of the community to speak to their unique circumstances.

Hypothesis #1.4: Non-operator landowner objectives for their land determines to what extent a land manager can pursue climate-smart practices

Much of US farmland is operated under a lease agreement with a non-operating landowner, many of whom do not live on or participate in the direct management of the farm. There are two main types of non-operating landowners: individuals or families who have inherited land and organizations purchasing farmland as an investment. This physical distance between the owner and the land combined with the structure of lease agreements between landowners and operators has led to well-documented challenges to conservation practice adoption and can also complicate participation in federal conservation programs. On one hand, implementing new conservation practices may cause short-term yield reductions, followed by recovered or increased yield and reduced input costs in later years, which can complicate operator finances when engaged in an annual rent payment agreement. On the other hand, investor-landowners may be well-positioned to assist operators in changing practices by providing access to capital. Efforts are underway to reach landowners with additional information about conservation practices and programs and to understand the role that revising lease agreements could play in advancing practice adoption.

Category 2: The role of data and modeling

Hypothesis #2.1: Availability of specific, actionable information on environmental outcomes can drive climate-smart agriculture adoption

Environmental outcomes related to nutrient cycling (soil C emissions and sequestration, soil N emissions) are scientifically complex to predict. Available simulation tools require significant field data for “ground truthing” and calibration, rendering them primarily useful in a research context. This limits the use of such tools in decision support contexts that can illustrate for farmers the potential benefits specific to their fields and practices. As a result, existing decision support tools either rely on simpler models that are less useful in scenario development and/or require onerous data and farmer effort, which is a significant barrier to widespread use. Translation of environmental modeling results into actionable guidance is a necessary first step. Then, providing information based on detailed modeling back to land managers can help overcome hesitancy and uncertainty regarding the environmental benefits of practice changes.

Hypothesis #2.2: The burden of data collection and entry limits use of digital tools

Many digital tools in both the public and private sector promise to use data to provide insights to make climate smart agriculture more achievable. However, lack of data standards and the time burden for data collection hinder progress in this area. Farmers and their trusted advisers may already spend a great deal of time entering data into a platform, then feel tied to that platform unless they repeat the effort elsewhere. The full value of precision agriculture technologies cannot be realized due to these difficulties. Increasing uptake of digital tools could be enhanced by enabling data interoperability and setting standards between platforms as well as increasing farmer familiarity and comfort with the use of digital tools.

Hypothesis #2.3: Limits of data sharing across platforms limit agricultural research

Concerns about data ownership and privacy agreements also limit how agricultural research can take advantage of “big data” methodologies that can analyze vast amounts of information for insights and produce useful analysis on the effectiveness and consequences of changes in farming practices. This barrier limits the public sector research that can be done using actual farm-level records of daily management, and must rely instead on aggregate statistics and regional information derived from remote sensing.

Category 3: Cultural considerations in farming practice transitions

Hypothesis #3.1: Farming culture influences uptake of climate-smart agricultural practices

The U.S. agricultural culture has been shaped over many years to focus on high productivity and efficiency to maximize yields and profit. This has, in turn, led to systems that reduce labor input and consolidate land and farm operations and maximize financial security through government support programs. Transitioning to climate-smart agriculture practices involves additional risk that may, in the short term, limit productivity growth and define economic sustainability through land resilience to extreme events. Starting down the path towards such systems that require more time, training, and, potentially, cost that lead to better climate outcomes can be out of step with cultural expectations, and clearly defining and communicating the benefits in line with cultural expectations will increase uptake.

Hypothesis #3.2: Perception that the costs of changing practices is borne by the farmer while the benefits accrue to society at large is a barrier to transitions

For many years, farmers have been hearing that conservation, sustainability, regenerative and climate smart practices reduce negative environmental impacts. However, there is also the perception society is still asking the farmer to foot the bill for these changes that benefit society at large. While financial support from government programs and private sector incentive programs can assist, the transition to climate-smart practices also involves significant time investment and risk that must be borne by the farmer. Emerging market-based approaches and new and enhanced government and partnership programs to support climate-smart practices could help, if sufficient support is provided to assist farmers in taking advantage of the opportunities available. However, until farmers are either taxed for their environmental impacts or subsidized for the full opportunity costs of their pro-environmental actions, they won’t use as many conservation management techniques as the broader society wants to see.

Hypothesis #3.3: Community perceptions of the science of climate change and value of conservation influence farmer willingness to transition to climate smart agriculture

Skepticism from rural communities of the causes of and risks posed by climate change has been documented by surveys. At the same time, there is evidence of interest in demonstrating commitment to sustainability as evidenced by a desire to communicate participation in voluntary conservation programs. Understanding the prevailing attitudes towards science and conservation in a community to foster collaboration is crucial for identifying effective messaging and action on agricultures impact on the environment

Hypothesis #3.4: Prior experience with conservation programs colors expectations and influences willingness to participate in climate smart agriculture programs

Previous programs promoting financial payment for climate mitigation and other ecosystem services, such as the Chicago Climate Exchange, did not live up to expectations. In addition, negative experiences with government regulations or “red-tape” involved in accessing government programs may influence whether a farmer perceives new initiatives as worth the effort. Current enrollment in ecosystems markets is low, fewer than <1% of farmers, despite the diversity of organizations developing and promoting opportunities now. Identifying the source of skepticism will help in development of future public and private sector programs that can achieve wider adoption of practices.

Category 4: Enabling successful practice transitions from a farm business perspective

Hypothesis #4.1: Payment for environmental performance will lead to the most effective practice implementation

Farms are businesses and it is generally agreed that changes in operations must have a financial return, through increasing profit (by increasing yields and/or reducing production costs), or through some other financial payment to participate in a program, adopt a practice or achieve an ecosystem service outcome. Changing practices from a known system to a new system involves taking on new risks to short-term farm profitability. This goes beyond familiar concerns for yield and crop prices: now growers must consider the costs of new equipment or products, and their continued access to financial mechanisms such as loans and crop insurance. Financial mechanisms that provide payments only after environmental improvement is achieved – which are uncertain and can occur multiple years after the costs of the transition are incurred – are less effective than providing incentive payments that offset the cost and risk of practice changes prior to or in early stages of adoption.

Hypothesis 4.2: Ag retail business models built around selling services can contribute to conservation practice success in the farming communities they serve

Agricultural retailers that offer services to support their growers as they adopt conservation practices – such as digital tools and individualized planning services – are better positioned to profit from supporting their customers in adopting climate smart practices, compared to business models focused on selling larger volumes of products (seed, fertilizer, chemicals). There are challenges to ag retail business that impact willingness and ability to adopt such a business model, including the investment in staff training and education, and existing business relationships with both farmers and input supply companies. These challenges are amplified by the competitive business environment for ag retail, including fluctuations in commodity prices and the emergence of direct-to-farmer wholesale approaches to agriculture input supply. Key questions for the success of climate-smart agriculture include how a successful ag retail business system can profit while supporting conservation practice adoption as a primary business goal. As interest in climate-smart agriculture increases, retailers can help producers overcome barriers to adoption of certain practices by ensuring necessary inputs (e.g. cover crop seed) and services (e.g. split application of fertilizer) are offered to their customers.

Hypothesis 4.3: The economic value of farmland can be both a barrier and an incentive to changing practices

Farmland value in the United States continues to rise due to many factors and is influenced by overall financial conditions as well as the location of the land and potential value of agricultural products produced on the land. While cost of purchasing or leasing cropland is prohibitively high for new farmers who do not inherit land, it also makes the farmland attractive to investor purchasers. In the case of leased farmland, lease agreements can incentivize conservation practice adoption (by investing in long-term land quality) or make it more difficult (focus on annual production and profits is disincentive for managers to adopt practices with long term land quality payoffs). As land prices are being driven ever-higher due to increased investor interest, especially in agricultural regions adjacent to expanding urban areas, understanding what conditions best enable climate-smart practice adoption and support improving farmland climate resilience as an investment is needed.

Hypothesis 4.4: Historical inequality in farmer access to land, technical assistance and financial services shapes current attitudes about and access to conservation programs

Access to technical services as well as financial services is critical for most farmers to acquire land to farm, purchase equipment and plan and fund their operations year to year. Access to equitable financial mechanisms and USDA conservation programs has been barrier for historically disadvantaged communities of farmers (Black, Indigenous, minority groups), preventing some from scaling up operations or driving others out of farming entirely. Farmers with established relationships with lenders may more easily access financial support for practice changes, while new farmers may need to provide additional evidence of expected financial impacts. Exploring whether and to what extent these historical systemic barriers continue to prevent farmers' access to conservation programs and assistance and limit the diversity of farming systems in the country could open opportunities to increasing equity in agriculture.

Category 5: The agricultural value chain inadvertently can incentivize or disincentivize conservation practice adoption through market demands

Hypothesis 5.1: Lack of markets and infrastructure for farm products can make it financially prohibitive for farmers to diversify crop rotations

One common recommendation for climate-smart agriculture is diversification of the farm ecosystem to include additional cash crops, cover crops and to integrate livestock grazing. For example, integration of small grains like oat or wheat in the Corn Belt could accelerate diversification of the corn-soybean system in a manner that improves soil health. New regional markets for these crops would need to emerge, and additional agronomic and the necessary transportation, storage and processing infrastructure would also need to be created in the regional grain processing system. In addition, appropriate seeds and agronomic guidance may not be available because both public and private sector crop breeding programs have historically focused on the main commodity crops.

Hypothesis 5.2: Diversification of standards and programs contributes to confusion and inaction

Many corporate buyers of agricultural products have sustainability, climate or environmental sourcing goals that relate to on-farm practices of their suppliers. With more companies setting such goals, there is opportunity for a collaborative approach that presents a unified signal, but also risk of the corporate interest fragmenting the messaging in a bid for market differentiation. Farmers may find the diversity of terminology, tools, standards and programs for reporting on these objectives challenging to navigate, and overall participation may be reduced as a result. Efforts for standardization of metrics and reporting on environmental progress help farmers to benefit from corporate programs and private sector market opportunities.

Hypothesis 5.3: Vertical integration and reduced competition in input suppliers and commodity purchasers reduces opportunities for climate smart practice adoption

Mergers and acquisitions in the agricultural businesses that both provide inputs (seed, fertilizer, etc.) and markets (grain, meat, etc.) reduce choices for farmers. Overall, such consolidation has led to increased input costs, compounded by lower prices for farm products. This creates greater producer reliance on government supports and financial services to continue operations. Consolidation also reduces options for farmers. For example, growers combating pesticide resistance who wish to plant corn or cotton *without* Bt traits may be unable to find quality seeds that are adapted for their regions.

A note on policy and regulation: We recognize that federal and state government policies and regulations can both incentivize and disincentivize climate smart practice adoption. Our focus here is on the questions specific to voluntary, private sector efforts to influence such adoption; while there may frequently be intersections with government programs, the underlying question of whether and under what conditions these voluntary efforts can increase the scale of adoption will ultimately also inform discussions on new policies or regulatory actions needed to meet national environmental objectives.

Resources:

Barton, B, K James, E Conover, R Paulekas, R Raimond. 2020. Strengthening Sustainable Sourcing Company Commitments for Water Quality in US Row Crops. Ceres and Meridian Institute.

Neto, LCM, B Brewer, AW Gray, L Castro, M Keshavarz. 2021. Ag Retail in Transition: Evaluating a fee-based sustainability service model. Working Paper. Purdue University. Center for Food and Agriculture Business.

USFRA. 2021. Transformative Investments in Climate Smart Agriculture.

International Panel of Experts on Sustainable Food Systems. 2017. Too Big to Feed, IPES-Food Full Report. Available online at: http://www.ipes-food.org/_img/upload/files/Concentration_FullReport.pdf

Slattery, D, Rayburn, K, Birt, N. Growing for the future: Business lessons from ag retail's conservation leaders. EDF and Trust in Food.

Prokopy, L, BM Gramig, A Bower, SP Church, B Ellison et al. 2020. The urgency of transforming the Midwestern U.S. landscape into more than corn and soybean. Agriculture and Human Values DOI: 10.1007/s10460-020-10077-x

Diamond, EP, R Bonnie, E Rowe. 2020 Rural Attitudes on Climate Change. Nicholas Institute for Environmental Policy Solutions. Duke University. NI-R 20-06

Peterson, H.M., R.D. Christianson, J. Frankenberger, J. Bramblett, A. Echols, K. Flahive, S. Flis, B. Haglund, J. Hatfield, S. McMahon, and S. Shafer. 2020. Prioritizing Resources to Meet Water Quality Goals. Sand County Foundation, Madison, Wisconsin.
Available at: https://sandcountyfoundation.org/news/publications.

Peterson-Rockney, M., P Baur, A Guzman et al. 2021. Narrow and Brittle or Broad and Nimble? Comparing Adaptive Capacity in Simplifying and Diversifying Farming Systems. Frontiers in Sustainable Food Systems. DOI: 10.3389/fsufs.2021.564900

Prokopy, LS, K Floress, JG Arbuckle, et al. 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). DOI: 10.2489/jswc.74.5.520

Brock, Caroline, Jessica D. Ulrich-Schad, and Linda S. Prokopy. 2018. "Bridging the Divide: Challenges and Opportunities for Public Sector Agricultural Professionals Working with Amish and Mennonite Producers on Conservation." Environmental Management. 61(5): 756-771.

Survey resources recommended:
https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/conl.12750

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0253872

https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/conl.12750