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How Social Network are Influencing the Implementation of Sustainable Agriculture In Central Massachusetts

Project Team:

Jeffrey Compere (jlcompere@wpi.edu)

Abraham Koffman (akoffman@wpi.edu)

Project Advisors:

Professor Michael Elmes

Business School

Professor Laureen Elgert

Global School

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Abstract

This project examines some of the relationships in the agricultural social networks of Central Massachusetts and their impact on the implementation of sustainable agriculture. Industrial agriculture results in many negative externalities and a fragile production system; a resilient and sustainable agricultural system has the potential to build a more robust approach to agriculture. Through semi-structured interviews with stakeholders, themes were identified of how social networks influence how individuals are implementing sustainable agricultural practices. Our results show that the internet, economic viability, bridging of networks, and the continued renegotiation of institutional legitimacy are active dimensions of the social network that influence the implementation of sustainable agriculture.

Executive Summary

This executive summary provides an overview of the key findings and conclusions presented in “How Social Networks are Influencing the Implementation of Sustainable Agriculture in Central Massachusetts”. The current issues around climate change and ecological degradation necessitate the transition from an unsustainable fragile industrial, agricultural system to a sustainable, resilient agricultural system. The current industrial agricultural system is reliant on methods of production that produce ecological, social, and economic negative externalities. Sustainable agricultural practices exist that can produce positive ecological, social, and economic externalities. Some of these sustainable practices include minimal tillage, livable wages, and reduced pesticide and fertilizer usage. Such practices improve water infiltration and soil health, support a healthy local economy, and prevent damage to nearby ecosystems.

Transitioning from an unsustainable agricultural system to a sustainable agricultural system is incredibly challenging due to the wicked complex adaptive nature of social and environmental systems. What practices are actually sustainable is constantly being negotiated amongst stakeholders, with many vehemently disagreeing with each other on the proper pathways forward, creating a wicked mess of opinions. The interconnected and interdependent aspects of the agricultural systems make it complex when attempting to change course.

Many actors are actively building a sustainable agricultural system. By understanding how these actors are connecting and collaborating through their social networks, we can better understand how this transition to a sustainable agricultural system is progressing. Social networks are composed of individuals tied together through relationships. Social networks can be clustered around organizations or linked through shared values and norms. Understanding how individuals are engaging their social networks to access new knowledge and resources could provide perspective on the barriers and opportunities sustainable agricultural farmers are experiencing.

Through semi-structured interviews with stakeholders, themes were identified of how social networks influence how individuals are implementing sustainable agricultural practices. In the interviews, the themes of how the internet is being used to share and maintain sustainable practices, the ongoing renegotiation between individuals and institutions, a holistic approach to farming in the face of financial instability, and the bridging of separate networks were identified. These findings highlight the importance social networks currently play in the maintenance and implementation of sustainable agriculture practices in Central Massachusetts.

Acknowledgments

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Introduction

The global problem this project explores is how social networks impact the implementation of sustainable agricultural practices. Agriculture is the process of growing, processing and distributing food, fuel, and fiber to meet the demands of a population. These demands could range from healthy food to cheap cotton for cheap clothing. Since the Green Revolution, the Industrial Agricultural system has dominated the agricultural markets using capital cost-efficient practices such as concentrated animal feedlots (CAFOs), pesticides, mono-crops, and synthetic fertilizers. While these practices drastically increased the number of calories produced per acre farmed, they show diminished results over time. In response to such practices, pests develop pesticide resistance, soil organic matter and biological life degrade, and watersheds dry up, reducing crop resilience and yields. In addition, the dominant agricultural system has created a range of negative ecological, economic, and social externalities (Cissé et al., 2022; Smith et al., 2007).

Negative ecological externalities range from biodiversity loss, eutrophication in fisheries and waterways, soil degradation and erosion, air and water pollution, deforestation and habitat destruction, increasing antibiotic resistance, and contribute somewhere around 30% to global warming (Domingo 2021; Mateo-Sagasta 2017; Smith et al. 2007). Such negative environmental externalities are felt in the land, and the human body; obesity, cancer, and depression rates have skyrocketed, and ⅓ of Americans are nutrient deficient, all with strong links back to industrial agricultural practices (Fuhrman 2018; Smith et al. 2007; Bird 2017). A focus on a few staple crops to meet caloric needs has resulted in cheap, basic commodities. These cheap staple crops have resulted in simplified diets based on the few staple crops turned into fast food (Gillespie 2017; Sands et al. 2009). This food system based on caloric-dense foods lacks micronutrients and reinforces cheap nutrient-less food as the most economical choice (Fuhrman 2018).

Economic and social externalities include abusive working conditions for migrant workers, the destruction of rural economies and their communities, and a mental health crisis among industrial farmers (National Center For Farmworker Health 2017; Smith et al. 2007). As farms and food processing facilities are consolidated, the amount of rural farm jobs decreases, reducing the amount of money being spent in local economies. This combines with exploited migrant workers undercutting the local labor force, again reducing the amount of well-paying jobs and money circulating in the local economy. The limited surviving farms and processing facilities face economic pressure from transnational corporations to perform to a certain standard, or they lose their livelihood. The industrial agricultural system is a non-resilient system that is increasingly inefficient and easily disrupted (Rotz & Fraser 2015). Such negative externalities produced by industrial agriculture impact those lowest in the socioeconomic hierarchy and create a significant social justice issue.

Sustainable agriculture has emerged as a solution to mitigate those negative externalities caused by industrial agriculture. Sustainable agriculture is the practice of producing both the

food and fiber needs of people while enhancing the environment and the quality of life for farmers and other people while promoting economic viability (USDA, 2023). The many practices utilized by sustainable agricultural farmers are varied depending on geographical context: no-till or reduced till, silvopasture, agroforestry, rotational grazing, cover crops, and diversification of crops have been utilized (Francis, 2011). While viable solutions exist, there are multiple barriers preventing implementation.

The farmers that seek to overcome such negative externalities face considerable obstacles. Economic barriers include historical farmer debt levels and monopolization of agricultural markets. Political obstacles intertwine with economic impediments such as zoning laws allowing low-density housing on arable land, government subsidization of industrial produced crops, and lack of political power for small and medium farmers (Albizua, 2021, Ferguson, 2021). Farmers may want to switch to more sustainable practices, but with yearly payments due on debt, which most farmers have, the transition is untenable due to large drops in farmland productivity when transitioning to new methods. Selling land to developers may be the clearest way for farmers to clear their large debts. Cultural hindrances such as the 'American' fast food cuisine preference restrict sustainable agriculture's viability. Current agricultural infrastructure is built for GMO industrial farming practices, making Organic sustainable agriculture's current logistics uncompetitive. (Environmental Protection Agency, 2023; United States Department of Agriculture, 2023; American Farmland Trust, 2020). Such path dependencies make transitioning incredibly challenging.

Transitioning to an improved system is further complicated because agriculture is part of a complex adaptive social-ecological system (Levin 1998; Fuller 2013). The factors affecting agriculture range from social customs and market forces to regional weather patterns and ecological disturbances. This complex of multiple factors creates a dynamic, uncertain, interconnected, and interdependent mess of influences (Bodin 2009). Identifying solutions that will have a positive impact frequently results in conflicting opinions and uncertainties. This results in a wicked problem, a problem without a defined end goal or agreed-upon problem. The natural variation and scale dependencies of such a complex adaptive system further complicate identifying possible alternative pathways to building a resilient sustainable agricultural system. Strengthening and leveraging farmer social networks has been identified as key to implementing sustainable agriculture and overcoming such barriers (Chaudhuri et al. 2021; Coulibaly et al. 2021; Albizua et al. 2021; Pratiwi & Suzuki 2017).

The ability of a farmer to successfully implement an economically, socially, and ecologically sustainable farm is contingent in large part on a farmer's knowledge of practices (Gebska 2020). While sustainable agricultural systems also require more structural support, such as policy, resource access, and social support. As the socio-ecological systems farmers are embedded in are rapidly morphing ecologically, socially, and economically, farmers must quickly adapt to such changes to succeed (Pratiwi & Suzuki 2017).

Farmers are embedded in social networks through which they exchange resources and information (Coulibaly et al. 2021). Information on beneficial land management and successful economic practices can propagate amongst farmers through these social networks, increasing the number of farmers, and thus acres, engaged in sustainable agriculture practices (Albizua et al. 2021; Chaudhuri et al. 2021; Pratiwi & Suzuki 2017). Adapting location-specific social, economic, and ecological practices is essential to the successful implementation of sustainable agriculture (Coulibaly et al. 2021; Robertson et al. 2022; Albizua et al. 2021). Communication in social networks is essential to the success of sustainable agriculture.

The goal of this project is to examine some of the relationships in the agricultural social networks of central Massachusetts and assess how they impact the capacity of farmers to implement sustainable agriculture. There are many established social institutions, such as the Northeast Organic Farming Association, Massachusetts Department of Agriculture, and Massachusetts Food Collaborative actively collaborating and organizing the social network to advance the adoption and creation of a sustainable agriculture system. While massive progress has been made, and there are many large organizations taking action and making changes, it is important to continue to center individual farmer perspectives on how the implementation process is proceeding. This may allow the identification of gaps in the ongoing collaboration in the sustainable agricultural social network as actors attempt to change and improve the system.

Our research used qualitative methods to learn about how farmers are using their social networks to implement sustainable agriculture. We used semi-structured interviews to ask farmers and other agricultural actors about their interaction with their social networks. These interviews allowed us to glimpse some ways these actors engage in their networks and identify some common network themes between the actors' different experiences.

Background

Collaboration and communication amongst actors in social networks have been identified as a way to overcome wicked problems in complex adaptive systems through autonomously coordinating independent actors to achieve collective goals (Weber 2008). Mapping the quality of communication and collaboration in relationships amongst current actors in an agricultural social network can increase current and future stakeholder awareness and facilitate collaborative approaches to overcoming interconnected and interdependent barriers (Lundgren 2021; Parks 2022; Osti 2015; Jessop et al. 2008). By understanding the topography of the social network actors could better leverage potential resources in their environment to achieve their goals of participating in and improving the agricultural system (Hauck 2016; Trauger 2009; Renting et al. 2012). Viewing one's position as located in a social network can mix the perceived closed and open social structures, which can benefit cooperation and social learning through improved information and resource propagation (Bruce 2021).

The background chapter will first cover some basic social network terminologies. Then it will explore how social networks contribute to the complexity of systems, and how they have been leveraged to implement goals in such complex adaptive environments. It will finish with how social networks have been and are being leveraged by actors to promote sustainable practices.

1.0 Social Networks

A social network is a social structure assembled from social actors and the relationships between them (LibreTexts 2021). Social actors can be individuals or organizations and are represented in the social network as nodes. The relationships and differences in power between the nodes or actors can be represented by ties. Social networks can feature a few central nodes or hubs, that form more connections to other nodes than the rest of the nodes in the network and thus could have more power. A scale-free network is one that has central hubs, while a random network would have nodes that are more evenly distributed in their amount of connections (Aarstad et al. 2013).

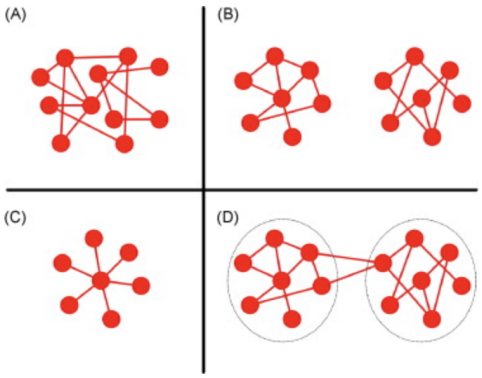

Fig. 1. Some common network topologies. (A) A network that has no significant central node. (B) A network with two separate networks and a high degree of modularity. (C) A scale-free network with a central hub. (D) Two distinct social clusters interconnected through bridging ties. (Bodin 2009)

Scale-free networks often emerge due to new actors joining a network connecting with the node that is already highly connected and embedded in the network. These hubs in the network often appear to have more information and resources than other nodes. Scale-free networks result in most information passing through a central location, decreasing or increasing the propagation and synthesis of certain information, at the discretion of the central actor (Aarstad et al. 2013). This social network structure may limit the dissemination, adoption, and trialing of new appropriate practices when compared to more loose networks. Rhizomatic networks are a combination of loose and dense social network formations.

1.1 Social Institutions

Social institutions play an important role in governing how social networks act. Social institutions are the mediator between people-and-people relationships and people-and-environment relationships. Social institutions, as defined by Leach et al., are "regularized patterns of behavior between individuals and groups in society" (Leach et al. 1999). The ecosystem of ties between actors in a distinct social network can be governed by or influenced by different social institutions. Social institutions can influence what is or is not appropriate information to pass along in networks and can have drastic effects on outcomes.

Social institutions and the social networks they emerge from can be broadly categorized into two types: formal and informal (Vonneilich 2022). Formal networks are often governed by formal social institutions, often seen as formal organizations and associations often with written codes and enforced through official means; an example would be the United States Department of Agriculture (USDA) (Leach et al. 1999; Vonneilich 2022). Informal institutions often govern informal social networks, such as the unwritten norms and rules of a friend group, family, and their informal enforcement methods.

Organic agriculture used to be a social network governed by more informal institutional norms of reciprocity amongst stakeholders. The meaning of organic was still being established. The informal norms around organic agriculture were codified into formal laws enforced by the USDA. This resulted in a more established social network governed by explicit informal and formal institutions. These institutions were quickly circumvented, with the Organic social network turning into one dominated by social norms of profit first (Guthman 2014). Farmers access informational resources through their informal social networks when they don't have access to formal institutions, or those formal institutions are failing to provide adequate support (Pratiwi & Suzuki 2017).

Institutions and the social networks that they are embedded in are emergent from relationships of reciprocity founded on differing interests and sentiments. The "persistence of

social patterns over space and time need affective, normative ties"(Petrzelka et al., 2000). These ties can range from shared interests or norms to sentiments. Networks can be formed around shared values and norms or shared goals and interests. Formal institutions and strong social networks are created through a cyclical process of legitimacy building through results.

1.2 Tying social networks and institutions together

Social networks and their accompanying social institutions are often categorized by the quality of ties among actors. A social network composed of strong ties within a family or one composed of weak ties among acquaintances may result in either a loose or tight network respectively. Networks with strong ties can often be closed networks. Closed networks, often formed around shared values and identity, often result in a lower degree of connection to outside actors. This low degree of connectivity with outside actors can reduce the amount of new information or opportunities available to those inside the closed networks, but the increased familiarity with actors in the closed network often results in information being shared faster. Open networks are often networks with weak ties, which may result in information disseminating more slowly, but more exposure to new ideas and resources from outside one's primary network (LibreTexts 2021; Felin, 2014).

Peer networks, or social networks of strong dense ties amongst friends and family, are essential to adopting location-appropriate sustainable practices, and one's position in peer networks has a significant impact on the successful implementation of appropriate practices (Pratiwi & Suzuki 2017). Such a spillover effect happens in dense, tight social networks where farmers rapidly adopt practices as information and resources are spread quickly through dense social clusters. Yet social networks ties outside of such peer networks and into advice-based networks are crucial to the transmission of new practices among farmers (Pratiwi & Suzuki 2017).

Small-scale networks or rhizomatic networks are types of social networks with strong tight-knit local clusters but short bridges or paths between similar dense clusters (Aarstad et al. 2013). This is in contrast to scale-free networks with their centralized hubs. Rhizomatic webs function in a decentralized manner and can be more adaptive and able to easily assimilate applicable new information. This type of network usually involves person-to-person connections rather than a central formal organization. Sometimes referred to as a mycorrhizae network structure, this social network type may connect disparate actors and agents in unrelated social networks and economic systems. This can result in relationships of reciprocity, enabling optimal distribution of resources and information (Bendfeldt 2020).

New farmers can act as bridges linking established networks and their associated appropriate practices with other distinct network clusters and their different associated appropriate practices (Parks 2022). Such cross-pollination can lead to enhanced adaptive capacity as the socio-ecological system shifts (Skaalsven et al. 2020; Kreft et al. 2023).

Individuals with extensive and more connected peer and personal networks are associated with market reach and economic sustainability (Scott & Richardson 2021).

1.3 Territories of social networks

Different social networks can be delineated as distinct territories. Different territories describe internal and external differences. Territories are often defined by formal borders but can exist between social networks that hold differing values or goals (Jessop et al. 2008). Producers and consumers of Organic or industrial agricultural products are two distinct networks that are defined around shared values or goals.

Territories in social networks can exist at differing scales, be nested, and blend together. Farmers that use specific appropriate Organic practices may form nested groups, that assemble to create the larger Organic social network (Gailing 2019; Osti 2015; Jessop et al. 2008). Often an individual is part of multiple networks, consuming both Organic and non-Organic products. For this reason, social networks should be assembled where each node is an individual; this offers the most clarity but is not often practical to map The different territories and scales of a social network shift based on the place and perspective being taken to describe the network.

Social networks may have similar distributions of strong and weak ties and similar structures but be connected to different formal institutions and governed by different informal social institutions. Conventional confinement dairy farmer networks in Wisconsin, Pennsylvania, and New York have more weak ties with market-based actors while farmers who used more appropriate practices, such as rotational grazing, had more weak ties amongst other graziers and government agencies in the region (Nelson et al. 2014). Social networks may appear similar if one examines just the number of strong and weak ties, but actually these networks are governed by drastically different norms.

Differently structured and located social networks may have similar informal social institutions. From La Via Campesina to Freedom Farmer Cooperative, different social networks grow, in different places at different times, to share similar social institutions of self-sovereignty and reciprocity amongst humans and the land. Some social networks value slow food, while others value fast food. Some social networks seek profit for the individual or small ‘in group’ over the health and well-being of the broader general public. Social networks can be pollinated through communication, such as the Morocco Imazighen villages example below, where different social institutions can radically transform the properties of a social network (Petrzelka et al., 2000).

A case study in Morocco of two Imazighen villages demonstrated how new institutions can shift the social regime from closed to open and modular. In village informal institutions, collective labor on each other's land, and communal wedding days, to name a few, maintained a sustainable metabolism between the local community and their environment. The introduction of a new institution, money, upset the sustainable socio-ecological dynamic. Villagers with money

issued by actors outside of the village territory and large in scale and power disembedded themselves from the former system of local reliance and interdependence (Petrzelka et al., 2000). The power dynamic shifted in favor of the individual with money. The person who gained money now had solidarities based on interest, with many of those outside the local setting. This turned into those with money abusing the local environment for short-term profits because they gained a level of social and physical mobility or modularity (Appel 2012). Once the local environment and its society had been ransacked and sold to those outside the local setting, those with the most money could abandon the place. As Petrzelka et al. documented, the existence of informal and formal institutions, and the introduction of new institutions, can radically affect or disrupt the metabolism of a socio-ecological place.

Social networks are dynamic and constantly evolving over time. Over time a social network with a rhizomatic network structure may shift to favor a central hub or intermediary node, and as legitimacy is being renegotiated the network may shift back. The shifting between closed or open social networks, scale-free, modular, or rhizomatic social structures, can provide rich grounds for healthy communication to grow and facilitate progress in overcoming the interconnected and adaptive barriers to implementing sustainable agriculture. The process of association and dissociation may not always be tenable, which makes examining the informal and formal social institutions that govern such social network topographies critical (Pratiwi & Suzuki 2017; Albizua et al. 2021).

2.0 Complex Adaptive Systems and Wicked Problems

Agriculture is a complex adaptive system due to its complex, uncertain, and interconnected nature with other economic, social, and environmental factors (Weber 2008; Murakami 2017). A system composed of ecological systems is very complex. This is due to both the social and ecological systems that compose the agricultural system being complex adaptive systems (Fuller 2013). The socio-ecological agricultural system has both actor-actor interactions and actor-environment interactions. The system's complex interconnected parts feature wiley feedback loops and delays that are hard to predict. The embedded, distributed, and interconnected nature makes negative externalities appear dispersed and unrelated; the externalities from industrial agriculture and cuisine are emergent in many disparate places and range from elevated rates of diabetes and spiking cancer rates to massive algae blooms in the Gulf of Mexico (Malacoff 1998; Fuhrman 2018).

The agricultural system is composed of many interconnected actors, including different stakeholders, with often different and conflicting perspectives on how to properly govern the agricultural system and implement sustainable agriculture making it a wicked problem. These stakeholders may not even agree upon the bounds of the problem, making it even more challenging and uncertain when attempting to address the negative externalities of the current agricultural system (Rittel & Webber 1973; Murakami 2017). Some actors think GMO crops are the most sustainable while others think organic is more sustainable. What sustainable actually

means is still often debated and contested. This uncertainty and ambiguity about problems and solutions contribute to the wicked dimension of the current agricultural system (Lönngren 2021).

Because agriculture is a complex adaptive system the results of interventions are hard to predict and can result in unintended consequences. A small change to an arrangement between different components at the same scale or nested scale in a complex system can produce new system-wide emergent behavior (Lundgren 2021). Or a change to numerous nested systems can have no impact on the higher complex systems' emergent behavior (Palmer 2021). This has created the need for a more collaborative, flexible, and adaptive approach when attempting to understand and participate in the implementation of sustainable agriculture.

Due to the complex nature of the agricultural system coordination amongst the distributed and nested social networks can unintentionally leave out potential allies. An example of this occurred in conservation efforts, where there is an ongoing push to replace monocrop grass lawns with biodiverse diverse ecosystems (VermotLandTrust). This approach opens up the 'traditional' network of what most consider conservation to be. Douglas Tallamy, professor of wildlife ecology, explains in his book *Natures Best Hope*, how by expanding the boundaries of 'traditional' conservation into areas such as power and pipelines, railroads, suburban lawns, and roadsides, to name a few, land under conservation could expand by 599 million acres in the US. This change in coordinating conservation efforts is redefining the territories of 'conservation' and offering considerable hope in bleak times for biodiversity. In agricultural social networks similar efforts can be seen in the growth of agritourism (The Ground, Yamhill County, Oregon) and re-growth of urban/suburban farms (Detroit Black Community Food Security Network).

2.1 Industrial agricultural monopolies

Industrial agriculture businesses have a monopoly. They operate on a global scale and fix the agricultural markets and systems through control of knowledge, establishing and freezing how the networks fluctuate. To operate, it relies on agricultural techniques such as monocultures, artificial fertilizers, concentrated feed lots, and pesticides; while utilizing cheap, exploitative labor of migrant workers. "Globally, four or fewer firms also control almost all commercial agricultural inputs. Just four companies control 60% of the global seed industry and 90% of the global grain trade, and three companies control 70% of the agrochemical industry. (Canfield 2022) " In the United States, four such monopolies control the market for beef and grain processing, food distribution, and agro-inputs (Canfield 2022). Efforts to overcome the negative externalities in the industrial agricultural network are often controlled through central hubs funded and controlled by actors and networks that limit permissible discourses.

The Gates Foundation, a dominant actor in the industrial agriculture complex, drove an initiative to tackle nutrient deficiency in children through the consumption of 'super' bananas. Although a specific banana species had higher levels of the needed nutrients, the local population did not consume bananas. There existed easily grown appropriate culinary alternative sources of

the nutrient, and the banana cultivation methods destroyed local food production methods (Canfield 2022). The Intergovernmental Panel on Climate Change (working group 2) identified such monopolized interests of industrial agriculture as a central barrier to overcoming current negative agricultural externalities (Cissé et al., 2022).

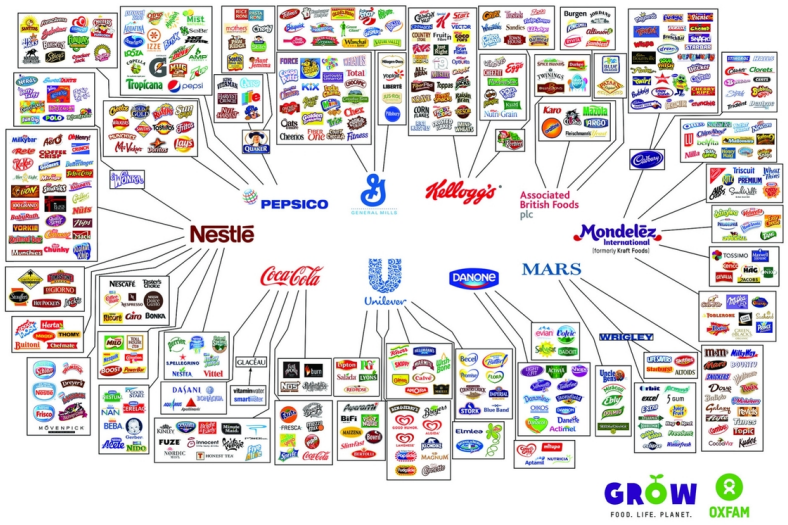

Figure 2: This network shows the ten transnational corporations that control the majority of the grocery retail market. (Oxfam 2014)

The United States agricultural network is built by employing a network of 2 to 3 million migrant or seasonal agricultural workers, with approximately 64.1% hailing from Mexico, and often being either undocumented or on temporary work visas. Unfortunately, the majority of these workers do not speak English as their first language, which further exacerbates their vulnerability to exploitation. This exploitation is particularly concerning, given that the average hourly wage for these workers is only $10.19, and there is no overtime, a grossly inadequate wage for their hard work. Compounding their challenges is the fact that many of these workers do not have access to public assistance such as health insurance or workers' compensation, due to their immigration status (National Center For Farmworker Health, 2017).

2.2 Farmland loss

The ongoing loss of farmland in the United States is negatively affecting the social networks that maintain vibrant farming commutes (Stain 2008; Ferguson 2021). The loss of rural land is a complex issue, with numerous contributing factors, including increased debts, zoning laws, and climate change. In particular, zoning laws and housing committees have advocated for more suburban development, which has resulted in the repurposing of farmland for low-density urban sprawl. Between 2001 and 2016, 11 million acres of agricultural land were taken out of production due to this ongoing trend. Urban sprawl negatively affects integrated pest management, by replacing animal habitats with grass monocultures and parking lots, contributing to pest issues. The loss of farmland contributes to the consolidation of large

industrial farms eroding rural economies and the social networks these healthy economies support (Ferguson 2021).

2.3 Degraded rural communities

The destruction of rural social networks has contributed to the alarming rise in suicides within the farming community in recent years. While mental health has been a significant issue within the farming profession, the rate of farmer suicides is now double that of other professions. This troubling trend may be attributed to a multitude of factors, including the consolidation of farms and destruction of rural economies, the intense economic pressures stemming from the excessive mortgage rates the few surviving farmers needed to take out to survive consolidation, the devastation caused by ecological disasters such as droughts, wildfires, and hurricanes, and the physical toll of hard labor and exposure to harmful pesticides (Bjornestad 2021; Environmental Protection Agency 2023). The average farmer is in substantial debt, around $1.3 million, which they take out to pay for expensive chemical additives and to survive during years when the crop yields fail.

3.0 How Social Networks can help Support Sustainable Agriculture

3.1 Black agrarian social networks

The black agrarian social network in America was vibrant and strong until it was destroyed due to racism (Ferguson 2021). The black farmer social network was built and strengthened by active individuals who leveraged and created dense social connections to achieve economic, ecological, and social sustainability and autonomy. Fannie Lou Hamer, a black agricultural activist, created Freedom Farm Cooperative, an economic, social, and ecological infrastructure. Freedom Farm Cooperative served as a critical hub in a growing network of black social and economic autonomy and sovereignty. It strengthened ties amongst the community, contributing to strengthening a social network that was redefining the power position of the black individual in American society.

Freedom Farm Cooperative supported the creation and dissemination of information about successful economic and ecological agricultural practices. It demonstrated a model of meeting material needs, housing and food, that could be replicated at a small scale to create local sovereign and autonomous economies. It served as a nursery, a source of baby pigs and seeds for new farms. Forming strong community bonds in a physical location, the black community was able to support each other by sharing resources and knowledge of agriculture. How to create compost and rotate crops. These dense rhizomatic social webs supported the coordination of a strong united black political voice. Farmers and the economic and social autonomy their farms granted them allowed them to play essential roles in organizing and supporting the civil rights movement. Fannie Lou Hamer was not a lone actor but rather one amongst many individuals, from Booker T Washington to W. E. B. Du Bois, in the black community aimed to build a radically new economic and social system (White, 2018).

> “Down where we are, food is used as a political weapon. But if you have a pig in your backyard, if you have some vegetables in your garden, you can feed yourself and your family, and nobody can push you around. If we have something like some pigs and some gardens and a few things like that, even if we have no jobs, we can eat and we can look after our families.”
>
> —Fannie Lou Hamer

> “In order for any people or nation to survive, land is necessary.”
>
> —Fannie Lou Hamer

These two quotes demonstrate the economic and political power such farming social networks built. This historic example demonstrates how such distributed rhizomatic networks were cultivated intentionally by individuals like Fannie Lou Hamer who shared their experience and knowledge with others. This allowed other individuals to operate their own farms and expand the network of black farmers and black political and economic autonomy. The current agricultural network in America is approximately 95% owned by white individuals, while BIPOC farmers only represent a mere 1.4% of all farmers. Additionally, women make up only 13.7% of all farmers, which highlights a significant disparity in the industry. This lack of ownership from other communities is why we see a rampant abuse of farmhands in large agricultural facilities (Environmental Protection Agency, 2023).

3.2 How the organic movement spread through a social network

The organic agriculture movement arose in the United States as a recent counter to the industrial agricultural industry. These networks of producers, consumers, and distributors sought to connect those who valued social and ecological sustainability. The consumers wanted produce not sprayed with toxic chemicals and the farmers wanted to farm without toxic chemicals. Organic started out as a disparate informal network governed by informal institutions that sought to redefine the relationships that tie the agricultural network together, both the human-to-human ties and the human-to-land ties, to one that centers reciprocity and sovereignty instead of making large sums of money (Guthman 2014; Canfield 2022).

As the organic movement gained popularity and market share, actors who valued profit over everything else started to take advantage of the informal nature of the scheme selling produce produced using industrial practices such as organic. The known and established actors who composed the organic movement network pushed to make Organic an official certification enforced by the US government to overcome such disingenuous practices. The United States Government enforces an Organic standard, which incorporates ideas such as continuous improvement of soil fertility; as defined in the U.S. Organic Plan, “an organic plan shall contain provisions designed to foster soil fertility, primarily through the management of the organic

content of the soil through proper tillage, crop rotation, and manuring." (7 U.S. Code § 6513 - Organic plan)

While enforced organic standards are more about what chemicals are not allowed to be applied, there are many other factors that go into Organic certification. Organic agriculture, even though it was a protected label by the government, quickly became an industrial Organic system that followed the letter to the law but did not keep the original spirit of the movement(Canfield 2022; Guthman 2014).

The organic movement in America was inspired by the agroecological transnational networks known as La Via Campesina. La Via Campesina is composed of a network of 182 organizations in 81 countries. This network serves to propagate knowledge and resources about ecologically, socially, and economically sustainable agricultural practices with the aim of increasing community autonomy and resisting the creep of extractivist-based industrial agriculture in their countries. This demonstrates how the informal social institutions of reciprocity in social networks such as La Via Campesina and other peasant agrarian movements can spread to other social networks (Canfield 2022).

The Real Organic Project is a formal institution created by a couple of Organic farmers in America that desire to redefine their territory and take back the organic narrative. As the Organic label has become intensely economically successful, large industrial agriculture companies have wanted a slice of the pie. This has led to lobbying to water the Organic standards down and the hacking of loopholes in the rules (Guthman 2014). Four such loopholes are hydroponically grown produce, concentrated animals feedlot, monocultures, and unfair labor practices, which can be used to produce and sell goods that are certified Organic. The Real Organic Project connects the distributed network of farmers by interviewing many different farms on their perspectives and opinions about organic farming and what is occurring. Many farmers express that most current Organic products sold go against the original spirit and intention of the organic movement; which is to produce an agricultural system that produces positive social, economic, and ecological externalities. The Real Organic Project sought to raise awareness about this cooption of the organic movement and establish a nationwide network of farms that are resisting this trend. The Regenerative Organic Alliance is another formal institution that arose out of the organic farmers network to counter the industrial agricultural cooption of regenerative and organic labels. These two newer formal institutions are joining an ever-increasing ecosystem of formal institutions created and run by farmers who value reciprocity and wish to nurture an agricultural system around such a value.

In the 2021 Food and Farm guide, published by Central Mass Grown, Luke and Whitney DeCiccio of Abundance Family Farm, located in Central Massachusetts, wrote an article titled *Small Farmers Banding Together to Fight for Organic Standards*. This article is an example of a singular actor taking autonomous action to raise awareness around the ongoing struggle in the food system between the USDA certifying agricultural practices as organic and the many farmers

saying such practices don't align with real organic agricultural practices. Abundance Family Farm used the Food and Farm guide as a way to strengthen the farmer social network by raising awareness in the Central Mass Grown social network that already shares many of the same values.

In the 2022 book *Healing Grounds*, Liz Carlisle documents modern and historical social networks of suppressed agroecological practitioners across the United States who are actively collaborating with networks overseas and in the United States to overcome the entrenched industrial agricultural system. These individuals steward the land using practices that center reciprocity amongst human society and amongst non-human society. The farms are often small in scale and centered around their home. These individuals cultivate bio-diverse crops that compose culturally appropriate and densely flavored cuisines. Many of the individuals who actively practice agroecology in the United States are farmhands on industrial farms. Others are more recent immigrants who brought their traditional farming practices from their home regions and set up farms to gain access to 'rare' ingredients. These individuals expand the agroecological networks into territory dominated by industrial practices where they serve as hubs for the transmission of such knowledge.

4.0 Farming and Agricultural Networks in Central Massachusetts

The number of farms and total acres under cultivation have been decreasing in Massachusetts and Worcester County. In MA, from 2012 to 2017, the number of farms decreased by 514, and 31,864 acres were taken out of production. In Worcester County, 6,500 acres were taken out of production. One-third of the farms in Worcester County are under 9 acres, another third are between 10-49 acres, and the last third is composed of farms over 180 acres. One of the 3 farms over 1,000 acres that existed in Worcester County in 2012 has gone out of business and is no longer being cultivated. In Worcester County, 75 more farms, compared to 2012, are reporting a net gain, and 17 fewer farms are reporting a net loss. Given that there has been a decrease in overall farming land in central Massachusetts, there has been a growing number of Organic and regenerative agricultural farms.

Despite a decreasing number of active farms and acres under cultivation, the network of USDA-certified Organic farms and their sales have increased in Worcester County and MA. Between 2012 and 2017, six more Organic farms have been certified in Worcester County for a total of twenty. It takes 3 years to transition from conventional to Organic, so there could be a lag in transition numbers. Worcester County had 4.1 million dollars in Organic sales in 2017, and Organic sales increased by 6.6 million across Massachusetts in the five-year timespan. The growth of Organic farms and sales is a good indicator and suggests that a shift to more sustainable agriculture is occurring. Along with more organic farms and sales, agricultural land under sustainable management practices has increased greatly between 2012 and 2017. (U.S Department of Agriculture, 2017, Table 42).

Between 2012 and 2017, the amount of farms using no-till and reduced-till management practices in Worcester County has more than doubled. No-till and reduced-till practices reduce erosion, improve water retention, and conserve the biological life that makes living soil. The acres under cover crops have increased across the state, while in Worcester County, the number has decreased. Cover crops also improve soil structure, improve water retention, reduce evaporation, and feed soil life. The number of farms practicing more complex forms of ecologically sustainable practices has also increased. Alley cropping, silvopasture, forest farming, windbreaks, and forester buffers are remarkably inclusive categories to measure, and there are many concerns with reading too much into this measurement. In the five-year span, the number increased by 240 across MA and 46 in Worcester County. This shows that information on more sustainable agricultural practices is steadily permeating agricultural social networks.

While these numbers look promising, the increase in Organic sales and farms and practices such as no-till and cover crops should be viewed skeptically. As past research into sustainable agricultural networks has demonstrated, the formal names presented by certain individuals and organizations to define their practices often can obscure the reality of their practices.

Methodology

Our research aims to identify the themes in the kinds of relationships that challenge and support individuals in the central Massachusetts social network as they implement sustainable agriculture. To this end, we will conduct semi-structured interviews with agricultural stakeholders to gather first-hand accounts and record the experiences and perspectives of farmers regarding the relationships that make up the social agricultural networks. These interviews will allow us to contextualize the links between the different actors. As collaboration is key to overcoming wicked problems in complex adaptive systems, recording and communicating common challenges and opportunities stakeholders face in the social network as they transition to sustainable agriculture may help stakeholders collaborate more effectively (Albizua et al. 2021; Chaudhuri et al. 2021; Pratiwi & Suzuki 2017; Weber, 2008). Due to social networks being complex adaptive systems, semi-structured interviews will provide a degree of freedom of communication needed when communicating about such tangled environments (Weber, 2008).

Objective Method: Semi-Structured Interviews

The interviews sought to understand how those in the agricultural network are interacting with each other to facilitate or restrict the adoption of agricultural practices that produce positive social, ecological, and economic externalities. The interviews were conducted in a semi-structured manner to gather thick descriptions of personal interactions with agricultural social networks (Clandinin, 2005). The loose nature of semi-structured interviews will allow the interviewee to expose characteristics of the social networks that were hidden to those not embedded in such network relations. Analyzing and comparing the interviewees' understanding of relationships in their social network characteristics will allow us to identify common social network themes.

We used qualitative inductive coding to identify common themes about the quality of relationships in the social network. This ranged from comments about how they were communicating and collaborating with their peers to comments about how norms were shifting or to unconventional business practices.

Our research is interested in understanding how different relationship types and network characteristics influence communication and collaboration in the social network and how this affects the implementation of sustainable agriculture. Using the research questions, we have created a list of broad questions we will ask the stakeholders about:

> What are some of the reasons you became a farmer?
>
> What does a ‘successful’ farm mean? How do you manage your farm? Is it sustainable/successful in a social, economic, and ecological sense? What would a successful sustainable farm look like?

How do you approach the challenges you face on your farm, both big and small? Who do you typically turn to for help or information, and how do you coordinate with your community to overcome these challenges?

What does community mean to you?
What does your community look like?

How do you connect with the members of your community?
Where do you connect with your community members?

Analysis

The goal of this study was to learn about the impact social networks play on sustainable agriculture. The research suggests that social networks play a critical role in the implementation and maintenance of sustainable agriculture. We found that social networks helped facilitate the transfer of knowledge and distribution of resources that are critical in the adoption and continuation of sustainable agriculture practices. Through coding our interviews we identified four themes:

1. The internet is serving as a tool for communication and information sharing.
2. Farmers struggle to maintain economic viability when implementing sustainable practices.
3. Bridging non-traditional social networks allows some farmers to succeed at their goals.
4. There is continuous negotiation of which social institutions are legitimate in the social network.

These findings support the importance that social networks play in the way actors are able to address the problems they face when implementing and maintaining sustainable agriculture. The following section gives a deeper analysis of these findings.

Theme 1: The Internet serves as a tool for communication and information sharing

The ability of the internet to help people overcome geographic barriers allows the farmers and distributors that were interviewed to communicate with distant social networks, distribute knowledge, conduct business and learn about sustainable agriculture. The internet was found to be a crucial tool in the growth and maintenance of their social networks.

Theme	Quotation
Information is being gathered and distributed by farmers in online formats	" Jack was the editor of the newspaper The Natural Farmer… We email a weekly newsletter." (Farmer 1)
The internet has increased accessibility to knowledge removing barriers to information	"Social media is an interesting thing… Facebook has been a big resource, my vet will roll her eyes, but then we will discuss… Different groups you can go on, and you know whose answer you can trust." (Farmer 2)

Social media is being utilized to connect people together and build social networks	"As much as I don't like social media, It's really definitely a big part of making sure I can stay connected with family and friends in the south, and people from old land trust communities I've been at." (Farmer 3)

Farmers expressed their reliance on social media as a means of *staying connected* with other farmers, distributors, and friends in their social networks. Platforms such as Facebook, Instagram, and Whatsapp were some of the apps mentioned for that purpose. Farmer 3 expressed, "A big part of making sure I can stay connected with family and friends" Although the farmer was apprehensive about using social media, they still saw the usefulness of using Instagram to connect with friends and family. There is an importance to staying in contact with friends and family members because alienation is often felt in the farming community (National Center For Farmworker Health, 2017). The ability to stay in touch with others in real-time has become a fundamental aspect for individuals to grow their social networks and agricultural practices.

Farmer 4 also recognized the value of social media through their utilization of a group chat with fellow farmers they used to work with. The group chat served as a platform to exchange valuable information about agriculture and business, such as getting access to government grants. This was especially helpful since some of the people were starting up their own practices. Through the group chat they were able to access their peer network that all help and support each other.

Another vital use of the internet for farmers has been the ability to *gather and distribute information* online. Given the challenges associated with setting up an agricultural practice, such as the costs and experience needed, having instantaneous access to information can help overcome those barriers. This was expressed by Farmer 2 who uses facebook as a means of accessing new information. He said that when he comes across new information, he will note and then discuss it with his vet as a means of verification. This shows the importance of social media as a valuable tool for learning.

Farmer 1 created an online newsletter that provides valuable information to subscribers. The newsletter is distributed to subscribers weekly, sharing information about the farm, local events, and collaborations. The newsletter is designed to easily access sections including *"Expressing Gratitude this Week"* as seen in **Figure 1**, details about upcoming workshops, and links to their social media. It also has vital information such as product pickup locations and SNAP pricing so that subscribers can stay informed. Even if not subscribed, the information is still accessible online. The accessibility acts as a significant opportunity for the growth of sustainable agriculture.

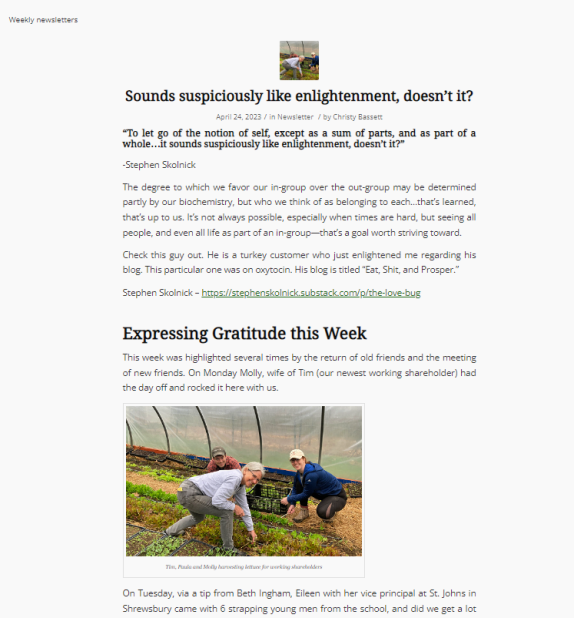

Figure 1

This figure is displaying the online news newsletter that one farmer has been using to share and advertise their business.

Another social media platform that has been utilized by Farmer 1 is Youtube. The channel currently has 453 subscribers, where they share information about agricultural practices and recipes. Some of those being videos such as *"How to Prune a Peach Tree"* and "*How to preserve Summer Squash"*. The most popular videos on their channel are ones dealing with food preparation and preservation. The videos are also compiled from a list of playlists, as seen in **Figure 2,** as a better way to navigate their channel. Youtube has become popular amongst farmers as a means of sharing their experiences and knowledge. The videos can be very useful for farmers to promote their business but also to people who may need a visual reference for sustainable agricultural practices.

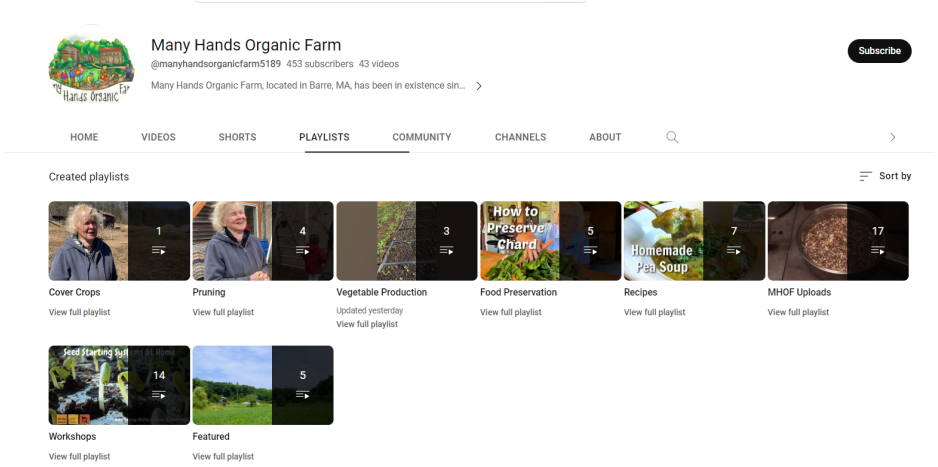

Figure 2

This figure is displaying one of the farmer's Youtube channel with all of the playlists organized into different categories

The Real Organic Project and North Organic Food Association (NOFA) hold online conferences utilizing the internet as a way to host and provide resources to farmers. The information presented is a mix of sourcing from local internal NOFA/Mass farm members and more non-farmer experts on such topics as accessing grants, legal proceedings, and racial justice. For instance, NOFA held an online component to their winter 2023 conference where they discussed the Farm Bill of 2023 that focused on food justice and sustainability practices, and a panel on racial equity focused on the transition to regional-based agriculture.

An integral aspect of the internet is the ability to conduct business through it; this can be seen in online marketplaces for produce or through advertising seen on social media. Through online market spaces, these farmers have been able to sell their produce and goods. This allows them to expand their business networks and to connect with their consumers. For example, the director of the local food hub and Farmer 1 have online market spaces that sell goods directly to those consumers. They utilized the internet to connect with their social networks and create new stable markets.

Theme 2: A holistic approach to agriculture in the face of financial instability

The growth of sustainable agriculture faces a significant obstacle which is economic viability. In the interviews, various farmers expressed that the cost of implementing sustainable agriculture is a challenge due to various financial costs it takes to operate. The ongoing struggle for economic viability is also not helped by the need to contend in markets dominated and controlled by large industrial agricultural monopolies. In the face of these challenges the farmers that were interviewed have begun focusing on a holistic approach to agriculture and creating opportunities to help other sustainable farmers succeed in their practices.

Theme	Quotations
	"Everything we do is around relationships… I don't have relationship with an organization I have relationships with a human being. The community is the human beings not necessarily the organization" (The Director of the Local Food Hub)

Theme	Quotations
A social focus in the good treatment of workers	“We've always been organic, and always have had a lot of animals, they are in a rotation with the vegetables in some level.” “Always tried to really pay our staff well, and treat our volunteers well, and make it a place where they want to come and have fun.” (Farmer 2) “It all starts with the morality of the workers, how you treat workers.” (Farmer 3) “We have never been able to make an economic living here.” (Farmer 1)
A lack of economic viability	“Money is not the primary measure of success.” (Farmer 2) “This is a farm, it is a business, we do file taxes, but it doesn’t pay the bills.” (Farmer 2) “We have never been able to make an economic living here.” (Farmer 1) “It is not economical at all, it would not be possible for me to keep operating without the support of my partner and his full-time office job.” (Farmer 5)
Ecological focus in the face of a lack of economic viability	“It is one that provides for people, plants and animals without depleting the land. A farmer is a steward of the land.” (Farmer 5) “I like being able to see the work that I put in, these seeds that I started, nurshied and turned into food that I can give to people.” (Farmer 4) “They(the animals) are good for the heart.”“My ecological goal is to leave this property better than I found it.” “When you buy an animal from us, you kinda of bought me to.” (Farmer 2)

The current struggle small-scale farmers are facing in their attempts to be a business while practicing sustainable agriculture. This type of struggle exemplifies the ongoing struggle sustainable practices have while competing with industrial agriculture. Small-scale farms are expected to operate as a business despite the size or type of practice they are engaged in. This means they pay taxes as a business. This is why many of these farmers are using supplemental incomes such as their significant others and other jobs.

Since the lack of financial sustainability many of the actors rely on supplemental sources of income. Whether that be donations, government grants, assistance programs, and other sources in order to fund their agricultural practices. On the websites of Farmer 1 and The Regional Food Hub, they both utilize donations. These donations helped them run their business as a supplemental source of revenue to operate. Farmer 3 utilized government assistance in the form of grants in order to build their greenhouse for seedlings. And Farmer 1 allows customers to utilize Supplemental Nutrition Assistance Program (SNAP) to purchase the CSA's products. This shows that government assistance and grants play a substantial role in how the people we interviewed were able to have a sustainable practice.

Instead of measuring their success through an economic measure, the farmers in the study utilize a holistic lens as an alternative indicator of their success. Farmer 4 expressed, "When I was up in Maine my boss had a more holistic approach to success.. financial success was just one of many variables, I share that ethos.. No expectations to make a lot of money from this". Their boss prioritized a holistic approach over a profit incentive. They prioritized practices such as providing their volunteers and workers with good working conditions and an inviting atmosphere that makes them want to come back to volunteer on the farm. The director of the local food hub expressed this "Everything we do is around relationships… I don't have relationship with an organization I have relationships with a human being. The community is the human beings not necessarily the organization" This demonstrates the stakeholders' priorities, which emphasize that people are the central component of social networks, and personal relationships are therefore integral to their values.

As expressed before a significant hurdle for farmers is being able to compete in markets with the industrial agricultural monopolies. Market trends pose a significant challenge for sustainable food networks as the supply of sustainable agriculture is not always consistent. Unlike industrial agriculture which can deliver a uniform product each time, sustainable agriculture is affected by environmental factors such as extreme weather. This was identified by an actor when referencing how apples become more expensive when exposed to a certain amount of water. This means that keeping consumer retention in the sustainable agricultural market can be a challenge. In order to maintain consumer retention this actor used dinners between the consumers and farmers as a way of fostering social connection. This approach is effective in fostering personal connections between the consumers and suppliers, which creates a sense of personability. Also known as *relationship marketing* it involves establishing personal relations with consumers to create brand loyalty.

By creating networks for small-scale and sustainable farmers it can help fight against the challenge of competing with industrial agriculture. The director of the regional food hub was one person interviewed that expressed this importance. On their website it says “Fuel economic development through the support of emerging entrepreneurs and increased consumption of locally produced food”. There is a need for markets that have sustainable agriculture and the farmers that utilize those practices so they can also be economically sustainable.

Theme 3: The Institutions in the Agricultural Social Network are Actively Being Renegotiated

There is continuous negotiation of institutional legitimacy in the social network. The two clearest examples of shifting institutional legitimacy are Farmer 2 joining and then leaving Central Mass Grown and Farmer 4 discussing the change in openness around sharing agricultural best practices. Institutional legitimacy refers to individuals recognizing and accepting social norms and organizations as valid and appropriate (Buchanan 2018). We know some organizations are not useful for certain actors and some social norms are losing their validity in the agricultural social network because participants talked about the formal organizations and informal social norms that are changing because they are seen as restricting and unhelpful.

Theme	Quotations
Organizations can fail to provide support and lose credibility with certain farmers.	“Central Mass Grown took a tour of member farms in our area with local state reps. They went to veggie farm, drove past my farm to the guy who raises animals for slaughter and sells meat, then to the apple farm. On their way back to Worcester, they would have driven past me again. I am no longer a member of Central Mass Grown.” (Farmer 2)
The social norm of sharing information and techniques is growing in the social network amongst younger farmers.	“With young farmers it is really important to be open with information have everything be open source... Which is different from older farms or bigger farms they view anything as kind of a threat... Create networks that benefit everyone not everyone keeping their secrets” (Farmer 4)

Farmer 2 joined Central Mass Grown looking for support and resources for growing their alpaca fiber, therapy, and agritourism venture. Despite being part of the organization, they voiced they were excluded, “drove past my farm,” from a state-led research tour investigating how best to support local farms. This experience pushed Farmer 2 to find and strengthen alternative institutions to help them achieve their goals; Farmer 2 is now an active member of the Alpaca Owner Association. Farmer 2 still thinks highly of the work done by Central Mass Grown and is still an active member of Central Mass grown’s facebook page. Their case illustrates how existing organizations that are engaged in supporting the transition to sustainable agriculture can leave out actors, become detours instead of opportunities, and be less than helpful and inclusive. This also suggests that Central Mass Grown is focused on economically and single category operations such as market gardeners, livestock farmers, and orchards.

Farmer 4 discusses what they identified as a cultural shift in the social norm of knowledge sharing. They speak to the concept that new farmers are more open to sharing their practices than older farmers; this suggests that the network is more open. Farmer 4 stated, “With young farmers it is really important to be open with information have everything be open source.. Which is different from older farms or bigger farms they view anything as kind of a threat.. Create networks that benefit everyone not everyone keeping their secrets.” Sharing of knowledge is seens as more appropriate than keeping it to oneself. If this shift to an open network structure away from a more closed network structure is actually occurring, it could have drastic implications for the speed of communication and collaborative learning. This could lead to appropriate economic, sustainable, and ecological practices propagating faster through the network, resulting in increased growth of the sustainable agricultural system.

The shifting of social institutions suggests that the networks engaging in implementing sustainable agriculture are actively adapting and attempting to overcome the barriers individuals face. The changing of social norms in the network, sharing of agricultural practices, and creation of new organizations, Real Organic Project, is important because the complex adaptive system is constantly changing and creating new barriers and opportunities. The shifting of social institutions, organizations and social norms, as the interviewees identified, suggest that the network is actively adapting and attempting to open up to overcome the barriers and grasp the opportunities individuals face to better implement sustainable agriculture in Central Massachusetts.

This theme speaks to the adaptive nature of the complex social system. Such adaptive changes in the system may not always be beneficial, which is supported by the degradation of Black American farmers movement and the ongoing issue around Organic certification.

Theme 4: Bridging Social Networks has Helped Farmers Achieve their Goals

Bridging and leveraging frequently unassociated social networks has enabled some interviewees to achieve their goals by creating new markets, experiences, and resource

niches. We know the bridging of traditionally separated social networks enabled the stakeholders to achieve their goals. Stakeholders working towards achieving their goal by bridging networks include The Worcester Food Hub intermediary role between hospitals and local farms, Farmer 1's customers helping out on the farm, Farmer 5 gathering scraps from their customers to feed chickens, Farmer 3 gaining experience on land trusts, and Farmer 2 hosting fairs.

Theme	Quotations
Bridging traditional divides between social networks can support the achieving of goals.	"Always tried to really pay our staff well, and treat our volunteers well, and make it a place where they want to come and have fun." (Farmer 1)
Individual can move between distinct social networks to gain skills and experiences that allows them to meet their goals.	"Helping friends out with these land trusts, helping them build their land, using that skills I built from not actually working, and then coming in as an assistant manager." "I like being able to see the work that I put in, these seeds that I started, nurshied and turned into food that I can give to people." "It all starts with the morality of the workers, how you treat workers." (Farmer 3)

The Worcester Food Hub director's goal is to "create opportunity through food." This has been worked towards through serving to aggregate and distribute local foods between producers, value-added entrepreneurs such as restaurateurs, and consumers such as schools and hospitals. Connecting local produce to formal institutions opens up a new large consumer base for farmers' produce, increasing their economic viability and the local communities' food security. This provides benefits to all those involved in such transactions.

Farmer 1 makes use of their customer social network to have volunteer laborers to ensure the continuation of farm operation. While visiting Farmer 1 to interview them, there were a few volunteers who happened to also be CSA members, who expressed how much it meant to them to help out on the farm. The bridging of customer/consumer and farmer networks allowed Farmer 1 to achieve their goal of making the farm a place people wanted to be at, improving the farms economic viability and supporting a healthy community.

In a very similar sense, Farmer 5 works towards their goals of land stewardship by returning the nutrients to the land by chicken composting their customers' food scraps, "customers love to bring scrap foods for the chickens." Usually, businesses must buy compost and chicken feed, and in this case, Farmer 5 was able to offset these costs. This benefits the customers who have a place to compost and Farmer 5 who can better achieve their goal of returning nutrients to the land.

Farmer 3 leveraged their political friendships to gain farming experiences on communes and land trusts before getting an assistant manager position on a more traditional and economically centered farm operations. Farmer 3 wants to help others while being treated with respect, "it all starts with the morality of the workers, how you treat workers," they found that through being a farmer, one could achieve their goal. Through leveraging experiences in frequently unassociated, farming and activism, networks Farmer 3 was able to achieve their goal of finding a carrier that treats the workers with morality. Farmer 2 refuses to kill their Alpacas to maximize yields due to them being emotional support animals and more pets. To work around this barrier and produce some economic income, Farmer 2 hosts agritourism fairs. As Farmer 2 stated, "The fairs in theory are not in the bi-laws of the town, if we have 10,000 people they might do something." In summary, the interviews suggest actors who bridge unassociated, unlinked, established social networks can find alternative or innovative ways of being able to achieve their economic, social, and ecological goals.

Conclusion

Our research identified four themes occurring in the Central Massachusetts agricultural social network: the bridging of frequently segregated social networks is creating new niches and opportunities for some stakeholders, farmers are putting a holistic focus on farm management over economic viability, the internet is being used to overcome geographical limitations and maintain and assemble 'peer' social networks for access to knowledge and resources, and there is continues negotiation of institutional legitimacy in the social networks. The findings that were identified are broad and point to the necessity for a continued study of the social norms and organizations governing the Central Massachusetts agricultural social networks.

It appears as if social norms of reciprocity are spreading in the social network, as seen in information being shared online and newer farmers being more open with sharing their agricultural practices. This aligns with the case of La Via Compesina influencing the Organic movement to hold more social norms based on reciprocity. Economic viability is a major issue for many farmers, this is not a surprise as our background research on monopolies controlling the markets and the increasing price of farmland suggests farmers face an uphill struggle to be financially stable.

Recommendations

Further research should be conducted on the landscape of online agricultural social networks. There is an active discourse occurring amongst internet users around what sustainable agricultural practices are effective and valid. There could be distinct differences between the types of support each format of the internet plays Youtube, Facebook, or weekly email newsletter. Different generations of farmers may use different online spaces to communicate and collaborate with each other. Understanding this online ecosystem of communication could help new farmers integrate into their agricultural social networks better.

More research could be conducted to identify which parts, formal institutions and internet social networks, are more focused on the different aspects of sustainability, economic, social, and ecological. Another finding that could use more research is why the social norm of sharing farming information and techniques is appearing amongst new farmers. This social norm has drastic implications for the speed effective sustainable practices are shared and how people collaborate to build a sustainable agricultural system.

Limitations

There were many limitations faced during the process of this study. Those limitations were common such as time and access to information. As well as more severe limitations in terms of the researchers' inexperience in both social networks and conducting semi-structured interviews. There was one cycle of interviews limiting the amount of information and depth that could be collected. The study is also missing a more historical section on the work done by US-based (historical and current) sustainable agriculture practitioners and institutions that have built legitimacy around sustainable practices.

When examining the interviews it became apparent that breaking up the agricultural network more could have helped. Instead of looking for farmers, we could have specified looking at market gardeners or fiber farmers. By focusing on Central Massachusetts as the scale for examining the social network, the study may have limited the identifiable issues that are impacting the agricultural network. Examining similar scales, regional, of agricultural social networks in different regions could reveal more national themes around how agricultural social networks are functioning. We did, however, make use of the diversity of interviewees to identify broad themes, but focusing on specific farming types, animal husbandry, market gardeners, and orchards, would have yielded more precise themes that influenced distinct regions of the agricultural network.

Work Cited

"7 U.S. Code § 6513 - Organic Plan." Legal Information Institute, Cornell Law School, https://www.law.cornell.edu/uscode/text/7/6513. Accessed 26 Apr. 2023

About — Central Mass Grown. (n.d.-b). Central Mass Grown. https://www.centralmassgrown.org/about-2. Accessed 26 Apr. 2023

About NRCS | Natural Resources Conservation Service. (n.d.). Natural Resources Conservation Service. https://www.nrcs.usda.gov/about Accessed 26 Apr. 2023

Albizua, Amaia. Et al. "Social Networks Influence Farming Practices and Agrarian Sustainability." *PLOS ONE*, vol. 16, no. 1, Public Library of Science, Jan. 2021, p. e0244619. https://doi.org/10.1371/journal.pone.0244619. Accessed 26 April. 2023

Appel, Hannah. "Offshore Work: Oil, Modularity, and the How of Capitalism in Equatorial Guinea." *American Ethnologist*, vol. 39, no. 4, 2012, pp. 692–709, www.jstor.org/stable/23358110. Accessed 19 Nov. 2022

Bird, Julia, et al. "Risk of Deficiency in Multiple Concurrent Micronutrients in Children and Adults in the United States." *Nutrients*, vol. 9, no. 7, MDPI, p. 655. 2017. https://doi.org/10.3390/nu9070655. Accessed 26 Apr. 2023

Bjornestad, Andrea, et al. "An Analysis of Suicide Risk Factors among Farmers in the Midwestern United States." *Int. J. Environ. Res. Public Health*, 2021, vol 18, no. 7. https://doi.org/10.3390/ijerph18073563. Accessed 26 Apr. 2023

Buchanan, Allen, "Institutional Legitimacy', in David Sobel, Peter Vallentyne, and Steven Wall (eds), *Oxford Studies in Political Philosophy Volume 4*, Oxford Studies in Political Philosophy (Oxford, 2018; online edn, Oxford Academic, 18 Jan. 2018, https://doi.org/10.1093/oso/9780198813972.003.0003, Accessed 25 Apr. 2023

Bodin, Örjan, and Beatrice Crona. "The Role of Social Networks in Natural Resource Governance: What Relational Patterns Make a Difference?" Global Environmental Change-human and Policy Dimensions, vol. 19, no. 3, Elsevier BV, pp. 366–74., Aug. 2009 https://doi.org/10.1016/j.gloenvcha.2009.05.002. Accessed 26 Apr. 2023

Bruce, Ann, et al. "Social networks and farming resilience." *Outlook on Agriculture*, vol.50, no.2, p. 196–205. 2021. https://doi.org/10.1177/0030727020984812. Accessed 26 Apr. 2023

C. A. Francis & P. Porter. Ecology in Sustainable Agriculture Practices and Systems, *Critical Reviews in Plant Sciences*, (2011) 30:1-2, 64-73, https://www.tandfonline.com/doi/abs/10.1080/07352689.2011.554353?journalCode=bpts20. Accessed 26 Apr. 2023

Canfield, M. C. (2022). *Translating Food Sovereignty: Cultivating Justice in an Age of Transnational Governance*. Stanford University Press.

Carlisle, Liz. *Healing Grounds: Climate, Justice, and the Deep Roots of Regenerative Farming*. Island Press, 2022. Kindle.

Cissé, G., R. McLeman, H. Adams, P. Aldunce, K. Bowen, D. Campbell-Lendrum, S. Clayton, K.L. Ebi, J. Hess, C. Huang, Q. Liu, G. McGregor, J. Semenza, and M.C. Tirado, 2022: Health, Wellbeing, and the Changing Structure of Communities. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1041-1170, https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter07.pdf Accessed 26 Apr. 2023

Chaudhuri, Sriroope, et al. Reflections on farmers' social networks: a means for sustainable agricultural development? *Environ Dev Sustain* vol. 23, 2973–3008 (2021). https://doi.org/10.1007/s10668-020-00762-6. Accessed 26 Apr. 2023

Coulibaly, Pierrette Tiefigue, et al. "The Effect of Farmers Social Networks on Sustainable Agricultural Practices Adoption: A Scoping Review Protocol." *International Journal of Sustainable Agricultural Research*, vol. 8, no. 1, Conscientia Beam, Jan. 2021, pp. 56–60. https://doi.org/10.18488/journal.70.2021.81.56.60. Accessed 26 Apr. 2023

Domingo, Nina G. G., et al. "Air Quality–related Health Damages of Food." *Proceedings of the National Academy of Sciences of the United States of America*, vol. 118, no. 20, National Academy of Sciences, May 2021, https://doi.org/10.1073/pnas.2013637118. Accessed 26 Apr. 2023

Felin, Teppo, and Todd R. Zenger. "Closed or Open Innovation? Problem Solving and the Governance Choice." Research Policy, vol. 43, no. 5, June 2014, pp. 914–25. DOI.org (Crossref), https://doi.org/10.1016/j.respol.2013.09.006. Accessed 26 Apr. 2023

Ferguson, Rafter. "Losing Ground Farmland Consolidation and Threats to New and Black Farmers and the Future of Farming" www.ucsusa.org/resources/losing-ground. April 2021.

Fuhrman, Joel. "The Hidden Dangers of Fast and Processed Food." *American Journal of Lifestyle Medicine*. 2018;12(5):375-381. https://pubmed.ncbi.nlm.nih.gov/30283262/. Accessed 26 Apr. 2023

Fuller, Tony. Qingwen, Min. "Understanding Agricultural Heritage Sites as Complex Adaptive Systems: The Challenge of Complexity," *Journal of Resources and Ecology* 4(3), 195-201, (1 September 2013). https://doi.org/10.5814/j.issn.1674-764x.2013.03.002. Accessed 26 Apr. 2023

F. Berkes, C. Folke, J. Colding (Eds.), Navigating Social–Ecological Systems: Building Resilience for Complexity and Change., Cambridge University Press (2003). Accessed 26 Apr. 2023

Guthman, Julie. *Agrarian Dreams : The Paradox of Organic Farming in California*. Berkeley, University Of California Press, 2014. Kindle.

Gebska, Monika, et al. 2020. "Farmer Awareness and Implementation of Sustainable Agriculture Practices in Different Types of Farms in Poland" *Sustainability* 12, no. 19: 8022. https://doi.org/10.3390/su12198022. Accessed 26 Apr. 2023

Gillespie, et al. "Agriculture, Food Systems, and Nutrition: Meeting the Challenge." *Wiley Online Library*, 2017, https://onlinelibrary.wiley.com/doi/full/10.1002/gch2.201600002. Accessed 26 Apr. 2023

Hauck, J., et al. 2016. "Using social network analysis to identify key stakeholders in agricultural biodiversity governance and related land-use decisions at regional and local level. *Ecology and Society*" 21(2):49. https://www.jstor.org/stable/26270396. Accessed 26 Apr. 2023

Jessop, B, et al. (2008). "Theorizing Sociospatial Relations. *Environment and Planning D: Society and Space*", *26*(3), 389–401. https://doi.org/10.1068/d9107. Accessed 26 Apr. 2023

J. Aarstad, et al., "In what ways are small-world and scale-free networks interrelated?," *2013 IEEE International Conference on Industrial Technology (ICIT)*, Cape Town, South Africa, 2013, pp. 1483-1487, https://www.researchgate.net/publication/261224042_In_what_ways_are_small-world_and_scale-free_networks_interrelated. Accessed 26 Apr. 2023

Kekulandala, et al., "Exploring Social Networks in a Small Tank Cascade System in North Central Sri Lanka: First Steps to Establishing Adaptive Governance." *Environmental Development*, Elsevier BV, Mar. 2023, p. 100847. https://doi.org/10.1016/j.envdev.2023.100847. Accessed 26 Apr. 2023

Kramer, Anna. "These 10 companies make a lot of the food we buy. Here's how we made them better." (2014, December 10). Oxfam. https://www.oxfamamerica.org/explore/stories/these-10-companies-make-a-lot-of-the-food-we-buy-heres-how-we-made-them-better/. Accessed 26 Apr. 2023

Kreft, C., Angst, et al., Farmers' social networks and regional spillover effects in agricultural climate change mitigation. *Climatic Change* 176, 8 (2023). https://doi.org/10.1007/s10584-023-03484-6. Accessed 26 Apr. 2023

Leach, Melissa, et al. "Environmental Entitlements: Dynamics and Institutions in Community-Based Natural Resource Management." *World Development*, vol. 27, no. 2, Feb. 1999, pp. 225–247, 10.1016/s0305-750x(98)00141-7. Accessed 11 Dec. 2019.

Levin, Simon. Ecosystems and the Biosphere as Complex Adaptive Systems. *Ecosystems* 1, 431–436 (1998). https://doi.org/10.1007/s100219900037. Accessed 26 Apr. 2023

Libretexts. "5.3H: Social Networks." *Social Sci LibreTexts*, 20 Feb. 2021, socialsci.libretexts.org/Bookshelves/Sociology/Introduction_to_Sociology/Book%3A_Sociology_(Boundless)/05%3A_Social_Interaction/5.03%3A_Elements_of_Social_Interaction/5.3H%3A_Social_Networks#:~:text=A%20social%20network%20is%20a%20social%20structure%20that,Social%20networks%20are%20composed%20of%20nodes%20and%20ties. Accessed 26 Apr. 2023

Lönngren, Johanna. Van Poeck, Katrien. "Wicked Problems: A Mapping Review of the Literature." *International Journal of Sustainable Development and World Ecology*, vol. 28, no. 6, Taylor and Francis, Aug. 2021, pp. 481–502. https://doi.org/10.1080/13504509.2020.1859415.

Lundgren, Jakob. The Grand Concepts of Environmental Studies Boundary objects between disciplines and policymakers. *J Environ Stud Sci* 11, 93–100 (2021). https://doi.org/10.1007/s13412-020-00585-x. Accessed 26 Apr. 2023

Malakoff, D. (1998). Death by Suffocation in the Gulf of Mexico. *Science*, *281*(5374), 190–192. https://doi.org/10.1126/science.281.5374.190. Accessed 26 Apr. 2023

Massachusetts Coalition for Local Food and Farms. (n.d.-b). https://www.localfoodma.org/ Accessed 26 Apr. 2023

Mateo-Sagasta, Javier, et al. "Water Pollution From Agriculture: a Global Review". The Food and Agriculture Organization of the United Nations Rome and the International Water Management Institute on behalf of the Water Land and Ecosystems research program Colombo. 2017.

Mateo Mier y Terán Giménez Cacho, et al. Bringing agroecology to scale: key drivers and emblematic cases, Agroecology and Sustainable Food Systems. 2018. 42:6, 637-665, https://archive.foodfirst.org/wp-content/uploads/2019/06/Mier-Ter%C3%A1n-et-al-ENG-1.pdf Accessed 26 Apr. 2023

National Center for Farmer Health. "Demographics - National Center for Farmworker Health." *Migrant and Seasonal Farmworker Demographics Fact Sheet*, 2012,

http://www.ncfh.org/uploads/3/8/6/8/38685499/naws_ncfh_factsheet_demographics_final_revised.pdf. Accessed 26 Apr. 2023

Nelson, K.C., et al. "Social networks in complex human and natural systems: the case of rotational grazing, weak ties, and eastern US dairy landscapes". *Agric Hum Values* 31, 245–259 (2014). https://doi.org/10.1007/s10460-013-9462-6 Accessed 26 Apr. 2023

Otsi, G. "Socio-spatial relations: An attempt to move space near Society." *Socio-spatial relations: an attempt to move space near society.* (2015) Retrieved February 20, 2023, from https://www.researchgate.net/publication/282442154_Socio-spatial_relations_an_attempt_to_move_space_near_society. Accessed 26 Apr. 2023

O' Toole, Jacqueline. Institutional storytelling and personal narratives: reflecting on the 'value' of narrative inquiry, Irish Educational Studies, (2018) 37:2, 175-189, https://www.tandfonline.com/doi/abs/10.1080/03323315.2018.1465839. Accessed 26 Apr. 2023

Palmer, Margaret. "Building the Basics Part 1: Socio-Environmental Systems as Complex Adaptive Systems." *YouTube*, YouTube, 16 July 2021, https://www.youtube.com/watch?v=8ikT58dCH5E&t=120s.

Parks, Mellissa. 'Exploring the influence of social and informational networks on small farmers' responses to climate change in Oregon." *Agric Hum Values* 39, 1407–1419 (2022). https://doi.org/10.1007/s10460-022-10331-4 Accessed 26 Apr. 2023

Petrzelka, Peggy, and Michael Bell. "Rationality and Solidarities: The Social Organization of Common Property Resources in the Imdrhas Valley of Morocco." *Human Organization*, vol. 59, no. 3, Sept. 2000, pp. 343–352, https://www.researchgate.net/publication/277357862_Rationality_and_Solidarities_The_Social_Organization_of_Common_Property_Resources_in_the_Imdrhas_Valley_of_Morocco. Accessed 22 Aug. 2019.

Pratiwi, A., Suzuki, A. "Effects of farmers' social networks on knowledge acquisition: lessons from agricultural training in rural Indonesia." *Economic Structures* 6, 8 (2017). https://doi.org/10.1186/s40008-017-0069-8 Accessed 26 Apr. 2023

Renting, H. M. Schermer, and A. Rossi. "Building Food Democracy: Exploring Civic Food Networks and Newly Emerging Forms of Food Citizenship". *The International Journal of Sociology of Agriculture and Food*, vol. 19, no. 3, Dec. 2012, pp. 289-07, doi:10.48416/ijsaf.v19i3.206. Accessed 26 Apr. 2023

Rittel, Horst W. J., and Melvin M. Webber. "Dilemmas in a General Theory of Planning." *Policy Sciences*, vol. 4, no. 2, June 1973, pp. 155–169,

www.sympoetic.net/Managing_Complexity/complexity_files/1973%20Rittel%20and%20Webber%20Wicked%20Problems.pdf, https://doi.org/10.1007/bf01405730. Accessed 26 Apr. 2023

Robertson, Bethany. "Farmers Are Finding a New Following on Social Media – Our Research Suggests It Could Help With Isolation." *The Conversation*, 2022. theconversation.com/farmers-are-finding-a-new-following-on-social-media-our-research-suggests-it-could-help-with-isolation-176610. Accessed 26 Apr. 2023

Rotz, S., Fraser, E.D.G. Resilience and the industrial food system: analyzing the impacts of agricultural industrialization on food system vulnerability. *J Environ Stud Sci* 5, 459–473 (2015). https://doi.org/10.1007/s13412-015-0277-1. Accessed 26 Apr. 2023

Salpeteur, Matthieu, et al. "Networking the Environment: Social Network Analysis in Environmental Management and Local Ecological Knowledge Studies." *Ecology and Society*, vol. 22, no. 1, 2017. *JSTOR*, http://www.jstor.org/stable/26270046. Accessed 15 Mar. 2023.

Salvini, Giulia. Van Paassen, et al. "A Role-playing Game as a Tool to Facilitate Social Learning and Collective Action Towards Climate Smart Agriculture: Lessons Learned From Apuí, Brazil." *Environmental Science & Policy*, vol. 63, Elsevier BV, Sept. 2016, pp. 113–21. https://doi.org/10.1016/j.envsci.2016.05.016. Accessed 26 Apr. 2023

Sands, David, et al. "Elevating optimal human nutrition to a central goal of plant breeding and production of plant based foods." *Plant Science* 177, 377-389 (2009). https://www.sciencedirect.com/science/article/pii/S0168945209002167. Accessed 26 Apr. 2023

Scott, C. K., & Richardson, R. B. "Farmer social connectedness and market access: A case study of personal networks among emerging farmers." Journal of Agriculture, Food Systems, and Community Development, 2021, 10(2), 431–453. https://doi.org/10.5304/jafscd.2021.102.024. Accessed 26 Apr. 2023

Skaalsveen, Kamilla, et al. "The Role of Farmers' Social Networks in the Implementation of No-till Farming Practices." *Agricultural Systems*, vol. 181, Elsevier BV, May 2020, p. 102824. https://doi.org/10.1016/j.agsy.2020.102824. Accessed 26 Apr. 2023

Smajgl, A., et al. "Empirical characterization of agent behaviors in socio-ecological systems." *Environmental Modelling and Software*, (2011), *26*(7), 837–844. https://doi.org/10.1016/j.envsoft.2011.02.011. Accessed 26 Apr. 2023

Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, 2007: "Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://archive.ipcc.ch/publications_and_data/ar4/wg3/en/ch8.html. Accessed 26 Arihan,pr. 2023

Stain, Helen J., Kelly, Brian. Lewin, et al. “Social Networks and Mental Health Among a Farming Population.” *Social Psychiatry and Psychiatric Epidemiology*, vol. 43, no. 10, Springer Science+Business Media, May 2008, pp. 843–49. https://doi.org/10.1007/s00127-008-0374-5. Accessed 26 Apr. 2023

The Ground. (n.d.). The Ground. https://www.theground.love/. Accessed 26 Apr. 2023

Table 42. Organic Agriculture: 2017, Census of Agriculture - County Data, U.S Department of Agriculture 2017 https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Massachusetts Accessed 26 Apr. 2023

Trauger, A. “Social Agency and Networked Spatial Relations in Sustainable Agriculture.” *Area*, vol. 41, no. 2, 2009, pp. 117–28. *JSTOR*, http://www.jstor.org/stable/40346180. Accessed 19 Feb. 2023. Accessed 26 Apr. 2023

United States Environmental Protection Agency. Enviro Atlas. Sustainable Management of Food Basics Retrieved: April, 20, 2023 https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics Accessed 26 Apr. 2023

VermontLandTrust. “Nature’s Best Hope With Doug Tallamy.” *YouTube*, 14 Mar. 2023, www.youtube.com/watch?v=CQ-UwOkuz4s.

Vivero Pol, Jose Luis, The Value-Based Narrative of Food as a Commons. A Content Analysis of Academic Papers with Historical Insights (November 7, 2016). http://dx.doi.org/10.2139/ssrn.2865837. Accessed 26 Apr. 2023

Vonneilich, N. Social Relations, “Social Capital, and Social Networks: A Conceptual Classification.” (2022) Klärner, A., Gamper, M., Keim-Klärner, S., Moor, I., von der Lippe, H., Vonneilich, N. (eds) *Social Networks and Health Inequalities*. Springer, Cham. https://doi.org/10.1007/978-3-030-97722-1_2. Accessed 26 Apr. 2023

Weber, E.P. and Khademian, A.M. “Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings.” *Public Administration Review*, 68: 334-349. (2008) https://doi.org/10.1111/j.1540-6210.2007.00866.x. Accessed 26 Apr. 2023

Reference List of Interviewees

Farmer 1 - CSA/Founder of NOFA/Mass, in-person interview, Feb 24th, 2023

Farmer 2 - Alpaca/Llama Fiber and Agritourism Farmer, in-person interview, Feb 17th, 2023

Farmer 3 - Assistant Manager, Zoom interview, March 14th, 2023

Farmer 4 - New Market Gardner, in-person interview, March 31st, 2023

Farmer 5 - Mixed Agricultural Operation, email submission, Feb 20th, 2023

Director of a local food hub - Worcester Food Hub, Zoom interview, March 17th, 2023