Breaking the Loop: Strategies for Fighting Climate Change on U.S. Farms

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Breaking the Loop: Strategies for Fighting Climate Change on U.S. Farms

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By
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**Breaking the Loop: Strategies for Fighting Climate Change on U.S. Farms**

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Abstract

Climate change is an increasingly urgent area of research due to the hardships it causes for lands and communities across the globe. Specifically in regard to the United States (U.S.), climate change has many concerning implications on our agricultural system. Increased weather hazards, decreased crop production, and drought are just a few of the hardships American farmers are facing in their fight to keep their farms alive and feed their communities, despite a rapidly changing climate. This study investigates how farmers can fight and prevent climate change through the use of specific mitigation and adaptation strategies on their farms. Semi-structured interviews were conducted among environmental and agricultural professionals from the Midwest U.S. with the intent of uncovering their opinions on climate-smart agricultural practices, their effectiveness, and the feasibility of their implementation on American farms. Analysis of the participants’ responses indicate their primary concerns about the current U.S. agricultural system are the unsustainable practices that are contributing to climate change. The interview data suggests that a multidimensional approach that integrates a variety of sustainable practices – including reducing tillage, enhancing irrigation and animal waste processing systems, diversifying crops, and integrating ‘green’ energy – would be the most effective and feasible way for U.S. farmers to combat climate change. Further research in this area could examine how effective these strategies are in practice and dive deeper into understanding how widespread their implementation currently is.
Introduction

The relationship between climate change and agriculture is a pressing topic in current scientific and social research. Despite the public’s varying perspectives on climate change and the harm it causes (Semenza et al., 2008, p. 482), scientists and farmers argue it is undeniable that the changing climate is negatively impacting ecosystems and communities across the globe (IPCC, 2022, p. 5). Focusing specifically on the United States (U.S.), an increasingly unpredictable climate threatens the resiliency of our nation’s lands and communities (USDA, 2021, p.2). The U.S. Department of Agriculture is concerned about the unsustainability of many current American agricultural practices, as they disrupt natural environmental processes and contribute to greenhouse gas emissions. This then worsens the severity of climate change, contributing to a feedback loop that is difficult to break out of.

The changing climate creates vulnerabilities within our social, economic, and environmental systems that have significant impacts on Americans’ quality of life and relationship with our land. (USDA, 2021, p.3). Farmers are particularly vulnerable – and will grow more so as time goes on – as they are faced with the monumental task of finding and implementing solutions to these “wicked problems” (p.2). Originally defined by city planning theorists Rittel and Webber in 1973, “wicked problems” refer to situations in which any solutions that are developed to solve a problem inevitably end up causing new problems. The complex nature of climate change is a prime example of a wicked problem.

This study utilized semi-structured interviews to examine how professionals in the fields of agriculture and environmental science feel American farmers should address the wicked problem of climate change. Five professionals interviewed for this project, and interviews ranged from twenty to thirty-five minutes. Interview questions ask the participants to comment on their
concerns related to climate change and agriculture, as well as the effectiveness and feasibility of certain climate change mitigation and adaptation strategies. The participants’ responses indicate that an integrated, multidimensional approach to that integrates a variety of sustainable farming practices would be most effective and most feasible for the majority of American farmers. The professionals’ commentary on obstacles to the implementation of these strategies focus primarily on financial barriers, but also on the impact of stigmas and social norms in rural communities.

**Background**

Climate change has been a continuously growing area of research in recent decades, largely due to the impacts it will have on our food systems. Global greenhouse gas (GHG) emissions have increased at least 75% since 1970 (Seijan et al., 2015, p. 38). These emissions have contributed to the continuous warming of our climate and are causing a variety of environmental issues. As described by the United States Department of Agriculture (USDA) in their 2021 *Action Plan for Climate Adaptation and Resilience*, there are five key ways in which climate change is making American agricultural systems more vulnerable.

1. First, climate change “threatens growth in agricultural productivity through direct effects such as changes in temperature and precipitation patterns” (USDA, 2021, p. 3). Farmers who have been growing crops for decades, and those that came before them, grew accustomed to a relatively predictable temperature and precipitation pattern. This is now greatly disrupted as a result of our warming atmosphere, leading to slower crop growth, increased risks of pests and diseases, and crop failure/destruction (p.4).

2. Lack of sufficient water quantity and quality is another main concern for farmers (USDA, 2021, p. 6). Climate change is leading to a variety of impacts on water, including “earlier snowmelt, reduced water supply, more intense and frequent drought, degraded water
quality, excess soil moisture, and greater flooding” (p.6). Water quantity and impact agriculture through effects on soil health, which is important in determining a farmer’s success with crop production (p.7). Water quality is also impacted by agriculture via “excessive runoff and soil erosion, which lead to field production issues and downstream impacts of quality of water resources, including eutrophication and hypoxia” (p.7).

3. The third primary climate-related concern of the USDA is that low-income and minority communities “are more likely to be vulnerable to the impacts of climate change” in a variety of ways (USDA, 2021, p. 9). Health problems caused by air and water pollution, food insecurity due to stresses and vulnerabilities within the food system, and an increased risk of being displaced due to extreme weather events are all ways in which these groups are disproportionately impacted by climate change (p. 9). As climate change continues to threaten American lands and agriculture, these populations will continue to grow more vulnerable.

4. Fourth, climate change is causing “more frequent and intense disruptive [weather] events including hurricanes, floods, drought, and fires” (USDA, 2021, p. 10). Major weather events can wipe out entire communities in a matter of minutes. Rural communities are likely to be disproportionately impacted, as they often lack the communication, technology, and resources to prepare for extreme weather ahead of time (p. 10). Of course, rural areas are where the majority of American farming takes place, meaning our nation’s ability to produce sufficient quantities and qualities of food is put at risk by climate change-induced weather events.

5. The USDA’s final concern regarding climate change is the impact it will have on our nation’s infrastructure and public lands. With changes in weather patterns and an increase
in extreme weather events, there is a risk of damage to our buildings, roads, bridges, and national/state parks (USDA, 2021, p. 13). Much of the infrastructure in the U.S. is already aging and in need of updating, and climate change-induced weather events will increase the likelihood of damage occurring. Not only will this leave communities in disrepair, but it will also impact our distribution system. A study by the National Sustainable Agriculture Information Service found that fresh produce travels on average 1,500 miles on average before reaching its final destination (Hill, 2008, p.1) Damaged infrastructure will impact our ability to send agricultural products across the country, threatening American communities’ access to food certain foods and threatening the financial security of American farmers.

Despite all of the ways in which climate change negatively impacts agriculture, agriculture also inevitably contributes to climate change. This complex relationship between climate change and agriculture can be represented by a feedback loop. Based on an article by environmental engineers Bajželj & Richards (2014), Figure 1 demonstrates how climate change and agriculture interact with each other within this loop (p. 899). Agriculture “affects the climate through the emissions of greenhouse gases (GHGs) and also through agricultural expansion into areas of natural vegetation” (p. 899). These emissions get trapped in our atmosphere, causing the

![Figure 1. The graphic above demonstrates the cyclical relationship between climate change and agriculture. Agriculture contributes to climate change via greenhouse gas emissions (GHGs), and these GHGs further the warming of the climate, thereby continuing the feedback loop. Sourced from: Bajželj & Richards (2014).](image-url)
global temperature to rise over time. This global rise in temperature leads to all of the hardships discussed earlier in this section, including increased weather hazards and lack of sufficient water quantities (USDA, 2021). These impacts threaten the ability of farmers to produce quality crops, resulting in implications for our country’s social and economic systems. Sourced from the book: *Climate Change Impact on Livestock: Adaptation and Mitigation*, the infographic below lists many of the sources of greenhouse gases from agriculture (Seijan et al., 2015). This serves as a helpful reminder of the many inputs that contribute to the continuation of this feedback loop.

**Figure 2.** The graphic at the left provides a visual representation of the sources of greenhouse gases in agriculture, forestry, and other forms of land use. From: V. Seijan et al. (2015).
Breaking the feedback loop between agriculture and climate change is incredibly difficult, as farmers must commit “to reducing emissions to safeguard the environment” while simultaneously growing enough food to support the population (Sejian, et al., 2015). It would seem logical to expand agricultural lands in the face of decreasing agricultural productivity, but current issues will only be intensified if agriculture is expanded. Finding a solution to this dilemma is the goal of this research project. How can American farmers produce food in a way that is resilient and ecologically-sound, while still growing enough to support our people?

Cynthia Rosenzweig, leader of the Climate Impacts group at the NASA Goddard Institute for Space Studies, and co-author Francesco Tubiello’s 2007 article, “Adaptation and Mitigation Strategies in Agriculture,” brings up insightful ideas on the need for using both adaptation and mitigation to help combat climate change. They write that “choosing effective adaptation and mitigation strategies will represent a key challenge for farmers over the coming decades” (Rosenzweig & Tubiello, 2007, p. 870), as “strategies will vary with agricultural systems, location, and scenarios” on individual farms (p. 260). Overall, the authors suggest that a comprehensive, sustainable solution to breaking out of this feedback loop can be found through the use of carefully selected adaptation and mitigation strategies. It is also important to note that climate-change mitigation takes place over a very long period of time, as it requires global reduction of greenhouse gas concentrations in the atmosphere (EPA, n.d.). Adaptation strategies, alongside mitigation strategies, are necessary for this reason; our farmers are being forced to “adapt at the same time they are called on to reduce emissions at the farm level” (Rosenzweig & Tubiello, 2007, p. 870),
Methods

It seems to be well established within the literature that both mitigation and adaptation strategies will be needed if we wish to effectively combat the impacts of climate change within our agricultural system (Rosenzweig & Tubiello, 2007). However, it remains unclear what the most effective strategies are in the eyes of environmental science professionals, as well the reasons it may be difficult for some farmers to implement these practices. For this reason, the primary goal of this project was to answer the following questions:

1. What are environmental science professionals’ perceptions of common climate change mitigation and adaptation strategies?

2. What barriers exist that may prevent farmers from implementing these practices?

I chose to specifically ask about no-till agriculture, enhanced irrigation systems, enhanced animal waste processing systems, and implementing renewable energy on farms, as these were the mitigation and adaptation strategies I saw come up most often when reviewing the literature on these topics.

The data included in this report was sourced from semi-structured interviews with environmental and agricultural professionals. When considering what types of individuals I would reach out to, I contemplated what types of professionals would best be able to answer the research questions stated above. I compiled a spreadsheet of various organic agriculture specialists, extension coordinators, small farmers, professors, and watershed restoration workers from organizations and universities in Illinois and nearby states. I sent out requests for participation to these 23 individuals via email. A flyer about the project was posted on the Northern Illinois University Environmental Studies Facebook page, Instagram, and blog. I also posted information about the project on my personal social media pages and had family and
friends share the posts on their pages. I received one response indicating interest in participation from the flyer, and four from email interactions.

I conducted semi-structured interviews with participants via phone or online video chat services (e.g., Zoom). The meetings took place during October and November of 2023. Participants were located in cities across the U.S, but primarily were based in the Midwest. In total, there were 5 interviews with 5 different participants. Their areas of expertise as well as the depth of experience they have in their fields ranges greatly between participants. On the Informed Consent Form for this research, individuals were asked whether or not they would like their real name included in the final report. Four out of five participants opted to have their name included. The one that opted to remain anonymous will hereon be referred to as “Anonymous Participant 1.” Short biographies of each participant are provided below.

- **Ashley Adair** is an Organic Agriculture Extension Specialist. She earned her MS in Crop Sciences in 2016. In her career, she “interface[s] with the public, especially those growing organic […] crops to understand what their needs are and help direct research efforts at the university to answer those questions.”

- **Arielle Cassiday** is a Geography and Political Science Instructor. She earned her MA in Applied Geography in 2018 and will soon earn her PhD in Political Science. Cassiday has taught courses on “environmental studies [and] world and regional geography,” and says most of her “research thus far in life has been on water access and issues.”

- **Gabrielle Gamify** is a Senior Sustainability Research Analyst. She earned her BS in Environmental Studies and Sustainability in 2021. In her career, she oversees “most
of [the area’s] environmental planning efforts” and serves as the “project manager for [their] regional Climate Action Plan.”

• **Bradley Earnest** is an Environmental Consultant for a private engineering firm. In his work, he designs “planting and stormwater mitigation basins” and performs “post-construction, vegetation, and erosion control inspections for sites.”

• **Anonymous Participant 1** is a Professor for a College of Agriculture and Life Sciences. They earned their PhD in Extension Education in 2007. In their career, they focus on “food systems-based community development” and conducts research and “outreach and extension programming” to promote high quality food systems in local communities.

On average, interviews lasted 25-35 minutes. The interview recordings – some video recordings from Zoom, some voice memos from phone calls – were run through Parrot AI, a free transcription service. The transcripts were analyzed to determine when each participant answered each question, and these responses were then entered into a spreadsheet. Using an inductive process, I pulled out themes that come through in each response. A separate page on the spreadsheet displayed how many times each theme occurred across the participants’ responses to each question. These themes and the number of times they reoccurred guided me to my conclusions about the best recommendations for U.S. farmers to mitigate and adapt to climate change. The *Data Analysis* section below identifies the reoccurring themes present in responses from that part of the interview, along with any pertinent quotations from the interviews. The *Discussion* section will provide summarize the most common themes brought up in interviews and any conclusions or generalizations that can potentially be drawn from the responses.
Data Analysis

The first question of the interview for all respondents (Q2) was: In your words, what is your job/what is the focus of your career or research? I wanted to get a basic understanding of what these individuals are passionate about, as the participants’ backgrounds and areas of expertise could greatly impact their responses. The most common career themes mentioned were community-based research and university engagement. Three of the five respondents specifically mentioned these in their response. The theme of water, referencing both to quality and quantity, came up in two out of five participant’s responses. Other themes that came up only once in response to this question include regional/local planning, food systems, and environmental consulting. I was already aware that each of these participants had a strong environmental science background based on my initial research, but this question revealed that some have additional expertise in other areas that may influence how they respond to the remaining questions. (An important note: statistics like “three out of five indicate…” are not intended to insinuate that the other two participants do not agree with the idea being discussed. They simply did not mention it in their response.)

The next question (Q3) asked participants about how they study or address climate change in their careers. The majority of participants (three out of five) indicated that they address climate change in their career through policy. Arielle Cassiday explained that “from a political scientist’s perspective, we […] look at the economic and policy implications of climate change. What are some international treaties that we can sign on to our protocols? […] How does policy get made? […] How are we funding climate change initiatives and solutions?” Each of these topics is key to understanding how climate change solutions can be found through policy.
Themes mentioned by two participants include soil health, human-environment interactions, water, regional/local planning, and energy. Waste and food systems are some themes mentioned by only one respondent. These responses informed my understanding of how these individuals frame their efforts to combat climate change in their careers. Question 3A asked participants: Do you feel that agriculture makes a significant contribution to greenhouse gas emissions? All five participants indicated that they agree agriculture is a significant contributor to climate change. Two out of five mentioned the raising of livestock and the disruption of natural chemical processes in the soil when asked what aspects of agriculture they believe most heavily contributes to greenhouse gas emissions. Themes brought up by individual participants that do not reoccur in other interviews include biodiversity loss, deforestation, and machinery emissions.

Question 3B asked, if agriculture is a concerning contributor to climate change, should this be of concern to the U.S. government, and why? Once again, five out of five respondents agreed that agriculture’s contributions to climate change should be of concern to the federal government. Three out of five indicated the government should be concerned due to the negative economic implications climate change may cause for the American agricultural system. Two suggested that the primary concern is our nation’s food security, as climate change threatens the stability of our food supply. Next, participants were asked if there were any specific farming practices that are most concerning in regard to their contributions to climate change (Q3C). As indicated in Q3A, two out of five participants are most concerned about livestock emissions. Others stated that fertilizer/pesticide input, tillage, and overuse of technology of farming are the most concerning.
The next section of the interview focused specifically on mitigation strategies for farmers to prevent climate change. In other words, what are ways farmers can try to break out of the climate change and agriculture “feedback loop” that was discussed earlier on? Questions 4A1 through 4A4 ask the professionals to give their opinion on various mitigation strategies and their potential effectiveness at fighting climate change. The first of these was no-till/low-till agriculture, which refers to limiting the number of times that that the soil is turned over.

Generally, participants’ responses to Q4A1 indicated that reducing tillage is an effective way to mitigate climate change. Four out of five respondents agreed no-till minimizes disturbances to the soil, allows for better nutrient cycling, and maintains soil biodiversity. These four participants also emphasized cover cropping, or the planting of crops throughout the winter months to keep the soil covered, as an effective method of maintaining soil health across seasons. However, two out of five participants also note that no-till and cover cropping do not sufficiently mitigate climate change or greenhouse gas emissions by themselves, and therefore must be combined with other practices to be most effective.

The second mitigation strategy that participants were questioned on is enhancing irrigation systems to conserve water and reduce energy use, thereby reducing contributions to greenhouse gases. Each of the five respondents indicated that enhancing the efficiency of our systems for watering crops would be very helpful in the effort to mitigate climate change on farms. Three out of five respondents specifically commented that drip-irrigation is of particular interest to them as a way to save water and save farmers money in the long run.

The third mitigation strategy that respondents were questioned about was enhancing animal waste processing systems. Two out of five participants indicated that manure storage systems are a highly concerning area of agriculture that needs to be addressed urgently.
However, they did not reference animal waste’s contribution to greenhouse gases. They focused instead on the environmental injustices that are caused by poor animal waste management. These environmental justice concerns, while not directly related to the topic of this paper, are still important data to consider and could be a topic for further research.

The fourth and final climate change mitigation strategy that participants were questioned on is the implementation of renewable energy systems on American farms. All respondents agree that increasing the use of renewable energy in agriculture would be a positive thing, but four out of five suggested that energy needs to be depoliticized in order to make alternative energy systems more affordable and accessible to farmers. Two out of five also noted that high initial installation and infrastructure costs are a barrier to farmers being able to afford implementing these energy systems on their farms. These same two respondents went on to explain that better storage systems for alternative energy systems are needed in order to make energy production via wind, solar, and hydropower worthwhile.

Question 4B asked participants which of these practices they believe would have the strongest mitigation impact for climate change. All five respondents stated that they believed the biggest mitigation impact would be seen when a combination of approaches and practices is applied. All participants expressed similar feelings that the most pressing issues, and the best solutions, greatly vary depending on a farm or community’s location or financial status. Every situation must be evaluated individually to assess what climate change mitigation strategies would be most effective and impactful in that instance. This is a key finding of this study and will be discussed in further depth in the Discussion section.

Regarding climate-change adaptation strategies, participants were asked: What are some strategies U.S. farmers can employ to adapt to the observable effects of climate change on their
farms (Q5)? Most participants suggested that the best ways farmers can begin to adapt to climate change is by diversifying their crops. Four out of five expressed that diversifying crop production away from staples like corn and soybeans would greatly enhance the resiliency and nutritional value of our agricultural fields. Two out of five indicated that using no-till or low-till practices along with cover cropping are some of the most effective ways to adapt to climate change. It is important to note that no-till and cover cropping were promoted by participants as both mitigation and adaptation strategies. Many strategies could be used both in adaptive and mitigative ways. Two respondents also mentioned that a combination of approaches must be utilized to truly attack the issue, just like with mitigation strategies. There is not a ‘one-size fits all’ approach to dealing with climate change, as every farmer will face different issues. This is a common theme that has come up across many questions. My interpretation of this reoccurrence will be discussed further below in the Discussion section.

**Discussion**

**Participants**

I’d like to begin by discussing the participants, their backgrounds, and how these might have influenced the study. Despite the variety of disciplines the participants come from, there seem to be two “categories” of ways in which they most commonly address or deal with climate change in their careers. The first is the human impacts of climate change, including how people interact with their environment and govern themselves differently as a result of it. Several participants indicated they focus on human-environment interactions specifically, and the majority said they address climate change in their career through politics. The second category is the environmental impacts of climate change, including the health of our soil and water. Participants repeatedly stress the importance of soil health in many of their interviews. Having a
solid understanding of both the social and environmental impacts of climate change is essential to finding climate-smart solutions to unsustainable agricultural practices.

Community and University Engagement

I’d also like to address the significance of the participants’ emphasis on community-based research and university engagement in their responses. Respondent Ashley Adair said her job is primarily “to interface with the public, especially those growing organic […] crops to understand what their needs are and help direct research efforts at the university to answer those questions.” Anonymous Participant 1 also indicated that they most enjoy working on “community-based participatory research projects, or projects working with communities defining what the concerns are for them.” It is valuable to know that the majority of participants prioritize community and university engagement in their work. This has influence on their answers to further questions, especially regarding their emphasis on environmental justice issues caused by mismanaged agricultural waste.

According to the National Institute on Minority Health and Health Disparities, Community-Based Participatory Research (the form of research these participants promote and take part in) allows the community “to serve as an equal partner with scientists” to “ensure that interventions created are responsive to the community’s needs” (USDHHS, n.d.). This type of individualized, community-driven research seems beneficial when solving agriculture and climate change-related issues. Universities can utilize community-based research to understand what farmers need, help them secure the necessary resources, and assist in the effort to make agriculture more sustainable.


**Need for Individualized Conservation Plans**

Another common theme that came up often across participants’ responses is that there is no ‘one-size fits all’ approach to addressing climate change, as every farm and farmer is impacted differently. Across the participant’s responses, it is clear that each farmer will need to use an individualized plan to effectively address their unique situation and relationship with climate change on their farms. It is also repeatedly stated in respondents’ answers that a combination of mitigation and adaptation practices will be needed, as individual practices will not accomplish enough alone. For example, many noted that no-till and cover cropping do not sufficiently mitigate climate change or greenhouse gas emissions by themselves. Anonymous Participant 1 stated, “For me, no-till is not enough alone. It’s a part of a larger suite of agroecological principles that mimic ecological resiliency in our natural environments.” Participants seem to agree that a combination of soil health strategies – including, but not limited to no-till and cover cropping – are what will be needed to establish true resiliency and long-term soil health. This idea is applied to the bigger picture of combatting climate change more generally, as well. A combination of strategies that are shown to be effective at mitigating and adapting to climate change must be employed, and every plan for sustainability must be individualized for each farm’s unique situation.

**Prioritizing Strategies**

Another finding I would like to note is that several participants stated that adaptation must take precedence over mitigation in some cases, or vice versa. Though both are essential in the long run, there are cases where one would need to be prioritized to see the most beneficial impact. For example, when answering the question about enhanced irrigation systems, Bradley Earnest said, “drip irrigation would obviously be a super great way to reduce water overuse,
especially in drier climates or places where the soil has a really poor infiltration rate. […] But I think ultimately the solution is going to be to move away from water heavy crops in the first place.” Ashley Adair expressed a similar sentiment, emphasizing the importance of “timing the applications of any irrigated cropland carefully and selecting crops and crop rotations that favor the environment they’re in.” Participants seem to generally agree that enhancing irrigation systems for agriculture could help to mitigate the U.S.’ agricultural contributions to climate change, but there is also a need to rethink the sustainability of planting such water intensive crops in the first place. This, once again, supports the concept that each farm and farmer will require an individualized sustainability plan to assess what mitigation and adaptation practices are needed most.

**Obstacles to Strategy Implementation**

Throughout their responses to questions about mitigation and adaptation strategies, all participants commented on the barriers that may keep a farmer from being able to actually implement these strategies on their farms. When referring to implementing drip irrigation on large agricultural fields, Bradley Earnest stated, “The costs associated with something like […] that would be prohibitively expensive for a lot of farmers who are already […] swimming in debt.” Other participants expressed similar ideas that some of these strategies, while they would be greatly effective at combatting climate change, are just too expensive for farmers to realistically implement without outside funding or subsidies.

Financial and social barriers seem to be the two biggest obstacles participants see interfering with the implementation of these practices. Ashley Adair made an important point about some of the social influences that play a part in determining how likely these strategies are to be implemented. She expressed that she believes “many of the barriers are very social and
come from the farmer down the road who sees what you’re doing and thinks you’re, like, a bonkers hippie person or something like that. I think the social factors play a bigger role than a lot of folks give them credit for.” This is an important consideration that I feel is often overlooked when discussing barriers to farmers implementing sustainable practices. There is a stigma that surrounds change within agriculture, likely due to the heavy influence of tradition within the industry. This stigma must be broken, as Adair says, if these practices are going to be successfully adopted moving forward.

Participant Gabrielle Gamily stated in her interview, “I think that sometimes we tend to think of climate change as like the farmers are at fault or that the ag [sic] industry is at fault […] and blaming farmers is never the right way to go.” Despite the mutual agreement among professionals that agriculture is a contributing factor to climate change, I feel it is important to remember that this does not mean that farmers are the sole ones at fault for this. As indicated by the literature, years of tradition and lack of scientific knowledge of climate change along with pressures from large farming corporations have led farmers to continue to use unsustainable farming practices that contribute to climate change. Rather than focusing the blame on how farmers are contributing to climate change, we should redirect this effort toward developing and implementing sustainable practices for use on these farms.

An important question for any researcher to ask is: what is the value of this research moving forward? It is my hope that this information will be used to inform farmers in the U.S. about what strategies are available to them in their fight against climate change. American farmers are trusted with one of the most important jobs of all – feeding our nation. Providing these types of support and resources to our farmers will be greatly beneficial both for our food
system and for our people and will be increasingly necessary moving forward as our climate continues to change.

**Conclusions**

**Conservation in Agriculture**

Zoologist and Environmental Science Professor John Banks offers insight into how agriculture and conservation biology – two disciplines that, traditionally, have very different goals – may be able to work together to solve some the climate-related issues discussed in this project. Banks (2004) argues that elements of conservation biology, like “incorporating natural vegetation, mimicking natural systems, integrating community needs, and addressing economic issues, are all critical elements of mutually beneficial solutions” to these issues in agriculture. Participants of this research project expressed very similar sentiments in their responses.

The professionals that participated in this study all emphasize the need for a multidimensional, comprehensive approach to fighting climate change on U.S. farms. Participants agreed that each of the mitigation and adaptation practices discussed in this interview would certainly be helpful for farmers to adjust to the changing climate. However, they also reiterated several times throughout their interviews that these practices have an exponentially larger mitigation impact when used in tandem with other mitigation and adaptation strategies. The interview data suggests that the best way American farmers can fight climate change – both by reducing their contributions to climate change and by adapting to changing conditions – is by implementing individualized conservation plans, curated for individual land and financial situations, that integrate a variety of sustainable practices and approaches.
Key Findings

In summary, three key conclusions can be taken from the interview data.

1. Farmers should implement individualized, integrated conservation plans that incorporate a variety of adaptation and mitigation strategies unique to their farm’s situation.

2. Sometimes, adaptation must take precedence over mitigation, or vice versa. Priorities should be based on each farm’s individual situation.

3. Financial and social barriers exist that may prevent farmers from implementing mitigation and adaptation strategies.

Limitations

This study does have some potential limitations that are important to note. I had originally planned to interview both environmental professionals who are knowledgeable on climate change and local farmers who are already implementing some of these climate-smart practices on their farms. However, I struggled to get any farmers to respond to my communications. Of course, there will always be discrepancies in the desired participant population and the actual participant population. This can be caused by a variety of barriers, but for this particular project I believe this was likely due to the time of year in which the interviews were being conducted. Fall is the primary harvest time for many U.S. farmers and is therefore one of their busiest times of year. If I were to have conducted these interviews in the winter, I may have had an easier time getting farmers to participate.

Looking Forward

Because interviews were only conducted with environmental professionals, and not with farmers themselves, the scope of the study is limited. Future studies that are able to interview farmers could verify if the recommendations provided by the environmental professionals in this
study were effective and feasible for the average American farmer. It would also be valuable to collect information on whether any of these sustainable practices are already being implemented in our area, and to what degree local farmers would be open to implementing them. Another relevant limitation is the fact that the focus of this research project was specifically on agriculture and greenhouse gas emissions. This study does not account for ways agriculture impacts climate change off of the farm – including distribution, processing, etc. – and it does not dive into the many contributors to GHG emissions outside of agriculture. Further research could examine the various ways agriculture contributes to and is impacted by climate change in ways not able to be explored in this study.
References


