Maintaining Relevance in Agricultural Extension Programming Using Classical Extension Methods: A Social Network Analysis of the *Future of Farming Project*

by

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Abstract

Rural Sociology is credited with pioneering social network analysis (SNA) to study the connections between individuals. However, the use of SNA methods has been eclipsed by urban community research and continuations of the original method. This thesis applies traditional SNA to a modern agricultural extension program that is part of a project titled *The Future of Farming*. The research and extension team that leads the project is working to establish a network of row-crop farmers in Alabama who are willing to engage in peer-to-peer knowledge exchange about climate-smart technologies. Structured similar to classic Gemeinschaft networks, researchers facilitated regional engagement meetings (n = 11), that were mapped to examine the personal ties of farmers across the state. Semi-structured, face-to-face, interviews (n = 41) were sampled to complement the regional engagement meetings by allowing the individual farmers to provide a qualitative account of their ties to other members of the project. The meetings and interviews were video recorded, transcribed, and coded in NVivo. SNA was conducted in R using two measures: scores that represented attendees' degree of participation during the meetings, and the count of participants' name-drops (n = 300) during the meetings and their subsequent interviews. Results highlight researcher influence in farmer connectivity, the value of participatory approaches in agricultural extension, and the farmers' desires to engage with each other. This study serves to further revive SNA within rural sociology and further strengthen applied research methods.

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While it's my name on the cover of this thesis, without the endless support of my community, none of this would have been possible.

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List of Abbreviations

ACES	Alabama Cooperative Extension System
CC	Crop Consultant or Agronomist
EA	Extension Agent
ER	Extension- Research and Specialist
F	Farmer
FFP	Future of Farming Project
G	Government Employee
NRCS	Natural Resources Conservation Service
R	Researcher
SNA	Social Network Analysis
USDA	United States Department of Agriculture

CHAPTER 1. INTRODUCTION

Working closely with both agricultural researchers and farmers, cooperative extension systems have traditionally made effort to meet the needs of farmers as they arise (Kerr 1985). However, as the cooperative extension service has become more bureaucratic, there has been a shift in the way that agents work with farmers (Loomis and Beegle 1950) from the historical farmer-led approach (Jones and Garforth 1998) to a researcher-led model known as a "top-down" approach. This top-down model is known to be ineffective in communicating the objectives of extension (Ponniah et al. 2008), however, extension finds it a challenge to incorporate engagement strategies in agricultural programs (Ponniah et al. 2008).

The *Future of Farming Project* (FFP), led by a multi-disciplinary team of cooperative extension specialists and other agricultural researchers, examines the adoption of climate-smart technologies on row-crop farms in Alabama. One objective of this ongoing project is to establish a network of learning sites where participants can co-develop knowledge of climate-smart technologies and practices (Prasad 2020-2026). Yet, farmer networks existed before the project. Farmers historically relied on their social networks for information exchanges and support, which manifest in what can be described as Gemeinschaft networks (Tönnies 1957). Classical rural sociology used Social Network Analysis (SNA) to map the social connections within these rural networks. The graphics produced were then used to connect individuals with influential people who could provide aid and support when needed (Loomis and Beegle 1950). An example of SNA used in extension work can be found in Figure 1.1, where Loomis (1947) and (Loomis 1948) illustrated Gemeinschaft ties in a rural community.

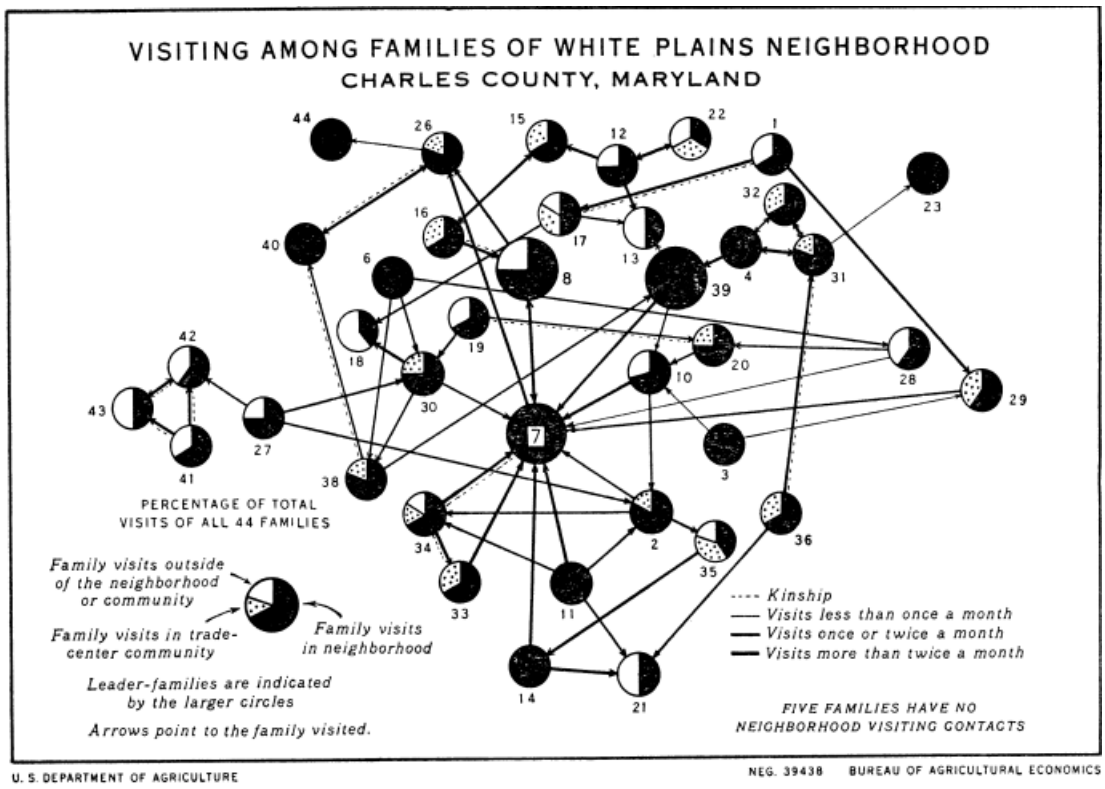

Figure 1.1. Social Network Map by Charles P. Loomis

The use of SNA dwindled in agriculture as cooperative extension systems more frequently accepted top-down models (Freeman 2011). This thesis revives the method as a way to illustrate: 1) the social networks of the FFP, 2) higher engagement meetings, and 3) who are engaged in the network. A mixed-methods approach was used including SNA and semi-structured interviews to examine the questions: Who might influence Alabama row-crop farmers to adopt practices and technologies; and how might cooperative extension transition to approaches that use social networks to better serve farmer interests?

CHAPTER 2. LITERATURE REVIEW

INTRODUCTION TO CLASSICAL RURAL SOCIOLOGY

Rural Sociology is credited as a pioneer in the use of social network analysis (SNA): the process of measuring social relationships using network and graph theory (Scott and Carrington 2011). One early adopter of SNA was Charles P. Loomis, a rural sociologist whose work included basic and applied research on rural communities combined with SNA and graph math (Vanderpool and Beegle 1995). His work as a professor at Michigan State University, a U.S. Department of Agriculture employee, a UN advisor, and an American Sociological Association president (Vanderpool and Beegle 1995) influenced generations of researchers who used social networks to effect systematic changes in communities (Bourne et al. 2017, Girvan and Newman 2002, Gray and Gibson 2013).

Despite rural sociology's early contributions to SNA, the application of social network theory has been overshadowed by urban interpretations and adaptions of the approach (Freeman 2011). Urban social networks favor social distance over geographic distance and illustrate dense clusters of people over a larger area (Herrera-Yagüe et al. 2015). In contrast, rural social networks are smaller, more closely connected, and less likely to be divided into subgroups (Klärner and Knabe 2019). In recent years, few studies in rural sociology contribute to social network analysis from a rural perspective, and even fewer incorporate mixed methods data. A digital search of *Rural Sociology* for "social network analysis" yielded 9 articles published between 1996 and 2022 (Beggs, Haines and Hurlbert 2010, Compagnone and Hellec 2015, Ghorbani et al. 2022). A digital search in the *Journal of Extension* for "social network analysis" found 13 articles published between 2010 and 2021 (Bain, Harden and Heim 2017, Redmore and Tynon 2010, Springer and Steiguer 2011). The research outlined in this thesis, like the works of

Loomis, uses the early concepts of rural sociology and traditional SNA to study modern rural networks.

CLASSICAL DESCRIPTIONS OF SOCIAL NETWORKS

Social systems are classically described as "a meaningful connection of two or more human persons… in which one party tangibly impacts the overt behaviors or state of mind of the other." They are made up of social interactions and the cultural elements that characterize these interactions (Loomis and Beegle 1950). Social systems are developed through the frequent and intense interactions between their members (Loomis and Loomis 1961), where interaction is "any event by which one party tangibly influences the overt actions or the state of mind of the other" (Loomis 1961). While research on social systems should be careful in presuming that the group is a microcosm of society at large (Homans 1961), social systems can mirror the characteristics of other systems, which allows for generalizations. (Loomis and Loomis 1961). One type of social system that forms in society is the concept of Gessellschaft and Gemeinschaft.

THE GESSELLSCHAFT-GEMEINSCHAFT DICHOTOMY

Tönnies (1957) devised the concepts of Gesellschaft and Gemeinschaft. Gesellschaft refers to the idea that associations should serve individual self-interest, and is often illustrated through impersonal relationships (i.e., corporations, universities). Gemeinschaft is a reciprocal relationship; has shared traditions, and can be described as intimate relationships (i.e., neighborhoods, churches, schools) (Tönnies 1957). Gemeinschaft is considered to have been more common in pre-industrialized society when the success of an individual relied heavily on the support and influence of the community (Foster 1953). The important requirement of Gemeinschaft is that the relationships are the end goal of the social network, and the actors are expected to have intimacy and feel connected (Loomis 1961). Moreover, these relationships are

characterized by a sense of trust, involvement, commitment, and loyalty among network members (Nilsson and Hendrikse 2011). Initially, Tönnies' conceptulatizaion of Gesellschaft-Gemeinschaft was criticized for its utopic framework. This led him to clarify that Gesellschaft and Gemeinschaft are ideal types, and do not exist in their purest form (Tönnies 1957).

Gemeinschaft in a Rural Context

Tönnies (1957) points toward rural communities as an exemplar of Gemeinschaft as people are "stronger there and more alive;" he saw rural communities as a "lasting and genuine form of living together." Gemeinschaft networks regard education and instruction to be the sharing of experiences with those who will go on to reciprocate the sharing of knowledge processes with others (Tönnies 1957). Researchers of classical rural systems identified these beliefs among studied participants (Loomis and Beegle 1950). Loomis and Beegle (1950) noticed that "[farmers] are… relatively more concerned with what goes on in the family, neighborhood, and local community than others."

Actors in Gemeinschaft networks are connected intimately to the land, as it symbolizes the labor and fulfillment of working in a collective (Adair-Toteff 1995).

> "It is first the broken fields, in which man by his own labor plants seeds, which tie his feet. This plowed land becomes the possession of successive generations and, through its cultivation by the ever-rejuvenated human energies, becomes thus an inexhaustible treasure…. The human being becomes bound in a twofold way, through cultivated fields and through the house in which he lives; that is to say, he is tied down by his own work." (Tönnies 1957)

Despite the clear alignment of rural social systems to Gemeinschaft, the concept is often avoided. Some scholars argue that Gemeinschaft is no longer present to a high degree in modern

communities, while others feel that since Gesellschaft-Gemeinschaft is not synonymous with urban-rural, it is an unnecessary concept in research (Wakeley 1967). A digital search of the journal *Rural Sociology* from 1990 to 2022 shows less than 40 published articles that integrated the concept of Gemeinschaft (e.g., Chávez (2005), (Corradi 2021, Naples 2010)). A digital search of the *Journal of Extension* showed zero published articles, despite this concept being rooted in the rural landscape. And, in a general literature search, even fewer use the notion of Gemeinschaft to examine agricultural networks (e.g., Sun, Zhou and Lei (2019)). However, there are prominent offshoots of Gemeinschaft that saturate modern research including the work of Weber (1981) and Flora, Flora and Gasteyer (2016).

While there is tension between the two researchers, Max Weber (1981) calls the work of Tönnies "of lasting importance." Weber approached the Gesellschaft – Gemeinschaft dichotomy from a rationalistic perspective. Where Tönnies's usage of Gemeinschaft included harmonious and utopian ideals, Weber (1922)emphasized that "struggle is a prerequisite for human culture." Every relationship has areas of struggle, even the most intimate of Gemeinschaft networks (Bond 2012). To date, Weber's version of Gemeinschaft-Gesellschaft is not widely used in the literature.

Rural sociologists heavily rely on Flora, Flora and Gasteyer (2016) for their community capitals frameworks (e.g., Brown (2022), Pratt and Warner (2019), Sherman (2018)). These capitals include natural, human, political, financial, built, social, and cultural. The community capitals framework focuses on the resources of a community that can be invested for the well-being of the community (Flora, Flora and Gasteyer 2016). Similar to Tönnies (1957), the concept of cultural capital are the community's values and traditions. These values are influenced by the environment and its people (Flora, Flora and Gasteyer 2016). Cultural capital is passed through

the process of socialization within the community which happens through frequent interactions. As the community strengthens its social ties, the community becomes better equipped to develop strategies to address struggle (Flora, Flora and Gasteyer 2016). “Repeated local influences” (Moussaïd et al. 2013), which Flora, Flora and Gasteyer (2016) identify as agents of change, influence the community through their high degrees of social and cultural capital. Literature urges social systems researchers to take notice of the community’s agents of change (Andriamihaja et al. 2021), and work to include them in the development of the community.

SOCIAL NETWORK ANALYSIS

As an early proponent of the development of SNA, Loomis and Loomis (1961) argues that:

> “The sociological analysis must deal with systems if it is to yield predictive propositions of any consequence… Human acts, groups, rules of conduct, and goals or values are interrelated, not isolated and autonomous variables.”

Studying systems in sociology is best achieved through social network analysis, a strategy for investigating social systems (Otte and Rousseau 2002). Social networks are the set of connections between individuals and the information that flows between them (Skaalsveen, Ingram and Urquhart 2020). These individuals, or network actors, are defined by a set parameter (i.e., geospatial, gender, age), and linked through a tie or a connection, such as an occupation or role (Borgatti and Halgin 2011). Analysis of the network occurs by compiling the parameters, actors, and ties between actors. (Scott and Carrington 2011). The analysis is most commonly illustrated by pictures and diagrams, called sociograms, which illustrate the patterns in the social relationships among actors and their networks, and which might not be apparent before the analysis was conducted (Scott and Carrington 2011). Research shows that individuals are more

likely to develop social networks with others who share characteristics; we can then generalize this finding to assume that individuals connected with others will share similar traits to their similar environments and values (Loomis and Beegle 1950, McPherson, Smith-Lovin and Cook 2001).

PEER-TO-PEER LEARNING SYSTEMS

Social networks play a key role in the education of their members. Both classical rural sociology and classical sociology emphasize that education is the transmitting of culture (Loomis and Beegle 1950, Tönnies 1957). In peer-to-peer learning, education takes place between individuals who are of similar status and who are considered to be equals (Topping 2005). Research has demonstrated that farmers value the sharing of experiences and knowledge (Knoot and Rickenbach 2011); when farmers participate in peer-to-peer learning programs, they are more active in stakeholder discussions, their community's agrarian networks, and more likely to adopt new practices and technologies (Baird et al. 2016, Cadger et al. 2016, Ingram and Nyangara 1997, Isaac 2012, Nakano et al. 2018, Skaalsveen, Ingram and Urquhart 2020).

Peer-to-Peer Learning and Extension

Early cooperative extension programs placed a heavy emphasis on personal contacts to share material and non-material cultural traits. As cooperative extension personnel became burdened with regulatory and service duties, it became difficult for local agents to form the relationships necessary to build strong peer-to-peer learning systems (Loomis and Beegle 1950). Subsequent extension programming exhibited a "top-down" approach; the extension agents present material to farmers who have little to no input into the content (Ponniah et al. 2008). Extension programs that follow a top-down approach are described as

> "… agricultural messages that had been designed and developed by research scientists, with limited input by the ultimate users of the technologies (the farmers)… the messages [are] often irrelevant, according to farmers surveyed" (Gautam 2000).

Opposite, participatory approaches to extension, including peer-to-peer learning programs, have had a positive impact on the effectiveness of agriculture extension (Axinn 1988). Participatory approaches to extension recognize that farmer social networks are not homogenous (Hagmann 1998). Participatory programs require active participation from the farmers to be successful, and much of the programming takes place through group meetings, demonstrations, and peer-to-peer learning among farmers (Ponniah et al. 2008). In participatory approaches, success is measured by the number of farmers actively participating, extension agents who work closely with farmers when facilitating new approaches, and research that is focused on the farmers' stated needs (Ponniah et al. 2008).

Ponniah et al. (2008) suggest that for cooperative extension systems to be impactful, programs should incorporate local people in the planning and execution of programming. Further, these programs should empower members of the network to use their systems of knowledge and communication to achieve success in their operations. Integrating farmer participation with extension will encourage the generic, top-down, model to fade and be replaced with a dynamic and tailored approach to extension in local communities.

RESEARCH OBJECTIVE

The goal of this research is to answer the questions: Who might influence Alabama row-crop farmers to adopt practices and technologies; and how might cooperative extension transition to approaches that use social networks to better serve farmer interests?

CHAPTER 3. METHODOLOGIES

THE FUTURE OF FARMING PROJECT

The FFP is an ongoing project that focuses on the adoption of climate-smart technologies among row-crop farmers in Alabama (Prasad 2020-2026). The climate-smart technologies addressed in the FFP include 1) nutrient management systems, 2) irrigation systems, and 3) cover crops. The research team consists of Auburn University faculty, ACES Specialists, an external consultant who is an agricultural economist, three cooperator farmers, and a team of graduate research assistants and post-doctorate fellows. A mixed-methods approach is used to understand Alabama row-crop farmers' knowledge and implementation of the climate-smart technologies. Additionally, the FFP aims to identify better methods of engagement, training, and demonstration of the technologies. The project includes three components. First, an incentive payment program to support the adoption of climate-smart technologies. Second, demonstrations of the technologies at regional engagement events were held at three cooperator farms. The purpose of these events is to present the technologies and determine farmers' barriers and limitations to adoption. The events also allow for the FFP research team to document the farmers' current knowledge of the practice, and their present use of the relevant climate-smart technologies. Third is the development of a learning network consisting of the FFP stakeholders: crop consultants and agronomists, extension agents, extension specialists, researchers, government employees, and farmers.

The research outlined in this thesis contributes to Objective 5 of the FFP: to create a network of farmer-managed learning sites to increase adoption, as well as the sub-objectives of eliciting farmer feedback and using social indicators as a tool for understanding knowledge and awareness of the technologies (Prasad 2020-2026). More specifically, this thesis seeks to

understand who influences Alabama row-crop farmers' information seeking and how cooperative extension can draw upon the networks to best serve farmers' needs.

Cooperator Farms

The FFP research team identified a Cooperator Farm for each of the three key row crop growing regions of Alabama. These farms serve as the hub for data collection, learning in the region, and demonstrations of climate-smart technologies. The cooperator farmers were chosen, in part, because they were assumed to be a communicator of information, or an agent of change (Andriamihaja et al. 2021), within the region. The cooperators were chosen because of their history of working with Auburn University and ACES, including research that had been conducted on their farms in the past. Research plots at each cooperator farm were designed to study the use of climate-smart technologies and to provide the means for demonstrating the regional engagement meetings.

Regional Engagement Events

The FFP research team coordinated regional engagement events that coincided with, or organized around, regional planting and harvesting dates, inclement weather, and other agricultural meetings. An Extension Specialist (ER), along with their sub-team of students and post-doctoral students, developed the material and agenda for the meeting, and present a mock-up of the event to the FFP research team. The ER was responsible for coordinating materials, a location to hold the meeting, and scheduling guest speakers. Those planning and leading meetings were also expected to follow the FFP's goals of incorporating engagement strategies and include engagement activities. Eleven events took place between September 2020 and December 2021. The events lasted approximately three hours each and included demonstrations, group discussions, and panel discussions from agricultural specialists. Participants were also

provided lunch. Farmers were not required to attend a specific region and were invited to attend events that were physically close to them, which led to some farmers attending events outside of their region.

The FFP research team selected attendees for the regional engagement events via snowball technique based on their current farming practices and their connections to the Alabama Cooperative Extension System (ACES) and the Natural Resources Conservation Service (NRCS). Extension specialists and county extension agents began by contacting farmers who they thought would be interested in participating in regional engagement events.

Each participant was assigned a pseudonym by their occupation or role in the project. This followed a CodeNumber system. Further, all participants are referred to using they/them pronouns, to protect their identifying features. Table 3.1 describes the pseudonym protocol for the FFP.

Table 3.1. Pseudonym Protocol of the Future of Farming Project.

Role	*Abbreviation*	*Color*
Crop Consultant	CC	Yellow
Extension Agent	EA	Blue
Extension Specialist	ER	Pink
Farmer	F	Green
Government Employee	G	Red
Researcher	R	Gray

Attendees at the FFP events provided demographic information during the sign-in process and received a name tag with a colored sticker identifying their occupation or role. Participants completed a form asking for their name, address, contact information, role or occupation, and primary county they work in. Each event was video recorded and transcribed using Microsoft Word's dictation feature and manually cleaned for accuracy. All participants

consented to videos and photos, as approved by the Auburn University Office of Human Research, IRB# 20-207 EX 2004. A list of the FFP regional engagement events can be found in Table 3.2.

Table 3.2. The Future of Farming Project Regional Engagement Events.

Event Code	***Date***	***Location***	***Description***	***Attendance***	***Engagement Strategy***
Event 1-S	Sept 24, 2020	Restaurant	Introductory meeting and information gathering	n = 21 *(EA = 2, ER = 3, F = 9, R = 7)*	Discussion with stakeholders about barriers and limitations to adopting conservation strategies.
Event 1-N	Dec 7, 2020	Barn	Introductory meeting and information gathering	n = 21 *(CC = 2, EA = 4, ER = 3, F = 3, G = 4, R = 5)*	Discussion with stakeholders about barriers and limitations to adopting conservation strategies.
Event 1-C	Dec 9, 2020	Research center	Introductory meeting and information gathering	n = 17 *(CC = 1, EA = 1, ER = 3, F = 5, G = 1, R = 6)*	Discussion with stakeholders about barriers and limitations to adopting conservation strategies.
Event 2-C	Feb 17, 2021	Farm	Cover crop field day	n = 25 *(CC = 3, EA = 2, ER = 3, F = 10, G = 2, R = 5)*	Introduction led by a farmer and explored cover crop demonstration sites.
Event 2-S	March 3, 2021	Farm	Cover crop field day	n = 23 *(EA = 3, ER = 5, F = 8, G = 2, R = 5)*	Introduction led by a farmer and explored cover crop demonstration sites.
Event 3-N	March 8, 2021	Farm	Cover crop field day	n = 20 *(CC = 2, EA = 3, ER = 4,*	Introduction led by a farmer and explored cover crop demonstration sites.

Event Code	*Date*	*Location*	*Description*	*Attendance*	*Engagement Strategy*
				F = 5, *G = 1,* *R = 5)*	
Event 3-C	June 3, 2021	Farm	Irrigation field day	n = 25 *(EA = 3,* *ER = 1,* *F = 4,* *G = 3,* *R = 14)*	Introduction led by a farmer and small groups discussed irrigation scenarios.
Event 3-S	*June 15, 2021*	*Farm*	*Irrigation field day*	*n = 22* (EA = 3, ER = 4, F = 3, G = 3, R = 9)	Introduction led by a farmer and small groups discussed irrigation scenarios.
Event 3-N	*July 15, 2021*	*Farm*	*Irrigation field day*	*n = 27* (CC = 1, EA = 3, ER = 4, F = 8, G = 3, R = 8)	Introduction led by a farmer and small groups discussed irrigation scenarios.
Event 4-C	*Dec 2, 2021*	*Research center*	*Nutrient management field day*	*n = 31* (CC = 4, EA = 3, ER = 7, F = 7, G = 2, R = 8)	Presentations from CCs and ERs and a live demonstration with chicken litter.
Event 4-S	*Dec 7, 2021*	*Restaurant*	*Nutrient management field day*	*n = 45* (CC = 3, EA = 6, ER = 3, F = 24, G = 2, R = 7)	Panel discussion with CCs and EAs.

The event was given a code in an EventRegion-Number format. The transcripts were reviewed and videos rewatched to assign each attendee a participation score. This score was used to quantify their level of engagement during the event and followed the Participant Scoring

Rubric found in Table 3.3. Scoring was based on the number of times the attendee spoke during the event, and their level of involvement in planning, leading, or hosting the event.

Table 3.3. Participant Scoring Rubric.

Score	***Description***
0.2	The individual attends the event but does not participate.
0.4	The individual attends but with minimal participation (e.g., answers direct questions or only speaks when spoken to).
0.6	The individual attends and participates many times during the event.
0.8	The event was hosted by the individual at their farm or another location.
1.0	The individual facilitated the event.

SEMI-STRUCTURED INTERVIEWS

After attending their first FFP regional event, all participants were contacted with a request for an interview through email, text message, or a phone call based on the participant's preference. Questions included inquiries on the participant's background, their prior experience in research, their involvement in their local farming community, and their opinions on the barriers and limitations to adopting nutrient management systems, irrigation systems, and cover crops. A copy of the interview guides can be found in Appendix 1 through Appendix 5.

Forty-one interviews were conducted using a semi-structured format and took place between October 2020 and January 2021. The interviews were done in person, over the phone, or virtually. The interviews lasted from an hour and eighteen minutes long to nineteen minutes long, with a mode of twenty minutes. Farmers were interviewed the most (n = 15), with researchers being second (n = 12). There were twenty-five interviews with participants from the central region, nine with participants from the southern region, and seven from the north region. Most interviews occurred virtually (n=19) or in-person (n=15) and seven were phone interviews. Interviews were video recorded and transcribed using Microsoft Word's dictation tool and

manually cleaned for accuracy. Virtual interviews were recorded in Zoom, transcribed within the program, and cleaned and formatted in Microsoft Word.

Table 3.4. Semi-Structured Interviews between October 2020 and January 2021.

Region and Mode of Interview	***Participants***						
	Crop Consultants (CC)	**Extension Agents (EA)**	**Extension-Research Specialists (ER)**	**Farmers (F)**	**Government (G)**	**Researchers (R)**	**Total**
Central	**1**	**1**	**6**	**4**	**1**	**12**	**25**
In-person			4	3			7
Phone	1						1
Zoom		1	2	1	1	12	17
North		**3**		**4**			**7**
In-person		2		1			3
Phone				3			3
Zoom		1					1
South		**2**		**7**			**9**
In-person				5			5
Phone		1		2			3
Zoom		1					1
Total	**1**	**6**	**6**	**15**	**1**	**12**	**41**

Primary NVivo Coding

The coding process aimed to identify themes within the data that could be useful to answer the initial research questions. Primary coding was conducted in NVivo. It was based on both the project objectives and previous literature. Emergent themes were also recorded. The author and another member of the FFP followed an inter-coder reliability protocol (Campbell et al. 2013), which served to ensure that the transcripts were thoroughly reviewed. Both researchers individually coded each transcript and then met to compare the codes and the rationale behind

the coding. Codes that did not match were discussed, a consensus was reached, and subsequent corrections were made.

Secondary NVivo Coding

Secondary coding for the SNA was conducted to track the connections between participants. These ties were identified by coding for unique "name-drops," or when one participant would mention another participant by name. A name-drop for an individual would only be counted once per transcript, rather than every instance in one transcript where the same person's name was referenced. Based on Borgatti, Everett and Johnson (2013), name-drop codes were considered to be the strongest form a tie within the network. Preliminary analysis showed that it was unlikely for someone to reference another participant if they did not currently have, or sought to have, the ability to access the person. For example, a name drop was found in the following exchange:

> R9: Is there any information that you haven't been able to access that maybe you would hope was existing?
>
> F15: I think there is really no way that so many farmers are doing-especially groups that are pushing the edge a little bit… Like [F18], but all of them I think are doing a little bit. He's doing some pretty neat stuff.

SOCIAL NETWORK ANALYSIS

A Social Network Analysis (SNA) was conducted to illustrate the social networks in the FFP and to visualize the impact of the engagement activities used in the project. Two data sets informed the SNA: event participation scores from regional engagement events and the name-drop codes. Data were compiled in Microsoft Excel to create the SNA. In Microsoft Excel, the Event Participation Score data was formatted as a weighted edge list and the Name-Drop data

was formatted as a directed 2-Mode Matrix. An attributes table was created in Microsoft Excel using reported demographic information. These data sets were uploaded to R, a free statistical computing and graphic software package (Chandra and Shang 2019), to illustrate the network structure of the FFP. Once uploaded, two SNAs were generated. The first SNA encompassed all FFP participants, followed by an SNA of all participants except ERs and Rs. The second SNA was of only farmers in the FFP. Lastly, an SNA was conducted for each region in the FFP.

In this study, a node is a participant, and edges are the total count of attendance and name-drops in the data. Degree is the number of direct connections each node has to others within the network. The directed network density is the average strength of all of the possible ties in the network. Modularity, in the context of this study, measures the strength of the separation into the FFP network's regions. Networks with high modularity have dense connections between the nodes within regions but sparse connections between nodes in different regions. The SNA was measured using eigenvector centrality, which measures the node's influence in the network based on the number of ties to other nodes. EigenCentrality is used to identify those individuals who influence the whole network: the agents of change in the FFP (Borgatti, Everett and Johnson 2013).

CHAPTER 4. RESULTS FROM REGIONAL ENGAGEMENT EVENTS AND SOCIAL NETWORK ANALYSIS

This chapter will begin by describing the *Future of Farming* (FFP) regional engagement events (see Table 3.2), followed by the initial results from the social network analysis (SNA). For the latter, SNAs were generated with 1) all FFP participants, 2) FFP participations excluding Extension Specialists and Researchers, 3) FFP farmer participants, and 4) the FFP regions. Additionally, the relationship between the FFP regional engagement events and the SNA is discussed. The codes discussing each category and event descriptions can be found in Table 3.1 and Table 3.2.

THE FUTURE OF FARMING PROJECT REGIONAL ENGAGEMENT EVENTS

The FFP's objective of shifting from a top-down model to a participatory model of extension is novel for both the participants and the FFP research team. When describing the FFP in the introductory meetings, the project was described as "a mutual learning process" (ER3, Event 1-S), and that the research team "would like to work with Alabama farmers, [and]… know their needs" (ER2, Event 1-S).

The invitation for participation in the FFP operated similarly to a snowball sample. This tends to result in a homogenous group of participants (Strunk and Mwavita 2020). When explaining the sampling process at the first FFP event, ER2 said

> "There were reasons we invited you. We were very specific. We would like for farmers to be eager to try things, that [are] interested, that [are] willing to go [the] extra mile to make things happen. Someone that is interested and would like to be a part of this… We want you to be a part of this main group that helps others" (ER2, Event 1-S).

Farmers who participated in the FFP (n = 66) were predominately white, non-Hispanic males (Table 4.1). As a point of comparison, of the more than 64,000 farmers in Alabama; 66 percent are male, and 34 percent are female (National Agricultural Statistical Service 2017). Fewer farmers attended north region events; generally, there are fewer farmers with larger farms in north Alabama. In contrast, the Southern region has more farmers, with smaller farms (ER1, Interview) (Table 4.2).

Table 4.1. Participant Demographics at the Future of Farming Regional Engagement Events.

Race	***Count***
Black/African American	1
Native American Indian	1
Not- Reported	1
White	63
Total	**66**

Table 4.2. Event Attendance at the Future of Farming Regional Engagement Events.

Region and Counties	***Attendance***
Central Alabama Autauga, Dallas, Elmore, Henry, Lee, and Macon	24
North Alabama Geneva, Lawrence, Limestone, and not reported	13
South Alabama Coffee, Covington, Dale, Elmore, Geneva, Henry, Covington, Houston, Jackson, Pike, and not reported	29

Regional Engagement Events

Eleven FFP regional engagement events occurred between September 2020 and December 2021. On average, 8 farmers would attend the regional engagement meetings, whereas an average of 11 ERs and Rs would attend the meetings. Further, an average of one CC, three EAs, and two Gs would attend the regional engagement meetings. Event 1-N had the lowest farmer attendance, with three farmers participating in the engagement meeting. Event 4-S was attended by 24 farmers; this was the most farmers to attend an FFP regional engagement event.

Event 2-S is an example of an event that prioritized interaction. This event was the second regional engagement event in the series on cover crops and took place in March of 2021. Event 2-S was hosted by cooperator farmer F3 and took place in F3's fields and barn. Eight farmers participated in the event, and their participation scores averaged 0.6, which was the highest average of farmer participation in this region.

> ER1 urged participation in the meeting during their welcome to the group:
>
> "We want to have a lot of discussions… No one in this area knows better than you… you know what's worked and hasn't worked in this area in terms of cover crops. So, please chime in where you have something to say" (ER1, Event 2-S).

The meeting began with an introduction by F2, a manager of F3's farm, during which they highlighted their use of cover crops and invited the other attendees to ask questions. Figure 4.1 shows the farmers discussing the cover crops and strategies and practices related to the process of planting and harvesting the cover crops. The event then moved to ER1's presentation of the demonstration field planted with various cover crops, which was aided by charts and graphs (Figure 4.2). Several participants took use of this time to ask questions and interact physically

with the planted cover crops, shown in Figure 4.3; these inquiries continued with the following presentation, which occurred in F3's barn.

Figure 4.1. Participants of Event 2-S conversing with a farmer about their cover crop practices.

Figure 4.2. Participants at the Future of Farming Project Event 2-S discussing a cover crop demonstration. This presentation was led by an Extension Specialist.

Figure 4.3. A Future of Farming Project participant took pictures of the cover crop demonstration plots.

The following two speakers on Event 2-S delivered a traditional cooperative extension presentation; there was no customization of the information and a heavy dependence on handouts. Moreover, the farmers appeared to be bored and disinterested; many farmers were looking at their phones and leaving the room to have private discussions with other participants. The meeting ended with a discussion led by R8, where the following exchanges took place during the event:

> R8: If you were to… start over, what would you be doing right now? Is there something… critical that you've taken away either today, [at] other meetings you been to, [or] other people you've spoken to?
>
> F6: … I would do the same thing I was… as I started.
>
> F17: And I'll just do what he does

Later in Event 2-S, F17 elaborated by stating:

> "A lot of farmers I think are good farmers. They may not realize I watch them. I watch what they do, and I try [to] do the same thing… I'm learning every day…[Coming to extension meetings]… gives us the opportunity for us to see what makes a difference."

In contrast, Event 4-C had the lowest participation of the FFP regional engagement events. The event was the first of the FFP's series on nutrient management systems and took place at Auburn University's E.V. Smith Research Center in Shorter, Alabama in December of 2021. Seven farmers participated in the event with a participation score average of 0.314. Of the 33 total participants, 17 were ERs and Rs. Four CCs attended the event, along with six EAs and two Gs.

Many variables contributed to the event's low engagement. First, the meeting had no farmer presenters, which conflicted with ER2's Event 1-S introductory statement:

> "We want to make sure… that we provide plenty of opportunities for experience exchange [of] knowledge. But also, for you to [put] back into this group and share what you have done; what you have tried that failed; what you have tried that worked; what you have seen at other places that are working or not working. And together figure out how to move this… program forward."

Instead, the schedule included presentations from ER1 and three CCs from major agrochemical companies. ER1 was unable to attend the event and had to rely on their technician to share the information. The sessions included little engagement. Furthermore, the CCs provided information from digital PDFs projected onto a wall, which is shown in Figure 4.4. Attendees found it difficult to read the projections and they were not provided physical copies.

Figure 4.4. A Crop Consultant presenting fertilizer information from a small PDF document.

During the meeting, an argument about fertilizer use arose between ER3 and a farmer participant. ER3, Event 4-C used phrases like "Right, I'll tell you one thing…" and "Yea, but the

research shows…" to tell the farmer why they should be using certain fertilizers. After the exchange, the meeting transitioned to a live demonstration of nutrient content in chicken litter, which was placed directly beside the lunch table.

> ER2: So, you want us to go there and look at the litter?
>
> ER3: Yes… And it smells… also don't touch it, just look at it visually… we are going to eat after this, so I think it's not a good idea (Event 4-C).

During the demonstration, ER3, Event 4-C also said to the group "I know… many people are bored right now… sitting here." At the time, many attendees looked at their phones (Figure 4.5) and drew on pieces of paper. Others left the meeting early.

Figure 4.5. Two participants at Event 4-C using their phones during the meeting.

SOCIAL NETWORK ANALYSIS OF THE FUTURE OF FARMING PROJECT

Social Network Analysis 1. General Future of Farming Project Network

The FFP network had 136 nodes with 562 edges, meaning there were 136 total attendees of the FFP with 562 connections between them. The average degree of the FFP was 3.958, which indicates the number of direct connections a node has with other nodes in the network. In the general network, the top nodes were ER2, ER1, ER3, R1, and F3 with EigenCentrality, which measures the node's influence on the network, ranged from 1 (F3) to 0.354 (R1), with higher centrality indicating higher levels of influence. The degrees of the top nodes range from 105 (ER2) to 33 (F3), indicating the most engaged nodes have a high number of documented connections within the network. 92 members of the network had a degree of zero. The SNA map of the general FFP network is illustrated in Figure 4.6. This figure was generated from the participant scoring rubric and the participant name-drops from the semi-structured interviews. The map follows the pseudonym protocol as described in Table 3.1.

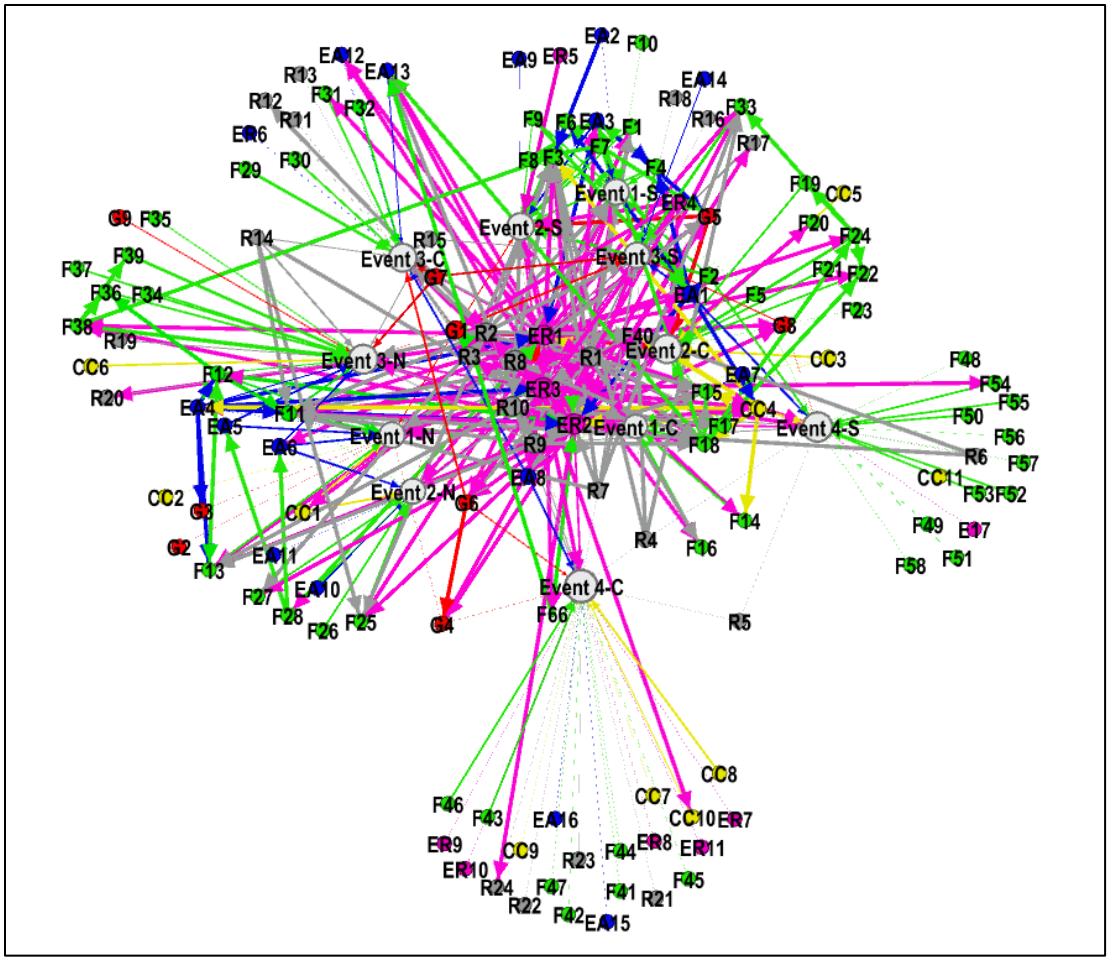

Figure 4.6. General the Future of Farming Project Social Network Map.

Figure 4.1 includes all participants of the FFP. The placement of each node was generated based on the node's participation score at the FFP regional engagement events. The name-drops from the collected semi-structured interviews are illustrated by the lines connecting a node to another node. For example, the line connecting R14 to F11 is representative of R14 name-dropping F11 in their interview. In this SNA, it is clear that the ERs and Rs in the FFP have a strong influence on the data, to the extent that it is difficult to visualize information related to the farmer participants just by seeing the map.

Social Network Analysis 2. Future of Farming Project Network without the Research Team

Once the general SNA was conducted, a modified network map was generated that removed ERs and Rs from the data. The goal was to visualize who the farmers were engaging within the FFP, which aided in answering the research question of who the farmers might be influenced by when adopting climate-smart technologies. Figure 4.7 identifies the relationship between participants of the FFP, without the presence of the ERs and Rs.

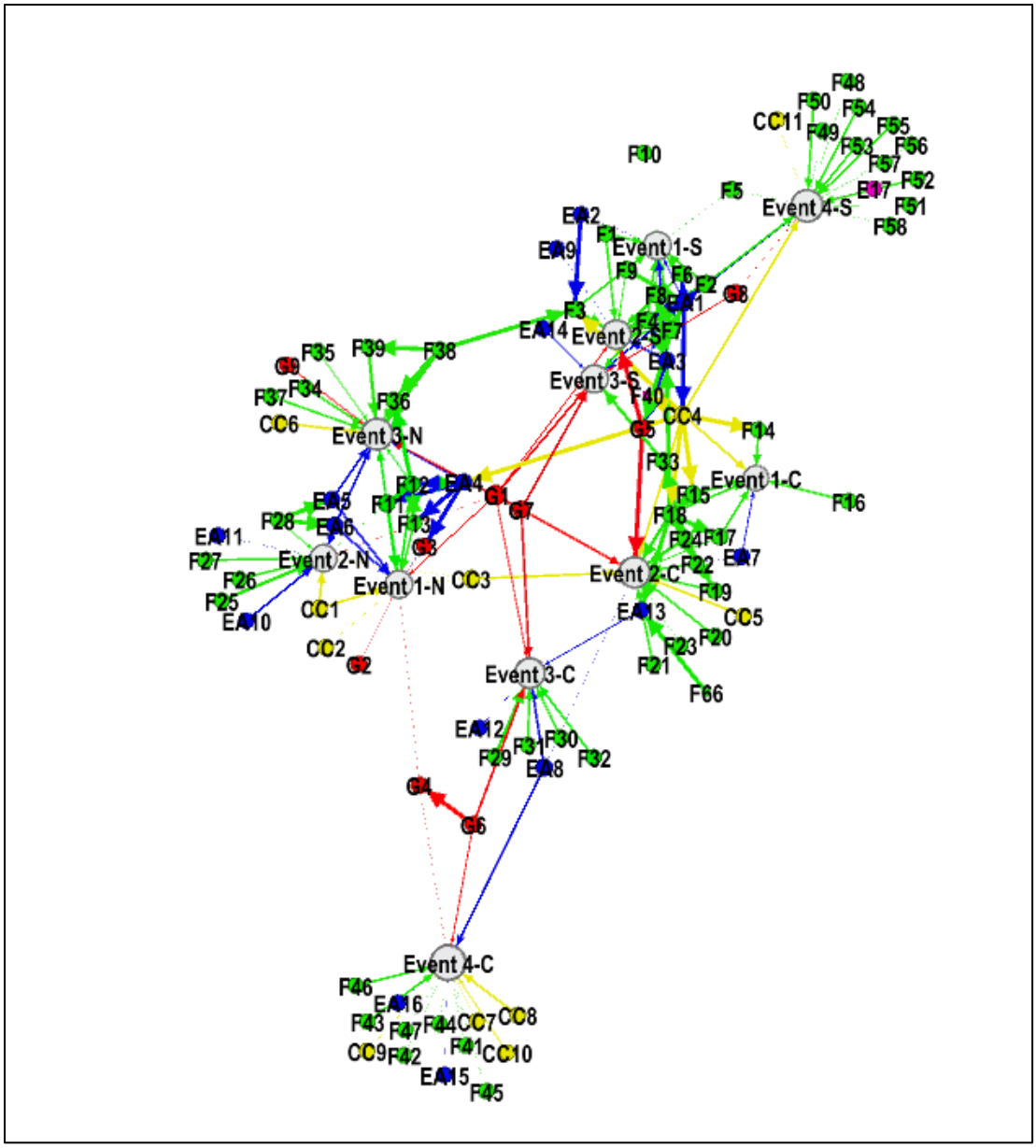

Figure 4.7. The Future of Farming Project social network map without Extension Researchers and Specialists and Researchers.

In removing the research team from the network, the farmers appear to have a stronger connection with each other. The modularity of the SNA increased from 0.305 in the general network to 0.641 in removing the ERs and Rs. Further, the top nodes in the network changed once the ERs and Rs were no longer present. Table 4.3 presents the statistics of the SNAs

conducted. A full list of the degree and EigenCentrality measures of the general network participants can be found in Appendix 6 and Appendix 7.

Table 4.3. The Future of Farming Project Social Network Analysis Statistics.

Statistic	***General FFP***	***Modified Network***
Total Nodes	136	90
Total Edges	562	50
Directed Network Density	0.028	0.005
Average Degree	3.958	0.521
Average Weighted Degree	3.085	0.521
Modularity	0.305	0.641

In the modified network, the top nodes are F18, EA4, EA1, F12, and CC4 with EigenCentrality measures ranging from 0.906 (F12) to 0.151 (EA1). Additionally, the degrees range from 9 (F18) to 7 (F12 and CC4). There is no overlap in the top nodes between the two SNAs. Table 4.4 identifies the top nodes in the network, along with their degrees and EigenCentrality measures.

Table 4.4. Top Nodes in the Social Network Analysis.

General Network			***Modified Network***		
Node	Degree	Eigenvector	Node	Degree	Eigenvector
ER2	105	0.741666	*F18*	9	0.216423
ER1	92	0.423723	*EA4*	8	0.508692
ER3	44	0.356258	*EA1*	8	0.015101
R1	36	0.353742	*F12*	7	0.906593
F3	33	1	*CC4*	7	0.038316

The stakeholder actors, EA4, EA1, and CC4, also had low centrality in the general FFP network but increased once the SNA was modified. EA4 attended both north events with low participation and was only name-dropped by 3 others in the interviews. However, in their interview EA4 name-dropped 11 others, suggesting they might feel connected to their region, while others in the region may not consider EA4 to be an important source of information. Next, EA1 attended a total of four events and had a high level of participation. They were name-

dropped by 4 others in the transcripts, but EA1 did not name-drop others in their interview. Although, it is important to note that the farmers who demonstrated a connection to EA1 also indicated their relationship goes beyond their positions in agriculture; one farmer explained they played on the same sports teams when they were growing up. Lastly, CC4 attended three events and had high levels of participation at each. They were referenced nine times in the transcripts and name-dropped eight other individuals.

Social Network Analysis 3. Farmers in the Future of Farming Project

Figure 4.8 illustrates the social networks of only the farmers in the FFP, without the presence of the research team or other stakeholders in the project. This analysis was run to further identify the network members who might influence the farmers to adopt climate-smart technologies. This SNA includes isolates, which are defined as a person who is not connected to others within the network (Wasserman and Faust 1994). These isolates are indicated by the farmers at Event 3-C and Event 4-C, who did not attend additional regional engagement events and were not connected to the network through name-drops. These isolates suggest the farmer network of the FFP has few central pockets and would benefit from integration within and across the regions.

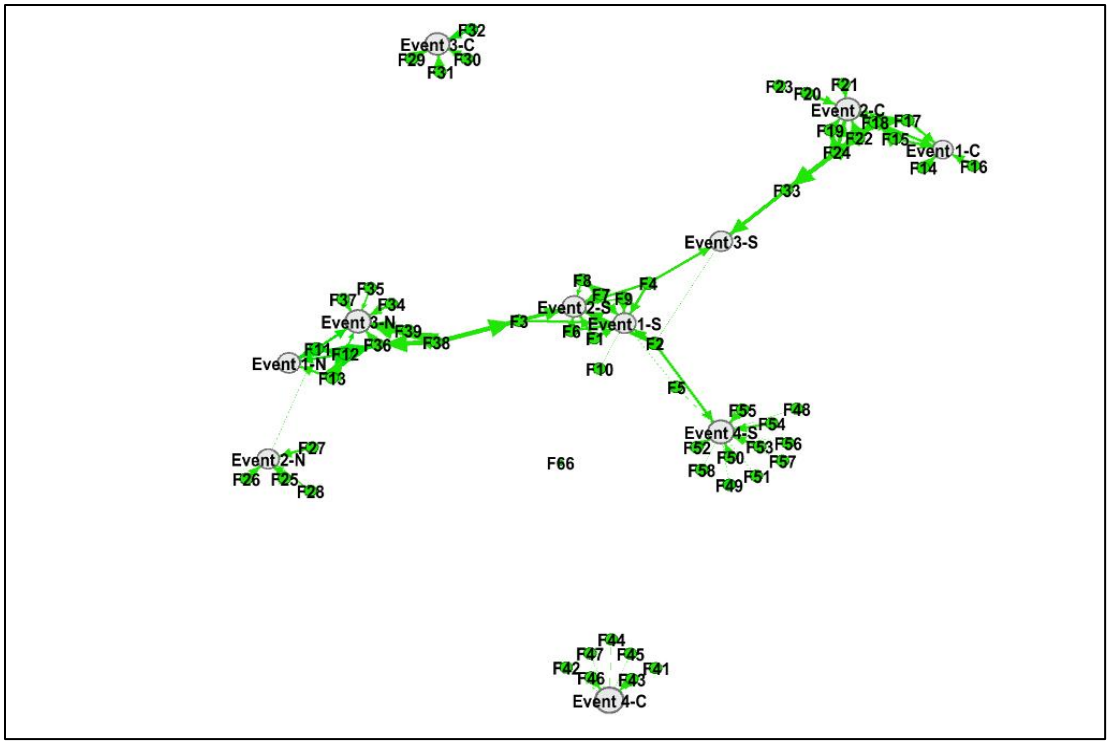

Figure 4.8. The Future of Farming Project Social Network Map with Farmers only.

In the general FFP network, F3 is the top node of the farmer participants with an EigenCentrality measure of 1.0. This also suggests that they are the most influential of the farmers in the FFP. Yet, when the ERs and Rs were removed, F3's EigenCentrality dropped to 0.061. F3's strong centrality in the general network stems from their status as an FFP cooperator farmer; they were mentioned 28 times in the transcripts, mentioned others 3 times, attended an event, and hosted another. This substantial drop in centrality indicated the data was skewed to be more representative of the researchers and cooperator farmers. In the modified network, farmers F18 and F12 are identified to have had high levels of influence within the FFP, but both were lower centrality nodes when the ERs and Rs were included. F18 operates in the central region and attended one FFP regional engagement event and hosted another. F18 was referenced 12 unique times within the interview transcripts and referenced 6 others in their interview. F12 also

moved higher in the network once the ERs and Rs are removed. F12 attended the two North region events and had higher participation scores at both. They referenced five other people in the FFP during their interview and were name-dropped four times.

Social Network Analysis 4. Social Network Analysis of the Regions in the Future of Farming Project

The regions of the FFP serve to provide personalized content related to climate-smart technologies to the farmers. By understanding the social networks that make up each region individually, the FFP research team will be better able to utilize local agents of change in developing content and hosting regional engagement events. Between September 2020 and December 2022, four events occurred in the central region, four events occurred in the southern region, and three events occurred in the north region. Table 4.5 highlights the degree and EigenCentrality of the eleven regional engagement events.

Table 4.5. Centrality Measures of the Future of Farming Project Regional Engagement Events.

Event Code	***Degree***	***Eigenvector***
Event 4 – C	33	.206
Event 4 – S	28	.262
Event 3 – N	27	.348
Event 2 – C	26	.412
Event 3 – C	25	.326
Event 2 – S	23	.364
Event 1 – N	21	.383
Event 1 – S	21	.334

Event Code	***Degree***	***Eigenvector***
Event 3 – S	21	.292
Event 2 – N	20	.391
Event 1 – C	17	.328

Central Region Social Network Analysis

The central region had a degree total of 101 across the four regional engagement events. Three farmers – F15, F17, and F18 appeared to attend more than one regional engagement event, but the majority of the farmers in the network only attended one event. Figure 4.9 shows all members of the FFP who attended regional engagement events in the central region, and Figure 4.10 shows only the farmer attendees.

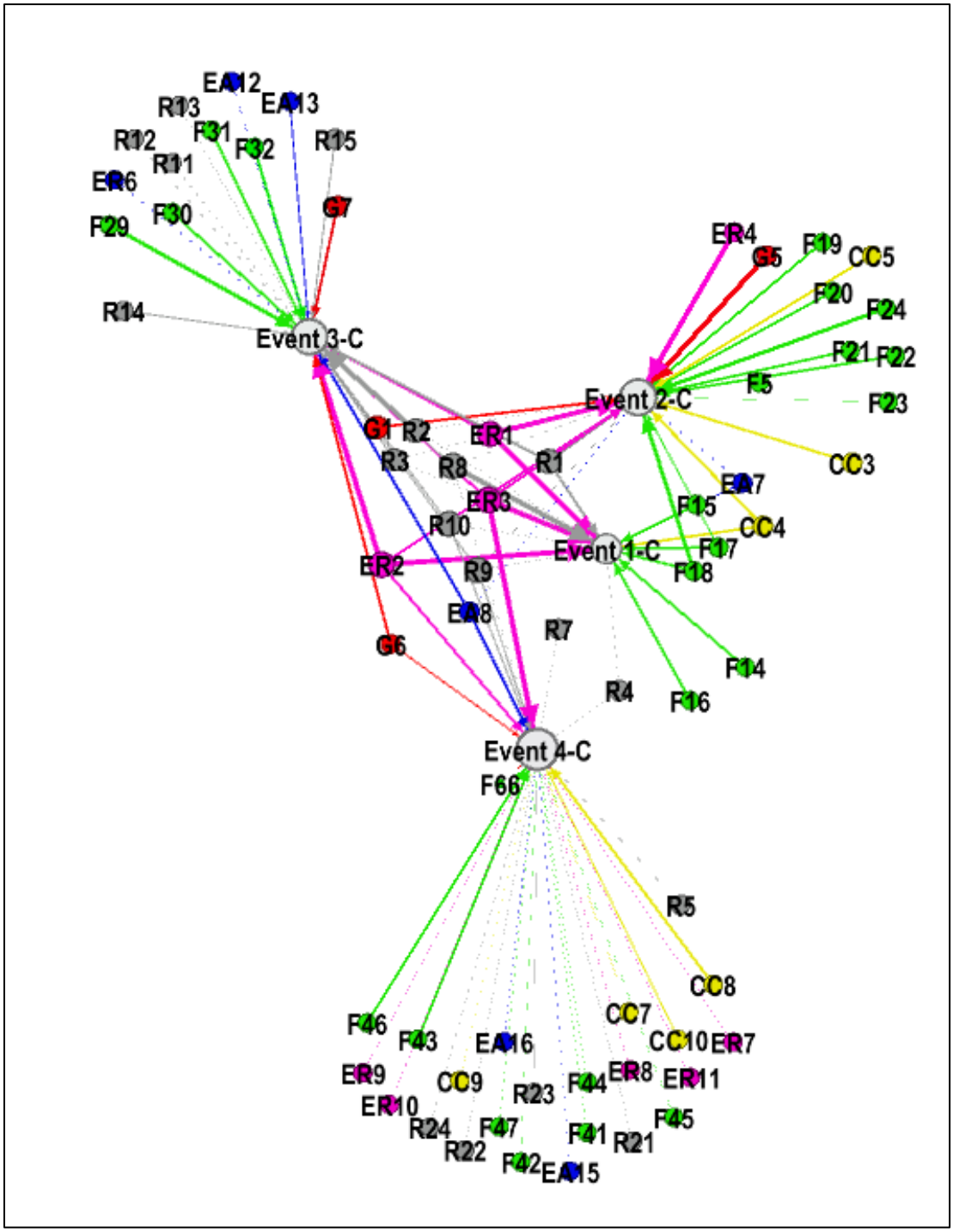

Figure 4.9. The Future of Farming Project Central Region Social Network Analysis.

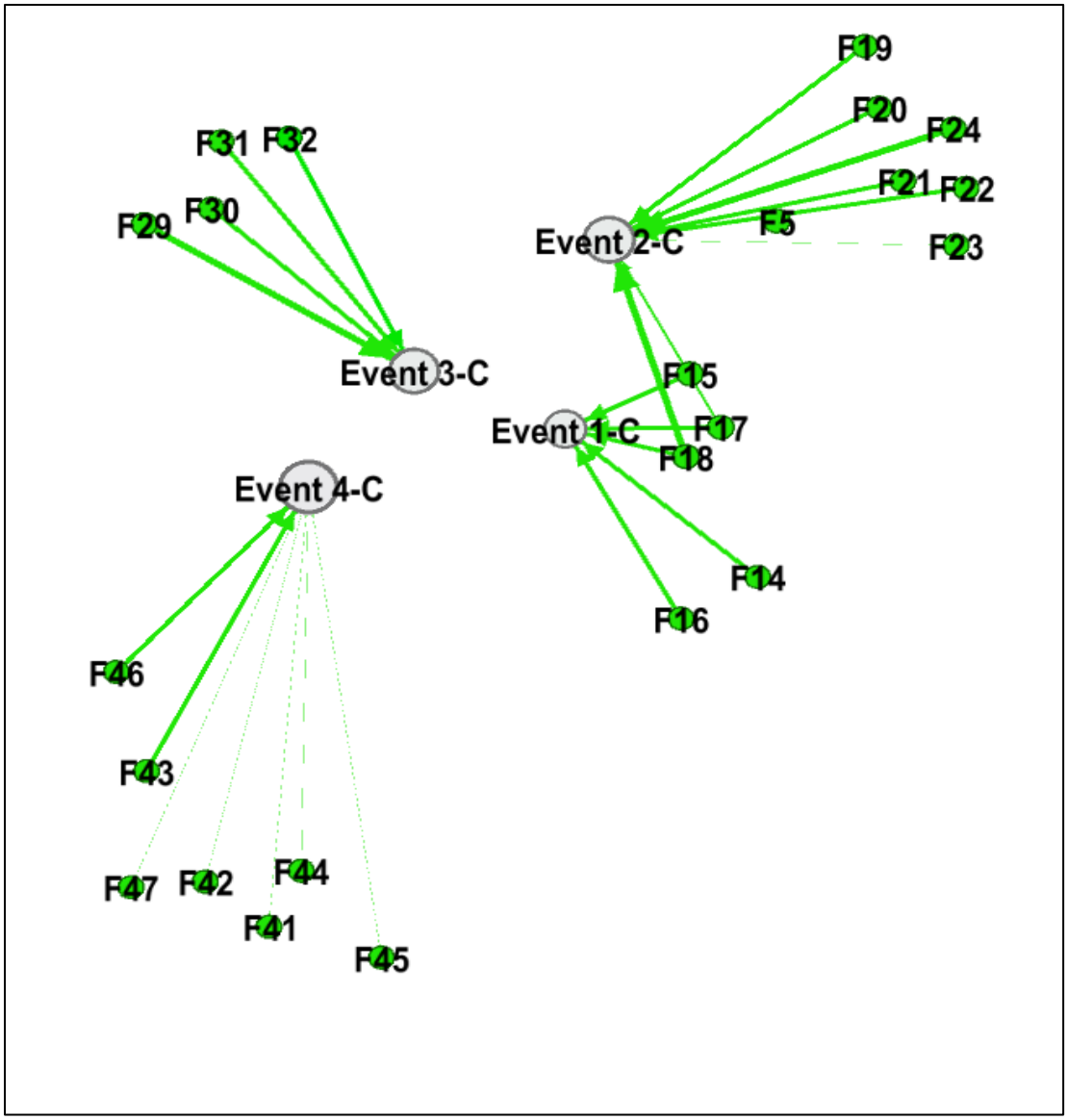

Figure 4.10. The Future of Farming Project Central Region Farmers Social Network Analysis.

While there was a higher degree, the low repeated participation might indicate to the FFP researchers that more work should be done to encourage attendance within the region. It is also important to note that the cooperator farmer for this region, F40, had not attended a regional engagement meeting, despite their role in the project. As the FFP progresses, the research team should consider addressing the expectations of the cooperator farmer to encourage their participation in the FFP.

South Region Social Network Analysis

The south region had a degree total of 93 from the four regional engagement meetings. Of these meetings, most farmers attended multiple regional engagement meetings. Farmers exhibited high centrality as demonstrated by their willingness to engage during the events. Figure 4.11 maps the southern region's social network, and Figure 4.12 identifies the social networks of the farmers. These maps assist in visualizing the influence that the farmers have within the network.

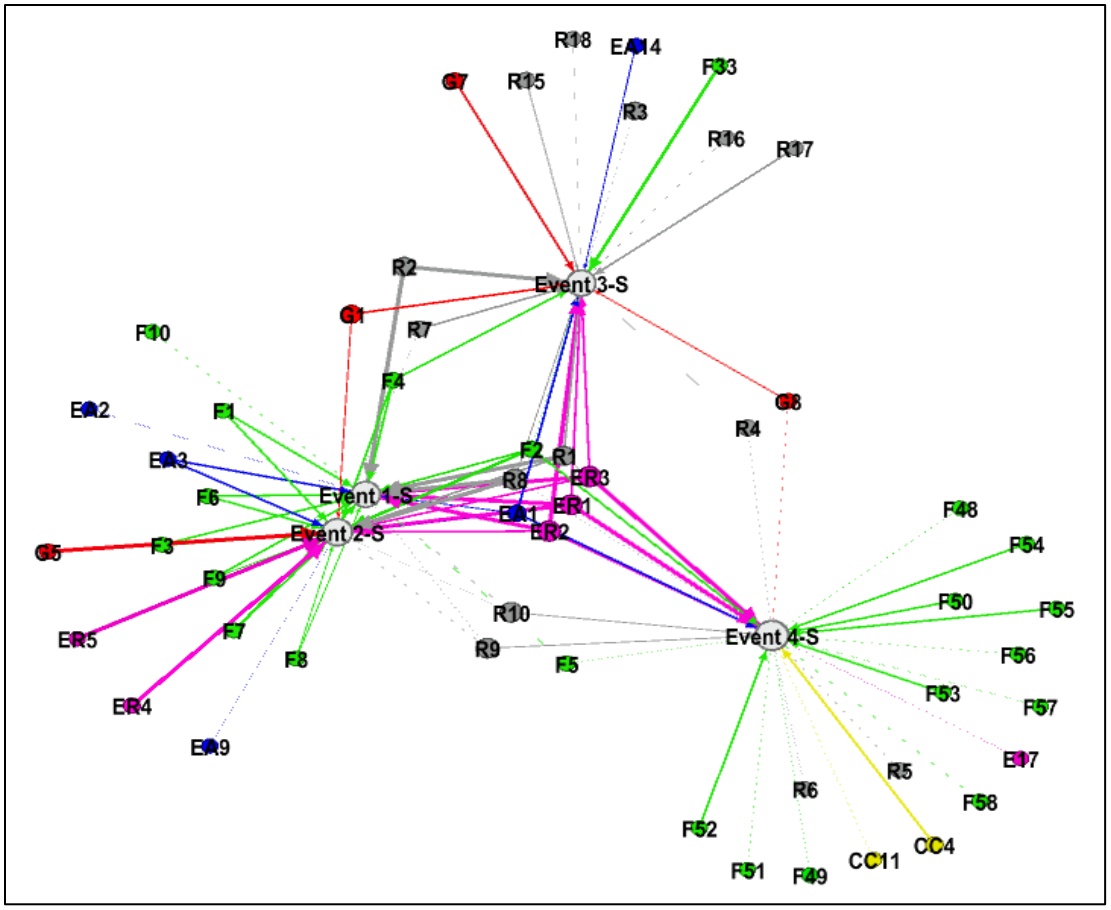

Figure 4.11. The Future of Farming Project South Region Social Network Analysis.

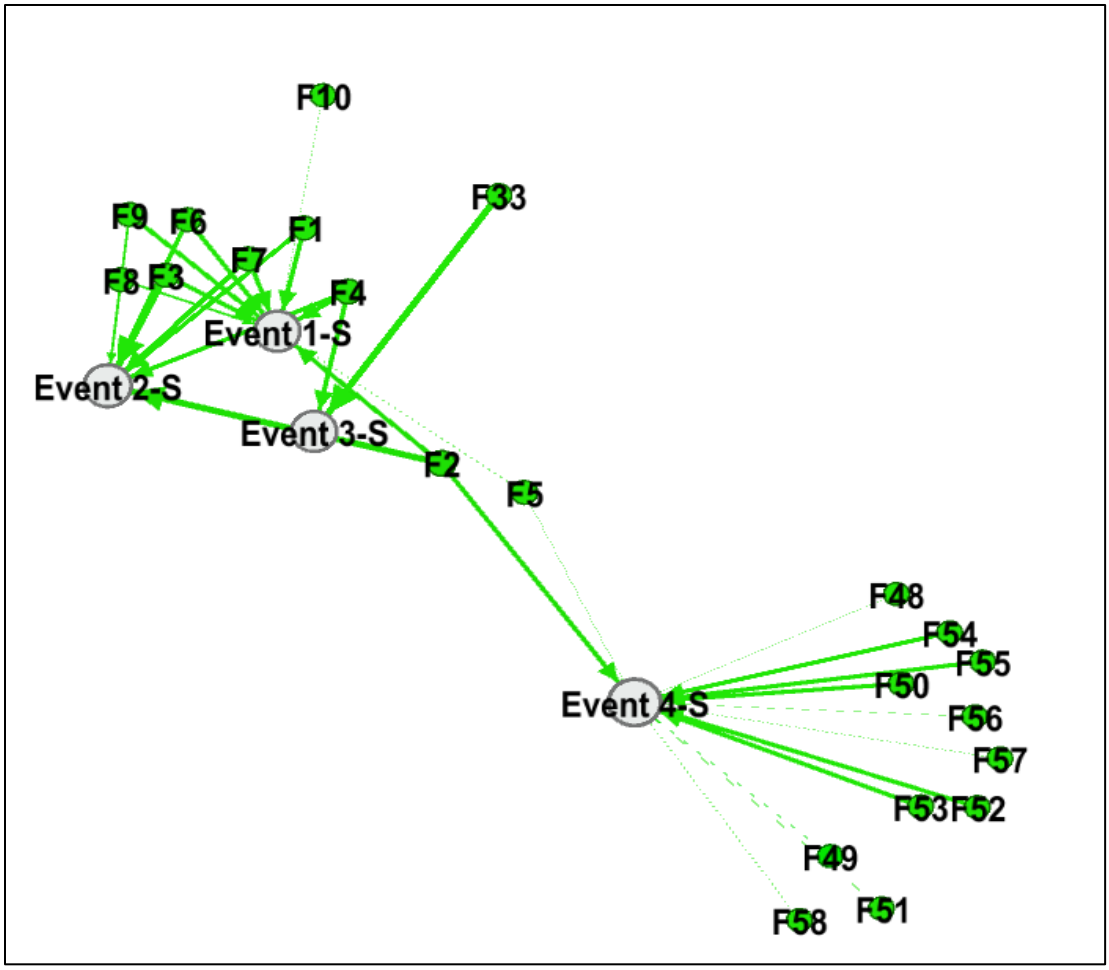

Figure 4.12. The Future of Farming Project South Region Farmers Social Network Analysis.

Figure 4.12 identifies F2 as being impactful in the FFP regional engagement events. They attended three of the events available, even though they are not a primary operator of their farm; F2 is the manager of cooperator farmer F3's operation. The influence of F2 indicates to the FFP research team that the more probable agent of change is not the assigned cooperator farmer, and a shift in roles may be appropriate as the project moves forward.

North Region Social Network Analysis

The north region had three regional engagement meetings and had a degree total of 68. The lower degree score could be contributed to both the lower number of opportunities for data collection and the lower number of the farmers attendance at regional engagement meetings. Three farmers attended more than one FFP regional engagement event: F11, F12, and F13. This region is the only region where the cooperator farmer attended engagement meetings and had a high level of participation. Figure 4.13 shows all members of the FFP who attended regional engagement events in the north region, and Figure 4.14 illustrates the farmer attendees.

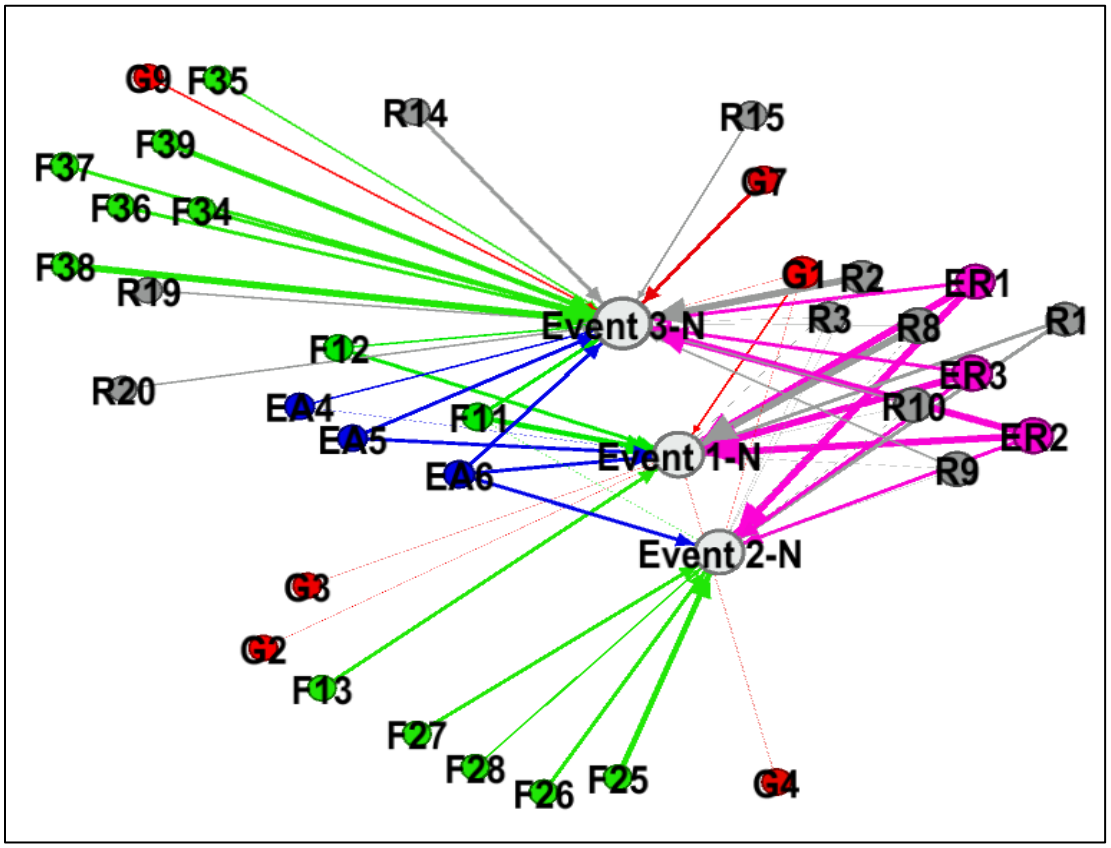

Figure 4.13. The Future of Farming Project North Region Social Network Analysis.

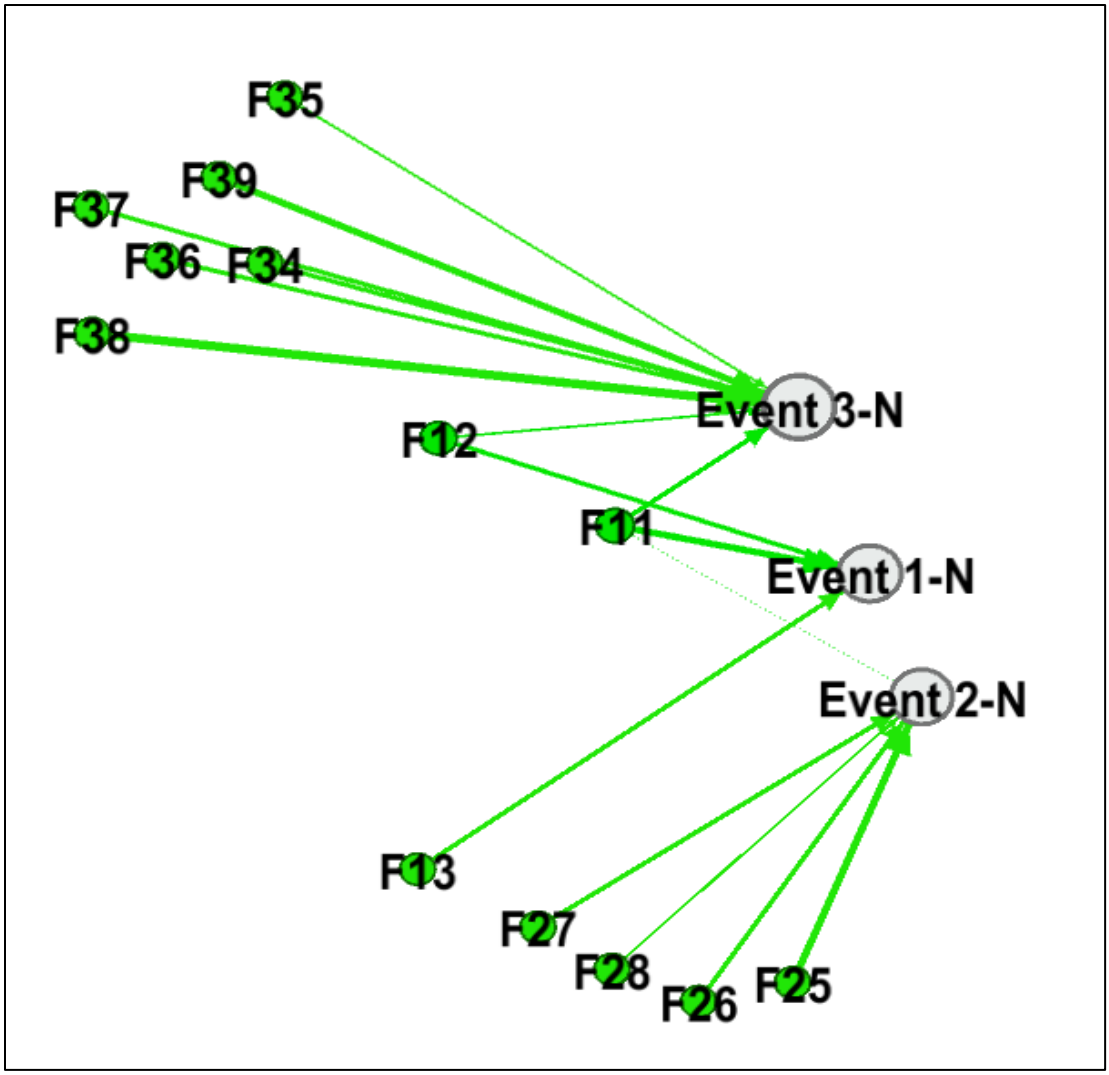

Figure 4.14. The Future of Farming Project North Region Farmers Social Network Analysis.

While the north region began with low attendance, it is encouraging that the regional engagement meetings have continued to see an increase in farmers participating, as opposed to a fluctuation. The FFP should consider increasing the number of farmers who attend this event by engaging with the EAs and Gs who have an established presence in the region. It is important to note that because this region has fewer farmers (ER1, Interview), it is expected this region to have fewer farmers attend the regional engagement meetings. Therefore, the FFP must retain those farmers who do participate in the regional engagement meetings.

CHAPTER 5. THEMES FROM QUALITATIVE DATA

This chapter identifies the main themes gathered from the qualitative coding conducted during the regional engagement meetings and the semi-structured interviews. Researchers identified that they lack a personal understanding of farmers' barriers and limitations to adopting the climate-smart technologies addressed by the FFP. Further, farmers desire personalized extension programs, which they do not typically receive with the current design of cooperative extension. Finally, farmers value learning from other farmers and emphasize having personal interactions with other members of their agricultural network, even if there is not a formal space for those interactions to take place.

> "[EXTENSION AND RESEARCHERS] DON'T ALWAYS HAVE THE BIG PICTURE."

The FFP research team designed the project to be a "mutual learning process… a journey where we will co-develop knowledge" (ER3, Event 1-S) between the research team, farmers, and other stakeholders. However, the general FFP SNA showed that the ERs and Rs are more central in the network than the farmers. The high centralization of the ERs and Rs (Fig. 4.1) made it a challenge to identify others who may also be agents of change in the FFP. The modified FFP SNA (Fig. 4.2) distribution allowed for clearly illustrated connections between the participants. The FFP regional engagement events had consistently more ER and R attendees than farmers. In the first two years of the FFP, the research team led the regional engagement events which increased their participation scores. As the project continues, the goal of the team is to step back and allow other FFP participants opportunities to plan, host, and lead meetings. As stated by ER2 (Event 1-N),

> "Sometimes… we think that we know what the farmers need. And a lot of times that's true because [of] our experience and our interactions with the farmers… But perhaps we don't always have the big picture or the full picture or… ."

The data also suggest that the ERs and Rs were at times unsure how to prepare for the interactive events with producer impact. The three cooperator farmers were not asked to join the FFP regional engagement event planning meetings, yet the research team admitted "We have not been able to really communicate very well why we want to do this and where this data is going" (ER2, Team Meeting).

Additionally, the ERs on the FFP spent limited time developing engagement strategies to be used during the regional engagement meetings; a list of potential approaches was provided by a Rural Sociology sub-team member, however, there was no consideration of using the list in the planning process. In fact, the list was ignored entirely.

"THERE'S NOT A ONE SIZE FITS ALL."

The findings show that regional engagement meetings that actively included farmers in the agenda had higher engagement measures and were more effective in developing gemeinschaft networks within the FFP. Agricultural extension and other stakeholders acknowledge know that "there's not a one size fits all" (G5, Event 2-S), and they appreciate the FFP for altering the content of the meetings and technology transfer process. Cooperator farmer F40 shared their goals for the FFP during their interview:

> "… If we can't find a way to create a program… that you can hand to somebody else that's in a different region. If we can't hand them something that's got previous success, we'll never have this movement go forward. We'll just constantly be just sprinkling just grains of sand… So, what I would love to see is over this five-year project to be able to

build a… system… I need to teach you how to think and what's your capabilities are more so than 'how do I survive?' or 'what kind of farm operations do I have?'" (F40, Interview).

Some farmers report the traditional lack of customization in cooperative extension programing is a barrier to implementing new technologies. "Every farm does things different… Farming is a lot of personal decision making" (F11, Interview). Top-down extension programming often forgets the differences between operations when disseminating information. Moving forward, cooperative extension needs to account for the variation in farms when attempting to share information with different audiences.

"I'M GOING TO LOOK TO SEE WHO'S DOING IT."

Farmer participants in the FFP actively reported the need for relevant and accessible information related to farming practices. However, most conservation research is supplied through Midwest universities, which is not inherently relevant to the southeast or Alabama row crop farmers' concerns. Regardless, the FFP farmers still utilize the available information as needed. When asked about what sources farmers turn to for information, they reported looking for experienced people, regardless of their geographic location. This was illustrated by the following interviews:

R9: Besides extension agents, are there other places where you turn for information about practices or just farming in general?

F40: Not really. I think that… the conservation world right now is a pretty small one… It's slowly gaining momentum, but you know between here and in the Midwest there's not a big vein of cover crops and no-till…. There's pockets but there's not that many of us that's really adopted it and are sticking with it right you know.

R10: Do you have anybody in the southeast that you can think of… where you turn to, or do you mostly look towards those Midwestern?

F40: I don't think there is anybody else, I don't know anybody this invested in cover crops (F40, Interview).

When asked the same question, F18 said:

"…When it comes down to where I think 'yeah is this possible, will it work,' I'm going to look to see who's doing it. There are some notable no-tillers like out in the Midwest that if their name is attached to it, [there's] something to it" (F18, Interview).

"INTERACTION IS STILL VERY IMPORTANT."

Farmers in the FFP are strong representatives of a gemeinschaft network; while they need the information from the ERs and Rs, they want to support their community. When asked why they decided to participate in the FFP, F11 said:

"As a grower and producer and… a steward of these farms, I feel like that I should participate in [the FFP], because… they're going to be beneficial to my occupation and my children's… . and others down the road" (F11, Interview).

This desire for permanency for their operation extends to their region. Farmers recognize the need to lean on each other to solve problems, which is aided when there is an identified social network.

"There are some huge problems we are going to face that either government is either going to tell us that we are going to have to face, or we're gonna have to figure it out somehow.… and you start talking to people because other people have the same problem… how are we going to solve this problem?" (F15, Interview).

However, farmers find it difficult to form strong community relationships, since the development of the internet eliminated the need to talk to people in person to find answers. Farmers "can just access any kind of information there is. Any kind of chemical label, any kind of application… it's just not necessary to…talk to people" (F11, Interview). In their interview, F26 discussed how there isn't information they can't access because of the internet, but they still enjoy the personal connections that develop when asking for information.

> R10: So, whenever you're trying to do all of these new things, and you're… looking at the Internet and talking with people about what to do, has there been any information that you have not been able to access that you wish you could, or have had any difficulty accessing?
>
> F26: Back in those years, you know, the internet wasn't available, as accessible. That's where getting out and visiting other farms and other growers and seeing what they're doing was invaluable. These days you can actually get on the Internet and do a lot of that. You can't do all of it, yeah, but the interaction is still very important, but you can see a lot of it without going anywhere now.
>
> R10: So, what resource then have you felt to be the most useful?
>
> F26: Well for me when I was doing it, it was the personal experience… being on the farm and seeing what other people were doing. Now I would say for you younger generation that's probably not the case.
>
> R10: Can you elaborate on that why you think that is?
>
> F26: Just because they have access to so much information now. You know the personal interaction is still important, but they have access to so much. They got a question; they

just look it up. And you know, I'm of the generation where… that's… not just what I turn to where the younger generation will.

Despite the claims made by older farmers, the younger farmers still expressed a desire for engaging with their social networks and contribute those connections to their successes in agriculture. F17, one of the FFP's younger farmers, said the following when asked where they learned to be a farmer:

> "My granddad passed away when I was 10 so I kind of didn't really have anybody to learn from. I think that my 10-year-old mindset you know, your grandfathers always kind of like this idol to you. So, I kind of had that perfect perception in my mind of what I wanted the farm to look like, and how I wanted to farm. But a lot of it I just kind of had to figure out as I went. I had an older farmer tell me one time to find somebody that farmed how you wanted to farm and go watch them. And if they wouldn't answer your questions, you could always sit on the side of the road and watch what they do. So, to a certain degree, I've taken that approach as well. If I see somebody doing something that I think might work for me… I try to find out what they're doing, why they're doing it, and how it's working" (F17, Interview).

Additionally, the farmers in the FFP recognize that they are a source of information for other farmers in their community, especially when it concerns the FFP topics.

> "I tell people every day that but like, I'm the only one right here that's kind of caught on. But I think a lot of people are watching me now- my neighbors I've kind of done some, and I had a guy stop me the other day like "hey, can I ask you like what all are you doing," and I kind of explained it and he said I need to do something like that. I was like man we're seeing benefits now that are just out of this world" (F18, Interview).

While future significance is a goal of the FFP research team, ERs, EAs, and Rs have discussed their growing inability to connect with the farmers they serve. In an interview with EA4, they said "… And extension, we've got to hire people who have [that] knowledge because… we're going to be [irrelevant] fifty years from now" (EA4, Interview). Farmers in the FFP agree that the longevity of the FFP is important to them. Several participants mentioned that they believed that the FFP would be beneficial to their operations if done correctly.

> "….What I would love to see is over this five-year project to be able to build a… system. I think we need to put together a program that's more mind-driven than land-driven, right? I need to teach you how to think and what your capabilities are more than 'how do I survive?' or 'what kind of farm operations do I have?'…. I want to see us put something that we could hand out and say 'if you do… A, B, and C, and if you get stopped on [anything] call us. The mentors in the group will help you get through it… . [Right now] they're telling you things that you already know, you just need somebody to encourage you, to push you to do it…. 'Cause once you begin something empowering them, all the sudden it's amazing what they can do (F40, Interview).

CHAPTER 6. CONCLUSIONS

This project was most inhibited by the COVID-19 epidemic. Due to Auburn University's epidemic protocols, sampling events were limited to individuals who were specifically invited; they were not open to the general public. The research team began to open the events to those not in the original group when COVID-19 requirements were relaxed, although the dates were still not widely announced. Furthermore, while sample events were held in person, some planning and initial information sessions were conducted virtually.

Despite this limitation, this thesis found key information regarding the incorporation of peer-to-peer learning in farmer social networks through agricultural extension programming. Both farmers and agricultural extension agents are new to the incorporation of participatory practices, which leads to difficulty in the planning and execution of extension programs. Agricultural extension and other stakeholders ought to pay particular attention to farmers' needs and their practices before the development of workshops and field days. Results of this study highlight that farmers are more likely to participate in extension programming that they find relevant to their concerns and allows for them to engage with the other farmers in their social network. Data suggest that farmers in this study are, in fact, utilizing the farmer learning networks developed by the FFP. Further, the data shows that farmers have a strong desire to provide support to their social networks. This research suggests that the farmers' social connections are strengthened by their participation in the FFP.

Little of the preexisting literature incorporates mixed-methods – Social Network Analysis and qualitative data--to study farmers. However, this approach to agricultural extension research is prevalent in the earlier works of Charles P. Loomis. This thesis extends his work by reapplying graph math to a rural setting, examining patterns of community ties, and how climate-smart

technologies and practices flow between farmers. As climate variations grow increasingly extreme, developing and promoting more effective communication and understanding of farming communities will prove crucial. Moreover, this research highlights the importance of a mixed-methods approach. By engaging both SNA strategies for examining farmer learning networks and qualitative stakeholder interviews, we discover a breath of individual knowledge and barriers to the spread of knowledge more broadly throughout the farming community. The FFP's farmer learning networks are in many ways reminiscent of the Gemeinschaft relationships observed by Tonnies and Loomis. The qualitative themes reinforce Loomis's work; members of a social network require trust and rapport to facilitate participation. Greater impact in terms of retention of the farmers in extension programming may be realized as relationships are strengthened.

When the cooperator farmer, F40, was asked about their feelings towards the FFP, they said "We can do what is expected of us, or we can do what we are capable of… let's do what we are capable of." The FFP is in a position to elevate the approach of cooperative extension programming by using peer-to-peer learning and multidisciplinary approaches. By developing rapport, providing current and relevant information in an engaging program, and incorporating farmers into the planning and leading of the learning networks, the FFP will propel agricultural extension away from top-down approaches and toward what cooperative extension is capable of, not simply what is expected.

CHAPTER 7. POSITIONALITY STATEMENT

As a fourth-generation farmer, my experiences, as well as the experiences of my parents, grandparents, and great-grandparents, have profoundly affected my role in this project. Our farm was impacted by the Tobacco Transition Payment Program, often known as the tobacco buy-out, which prompted us to transition from a row-crop operation to a grass-fed beef cattle ranch. This momentous time for our century farm has provided me with the wisdom of an established farm while also exposing me to the hardships that come with being new to the industry. As a primary decision maker for the farm, I have directly dealt with all levels of agricultural stakeholders, including cooperative extension and NRCS, and am familiar with their strengths and shortcomings from a producer's standpoint. When I was given the opportunity to work on the FFP, I reversed my traditional role as a producer and participated in the project as a researcher. I was able to hear farmers' stories and advocate for their needs from within the research team. While I am not naive enough to assume I did everything correctly, my main motive throughout this study was to be the farmer's voice; to offer them all I wish someone had given my family's farm. Because of this devotion, I developed great feelings of protectiveness for the FFP farmers. I tried to incorporate the farmers' experiences and persuade the research team to consider them in the logistics of the FFP.

I am grateful to the extension agents, government representatives, and other project stakeholders. However, there are several areas in which these stakeholders may improve, some of which I have outlined in my thesis. Despite its limitations, I firmly believe that cooperative extension is essential for farmers to prosper and evolve into businesses that can be passed down through generations.

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APPENDIX 1. CROP CONSULTANT INTERVIEW GUIDE

What is your background?

- What is your academic degree and job title?
- How long have you been in crop consultant?
- Do you have any experience with a conservation project (co-development of knowledge) like this?
- How do farmers first get in contact with you?
    - What demographic of farmers do you work with?
    - What is your impression of farmers perception of Extension/ consulting firms?
    - Are there row crop farmers that crop consultants do not work with or does not reach?

General Knowledge

- What soil conservation strategy or practice do you see as most important in Southeastern US row crop production?
    - If producers adopted this strategy or practice, what ought to be the soil conservation outcome?
    - What might prevent producers from the using this soil conservation practice?
- How do you think extension agents and other crop consultants would perceive this soil conservation strategy?

Perceived Behavioral-Control

- What is/are the [strategies, practices, or technologies] that you think would best address these soil conservation concerns?
    - What, new, [strategies, practices, or technologies] do you see as most compatible with their existing operations?
    - What, new, soil conservation [strategy, practice, or technology] are your producers most likely to try?
        - What challenges would you anticipate?
- Where do your producers turn for information or advice about soil conservation?
    - Who
        - Who regularly seeks your advice?
        - Do they use 2^{nd}, 3^{rd} opinions?
    - External sources (perhaps internally?)
    - What type(s) of information or advice are they unable to get?
    - What kind of information are you or your company unable to get?
- What soil conservation [strategies, practices, or technologies] do your producers currently use that impress you most?
    - Of the [strategies, practices, or technologies] skills that your producers currently have, what would you most like to see them strengthen?
    - Are there [strategies, practices, or technologies] that you would most like to learn about?

Perceived Costs and Benefits

- What is/are the [strategies, practices, or technologies] have been most successful to date?
    - How did you evaluate the success of this [strategies, practices, or technologies]?
        - What does success look like?
- What, new or innovative [strategies, practices, or technologies] is/are likely to have the greatest outcomes on these farms? (most potential)
    - What changes would you need to see to consider the [strategies, practices, or technologies] effective?
    - What characteristics would it need to have for you to recommend using the [strategies, practices, or technologies]?
    - What might cause you to stop recommending using the [strategies, practices, or technologies]?
- What do you see as the top 3 barriers or challenges preventing your producers from implementing a new [strategy, practice, or technology]?
    - What new conservation-based strategy, practice, or technology do you think producers are least likely to try? (why?)
        - How would you recommend we recruit more farmer participants?
            - Social media, extension meetings, newsletter, email…

APPENDIX 2. EXTENSION AGENT INTERVIEW GUIDE

What is your background?

- What is your academic degree and job title?
- How long have you been an extension agent?
- Do you have any experience with a conservation project (co-development of knowledge) like this?

General Knowledge

- What soil conservation strategy or practice do you see as most important in Southeastern US row crop production?
    - If producers adopted this strategy or practice, what ought to be the soil conservation outcome?
    - What might prevent producers from the using this soil conservation practice?
- How do you think extension agents and other crop consultants would perceive this soil conservation strategy?

Perceived Behavioral-Control

- What is/are the [strategies, practices, or technologies] that you think would best address these soil conservation concerns?
    - What, new, [strategies, practices, or technologies] do you see as most compatible with their existing operations?
    - What, new, soil conservation [strategy, practice, or technology] are your producers most likely to try?
        - What challenges would you anticipate?
- Where do your producers turn for information or advice about soil conservation?
    - Who
        - Who regularly seeks your advice?
        - Do they use 2nd, 3rd opinions?
    - External sources (perhaps internally?)
    - What type(s) of information or advice are they unable to get?
    - What kind of information are you or your company unable to get?
- What soil conservation [strategies, practices, or technologies] do your producers currently use that impress you most?
    - Of the [strategies, practices, or technologies] skills that your producers currently have, what would you most like to see them strengthen?
    - Are there [strategies, practices, or technologies] that you would most like to learn about?

Perceived Costs and Benefits

- What is/are the [strategies, practices, or technologies] have been most successful to date?
    - How did you evaluate the success of this [strategies, practices, or technologies]?
        - What does success look like?

- What, new or innovative [strategies, practices, or technologies] is/are likely to have the greatest outcomes on these farms? (most potential)
    - What changes would you need to see to consider the [strategies, practices, or technologies] effective?
    - What characteristics would it need to have for you to recommend using the [strategies, practices, or technologies]?
    - What might cause you to stop recommending using the [strategies, practices, or technologies]?
- What do you see as the top 3 barriers or challenges preventing your producers from implementing a new [strategy, practice, or technology]?
    - What new conservation-based strategy, practice, or technology do you think producers are least likely to try? (why?)
        - How would you recommend we recruit more farmer participants?
            - Social media, extension meetings, newsletter, email…

APPENDIX 3. CORE TEAM AND EXTENSION SPECIALIST INTERVIEW GUIDE

What is your background?

General Knowledge

- What soil conservation strategy or practice do you see as most important in Southeastern US row crop production?
    - If producers adopted this strategy or practice, what ought to be the soil conservation outcome?
    - What might prevent producers from the using this soil conservation practice?
- How do you think extension agents and other crop consultants would perceive this soil conservation strategy?

Perceived Behavioral-Control

- What is/are the [strategies, practices, or technologies] that you think would best address these soil conservation concerns?
    - What, new, [strategies, practices, or technologies] do you see as most compatible with their existing operations?
    - What, new, soil conservation [strategy, practice, or technology] are your producers most likely to try?
        - What challenges would you anticipate?
- Where do your producers turn for information or advice about soil conservation?
    - Who
        - Who regularly seeks your advice?
        - Do they use 2nd, 3rd opinions?
    - External sources (perhaps internally?)
    - What type(s) of information or advice are they unable to get?
    - What kind of information are you or your company unable to get?
- What soil conservation [strategies, practices, or technologies] do your producers currently use that impress you most?
    - Of the [strategies, practices, or technologies] skills that your producers currently have, what would you most like to see them strengthen?
    - Are there [strategies, practices, or technologies] that you would most like to learn about?

Perceived Costs and Benefits

- What is/are the [strategies, practices, or technologies] have been most successful to date?
    - How did you evaluate the success of this [strategies, practices, or technologies]?
        - What does success look like?
- What, new or innovative [strategies, practices, or technologies] is/are likely to have the greatest outcomes on these farms? (most potential)
    - What changes would you need to see to consider the [strategies, practices, or technologies] effective?

    - What characteristics would it need to have for you to recommend using the [strategies, practices, or technologies]?
    - What might cause you to stop recommending using the [strategies, practices, or technologies]?
- What do you see as the top 3 barriers or challenges preventing your producers from implementing a new [strategy, practice, or technology]?
    - What new conservation-based strategy, practice, or technology do you think producers are least likely to try? (why?)

Project Status

- Now that we're into the 2nd year, how do you perceive your role on this project?
    - In your perception, has your role changed? (how? why?)
    - Is there an aspect of your role that you would like to change? (why?)
    - What is the most important feedback that you've received about your role in the project? (why was it important to you?)
    - What are your personal goals for the next 1-2 years of the project?
- Team dynamics on all large projects are complex.
    - What is the most difficult aspect for you? (why?)
    - What would you most like to change? (why?)
    - How might the team go about making this change?
    - What seems to be working best? (why?)
- Have you received any feedback from producers or other stakeholders?
    - Has this feedback influenced your approach to the project?
    - Has this feedback influenced your opinion about the way the project ought to be organized or operate?
        - Do you see a way to change the project to address this feedback?
- Have you listened to (or read) any of stakeholder interviews?
    - What sticks out for you as an important comment? (why?)

APPENDIX 4. FARMER INTERVIEW GUIDE

What is your background?

- How long have you been farming?
- How long have you been farming this land?
- How long has the farm been in your family?
- How big is your farm?
    - Acres
    - One plot or spread out
- Do you own the land or rent it?
    - Who is the owner if renting?
    - How much say does the owner (if renting) have in your farm decisions?
- Have you participated in research before with your farm?
    - Has seed or chemical companies ever conducted trials
    - Has there been any research university or extension research done on your farm?
    - Were you able to voice your opinion in these projects? How did you respond during these projects?
- How are your yields in a year?
    - Do they average the same year to year?
    - How do you compare to your neighbors?
    - How have the recent rains impacted you?
- How did you learn to be a farmer?
    - What are your educational backgrounds?
    - Did you go to college?
    - Were you in 4-H or FFA? Any other organizations?
    - What made you decide you wanted to be a farmer?

Perceived Behavioral Control Questions

- Where are you most likely to turn for information or advice about soil conservation?
    - How comfortable do you feel expressing your needs and concerns with this person? Do you trust this person explicitly, or do you have reservations about your relationship?
        - *Do you feel comfortable voicing disagreement or confusion with this person?*
            - What would this look like?
        - *How likely are you to question their recommendations?*
        - *What qualities/requirements/characteristics/attributes do you look for in finding a source of information?*
    - What happens when you are presented with a new method, and you do not like it or feel comfortable using it?
    - What type(s) of information or advice about soil conservation have you not been able to access?
    - What resource/ information site has been the most useful and why? Which one has been the least?

- What is/are the [strategies, practices, or technologies] that you think would best address your greatest soil conservation concern?
    - What, new, [strategies, practices, or technologies] do you see as most compatible with your existing operation?
    - What, new, soil conservation [strategy, practice, or technology] are you most likely to try?
        - What challenges would you anticipate?
- Can you tell us a story where you felt the most successful in your operation related to your conservation methods? Are you proud of it?
    - Of the [strategies, practices, or technologies] skills that you currently have, what would you most like to strengthen?
- Are there [strategies, practices, or technologies] that you would most like to learn about?

Perceived Costs and Benefits

- What is/are the [strategies, practices, or technologies] that have been most successful to date?
    - How do you evaluate the success of this [strategies, practices, or technologies]?
- What, new, [strategies, practices, or technologies] is/are likely to have the greatest outcomes on your farm?
    - What changes would you need to see to consider the [strategies, practices, or technologies] effective?
    - What characteristics would it need to have to continue using the [strategies, practices, or technologies]?
    - What might cause you to stop using the [strategies, practices, or technologies]?
- What is the most significant barrier or challenge that might prevent you from implementing a new [strategies, practices, or technologies]?
    - What new conservation-based strategy, practice, or technology are you least likely to try?
- What barriers and challenges have you had in communication?

General Knowledge

- What soil conservation strategy or practice do you see as most important in Southeastern US row crop production?
    - If Southeastern row crop producers adopted this strategy or practice, what ought to be the expected soil conservation outcome?
    - What might prevent row crop producers from the using this soil conservation practice?
- How do you think others—row crop producers, extension, agronomists—would perceive this soil conservation strategy?

APPENDIX 5. GOVERNMENT INTERVIEW GUIDE

What is your background?

- What is your academic degree and job title?
- How long have you been working with NRCS?
- Do you have any experience with a conservation project (co-development of knowledge) like this?
- How do farmers first get in contact with you?
    - What demographic of farmers do you work with?
    - What is your impression of farmers perception of Extension/ consulting firms?
    - Are there row crop farmers that crop consultants do not work with or does not reach?

General Knowledge

- What soil conservation strategy or practice do you see as most important in Southeastern US row crop production?
    - If producers adopted this strategy or practice, what ought to be the soil conservation outcome?
    - What might prevent producers from the using this soil conservation practice?
- How do you think extension agents and other NRCS agents would perceive this soil conservation strategy?
- What about NRCS as a state agency assists farmers/producers the most with soil conservation?
- Are any farmers/producers uneasy about asking for help through NRCS?
- Do you have good rapport with your clients?

Perceived Behavioral-Control

- What is/are the [strategies, practices, or technologies] that you think would best address these soil conservation concerns?
    - What, new, [strategies, practices, or technologies] do you see as most compatible with their existing operations?
    - What, new, soil conservation [strategy, practice, or technology] are your producers most likely to try?
        - What challenges would you anticipate?
- Where do your producers turn for information or advice about soil conservation?
    - Who
        - Who regularly seeks your advice?
        - Do they use 2nd, 3rd opinions?
    - External sources (perhaps internally?)
    - What type(s) of information or advice are they unable to get?
    - What kind of information are you or your company unable to get?
- What soil conservation [strategies, practices, or technologies] do your producers currently use that impress you most?

    - Of the [strategies, practices, or technologies] skills that your producers currently have, what would you most like to see them strengthen?
    - Are there [strategies, practices, or technologies] that you would most like to learn about?

Perceived Costs and Benefits

- What is/are the [strategies, practices, or technologies] have been most successful to date?
    - How did you evaluate the success of this [strategies, practices, or technologies]?
        - What does success look like?
- What, new or innovative [strategies, practices, or technologies] is/are likely to have the greatest outcomes on these farms? (most potential)
    - What changes would you need to see to consider the [strategies, practices, or technologies] effective?
    - What characteristics would it need to have for you to recommend using the [strategies, practices, or technologies]?
    - What might cause you to stop recommending using the [strategies, practices, or technologies]?
- What do you see as the top 3 barriers or challenges preventing your producers from implementing a new [strategy, practice, or technology]?
    - What new conservation-based strategy, practice, or technology do you think producers are least likely to try? (why?)
        - How would you recommend we recruit more farmer participants?
            - Social media, extension meetings, newsletter, email…

APPENDIX 6. CENTRALITY OF THE FUTURE OF FARMING PROJECT

GENERAL NETWORK

Role	Degree	Eiganvector
ER2	105	0.741666
ER1	92	0.423723
ER3	44	0.356258
R1	36	0.353742
F3	33	1
F11	32	0.885156
R2	23	0.222294
EA4	16	0.111208
EA1	14	0.040732
G1	12	0.167723
R3	12	0.131918
F12	11	0.118906
EA3	10	0.140965
F4	6	0.018732
F7	6	0
G4	5	0.093557
F2	5	0.005125
F1	4	0.069519
F6	4	0.010249
F8	4	0.00088
CC1	3	0.038092
EA5	3	0.004213
F9	3	0
G3	2	0.010569
EA2	2	0
F5	2	0
F10	1	0
G2	1	0

APPENDIX 7. CENTRALITY OF THE MODIFIED FUTURE OF FARMING PROJECT NETWORK

	Degree	**Eiganvector**
F18	9	0.216423
EA4	8	0.508692
EA1	8	0.015101
F12	7	0.906593
CC4	7	0.038316
EA3	5	0.387478
F24	5	0.164769
F7	4	0
F11	3	1
F13	3	0.728763
EA13	3	0.334572
F4	3	0.30009
F3	3	0.061233
F38	3	0
F36	2	0.46256
F22	2	0.278639
G5	2	0.266807
F6	2	0.076632
F15	2	0.051166
F8	2	0.005034
F28	2	0
G3	1	0.271237
F17	1	0.164769
F19	1	0.11387
F33	1	0.11387
F14	1	0.051166
F2	1	0.038316
G4	1	0.005034
EA5	1	0.005034
EA6	1	0.005034
F39	1	0.005034
EA2	1	0
F9	1	0
G6	1	0
F1	0	0
F5	0	0

F10	0	0
G1	0	0
G2	0	0
CC1	0	0
CC2	0	0
CC3	0	0
EA7	0	0
F16	0	0
EA8	0	0
F20	0	0
F21	0	0
F23	0	0
CC5	0	0
EA9	0	0
F25	0	0
F26	0	0
EA10	0	0
EA11	0	0
F27	0	0
F29	0	0
F30	0	0
G7	0	0
F31	0	0
F32	0	0
EA12	0	0
G8	0	0
EA14	0	0
F34	0	0
F35	0	0
CC6	0	0
G9	0	0
F37	0	0