



**Advancing Economic Opportunities in
Regenerative Agriculture in Iowa:
Stakeholder Report**

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Executive Summary

Iowa State University (ISU) convened a team in the fall of 2023 to assess economic opportunities for regenerative agriculture within the state of Iowa; opportunities for associated commercializable innovations, technologies, and services; and options for state-supported growth through biosciences research and development. The following report summarizes workshops and conversations held with agricultural stakeholders as well as ISU administrators, faculty, and staff.

We found widespread enthusiasm and numerous opportunities for regenerative agriculture in the state of Iowa. Regenerative agriculture can support both new and expanded commercial activities – especially for farms and associated small businesses – and in both rural and urban communities. Stakeholders expressed immediate opportunities with cover crops, crop-livestock integration, and carbon, and growing opportunities with agricultural diversification, connections between food and energy, and reduced dependence on synthetic nitrogen.

The economic benefits to be captured through regenerative agriculture are multifold. Farmers listed those they realize as including improved long-term profitability, new or continued market access, and cost savings and freedom garnered through improved soil functioning and reduced dependence on expensive inputs. Stakeholders expected further community benefits including new or expanded small businesses and associated employment opportunities, more robust food systems with increased access to local foods, improved ability to attract and retain talent, and better environmental quality. Lack of labor and infrastructure, rather than science and technology gaps, were frequently mentioned as substantial barriers to expanding commercial enterprises supporting regenerative agriculture. New commercialization pathways exist, but other economic impacts were expected to be larger.

ISU faculty and staff are motivated to address stakeholder needs for data, knowledge, tools, and training. Research interest among ISU faculty and staff working on regenerative agriculture spans biophysical and human dimensions, and includes engineering. Thematic areas of research interest include crops, crop diversification and cover crops; livestock and crop-livestock integration; food systems; the intersection among agriculture, energy, and carbon; biological inputs; soil and environment; and economics, policy, and other human dimensions. Some of these areas have direct commercial application, whereas others contribute to broader knowledge or teaching on regenerative agriculture and quality of life. There is a gap between what researchers are currently working on and what they want to work on, suggesting substantial additional interest in regenerative agricultural research. There is substantial overlap between researcher activities and the economic opportunities identified by agricultural stakeholders.

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Introduction

Interest in regenerative agriculture is growing worldwide among farmers, businesses, public and private investors, and consumers.¹ Iowa, already a leader in agriculture, is poised to invest in this interest and thereby maintain its global competitive edge. Assets Iowa brings to regenerative agriculture include leadership in farming, agricultural technology, renewable energy, bioeconomic development, and entrepreneurship.² Specific opportunities in regenerative agriculture and the state's ability to leverage them are not widely known.

To address this gap, Iowa State University (ISU) convened a team to assess:

- Economic opportunities to expand regenerative agriculture within Iowa;
- The potential for associated commercializable innovations, technologies, and services; and,
- The potential for state-supported growth through biosciences research and development.

The team gathered input on opportunities in regenerative agriculture from a wide range of agricultural stakeholders and from ISU administrators, faculty, and staff. This report summarizes, in two parts, the series of workshops and conversations held with stakeholders in fall of 2023. The first part describes engagement with agricultural stakeholders across Iowa. Part 2 describes a workshop conducted with ISU administrators, faculty, and staff.

Part 1: Agricultural Stakeholder Perspectives on Economic Opportunities to Expand Regenerative Agriculture in Iowa

Background

In the fall of 2023, we engaged agricultural stakeholders in conversation about economic opportunities to expand regenerative agriculture in the state of Iowa. Stakeholders provided on-the-ground insights into current economic opportunities, opportunities they hope to see in the future, and the kinds of support they need to pursue such opportunities. We found that many of the opportunities and needed investments that were identified align with existing supports provided by the state of Iowa. The stakeholder perspectives we gathered are summarized below.

Stakeholder Engagement Methods

We engaged stakeholders active in agricultural supply chains through five virtual workshops, six individual interviews, and three written responses. We used a multipronged data collection method to accommodate busy and shifting participant schedules, since data collection occurred during the crop harvest season (September – November 2023), and also to allow for deeper conversations with several individuals highly active in expanding use of regenerative agricultural practices among farmers in Iowa. Participants were selected based on core team members' networks, recommendations from the Iowa Economic Development Authority (IEDA), and recommendations from study participants. Our sample

¹ Giller, KE, R Hijbeek, JA Andersson, J Sumberg. 2021. Regenerative agriculture: an agronomic perspective. *Outlook on Agriculture* 50(1):13-25.

² Tripp, S, J Dworin. 2023. Momentum: The Iowa bioscience strategy. Progress review and 2022 update. TEconomy Partners, LLC, Columbus, Ohio.

was not random or representative; rather, we sought creative ideas and to broadly understand stakeholder perspectives on economic opportunities to expand regenerative agriculture in Iowa. We also sought a diversity of responses based on our understanding of individuals' engagement with different areas of agricultural supply chains, specific products (corn, soybean, fruits and vegetables, beef, pork, aquaculture, biofuels), processes with large-scale environmental impact (carbon sequestration and nutrient retention), market focus (local, regional, global), and social and economic agricultural systems.

In September 2023, we sent participation invitations to 73 people; 55 invitees indicated willingness to participate, and 46 participated. Participating stakeholders included approximately 18 farmers (i.e., crop, livestock, and integrated farms), 25 people who provide inputs to or serve farmers (e.g., seed, fertilizer, pesticides, technical, financial, real estate), 17 people who work downstream of farmers in agricultural supply chains (e.g., product aggregators, marketers and commodity organizations, food and biofuel companies, verifiers), and nine people representing additional areas (e.g., environment, research, rural communities, underserved communities). Participant numbers do not add up to 46 because many have multiple roles. For example, several farmers also serve as technical consultants, provide custom management services for other farmers, and/or serve on boards of farmer or commodity organizations.

Stakeholders were asked about (1) their preferred definition of regenerative agriculture, (2) economic opportunities for regenerative agriculture in Iowa today and opportunities they hope to see 5-10 years from now, (3) barriers or gaps to expanding these economic opportunities, and (4) ways the state of Iowa could facilitate the expansion of regenerative agriculture. Workshop structure and the types and number of questions were crafted with the intent of meeting project goals while being respectful of stakeholder time and potential privacy concerns. We stated initial questions broadly to establish an open setting for the discussion and allow for diverse knowledge and creative responses, but probed for specific information based on participant responses.

Workshops and interviews were recorded and transcribed for accurate data collection. Transcripts and written responses were analyzed for themes according to the five areas outlined above. Names, employers, and other personally identifying information were redacted. While sample is purposeful (i.e., information-rich stakeholders were targeted) and not random, we looked for contrasting statements in our analysis to develop holistic understanding of stakeholder perspectives and to reduce bias in our findings.

Defining Regenerative Agriculture

We first asked stakeholders about their preferred definition of regenerative agriculture. We wanted to acknowledge the potential diversity of perspectives among participants and also give them an opportunity to learn from each other. Because workshops were only 1.5 hours long, we asked stakeholders to respond to example alternative definitions rather than supply their own. The definitions were:

- Definition A: "Regenerative agriculture is a systems approach to farming practices that leads to improvements in soil health and an increased capacity to rely on nutrient cycling and other natural processes to sustain productivity indefinitely."

- Definition B. “Regenerative agriculture is a systems approach to farming practices and technologies that work to regenerate topsoil, enhance natural ecosystem services, promote bio-sequestration of carbon, improve farm energy efficiency, and reduce negative externalities.³”
- Definition C. “Regenerative agriculture is a systems approach to farming practices that leads to improvements in the communities and natural processes and on which all people depend.”

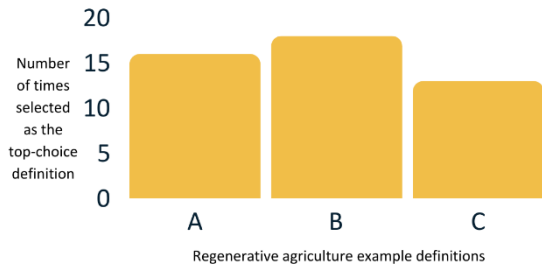


Figure 1. Agricultural supply chain stakeholder preferences for definitions of ‘regenerative agriculture.’

As shown in Figure 1, no one definition spoke to the majority of stakeholders. Many participants who farm and/or consult with farmers tended to prefer Definition A. One farmer summed up this perspective with, “And so the reason that we are doing the practices that we do is because of what [Definition] A is talking about. And it leads to profitability for the farmer.” Another farmer stated, Definition A “...reached out to me the most... soil health is one of the things that has really been in

our focus.” Concerns voiced by some about this definition is that it’s “too narrow” and ambiguous on what constitutes “soil health.”

Participants who preferred Definition B noted the “all encompassing” character of it, and its focus on multiple, measurable outcomes. People who work for businesses that aggregate and market agricultural commodities tended to prefer this definition. Participants who preferred either Definition A or C often reacted negatively to the “jargon-laden” character of Definition B. Many participants were unfamiliar with the term “externalities.”

Participants who preferred Definition C noted its simple, holistic character. One farmer stated, “I chose [Definition] C because... it's communities and natural processes. So, everything all in one, easy for me to understand.” A participant who works for a company that markets meat products indicated, “My top pick was [Definition] C... the broadest, and I think a more holistic approach.” Several participants who chose this definition were reacting negatively to the “narrow” focus of Definition A and “technology” focus of Definition B, recognizing that technology is often expensive for farmers and does not necessarily translate into profitability. Other participants indicated they had not previously considered regenerative agriculture as extending beyond farms to communities.

Several participants voiced ambivalence with all three definitions and provided their own. As an example, one stakeholder framed their definition of regenerative agriculture in terms of health: “Regenerative refers to practices, systems, and philosophies aimed at renewing, revitalizing, and restoring health to ecosystems, communities, and individuals.” Several stakeholders noted the importance of recognizing the history of regenerative agriculture in Iowa and beyond, including investing in Indigenous communities as historical leaders in regenerative agriculture. One stakeholder said, “sometimes regenerative agriculture is being used to describe practices that were originally Indigenous practices that aren't being recognized as having come from Indigenous communities.” Discussions about definitions sometimes

³Tripp, S, J Dworin. 2023. Momentum: The Iowa bioscience strategy. Progress review and 2022 update. TEconomy Partners, LLC, Columbus, Ohio.

We identified three major themes—cover crops, crop-livestock integration, and carbon—from stakeholder discussion of specific opportunities in regenerative agriculture today.

- **Cover crops** – Cover cropping was widely acknowledged as a regenerative farming practice, and stakeholders perceived associated new business opportunities. For example, one stakeholder said: “There's value generation being created, new jobs, there's a lot of young people taking on new jobs. There are farmers making private investment. The fact that farmers are growing cover crop seed and selling it to other farmers, that's a consumer business enterprise that I'm talking about today. That's fledgling. It's happening!” They perceived economic opportunities for farmers adopting the practice (i.e., financial incentives, reduced soil erosion, improved soil biology, improved nitrogen utilization) as well as along an entire supply chain (i.e., producing and marketing seed, seed drying and cleaning, technical support, custom planting, labor). Stakeholders also largely supported continued financial incentives to expand use. There was recognition that the cover crop supply chain needs to be expanded to support increased use of the practice, including support for infrastructure improvements. One farmer said, “There is a huge amount of infrastructure that we still have to put into place to be able to cover the number of acres that we need to cover. Actually, we should try to cover every acre of farmland... We need more seed production, for one, and then we also need... more [cleaning facilities]... And we'll also need trucking... So there's going to be an opportunity for jobs, for small businesses to be developed, whether it be trucking or custom application.” As one participant explained, “There's opportunities for manufacturers of that type of equipment... Like seed cleaning machines, aerial applicators, high clearance cover crop, interseeders. There's like all this business infrastructure that needs to be created to support the anticipated future demand for regenerative ag and practices like cover crops.” Another stakeholder stated, “anything related to cover crops, whether that's growing cover crops, supplying cover crops-- the whole supply chain around that. I think there's massive untapped potential there.”
- **Crop and livestock integration** – The majority of the discussion about improving integration between crop and livestock production focused on integrating ruminants to improve economic and ecosystem benefits, including soil health. Cover cropping was frequently mentioned as a regenerative practice, but often as a cost in the short-term. Participants discussed combining cover cropping with grazing to improve per acre income and create more revenue overall. One stakeholder said, “you think about particularly with cover crops and grazing cover crops, more value per acre, revenue per acre. And that system can work. And farmers start counting that revenue per acre, integrating the crop and livestock system is... We're at the early stages of tapping the value proposition of that enterprise in my view.” Several livestock producers who sell to local and regional markets noted state investments in expanding small-to-medium scale processing capacity, and their need for continued business assistance: “With capital investments and putting up the infrastructure and the initial risk that you take and all of it, to get these small businesses to profitability feels impossible at times. So, if we can help them get there faster or give them more resources for them to realize they're not profitable and the changes they need to make to become profitable, maybe we'd have more people stay in it.” Continued support for small lockers, as well as grazing (fencing, water, labor) were especially highlighted. Anaerobic digestion of manure and upgrading to renewable natural gas (RNG) was also mentioned as an emerging way to improve carbon and nutrient utilization, especially with swine production,

though fewer participants were aware of or ready to engage with this opportunity. Financial incentives currently exist to expand the use of anaerobic digestion through California's Low Carbon Fuel Standard and US Renewable Fuels Standard (RFS2). Concerns about the ability of Iowa businesses to continue to access California's clean fuel program prompted questions about whether there is a role for the state of Iowa to exert leadership. Although not explicitly stated, a challenge in expanding economic opportunities associated with RNG involves the difficulty of establishing pipeline interconnects. Support needed for smaller-scale, community-level biodigesters was also noted.

- **Carbon** – Discussions about carbon were framed both positively and negatively. Positive framing focused on market incentives to reduce the carbon intensity of biofuels and consumer goods through federal and state clean fuel policies and large companies paying for Scope 3 emissions reductions. Some participants were highly aware of tax incentives through the federal Inflation Reduction Act (45Z tax credits), which, depending on final rules, could cascade to farmers employing regenerative practices who sell their corn to ethanol plants as soon as 2025. Negative framing about carbon centered on its narrow scope as an environmental goal, longevity of soil carbon storage, low price of carbon credits, concerns about the ability to measure changes over a timeframe relevant to farmers, and that mention of 'carbon' prompts negative reactions from some farmers. Data requirements of carbon credit programs was listed as a barrier to farmer engagement. Concerns included privacy, record keeping costs, and whether farmers are being adequately compensated for the value of their data.

While noting the opportunities in regenerative agriculture in Iowa are more robust today than a decade or more years ago, stakeholders readily recognized the challenges. Many recognized the time and effort required for transitions, and indicated that dedicated planning and action will be needed for Iowa to realize its leadership potential. Specific areas discussed for growth included diversification, expanding the connections between agriculture and energy, and reducing dependence of corn cropping systems on synthetic nitrogen.

- **Diversification** – Farmer participants often said they are pursuing opportunities to diversify their agricultural income as a means to reduce market and production risk. The ways they discussed doing so included adding livestock and new crops, providing custom management services, or through value-added ventures. Direct marketing to consumers was mentioned as a way to capture more income from efforts to add new crops and livestock, but such efforts may also come with a lot more work and additional risks they did not anticipate. There was widespread support for investments in infrastructure to support diversification. For example, participants wondered if infrastructure being developed in support of cover cropping could be expanded to include new cover crops like pennycress, small grain (e.g., oats, wheat, rye, and Kernza), or oilseed production (e.g., carinata, camelina). It was acknowledged that multiple factors serve as barriers to small grain production, with development and availability of regionally-adapted varieties noted as a particular example. Participants also wondered if the state's program to expand local meat processing capacity could also support expansion of certified kitchens and fruit and vegetable processing, with a need for food hub infrastructure emphasized by multiple stakeholders. One farmer said, "When you look at the statistic that says about 90% of the food that is consumed in Iowa is coming from outside of the state, that creates a tremendous opportunity." An agricultural adviser summed up the discussion about diversification with, "So I think there's a

perception that farmers are wedded to this two-crop system. And I don't think that's true at all... Most of my clients would jump at the chance to diversify. We don't have the infrastructure." A farmer echoed these thoughts, saying: "I'm a corn and soybean farmer myself, but . . . I want my future, my farming future, to be more diverse than that. And so the barriers for me are based around how I can grow more than just corn and soybeans. And that is inclusive of ag finance, seed breeding."

- **Connections between agriculture and energy** – There was a lot of enthusiasm about Iowa's comparatively green energy grid, and that it is an important asset that can be expanded to offer food and fuel produced with a low carbon intensity. One participant expressed, "Iowa is uniquely positioned better than some of the surrounding states with a green energy grid, or a greener energy grid-- a more sustainable energy grid. So that provides a comparative advantage regionally, but then nationally, as well." Several emerging opportunities were discussed, including agrivoltaics, biodiesel, biogas, sustainable aviation fuel (SAF), and use of energy transmission corridors as grazing lands. This discussion was sometimes linked with discussion of the diversification theme by participants. As an example, SAF was discussed as an expanding market for ethanol, and several stakeholders noted the potential for making ethanol out of alternative feedstocks, including small grains. Producing agricultural outputs that have low carbon intensity also closely relates to reducing dependence of all crops on synthetic nitrogen and better managing nitrogen within cropping systems. As one farmer (who is also a farmer consultant) stated, "...it's the carbon-to-nitrogen ratio and biology that is paramount in order to make this work. And our knowledge in that realm is very much lacking."
- **Reducing dependence on synthetic nitrogen** – While not widely voiced, several participants, including farmers, strongly emphasized the economic and environmental opportunities associated with reducing the dependence of corn production systems on synthetic nitrogen fertilizer. One participant stated that the largest opportunity for regenerative agriculture in Iowa is to, "...reduce our reliance on synthetic nitrogen fertilizer.... There are environmental concerns about it. It's a significant cost of production... To me, that's a win-win." Several ways to achieve this were discussed, including through manure and other organic inputs, improving soil biology through a variety of practices (e.g., reduced tillage, cover cropping, crop rotations), and soil microbial amendments. While not explicitly mentioned, research efforts are underway to genetically alter corn to reduce its nitrogen demand or produce its own nitrogen.

In terms of other themes, participants further voiced excitement, but also concern, about the abundance of funding for a wide variety of regenerative agricultural practices that is or will soon be available through USDA Climate-smart Commodities and Regional Conservation Partnership Program projects, as well as other federal and state programs. The substantial financial incentives for farmers and other business to reduce the risk of trying new practices or expanding markets for new products was viewed positively, as well as the opportunity to collect data and learn about what provides value and what does not. The number of opportunities available to farmers, the limited availability of labor, and the inadequate staffing levels at local USDA Service Centers were perceived as challenges that could inhibit participation. Participants wondered whether and how the state of Iowa could provide a supporting role.

While noting the opportunities in regenerative agriculture in Iowa are more robust today than a decade or more years ago, stakeholders readily recognized the challenges. Many recognized the time and effort required for transitions, and indicated that dedicated planning and action will be needed for Iowa to

realize its leadership potential. Specific areas discussed for growth included diversification, reducing dependence of corn cropping systems on synthetic nitrogen, and expanding the connections between agriculture and energy.

Potential Ways for the State of Iowa to Foster Regenerative Agriculture

We asked participants about ways the state of Iowa could foster the expansion of regenerative agriculture. Stakeholders’ ideas on this topic were also diverse and numerous (Table 1). Stakeholders also voiced ideas for regenerative agriculture research. Table 2 lists several of these ideas, some of which cross over with the research ideas discussed by ISU faculty and staff (see Part 2). Many of these stakeholder ideas can be advanced through existing state of Iowa programs (Table 3); however, very few of these programs were mentioned by participants, suggesting that expanded outreach could generate further demand. Investing in people was a cross-cutting theme. One farmer stated, “The most important thing is... making these investments in farmers themselves. If we create the incentives—if we invest in the farmers themselves and then also collateral agribusiness, research, all those kinds of things—the people themselves, then we'll get to the outcomes.”

One of the biggest concerns, voiced repeatedly in the workshops, was labor. Many of the participants brought up labor in general as an impediment to enacting changes. The lack of workers, especially in rural areas, was cited as a hindrance, and a need was expressed for support in training, coordinating, building connections with, and funding employment opportunities for regenerative agriculture workers. One stakeholder voiced concern for how farmer labor is accounted for: “The farm labor thing is really important. One thing I find myself saying a lot is, ‘I wish we could do a study sometime to quantify how much of the labor required to execute Iowa’s crops harvest is unpaid.’ I would postulate it’s 50%, if not more. And none of the current economic analyses we do I think ever contemplate a world where that labor is paid.” A stakeholder who advises and coordinates farmers said, “Technologies aren’t going to do the work. The humans are going to do the work... And that’s our big issue right now is we don’t have enough humans to carry out the work.”

Several participants also noted that there are many people in Iowa, including many Indigenous leaders, who have extensive knowledge and networks around regenerative agriculture, but need investment in the work they are already doing. One stakeholder said, “there is . . . uncounted potential . . . in the people who are passionate about regenerative agriculture and who have poured a lot of . . . time and energy into, not only their own knowledge base, their own understanding, but as well as working on building out the much-needed network.” Investing in regenerative agriculture leaders and workers was also often seen as a step toward improving quality-of-life in rural Iowa: encouraging people (especially young people) to stay in Iowa, building community, and increasing economic opportunities across the board, especially for those who have not had as much access to such economic benefits in the past.

Table 1. Agricultural supply chain stakeholder perspectives on how the state of Iowa can support the expansion of regenerative agriculture.

Theme	Needs
Education and Communication	<ul style="list-style-type: none"> • Communication with farmers about regenerative agricultural principles and practices, and to address mindset barrier among some farmers • Communication with landowners, especially women landowners, about regenerative agricultural principles and practices, and to address knowledge barrier

Theme	Needs
Education and Communication (continued)	<ul style="list-style-type: none"> • Communication with lenders and insurance providers to help facilitate better understanding of the financial needs <i>and</i> economic opportunity of regenerative agriculture • Communication with ag retail sector, which plays a key role in providing services and trusted expertise • Communication with communities about the value of regenerative agriculture to rural health, vitality, and resilience • Communication with and support for existing community leaders and farmers who are already practicing regenerative agriculture • Facilitation of farmer-to-farmer networking, education, and mentorship • Sharing of success stories in regenerative agriculture and framing opportunities in terms of farmer-level, farm-level, community-level, and watershed-level benefits • Tools to help farmers and landowners select among the plethora of incentive programs (esp. multitude of Climate-Smart and Regional Conservation Partnership Program projects) • Tools to help farmers and other small or new businesses market their products • Training opportunities for new and existing producers, focused on agroecology, agroforestry, and skill-building in regenerative agriculture practices • Technical assistance (including from independent advisors) on practice implementation • Outreach to ensure stakeholders are aware of relevant state programs that can support regenerative agriculture
Coordination	<ul style="list-style-type: none"> • Convening of state task force that includes farmer, business, and community stakeholders to develop statewide strategy for regenerative agriculture that reflects a broad range of perspectives and opportunities⁵ • Convening of state, federal, and farm organizations toward creating standard protocols and platforms for protecting, sharing, and using farmer data, as well as mechanisms for returning more of the data value to farmers • Coordination support for farmers’ markets, food hubs, and new farmer-owned cooperatives, particularly for meat processing, fruit and vegetable processing, biofuels
Financing	<ul style="list-style-type: none"> • Equipment acquisition, including small to mid-scale equipment and adaptive equipment • Buffers for yield or other income dips with new practice adoption • Small-business and low-interest loans • Reward system for farmers investing in practices that yield environmental benefits • Support for planting prairie, oak savanna, other perennials
Infrastructure	<ul style="list-style-type: none"> • Seed cleaning and storage equipment for alternative crops • Small-to-medium meat processing facilities • Grazing infrastructure • Fruit and vegetable processing facilities • Food hub infrastructure

⁵ The Conservation Infrastructure effort, co-led by Iowa Agriculture Water Alliance and Iowa Department of Agriculture and Land Stewardship, provides an example multi-stakeholder framework and process for priority setting. This effort was focused on water quality, more specifically implementing the Iowa Nutrient Reduction Strategy ‘by accelerating farmer and landowner demand for conservation practices — through outreach, education, and training — and harnessing economic drivers, innovative market-based solutions, and new revenue streams to improve water quality’. The process and products of the strategy-focused working group, formed as part of the C.I. initiative, offers a significant ‘head start’ on developing a regenerative ag strategy. https://www.nutrientstrategy.iastate.edu/sites/default/files/documents/NRS2019AnnualReportDocs/INRS_2019_AnnualReport_AppendixA_CI19AnnualReport_R20200508.pdf

Theme	Needs
Infrastructure (continued)	<ul style="list-style-type: none"> • Flour and fiber mills • Natural gas line interconnects
Labor	<ul style="list-style-type: none"> • Programs to cultivate entrepreneurial mindset, skills, and abilities • Programs to address labor shortages in rural areas, including farm labor, skilled trade workers (electricians, plumbers, etc.), and USDA staff (including training, education, and outreach for workers, as well as housing, transportation, childcare, multilingual communications, and other rural community development support)
Land access	<ul style="list-style-type: none"> • Resources for connecting livestock farmers with crop farmers to explore grazing opportunities • Resources for connecting landowners with historically marginalized and new farmers • For beginning farmers • For farmers looking to develop diversified operations • For farmers looking to grow produce

Table 2. Stakeholder research interests for regenerative agriculture.

Thematic area	Research interests
Crops / Crop Diversification / Cover Crops	<ul style="list-style-type: none"> • Breeding and testing of alternative crops that are suitable in diversified cropping systems (including but not limited to perennial crops, cover crops, small grains (including barley for malt production), intercropping, crops that can be grown under solar panels) • Breeding and testing of alternative crops that are more adaptable to climate change • Assessing ethanol potential of alternative crops (small grains) • Developing the equipment necessary to manage more diversified/sustainable cropping systems • Improving precision pesticide/herbicide/manure application (and recommendations for avoiding drift)
Crop-Livestock Integration	<ul style="list-style-type: none"> • Development of decentralized aggregation systems to help reduce the number of confined animal feeding operations • Effects of cattle grazing on CRP fields
Other Agricultural Systems	<ul style="list-style-type: none"> • Exploration of systems outside of corn and soybean system and how to support such systems in Iowa
Human Dimensions / Education	<ul style="list-style-type: none"> • Inclusion of farmers and ranchers in the ideation and creation of innovations • Understanding mindsets around agriculture and how to effectively engage stakeholders in exploring new possibilities in regenerative agriculture • Understanding what influences adoption of beneficial practices and effective messaging, incentives, and support necessary for adoption • Increasing opportunities for regenerative agriculture training for students within universities and the broader community • Assessing farmer pathways to diversification - diversifying landscapes, diversifying risk, diversifying income stream • Exploring pathways to invest in the work of regenerative agriculture leaders in the state, including Indigenous farmers and communities

Agriculture and Energy	<ul style="list-style-type: none"> • Exploration of perennial corridors as a way to connect farms and offer a transmission pathway for energy, biogas, electricity, and livestock movement • Continued exploration of anaerobic digestion potential, including potential of small-scale, community-level digesters
Carbon	<ul style="list-style-type: none"> • Evaluating the interaction of USDA programs and private voluntary carbon initiatives
Biological Inputs (Microbials)	<ul style="list-style-type: none"> • Research on the effectiveness of biological inputs • Developing equipment to allow application better timed with crop/livestock needs and reduced GHG emissions
Soil	<ul style="list-style-type: none"> • Understanding and communicating the deep carbon cycle • Assessing nitrous oxide emissions • Assessing carbon-to-nitrogen ratio • Developing methods to assess changes in soil organic carbon, soil loss and health • Evaluating pathways to reduce reliance on synthetic nitrogen
Economics and Policy	<ul style="list-style-type: none"> • Quantifying the full economic value (including from environmental benefits) of regenerative agriculture practices and quantifying the economic value lost from non-regenerative practices • Identifying the public and private benefits of regenerative agriculture practices – and how cost-share structures can better support such benefits • Developing economic analyses focused on labor needs and what is necessary to pay for that labor • Developing tools to de-risk adoption of new technologies • Identifying new market opportunities and pathways (including processing, packaging, and transportation to viable markets) and how to reach producers with these opportunities
Models and Data	<ul style="list-style-type: none"> • Sensor and software development • Field and lab data collection on environmental performance • Developing tools to better estimate the greenhouse gas benefits of regenerative agriculture, including but not limited to updates to the GREET model • Developing predictive models to help producers make decisions and control their own data • Iowa-based scientific support for measurement, recording, and verification programs for ecosystem service outcomes <ul style="list-style-type: none"> • Developing inexpensive, easy, and fast ways for farmers to monitor wildlife and clean water (as opposed to only focusing on carbon monitoring) • Modeling to quantify the effects of practice and land use change under varying conditions (soil, climate) across a broader geography (reduce risk, inform policy)

Stakeholder Workshop Themes and Relevant State of Iowa Programming:

Many of the needs expressed in Table 1 and Table 2 align with the mission and programs of IEDA, a specific state of Iowa agency. IEDA’s mission is as follows:

The Iowa Economic Development Authority's mission is to strengthen economic and community vitality by building partnerships and leveraging resources to make Iowa the choice for people and business. Through two main divisions – business development and community development – IEDA administers several state and federal programs to meet its goals of assisting individuals,

communities and businesses. IEDA works to achieve its mission and goals to benefit Iowans while maintaining a high level of transparency.⁶

This mission reflects opportunities to pursue several of the investments noted by stakeholders. Workshop participants highlighted the need for facilitating statewide coordination to more effectively implement regenerative agriculture practices and systems. One stakeholder said, “I think the opportunities are massive when it comes to where people are putting their energy. I think we're seeing it move from pinpoints to aggregates around pinpoints, that shows promise... But I'm seeing a lack of coordination at a level that is demonstrating best in practice. There's a lot of scrambling versus a real concerted effort that pulls resources from an area and puts it into this.” As described in the mission, many of IEDA’s programs involve partnerships with other state and federal organizations/programs, indicating potential for statewide coordination of regenerative agriculture incentives, system-building, and market development. Such partnerships could contribute to conversations regarding changes in lending and crop insurance structures, additionality practices, and accessibility and equity that could support regenerative agriculture in Iowa. Community development programming, in conjunction with statewide partnerships, could support both improving access to land, funding, and education, training, and technical assistance, and also improving trust and effective communication between state entities and, in particular, minoritized communities who have historical and current leadership in regenerative agriculture.

From our understanding of IEDA’s programming, as described on the IEDA website, there are opportunities for investment in regenerative agriculture in almost all of IEDA’s current programming umbrellas. Several of these possible connections are outlined below in Table 3.

Table 3. Potential alignment between workshop themes and IEDA programming umbrellas.

Programming Umbrella	Example Programs (Currently Existing)	Regenerative Agriculture Opportunities and Investments
Innovation	America's Seed Fund: Iowa Program Angel Investor Tax Credit Program Demonstration Fund Innovation Acceleration Fund Innovation Fund Tax Credit Proof of Commercial Relevance (POCR) program Renewable Chemical Production Tax Credit Research Activities Tax Credit	Diversification: crops (small grains, cover crops, produce/local foods, alternative biofuels, agroforestry), type/size of farms, equitable economic opportunities Creative finance mechanisms to help farmers with initial costs, business development, equipment and market development, farmer-owned integration Research investments Support for market development, innovation more broadly
Small Business	America's Seed Fund: Iowa Program Business Expansion & Strategic Trends Business License Information Center Entrepreneurial Investment Awards (EIA) program IASourceLink Shop Iowa State Small Business Credit Initiative (SSBCI)	Diversification: crops (small grains, cover crops, produce/local foods, alternative biofuels, agroforestry), type/size of farms, equitable economic opportunities Creative finance mechanisms to help farmers with initial costs, business development, equipment and market development, farmer-owned integration

⁶ <https://www.iowaeda.com/all-programs/>

Programming Umbrella	Example Programs (Currently Existing)	Regenerative Agriculture Opportunities and Investments
Small Business (continued)	Targeted Small Business (TSB) program	Investments in smaller meat processors Support for market development Improvements in data quality and returns, development of data-sharing platforms Education, communication, and outreach initiatives
Growth	<p>Butchery Innovation and Revitalization Fund High Quality Jobs (HQJ) program New Jobs Tax Credit Targeted Jobs Withholding Tax Credit Workforce Training</p> <ul style="list-style-type: none"> • Accelerated Career Education Program • Community College Consortium • Iowa Jobs Training Program (260F) • Iowa Industrial New Jobs Training (260E) program <p>Apprentices and Internships</p> <ul style="list-style-type: none"> • Iowa Apprenticeship Program Funding • Iowa Student Internship Program • Science, Technology, Engineering and Mathematics (STEM) Internship program <p>Investment and Retirement</p> <ul style="list-style-type: none"> • Angel Investor Tax Credit Program • Employee Stock Ownership Plan Feasibility Study 	<p>Investments in smaller meat processors Diversification: crops (small grains, cover crops, produce/local foods, alternative biofuels, agroforestry), type/size of farms, equitable economic opportunities Creative finance mechanisms to help farmers with initial costs, business development, equipment and market development, farmer-owned integration Expansion of labor resources, training Contributions to rural community growth and development Research investments Education, communication, and outreach initiatives</p>
International	International Trade Office	Support for market development
Community Infrastructure	<p>Annexation, Discontinuance and Land Planning Community Development Block Grant (CDBG) program</p> <ul style="list-style-type: none"> • Career Link Employment Transportation program • Community Facilities & Services • Opportunities & Threats Fund (“Opportunity for Sustainable Community Activities”) • Water and Sewer Fund <p>Iowa Food Insecurity Infrastructure Fund Sustainable Land Use Planning</p>	<p>Expansion of labor resources, training Contributions to rural community growth and development Creative finance mechanisms to help build regenerative agriculture systems Development of cover crop, small grain, and local foods (direct-to-consumer and intermediary markets) infrastructure Diversification: crops (small grains, cover crops, produce/local foods, alternative biofuels, agroforestry), type/size of farms, equitable economic opportunities</p>
Revitalization	<p>Center for Rural Revitalization</p> <ul style="list-style-type: none"> • Support for business and community leaders 	Contributions to rural community growth and development

Programming Umbrella	Example Programs (Currently Existing)	Regenerative Agriculture Opportunities and Investments
Revitalization (continued)	<ul style="list-style-type: none"> • Support for small quality of life projects • Support for innovative projects addressing issues and challenges in rural communities • Support for programming to attract new residents to rural areas <p>Opportunity Zones</p>	<p>Creative finance mechanisms to help build regenerative agriculture systems, support business development and innovation</p> <p>Diversification: crops (small grains, cover crops, produce/local foods, alternative biofuels, agroforestry), type/size of farms, equitable economic opportunities</p>
Iowa Energy Office	<p>Clean Cities program (alternative fuels)</p> <p>Iowa Carbon Sequestration Task Force</p> <p>Iowa Energy Center</p> <ul style="list-style-type: none"> • Iowa Energy Center Grant program • Energy Infrastructure Revolving Loan Program 	<p>Support for market development (alternative fuels)</p> <p>Research investments</p> <p>Renewable natural gas infrastructure and updates to biogas-to-electricity policy</p>

List of Business Opportunities in Regenerative Agriculture Mentioned by Stakeholders
Livestock

- Grass-based livestock production
- Technical assistance on carbon intensity management and tracking for livestock production
- Specialty livestock production for niche markets
- Local, small-scale meat processing

Crops

- Technical assistance on soil health and agronomics of regenerative agriculture
- Low carbon-intensity corn and soybean production
- Small grain (i.e., oats, rye, wheat) crops as relay crops
 - Locally adapted genetics
 - Technical assistance
- Technical support for tracking and reducing the carbon intensity of crops
 - Soil sample collection to inventory soil organic carbon
 - Soil laboratory analysis to analyze soil samples for soil organic carbon
 - Outcome quantification to estimate greenhouse gas reductions and removals
 - Equipment manufacturing to support regenerative practice implementation
 - Companies and entities to enroll farmers and collect necessary data and information
 - Tech companies to develop data management systems
- High quality, verifiable nitrogen application data
- Reducing reliance on synthetic nitrogen fertilizer
 - Companies developing alternatives to synthetic fertilizers
 - Manure management planning and monitoring, recording, and verifying
 - Manure application
 - Biologicals
 - Nitrogen-fixing crops

- Cover crop supply chain
 - Growing, cleaning, drying, storing seed
 - Distribution
 - Planting
 - Termination
 - Consulting
 - Plant breeding
 - Grazing (also requiring fencing, water supply, management)
 - Harvesting biomass
 - Equipment that can plant into cover crops
- Perennials
 - Perennial crop and grazing corridors
 - Perennial nurseries
 - Planting of prairie, oak savanna
- Application of 'biologicals'
- Storage, sales, and technical support of regenerative agriculture-focused soil amendments not available at conventional co-ops

Equipment

- Small to mid-scale equipment for small grains, specialty crops, cover crops
- Large-scale equipment for cover crops
- Equipment for in-season nitrogen application
- Adaptive equipment to improve accessibility for people with different abilities

Local and Regional Foods

- Local foods
- Food hubs
- Culturally appropriate foods
- Certified kitchens
- Fruit and vegetable processing facilities

Other

- Data from the farm
- Improved sensing/measurement
- Ecosystem service markets (carbon credits, nutrient retention credits, credits for water quality, air quality, and biodiversity)
- Agrivolatics
- Agroforestry on marginal lands
- Biogas from anaerobic digestion
- Trades (e.g., electricians, plumbers)

Part 2: Iowa State University Administrator, Faculty, and Staff Perspectives on Research Opportunities in Regenerative Agriculture

Background

One key objective was to obtain input from a broad range of disciplines at Iowa State University (ISU) on current and envisioned future research relevant to regenerative agriculture to determine key science gaps, assess research and development capacity, and identify potential pathways for product and service deployment. The process for ISU stakeholder engagement through a workshop and a summary of some of the relevant research interests of attendees and potential commercial applications are summarized below.

Stakeholder Engagement

To specifically assess science barriers and research gaps stymying the development of commercializable innovations, technologies, and services in regenerative agriculture, we held a workshop for ISU administrators, faculty, and staff in November 2023. The workshop was advertised through news channels internal to ISU. One hundred and fifteen faculty and staff known by the core team to have interest in regenerative agriculture also received personal invitations to the workshop. Forty-four people participated including university, college, and department administrators; faculty with research, teaching, and/or extension appointments; and research and extension staff. Participants were associated with four of ISU's colleges – Agriculture and Life Sciences, Engineering, Ivy College of Business, Liberal Arts and Sciences – demonstrating broad interest in regenerative agriculture.

Information about the Iowa Bioscience Platforms, a state-supported mechanism to facilitate the commercialization of university research innovations, and preliminary results from the external stakeholder engagement were shared. Participants discussed 1) current research on regenerative agriculture, 2) research aspirations regarding regenerative agriculture, 3) potential economic opportunities associated with the research, and 4) potential for the research to be advanced through the Iowa Bioscience Platforms. Notes from the ISU workshop were aggregated and analyzed for themes. Names and other personally identifying information were redacted. We looked for contrasting statements during analysis to reduce bias in findings.

Research Opportunities in Regenerative Agriculture

ISU administrators, faculty, and staff were motivated to address stakeholder needs for data, knowledge, and tools. After hearing a presentation on our initial analysis of transcripts and written statements from agricultural supply chain stakeholders, one professor summed up group sentiment this way: “We have a lot of work to do.”

The discussions at the ISU workshop were wide-ranging, as reflected in Figure 3. There is substantial diversity, but also several common thematic areas, of research interest among ISU researchers working on regenerative agriculture (Table 4). Some of these areas have direct commercial application, while others contribute to broader knowledge or teaching on regenerative agriculture and quality of life. There was a gap between what researchers are currently working on and what they want to work on, suggesting substantial additional interest in regenerative agricultural research. There is, however, notable overlap

Table 4. ISU stakeholder research interests on regenerative agriculture and potentially commercializable applications.⁷

Thematic area	Current Research	Additional Future Research Interests	Commercial applications
Crops / Crop Diversification / Cover Crops	<ul style="list-style-type: none"> • Breeding and testing of crops for diversified cropping systems (including corn, soybeans, perennial crops [e.g., RegenPGC], cover crops, small grains, intercropping, and agri-voltaic crops) • Developing equipment necessary to manage more diversified/sustainable cropping systems • Valorizing prairie biomass through production of enzymes • Climate change and double cropping 	<ul style="list-style-type: none"> • Develop dedicated superior cultivars as perennial groundcover • Understand plant dormancy mechanisms, dryland plant genetics and engineer plants such as perennial groundcover with desirable period of summer dormancy • Add values to cover crops such as nitrogen-fixing ability • Evaluate long-term effectiveness of regenerative ag practices, including value of labor changes and economics • Nitrogen management optimization with extreme rainfall and water quality impacts 	<ul style="list-style-type: none"> • Crop advising • Equipment • Custom planting and harvest • Testing for quality (e.g., nutrition, ligno-cellulosic) verification • Product aggregation, processing, and sales • New corn hybrids; new soybean, cover crop, perennial groundcovers, and small grain varieties • Agri-ecologically based products • Lower carbon index crops • Dedicated energy crops
Livestock / Crop-Livestock Integration	<ul style="list-style-type: none"> • Understanding cow response to forages, and how to feed forages • Modeling the physical characteristics of forages • Developing data collection and reporting systems for livestock under various conditions (e.g, management of livestock in barns and free-range require different equipment) • Effects of cattle grazing on CRP fields • LAIYERS Project (land management for improved yields, environmental resilience and sustainability). Plot scale evaluating the impacts of reduced tillage, cover crops and poultry manure on soil health and water quality. 	<ul style="list-style-type: none"> • Deeper understanding of forage alternatives and process for dairy, including cover crops • Expand on LAIYERS GHG work, build out our team and extension work, and broaden project to on-farm • Interaction of systems for cattle/crop and other ag production • Identification of more efficient cattle systems and specific management strategies • Grazing effects on carbon and nutrient cycling, and pathways for getting more grazing livestock on marginal lands, cover crops, prairie strips, etc. • Incorporation of native forbs into livestock production for increased diversity, 	<ul style="list-style-type: none"> • Seed, semen, germplasm, stock development, production, and sales • Custom grazing; grazing cover crops • Pasture and feed mixes to improve efficiency and reduce enteric emissions from livestock • Water, shelter systems for livestock • Livestock aggregation, processing, and sales, including of products' new identity traits • Local meat processing results in more resilient supply chains. (e.g., one pork processing plant is 10 to 15% of U.S. capacity) • Biogas, biomethane • Beef on dairy model lends to secondary product

⁷ Current and future research interests reflect primarily information gathered at the workshop, supplemented by core team knowledge. This table does **not** represent an exhaustive, campus-wide review. Substantial additional regenerative agriculture research is ongoing or in various planning or proposal stages.

Thematic area	Current Research	Additional Future Research Interests	Commercial applications
Livestock / Crop-Livestock Integration (continued)	<ul style="list-style-type: none"> • Beef / dairy crosses to reduce total carbon footprint and increase market options, producing milk and beef from same animal (fewer total ruminant animals for same yield) 	<ul style="list-style-type: none"> ecosystem services, and reduced methane production. • Increase systems understanding of ruminant nutrition through multidisciplinary LCA to inform optimization of enteric methane emissions vs. other outcomes 	<ul style="list-style-type: none"> • Fencing, including virtual • Livestock grazing exchange • Specialty animal products • Local economies – feed supplies, vets, meat packing • Soil health, manure reduce reliance on synthetic N
Food Systems	<ul style="list-style-type: none"> • Does conservation improve honeybee health and productivity? <ul style="list-style-type: none"> ○ Do prairie strips improve beekeeping at a commercial scale? ○ Are consumers willing to spend more for prairie strip honey? • Working with the 10 food hubs around Iowa to aggregate Iowa horticulture crops for sales to schools and institutions • Study of Iowa’s horticulture crops including what is being grown, where being sold, pricing, etc. 	<ul style="list-style-type: none"> • Combining value-added product development studies for food entrepreneurs • Value-added products food development facility at ISU • Study food processing of fruit and vegetable crops including financial scales, desired crops to be processed and potential market outlets 	<ul style="list-style-type: none"> • Horticultural crops - new investments in cold and dry storage, processing, trucking and aggregation • Greenhouses • Prairie strip honey
Agriculture / Energy / Carbon	<ul style="list-style-type: none"> • C-Change / Grass2Gas - assessing ways in which perennials and winter crops can be used more widely as feedstock for anaerobic digestion and production of biogas • Evaluating whether the ‘boom’ in anaerobic digestion and current policy incentives can be used to incentivize and financially justify growing prairie as an energy crop • Economics of carbon markets, anaerobic digestion • Evaluating the interaction of USDA programs and private voluntary carbon initiatives • N optimization in ag (e.g., Iowa Nitrogen Initiative) • Anaerobic digestion system for ISU dairy farm 	<ul style="list-style-type: none"> • Quantify variability in plant tissue composition and biomethane potential of different native plant species • Evaluate willingness to adopt cover crops and prairie and switchgrass for biomass production in anaerobic digestion • Breeding crops for the unique environment of agrivoltaics • Valorizing prairie biomass through production of enzymes – develop this technology into a biorefinery design • Examine other feedstocks important to regen ag for anaerobic digestion such as small grains, in addition to ongoing work with prairie • Partner with the photovoltaics team for student-centric projects 	<ul style="list-style-type: none"> • Advisors • Equipment • Combining renewable energy and ag leads to multiple products from the same land, and when further coupled with regenerative ag practices, offers significant opportunities for developing and marketing lower carbon intensity products • Carbon credit sales (insets and offsets) • Increased renewable energy increases opportunities for upgrading biobased products, carbon capture and utilization, etc.

Thematic area	Current Research	Additional Future Research Interests	Commercial applications
Agriculture / Energy / Carbon (continued)		<ul style="list-style-type: none"> • Partnerships to maintain and grow agri-voltaics • Targeting energy generation systems on marginal or set aside lands to increase ecosystem services • Work with partners (e.g., political leaders, industry) to expand carbon footprint reduction initiatives through public private partnerships • Tools and processes to aid farmers in tracking and reducing C.I. scores • Green ammonia research 	
Biological Inputs (Microbials)	<ul style="list-style-type: none"> • Field data for calibrating and validating yield and environmental claims of products • Development of equipment to allow application better timed with crop/livestock needs and reduced GHG emissions 	<ul style="list-style-type: none"> • Co-location of field plot research on biologicals, soil health, soil sensors 	<ul style="list-style-type: none"> • Advisors • Product production and sales (new micro-bials) • Equipment • Custom applicators
Soil and Environment	<ul style="list-style-type: none"> • Developing improved methods to assess changes in soil organic carbon • Nitrous oxide emissions as function of management and climate • Assessing the impact of pipeline installation on dynamic soil properties • Spatial and temporal changes in soil health as a function of soil management • Extreme rainfall and leaching of nitrogen • Field and lab data collection on environmental performance • Development of tools to better estimate the greenhouse gas benefits of regenerative agriculture, including but not limited to updates to the GREET model • Quantifying the full value (including environmental benefits) of regenerative agriculture practices 	<ul style="list-style-type: none"> • Understand the microbiome of the regenerative ag systems • Better document and predict emissions of GHG from soil as a function of tile drainage and seasonal weather patterns • Improve knowledge of how soil minerals affect bioavailability of N, P, and K • Document impacts of animals (soil fauna) on soil properties and processes – likely of increased importance in more perennial systems • Better document, model, and predict soil properties at management scales • Expand study of Dakota Access Pipeline to recommend what farmers should do to reverse the negative effects of pipeline installation on soils • Examine freeze-thaw effect on soils following pipeline installation 	<ul style="list-style-type: none"> • Advising (soil, environmental, financial, market) • Testing and verification (field, lab, remote sensing, modeling) • Data management and protection • Data advances facilitate traceability and future market access for regenerative ag systems

Thematic area	Current Research	Additional Future Research Interests	Commercial applications
Soil and Environment (continued)	<ul style="list-style-type: none"> • Modeling to quantify the effects of practice and land use change under varying conditions (soil, climate) across a broader geography (reduce risk, inform policy) • Sensor and software development 	<ul style="list-style-type: none"> • Improve coordination of digital and precision ag with soil microbial research • Modeling production efficiency to demonstrate relationship to sustainability and environmental impacts • Can farming and the conservation of endangered species co-occur? <ul style="list-style-type: none"> ○ Will regen ag aid in the conservation of endangered species? (e.g., Monarch, rusty patch bumblebee) ○ Will this conservation cost farmers? 	
Economics, Policy, and Other Human Dimensions	<ul style="list-style-type: none"> • Evaluating net returns to integrated organic poultry and vegetable production in Iowa • Evaluating net returns to cereal rye as a winter crop in integrated crop-livestock operations in Iowa • Net returns for CRP and cover crops used in livestock operations • Inclusion of farmers in the ideation and creation of innovations • Understanding and shifting mindsets • Understanding what influences adoption of beneficial practices and effective messaging, incentives, and support necessary for adoption • Understanding farmer pathways to diversification of risks and income streams • Understanding barriers and facilitators of soil and water conservation practice adoption and disadoption • Understanding farmer and ag stakeholder perspectives on varied pathways toward diversification, specifically biomethane production, diverse crops, and livestock production 	<ul style="list-style-type: none"> • Does regenerative ag scale to be sustainable, especially economically? Factors to consider: willingness to pay, government policies and subsidies, supply chain structures • Research to inform policy change: Policies that make it easier / economically feasible to shift from degrading to regenerative systems • Conduct field experiments on social and economic issue(s) • Classification of precision ag farmers and conservation practices • Developing a research infrastructure to support novel, human-centered solutions to problems in the regenerative ag space • What happens to someone physically when interacting with prairie and other regenerative ag systems? • How do non-landowners get involved and make changes to the landscape? 	<ul style="list-style-type: none"> • Advisor services supporting expanded role of ecosystem services markets • Acceleration of regenerative ag economic opportunities through increased adoption of regenerative ag solutions • Opportunities for early engagement of future customers

Thematic area	Current Research	Additional Future Research Interests	Commercial applications
Economics, Policy, and Other Human Dimensions (continued)	<ul style="list-style-type: none"> • Documenting stakeholder views and attitudes towards regenerative technologies and practices and what factors drive these views and attitudes • Created a simple social-environment, systems-oriented computer simulation model (an agent-based model) to evoke storytelling with community partners • Collaborative storytelling among women landowners and researchers to support climate-smart action • How do farmers using regenerative practices gain legitimacy in their communities? 	<ul style="list-style-type: none"> • Create collaborations between ag researchers and engineers on regen ag technologies⁸ • Document pathways to regenerative ag. How have farmers who are really close to sustainable gotten there? How can their practices work with the other 98% of farms ('easy button' farmers)? • Pursue more collaboration and co-learning with tribal communities • Create a simpler computer simulation model that allows community stakeholders to explore the narratives / connections / synergies related to soil health, climate change, water degradation, land management practices, pollinators, etc. • Work with organizations and industry to create an ecological definition of 'regenerative ag' • Evaluate effective ways to reach landowners through extension 	

⁸ Numerous comments at ISU workshop focused on the importance of increased transdisciplinary collaboration and coordination to support growth of regenerative ag, noting that barriers and opportunities tend to be transdisciplinary.