Social Networks and Health Among Farm Owner-Operators

By

Jennifer Kowalkowski

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The dissertation is approved by the following members of the Final Oral Committee:

Barbara J. Bowers, Professor, Nursing
Susan J. Zahner, Professor, Nursing
Marlon P. Mundt, Associate Professor, School of Medicine and Public Health
Casper G. Bendixsen, Director, National Farm Medicine Center

Dedication

I dedicate this work to my dad, Mike Kowalkowski. Thank you, Dad, for showing me how to love life, value learning, and always believe in myself.

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Abstract

Over 3.5 million US farm owner-operators (FOs) are at risk for greater morbidity and mortality than other farm workers due to role-based occupational-related stress (ORS). Studies show that social support accessed through social networks can buffer negative health effects from stress. No studies have directly examined these relationships with ORS among farmers or FOs.

The purpose of this study was to explore social networks of farm owner-operators and the social supports available to them for mitigating negative health effects of ORS. The aims of this study were to identify and describe characteristics of FOs' social network members, describe sources of social support, and explore structural and functional properties of their social networks that may influence access to or exchange of social support resources for mitigating ORS.

A convenience sample of 71 FOs from a Midwestern County completed a mailed name generator (55.5% response rate) that solicited information about the participants' social networks related to ORS. Social networks of FOs for ORS were smaller than trust-based social networks reported in other populations. FOs had an average of 2.4 individuals in their personal networks, displayed a preference for females and kin-based ties, and reported higher levels of comfort discussing ORS with female network members. Differences in network structure and resource use were found by gender. FOs reported few connections and low comfort with members of affiliation networks specific to ORS. Historical shifts in agriculture have increased competition between farmers and potentially changed the nature of ORS.

Social support accessed through social networks may not be an effective or efficient approach to address ORS and HWB for FOs and farm families. FOs had small personal networks, and the size of FOs' networks was positively associated with ORS levels. Group membership and engagement at the local, state, and national levels showed no association with lower levels of ORS for FOs. It is possible that farmers experience ORS differently than explained by current theories and models, or that FOs do not use their social networks as described in the current by the body of literature.

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Chapter 1: Introduction

Background and Significance

Farm owner-operators (FOs), those who both own and make decisions for a farming operation, comprise 60% of the agricultural workforce in the US (USDA National Agricultural Statistics Service, 2019a) and suffer significantly higher rates of injury, disability, disease, and death than individuals working in other roles on farms (Dhananjayan & Ravichandran, 2018; Dignard & Leibler, 2019; Doney et al., 2017; Earle-Richardson et al., 2015; Guillien et al., 2016; Sekhotha et al., 2016; Wardyn et al., 2015; Yarpuz-Bozdogan, 2018). Although few studies have explored factors that contribute to these disparities, chronic stress associated with the nature of farm work, the unique role of FOs, and one's identity as a farmer have been implicated (Bendixsen, 2017; Daghagh Yazd et al., 2019; Olowobon et al., 2019; Vayro et al., 2020).

Heavy workloads, time pressures associated with the work of farming, as well as unpredictable and uncontrollable events, like flooding or equipment failures, are ubiquitous among farmers. These factors have been identified as sources of chronic stress and associated with self-reported poor health among FOs (Keating, 1987; Olson & Schellenberg, 1986; Stain et al., 2011; Thu et al., 1997). The continued existence of the farm, as well as the ability to pay hired help and provide income for their family rests on the decisions that FOs make daily (Fraser et al., 2016; Stain et al., 2011). Many FOs report high stress levels associated with finding qualified and reliable hired labor to assist with farm work (Arora et al., 2020; Walter, 2018), as well as stress from lack of preparation or interest in managing others (Rudolphi et al., 2020). Farming can put significant strain on relationships, particularly when the farm is a family business (Ang, 2010; Daghagh Yazd et al., 2019; Kilgannon, 2018). For FOs operating generational farms, the threat of financial insolvency and potential loss of the farming business, including the land, livestock, and buildings that have been in the family for generations, as well as the loss of one's identity as a farmer, can be crippling (Fraser et al., 2016; Kilpatrick et al., 2012). This stress can be compounded by the shame and humiliation of losing one's family history and legacy (Walter, 2018). FOs have reported that the threat of failure alone is demoralizing and contributes to feelings of depression and anxiety (Belyea & Lobao, 1990; Stain et al., 2011).

Role-based factors may increase FOs' exposures to health risks and make them more vulnerable to the negative health effects of occupational-related stress (ORS), thereby contributing to disparities in health outcomes between FOs and other farm workers (Ang, 2010; Furey et al., 2016; Jadhav et al., 2014; Lovelock, 2012; McMillan et al., 2015; Miller & Aherin, 2018). There are three main functional roles on farms, a) owners who have the financial liability for the farming operation, b) operators who make the day-to-day decisions for the farming operation, and c) farm workers who provide the labor in completing the work for the farm. These roles can overlap or be mutually exclusive depending on the organizational structure of the farming operation. Individuals who work in roles other than FOs will be referred to as other farm workers. Although there is often overlap between the activities that FOs and other farm workers engage in on the farm, FOs retain accountability and bear full financial liability for the farming operation (Ang, 2010; Arora et al., 2020; Kilgannon, 2018; Lovelock, 2012; McShane, 2016; Reissig et al., 2019). Studies show that FOs take greater risks and work longer hours than other farm workers, increasing their exposure to the risks and hazards associated with farm work (Ringgenberg et al., 2018). Because of their roles as owners and decision-makers of the farming business, FOs experience higher rates and prolonged periods of ORS than other farm workers (Furey et al., 2016; Jadhav et al., 2014; Leka & Jain, 2010; Miller & Aherin, 2018). This increases FOs' vulnerability to the negative health effects from ORS. Since the negative effects of chronic stress on physical, mental, and emotional health and well-being (HWB) are well-documented (Gouin et al., 2008; Marin et al., 2011; McEwen, 2008, 2017), there is compelling evidence to suggest that these role-based differences contribute to disparities in health outcomes between FOs and other farm workers (Furey et al., 2016; Rudolphi et al., 2020). Despite a growing body of research describing health disparities and the negative effects of ORS among FOs, no studies have examined this relationship directly.

Definition of Terms

Farms and Farming

Numerous terms are used to describe farming, or production agriculture, as well as the individuals who work in this industry. For the purposes of this work, terminology will be aligned with definitions

published by United States Department of Agriculture (USDA) Economic Research Service (ERS) (USDA National Agricultural Statistics Service, 2019a) (Table 1).

A *farm* is considered "any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year" (USDA National Agricultural Statistics Service, 2019a, p. VII). According to the USDA, farms are classified based on characteristics like ownership, organization, size, and commodity production. Farm ownership is a legal designation described by one of four categories: a) family or individual (sole proprietorship); b) partnership (including family partnership); c) corporation (including family corporations); or d) other, which can include estates or trusts, prison farms, and grazing associations (USDA National Agricultural Statistics Service, 2019a). Farms are also described based on their business organization as either a) more than 50 percent owned by one producer's household and/or extended family; or b) a Limited Liability Company, which "combines the pass-through taxation of a partnership or sole proprietorship with the limited liability of a corporation" (USDA National Agricultural Statistics Service, 2019a, pp. B-10). Although family farms are often envisioned as small operations run by one or two people that include the residence (Lehman & Hurnik, 1988; McGreal, 2019), according to the USDA (n.d.), family farms include "any farm organized as a sole proprietorship, partnership, or family corporation" (p. 1,). Farms that are organized as non-family corporations or cooperatives, as well as farms with hired managers (United States Department of Food and Agriculture, n.d.) are not considered family farms.

Farms are also classified and grouped according to their size as determined by the total land area in acres that is owned and operated (including land that is rented from others), or by annual gross cash farm income (GCFI), which is a measure of the farm's revenue (USDA National Agricultural Statistics Service, 2019a). Although farm size in acres is reported, it does not necessarily reflect farm productivity and is not a metric that allows for meaningful comparison of farms across types of commodities produced. For example, it is difficult to compare a 25-acre farm with a residence and three out-buildings on largely untillable land on which a couple raises 10-15 beef cattle each year to a 25-acre, stand-alone robotic dairy operation with a herd of 200 milking cows. Therefore, GCFI is typically used to classify

farms by size, though it is only used to classify family farms. Small family farms report annual GCFI less than $350,000, midsize family farms report GCFI between $350,000 and $999,999, and large-scale family farms report GCFI of $1,000,000 or more (USDA Economic Research Service, 2020). Finally, farms are described based on the types of commodities produced, using the North American Industry Classification System (NAICS) (USDA National Agricultural Statistics Service, 2019a).

Farming, also described as production agriculture, refers to engagement in activities on a farm that result in the production of agricultural commodities (USDA National Agricultural Statistics Service, 2019a). Geography, environmental conditions, and weather patterns largely determine the commodities produced by local and regional farming industries. Major agricultural commodities produced in Wisconsin include livestock like beef, pork, and poultry; dairy from both goats and cows; and field crops such as corn, soybeans, wheat, and oats, as well as fruits and vegetables like potatoes, peas, snap beans, cherries, and cranberries (USDA National Agricultural Statistics Service, 2019a). For the purposes of this study, farms of all sizes, types and commodity production were considered.

Farmers and Farm Owner-Operators

A *farmer* is anyone who self-identifies as employed in production agriculture on a farm (as defined by the USDA) (USDA National Agricultural Statistics Service, 2019a). Farmers are classified based on their employment status, land ownership, and functional role (USDA National Agricultural Statistics Service, 2019a). Hired farm workers are those individuals who are paid to work on a farm and includes paid family members. Contract laborers and migrant labor are hired to work on farms; however, they are categorized separately by the USDA, so are not included in counts of hired farm workers. Individuals with ownership of the farm and who are paid to work on the farm are considered self-employed. Full owners are those who operate land that they own, part owners operate both land they own and rented land, and tenants operate land that is rented or worked on shares for others (USDA National Agricultural Statistics Service, 2019a).

A *producer* is an individual who is responsible for making decisions for the farming operation, can be hired or self-employed, and includes those individuals who conduct farming business on land that

is rented or worked on shares (USDA National Agricultural Statistics Service, 2019a). Prior to 2017, the USDA used the term "operator" to describe this group, so the term "operator" is still commonly used throughout reports and literature to reference farm decision-makers. Farms can have more than one producer, and the individual who makes the most decisions for the farm is designated the principal producer (USDA National Agricultural Statistics Service, 2019a). The USDA does not have a separate classification to distinguish individuals who are both owners and producers from other farm workers. This population is the focus of this study, and the term *farm owner-operator* (FO) will be used to delineate this group of farmers. All other individuals who work on farms and who are not FOs will be described as *other farm workers.*

Health and Well-Being

The World Health Organization (WHO) defines *health* as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 2019, p. 1). Studies that describe the HWB of farming populations typically use indices like incidence and prevalence of disease or disability, life expectancy, premature death, or subjective ratings of self-reported health (Casey et al., 2001; Deboy et al., 2008; Eggebeen & Lichter, 1993; Elliot-Schmidt & Strong, 1997; Kutek et al., 2011) that align with the WHO definition of health. However, studies report that farmers associate health with the ability to work (Leenders, 2002; Long & Weinert, 1999; Reed et al., 2012) and others emphasize that farming is not merely an occupation, it is an identity or a way of life (Kilgannon, 2018). These qualities align more closely with dimensions of well-being than health. Therefore, both HWB will be considered within the context of ORS for FOs.

Well-being is a complex construct for which there is no single definition, metric, or assessment tool (Diener et al., 2017; M. F. King et al., 2014; National Academies of Sciences Engineering and Medicine, 2018). Well-being is a subjective state that is often described as comprised of two dimensions, a) expressed, and b) evaluative well-being (National Research Council, 2013). Expressed well-being refers to an assessment of how people experience life, specifically the presence of positive mood or absence of negative mood (Ryan & Deci, 2001). Expressed well-being measures the degree of pleasure in

one's life and is concerned with emotional states and sensations (Ryan & Deci, 2001). Conversely, evaluative well-being refers to feelings that one has fulfilled or realized their true nature or purpose in life (National Research Council, 2013; Ryan & Deci, 2001). Evaluative well-being occurs when the activities in which a person engages align with their values and beliefs and signifies living authentically (Ryan & Deci, 2001). This bi-dimensional paradigm of well-being has been challenged by many researchers (Dodge et al., 2012), with a number of contemporary researchers viewing well-being as a multidimensional construct (Dodge et al., 2012).

Some researchers subscribe to the view of Shin and Johnson who described well-being as a holistic evaluation of one's quality of life based on personally defined criteria (Dodge et al., 2012), and use a single, global measure to assess it. A great deal of research related to well-being employs a single item to measure well-being, despite skepticism of the sensitivity and specificity of this approach (National Research Council, 2013). Another challenge of defining well-being is the degree of overlap among well-being related concepts like emotions, personality traits, self-efficacy, and resilience. There is empirical evidence of reciprocal associations between these concepts, yet findings are not consistent across studies. Given the interrelatedness of well-being and other factors, no perfect measure for well-being exists (Diener et al., 2017; National Research Council, 2013). Additionally, no recommendations for assessing well-being among farming populations have been proposed.

Self-reported well-being continues to be used in health research as an indicator of overall health, despite the lack of a single conceptual and operational definition, and varied opinions regarding its validity, sensitivity, and specificity (Dodge et al., 2012). Unlike other health metrics, such as blood pressure, weight, or number of chronic health conditions, well-being captures an individual's global appraisal of their current state. Whether a single item to assess overall well-being, or two items to separately assess expressed and evaluative well-being, this metric allows individuals the flexibility to consider those factors most salient in their lives. For example, an individual's values, beliefs, occupation, and economic stability may affect the extent to which finances, a chronic health condition, or change in health care policy affects their overall well-being. In addition, using a global measure of well-being in

conjunction with an assessment of health allows researchers to indirectly assess for factors, such as chronic stress that can cause pathophysiologic changes. As a metric used in health research, well-being is not designed nor intended to statistically associate discrete processes or identify causal relationships. Rather, it is a global measure that should be used within the context of existing literature and theory to explore factors that underlie the phenomenon under study, and to understand how these factors are experienced by individuals within their local contexts. For the purposes of this study, well-being will be combined with health within the context of stress related to the farm. HWB among FOs will be conceptualized as a state of being in which a farmer rates their health (as defined by the WHO) as good or better, is able to engage in the work of the farm, and is free of farm-related distress.

Distress

Distinct from eustress, *distress* is conceptualized as a psychological state, and part of the multidimensional construct, stress (Farmer & Ferraro, 1997; Le Fevre et al., 2006). Initially described by Selye (1964), there is no single definition in the literature or consensus for its underlying mechanisms or processes. According to LeFevre and colleagues (2006), distress results from negative perceptions of stressors, or maladaptive responses to stress. Several factors are believed to influence whether an individual perceives a stimulus as negative (Le Fevre et al., 2006). These include a) the amount of demand the stress represents to the individual; b) the source and timing of the stress stimulus; c) the degree of control the individual has over the situation and outcomes; and d) the degree to which the stressor is considered desirable. Researchers theorize that when an individual formulates a negative appraisal of a stressor and subsequently attaches a negative meaning to that stressor, they experience distress (Farmer & Ferraro, 1997; Walker & Walker, 1987). The psychological state of distress can both cause and perpetuate maladaptive responses to stress (Le Fevre et al., 2006; Walker & Walker, 1987). In these situations, a self-perpetuating and mutually reinforcing cycle of distress and maladaptive behavior can occur, contributing to negative perceptions of HWB (Farmer & Ferraro, 1997). Distress is a form of chronic stress, which is known to negatively affect physical, mental, and emotional health, and contribute to adverse physiological changes that increase risk for chronic disease (Farmer & Ferraro, 1997; Gouin et

al., 2008; Marin et al., 2011; McEwen, 2008, 2017). For the purposes of this study, distress is defined as stress that is perceived as negative, threatening, or harmful, or stress that elicits a maladaptive response.

Chapter 2: Literature Review

Health and Well-Being Among Farmers

Over 60% of the total agricultural workforce in the US are FOs (USDA National Agricultural Statistics Service, 2019a). All farmers are at high risk for illness, injury, disability, and death from exposures and hazards associated with their work (De Brún & McAuliffe, 2018; Dhananjayan & Ravichandran, 2018; Dignard & Leibler, 2019; Doney et al., 2017; Earle-Richardson et al., 2015; Guillien et al., 2016; Sekhotha et al., 2016; Wardyn et al., 2015; Yarpuz-Bozdogan, 2018). Farm machinery poses significant health and safety risks including noise-induced hearing loss (Cramer et al., 2017), low back pain and hypertension from whole-body vibration (Bennet, 2018; Cramer et al., 2017; Essien et al., 2018; Upper Midwest Agricultural Safety and Health Center, 2019), as well as traumatic amputation or death (National Institute for Occupational Safety and Health Division of Safety Research, 2018). Working with livestock, like cattle, horses, goats, or hogs, is also hazardous work (National Institute for Occupational Safety and Health Division of Safety Research, 2018) and can result in traumatic musculoskeletal injuries, respiratory illness, and zoonotic infections including methicillin-resistant *Staphylococcus aureus* (MRSA) (Nadimpalli et al., 2018; Wardyn et al., 2015). Farmers working with field crops risk routine exposure to pesticides, herbicides, fertilizers, fumes, gases, and dusts (Darcey et al., 2018; Dignard & Leibler, 2019; Doney et al., 2017), and can have prolonged exposure to the sun (Jones et al., 2009). These exposures increase farmers' risks for developing hypertension, cardiovascular disease, respiratory illnesses (Demos et al., 2013), skin diseases, and cancer (Carley, 2015; Darcey et al., 2018; De Brún & McAuliffe, 2018; Doney et al., 2017; Earle-Richardson et al., 2015; Jones et al., 2009). Given the physical nature of farm work, musculoskeletal injuries like sprains and strains are also common (National Institute for Occupational Safety and Health Division of Safety Research, 2018), and many farmers report lifelong physical disability (Miller & Aherin, 2018).

Although findings are mixed across studies (Daghagh Yazd et al., 2019; Donham et al., 2011; Donham et al., 2019; Douglas et al., 2018; Essien et al., 2018; Guillien et al., 2019; Variyam & Mishra, 2005), compelling data suggests that farmers have an increased risk for and prevalence of chronic disease, particularly cardiovascular (Earle-Richardson et al., 2015) and chronic lower respiratory disease (De Brún

& McAuliffe, 2018; Guillien et al., 2016), compared to non-farming populations (Dignard & Leibler, 2019). In one study (DeLamater & Ward, 2013), 46% of farmers had clinical hypertension and 46% also had high serum cholesterol, both of which were significantly higher than the national averages of 33.2% (Centers for Disease Control and Prevention, 2017b) and 11.8% (Centers for Disease Control and Prevention, 2017a) respectively. In addition, 83% had four or more risk factors for cardiovascular disease among this group of farmers (Davis-Lameloise et al., 2013). In another study (Carley, 2015), 63% of farmers met criteria for pre-hypertension, compared to the national average of 30% (Centers for Disease Control and Prevention, 2017b). However, these farmers had lower rates of stage one hypertension (15.9%) than the general population (33.2%) (Centers for Disease Control and Prevention, 2017b). Chronic exposure to herbicides and pesticides has been linked to increased cardiovascular disease including congestive heart failure, peripheral arterial disease, and both increased incidence of and mortality from myocardial infarction (Sekhotha et al., 2016). In addition, studies have consistently shown that, on average, prevalence of overweight and obesity is greater among farmers than non-farmers (Blackburn et al., 2009; Brumby et al., 2011; Carley, 2015; Donham et al., 2019).

Exposure to vapors, gases, dusts, and fumes is associated with development of COPD, and respiratory illness is common among farmers. In their lifetime, 10-30% of all agricultural workers will experience an occupational-related respiratory condition from inhaling organic or inorganic dusts like endotoxins, molds, fumes, gases, vapors, smoke, and aerosols (Hunt, 2019). In one study of individuals currently employed in farming, 70.3% of participants reported high exposure to vapors, gases, dusts, and fumes, including some that are known carcinogens (Doney et al., 2017). Data suggest that farmers have higher rates of chronic lung disease, such as chronic obstructive pulmonary disease (COPD), than non-farmers, although use of different diagnostic criteria and metrics across studies makes comparisons difficult (Fix et al., 2020). In one study, 5.1% of farmers were diagnosed with chronic lung disease compared to 2.9% of non-farmers (Guillien et al., 2016). Another study that estimated the prevalence of asthma and COPD among farmers concluded that the odds of asthma among farmers were 1.82 times

greater than the general population, and that odds of undiagnosed COPD were 3.17 times greater than the general population (Earle-Richardson et al., 2015).

Contributing Factors

Farming, Farming Culture, and Rural Living

Traits commonly associated with farming, farm culture, and rural living may contribute to or exacerbate health disparities among farmers and influence their health decision-making. Farmers are more reluctant to seek health care services whether for physical or mental health concerns than the general population (Earle-Richardson et al., 2015). In addition, they are more likely to accept illness and death as normal and a natural life process (Gessert et al., 2015). Labor intensification, the approach of working harder and more hours, is a common practice among farmers (Kilpatrick et al., 2012). They tend to prioritize work completion over health, particularly when faced with time- or weather-sensitive work (Xiang et al., 2018). Farmers are more likely to rely on informal than formal networks for advice-seeking than the general population (Elliot-Schmidt & Strong, 1997), further reducing utilization of health care services. However, when their function is severely limited by an illness or injury and they cannot continue to work, farmers are more likely to seek health care services than when they can continue to work (Elliot-Schmidt & Strong, 1997; Gessert et al., 2015).

Farmers have been described as stoic and self-reliant, employing problem-solving over help-seeking approaches (Fuller et al., 2009; Kennedy et al., 2014; Rosenblatt, 2000). A widespread conviction among farmers is that “to be sick or injured somehow implies a weakness and a loss of social acceptability” (Elliot-Schmidt & Strong, 1997, p. 60). Unrelenting demands and the unpredictable nature of farm work make it difficult for farmers to engage in regular health promotion activities or to keep scheduled appointments with health care providers (Meit et al., 2014). Even when recommended, famers are often skeptical of taking medications because of potential cognitive or physical effects that could limit their ability to continue working or that would put them at increased risk for injury (Xiang et al., 2018). These characteristics are consistent with the labor-intensification approach taken by many farmers.

Another cultural norm among farmers, is to not 'share or air' their personal problems (Elliot-Schmidt & Strong, 1997; Slama, 2004). This is often the case with issues related to stress or emotional concerns. The inability to deal with the stress of farming is considered a weakness (Kennedy et al., 2020; Sorensen et al., 2017), and stigma against seeking mental health services is high in farming communities (Fuller et al., 2009; Kilpatrick et al., 2012; Rosenblatt, 2000; Rosenblatt & Karis, 1993). Lack of anonymity has been cited as a reason that rural residents choose not to seek healthcare services, particularly for mental health (Cuthbertson et al., 2020; Roy, 2014). In most rural communities, there are limited locations to obtain services and personal vehicles are easily identifiable. Concerns of lack of anonymity prevents farmers from seeking counseling or other mental health services locally (Roy, 2014). Even when local services are available, farm families may not use them (Cole & Bondy, 2020). As a result, rural residents often access mental health services when they are sicker than their urban counterparts (Slama, 2004).

Dissatisfaction with Care

Many farmers have deferred seeking health services after prior negative experiences with health care providers. Farmers reported that providers were unaware of their needs as farmers and "ignorant and insensitive to farm life" (Kilpatrick et al., 2012, p. 40). Others felt that providers had cast judgment on their behaviors or decisions related to their health, or suggested treatment plans that were incompatible with their daily work (Vayro et al., 2021). A shared understanding of the needs of farmers reduced the stigma associated with mental health and was perceived by one group of farmers as providers caring about them (Kilpatrick et al., 2012). Providers have also experienced challenges working with farm families, with many stating that they feel ill-equipped to meet farmers' needs (Rosenblatt, 2000; Scheerer & Bandt, 2001). Access to providers who deliver culturally relevant care and understand farming practices influences famers' health seeking behaviors (Kilpatrick et al., 2012).

Provider Shortages and Limited Service Availability

Farmers face limits to health care access due to provider shortages and limited service availability (Brundisini et al., 2013; Frybarger et al., 2019). The number of primary care physicians in rural areas is

less than half that of urban areas, and the majority (85%) of rural US counties have been designated health provider shortage areas (HPSAs) by the Health Resources and Services Administration (HRSA) (Health Resources and Services Administration, 2021a; Health Resources and Services Administration National Center for Workforce Analysis, 2015). In fact, the number of providers per capita decreases with increasing rurality (Anderson, 2014; Andrilla et al., 2018; Health Resources and Services Administration National Center for Workforce Analysis, 2015; Larson et al., 2016; LaSala, 2000). Shortages of mental health providers is especially bleak in rural communities, with shortages in rural counties over twice that of urban counties (Andrilla et al., 2018; Larson et al., 2016) (Table 2). Shortages of non-prescriber mental health providers range from 18% (counselors) to 47% (psychologies) in rural counties, with even larger shortages of mental health providers with prescriptive authority. Currently, 65% of rural counties have shortages of psychiatrists, 85% have shortages of Psych-Mental Health Nurse Practitioners (Andrilla et al., 2018; Larson et al., 2016), and approximately 17% of all rural counties in the U.S. have no trained mental health providers (National Academies of Sciences Engineering and Medicine, 2018; Rosenblatt & Karis, 1993). Provider shortages are just one of many factors in rural communities that contribute to access-based health disparities among farming populations (Anderson et al., 2019).

Limited service availability and closure of local hospitals also contributes to poor health outcomes among farmers. In 2017, there were approximately 2,250 rural hospitals, accounting for 48% of hospitals nationwide. Although rural hospitals account for only 16% of all inpatient hospital beds they are spread over and service 84% of the nation's land mass (United States Government Accountability Office, 2018). They are less likely to have critical care units, inpatient rehabilitation services, or inpatient psychiatric services (Freeman et al., 2015; The Chartis Group Center for Rural Health, 2017). Specialty services offered in the clinic setting are often limited in rural areas, with some communities lacking cardiac, pulmonary, or psychiatric services (Freeman et al., 2015). In addition, emergency medical services are typically staffed by volunteers who have a lower level of training than emergency providers in urban areas. Geographic distances and time for volunteers to respond contribute to significantly longer response times for many rural residents and contribute to delays in advanced care (The Chartis Group

Center for Rural Health, 2017). This can have profound effects for morbidity and mortality among farmers, given their high risk for traumatic amputations or crush injuries (Arcury & Quandt, 1998; Gross et al., 2015; Lewis et al., 1998; Lizer & Petrea, 2008). In recent years, rural hospitals have been closing and losing essential services. Since 2010, 95 rural hospitals closed and nearly 700 more are at risk for closure (National Rural Health Association, 2019). From 2013-2017, 64 rural hospitals closed due to financial stress, a number that is more than twice that of the number that closed in the previous five years (United States Government Accountability Office, 2018). Loss of maternity and obstetric care has left the majority of rural women with drive times exceeding the recommended 30 minutes to a hospital with maternity services (Anderson et al., 2019; National Rural Health Association, 2019). Currently, 54% of rural counties offer no hospital-based obstetrics care (Centers for Medicare and Medicaid Services, 2019), a major concern for female farmers.

Geographic Isolation and Transportation

For many farmers, geographic location and transportation pose serious barriers to accessing care. Farmers typically have long travel distances to access health services (Brundisini et al., 2013), so the time for a standard health appointment can mean loss of a significant amount of productive work time (Reed et al., 2008). Much work of the farm is time-sensitive and weather-dependent, with unanticipated projects or incidents occurring frequently (Olson & Schellenberg, 1986; Sutherland & Glendinning, 2008). Delaying completion of some farm work, for even an hour, can drastically affect production (Sutherland & Glendinning, 2008). Farm income is highly volatile and dependent on production yields and market prices (Olson & Schellenberg, 1986), and some delays can create financial ripple effects that last for days, weeks, or even months (Armstrong & Schulman, 1990; Sutherland & Glendinning, 2008). To avoid financial impacts from reduced production, farmers will often delay care in order to complete their work as long as they are physically able (Vayro et al., 2020).

Transportation can be a barrier for farmers seeking care, even when it is needed (Brundisini et al., 2013; Weathers et al., 2004). Studies have shown that lack of reliable transportation, the inability to drive, or the fear of driving to urban centers prevents some farmers from seeking care (Drerup et al., 2021;

Frybarger et al., 2019; Reed et al., 2008). In rural and remote communities with no public transit or alternative transportation options, some farmers must rely on friends or family members to attend medical appointments (Frybarger et al., 2019; Reed et al., 2008). Even when reliable transportation is available, the cost for fuel may exceed farmer's financial resources (Reed et al., 2008).

Insurance Coverage and Cost of Care

Lack of sufficient health insurance coverage or the inability to afford care also contribute to health disparities among farmers (Drerup et al., 2021; Frybarger et al., 2019). In 2015, the USDA's Agricultural Resource Management Survey (ARMS) reported that the percentage of farmers and non-farmers with no health insurance coverage was 10.7% and 9.1% respectively (United States Department of Agriculture Economic Research Service, 2019). The similarity in rates was attributed to health benefits attained through off-farm employment. The rate of uninsured farmers has remained relatively stable, according to a 2018 Farmers Business Network survey, with 11% of all farmers reporting no health insurance coverage (Fatka, 2019). Among farmers, rates of insurance are not consistent. Dairy farmers are most likely to be uninsured, with 41.4% reporting no health insurance coverage according to the 2015 USDA ARMS (2019). Farmers without health insurance most often cited high cost of premiums and high out-of-pocket costs as reasons for lack of coverage (Inwood et al., 2018). Some farmers remain reluctant to accept subsidies or public health insurance even when they would qualify for benefits, and many farmers are not aware that only income, and not assets, are used to determine Medicaid and Marketplace subsidy eligibility, so they do not apply (Andrews, 2013).

Even when insured, many farmers delay care due to high out-of-pocket expenses or inability to pay. In one study, 9% of farmers in Kentucky and South Carolina delayed care due to costs (Reed et al., 2008). In another study, 64% of farmers surveyed were not confident they could cover the cost of a major illness or injury without accumulating significant debt (Inwood et al., 2018). The costs for health insurance premiums and health care have been reported as the largest threat to the financial viability of farms (Inwood, 2015). Over half (53%) of farmers were concerned about long-term care needs, reporting that they would have to sell all of their farm assets to pay for nursing home or in-home health care

(Inwood et al., 2018). It is important to note that independent farm owners are not covered by workers compensation or receive pay for time off when sick or injured, perpetuating the cultural practice of working unless one is physically unable (Fatka, 2019). One study reported that farmers who were most likely to delay needed health care had lower income, higher numbers of health conditions, and had higher rates of private health insurance coverage than farmers who did not delay receipt of health care services (Reed et al., 2008). This study also reported that farmers were ten times more likely to have private health insurance coverage, specifically high copay-high deductible plans that did not cover preventive care, than the general population (Reed et al., 2008).

Health and Well-Being of Farm Owner-Operators

Although literature comparing FOs to other farm workers is scarce, available data clearly indicate that FOs suffer higher rates of disability and death than other farm workers. The proportion of FOs who report a disability due to a farm-related injury (19.2%) is over twice that of other farm workers (9.0%) (Miller & Aherin, 2018). In addition, FOs have two times the prevalence of occupational-related hearing loss than other farm workers (Miller & Aherin, 2018). Data show that FOs suffer a greater burden of mental health problems than both other farm workers and the general population (Daghagh Yazd et al., 2019; Kilpatrick et al., 2012; Ringgenberg et al., 2018). In one study, the point prevalence for symptoms of Generalized Anxiety Disorder among a sample of FOs was 71%, while 53% of the sample met criteria for depressive disorder (Rudolphi et al., 2020). Both rates exceeded those for all farmers (59.4% anxiety; 35% depression) and the US adult population (18.1% anxiety; 6.7% depression) (Rudolphi et al., 2020). Although some studies have reported lower rates of anxiety and depression among FOs than other populations (Bjornestad et al., 2019; Daghagh Yazd et al., 2019; Variyam & Mishra, 2005), elevated rates of suicide belie these findings. Among all occupational groups, farmers have the highest rates for suicide, and rates are higher among FOs than other farm workers (Arnautovska et al., 2015; Bryant & Granham, 2016; Pickett et al., 1993). In a study that examined nearly 20 years of suicide data for farmers, 65% of the suicide deaths were among FOs (Ringgenberg et al., 2018).

Contributing Factors

There are several behavioral characteristics attributed to FOs that increase their risk for injury and illness and likely contribute to health disparities among this group. Studies show that FOs are more likely to engage in farming practices that increase their risk for injury and illness and are less likely to seek medical care following a farming injury or accident than other farm workers (Dosman, 2015; Lovelock, 2012; Roy et al., 2017b). Among a sample of FOs who employed other farm workers, FOs reported they would forgo equipment repairs or jury-rig machinery in order to continue working but would not do so if it risked the safety of hired farm workers. They also reported doing work alone that they knew was unsafe and should be done with assistance (Voaklander et al., 2019). On average, FOs are more likely to sleep less than six hours per night and report greater daytime sleepiness than other farm workers (LaBrash et al., 2008). During periods of peak seasonal work or when facing inclement weather, FOs are significantly more likely to extend their workday to complete work than paid farm workers (Lovelock, 2012). Not surprisingly, FOs report greater daytime sleepiness than other farm workers which increases their risk for injuries due to inattention or slowed cognitive function (N. King et al., 2014). In fact, FOs have 1.48 times the odds for injury than other farm workers (Jadhav et al., 2014). Inadequate sleep is also associated with chronic illness, like cardiovascular disease, from loss of restorative functions of sleep, as well as mental health or behavioral problems from impaired psychological function (Heaton, 2010; N. King et al., 2014). Researchers have noted a statistically significant association between stress from financial threat and farm job stress, feelings of mental distress, symptoms of anxiety and depression, and farm-related injuries for FOs (Furey et al., 2016). There is some speculation that FOs engage in greater risk taking than paid workers because they identify as a farmer (Lovelock, 2012) and fear the financial and emotional implications of losing the farm, particularly when it is a generational farm (Kilgannon, 2018; Lovelock, 2012).

Although FOs take risks that may contribute to disparate health outcomes, many researchers attribute elevated rates of morbidity and mortality among FOs to the damaging health effects of chronic ORS (Furey et al., 2016; Jadhav et al., 2014; Leka & Jain, 2010; Miller & Aherin, 2018). Poor health

outcomes for FOs have been linked to chronic stress from heavy workloads and time pressures associated with the work of farming (Rudolphi et al., 2020). Weather events like flooding or droughts are known sources of chronic stress, distress, and reports of poor health (Stain et al., 2011). A recent study of FOs (Reissig et al., 2019) reported that financial uncertainty, heavy workloads, long work hours, and interconnectedness of work and home life were significant sources of stress and contributed to feelings of hopelessness and despair. Farming is known to put significant strain on relationships, particularly when the farm is a family business (Ang, 2010; Daghagh Yazd et al., 2019; Kilgannon, 2018).

Income for all farm workers is dependent on uncontrollable external factors such as weather, disease and financial markets, and FOs bear accountability for the financial liabilities of the farming business (Fraser et al., 2016; Jones et al., 2009). The continued existence of the farm, as well as FO's ability to pay hired help and provide income for their family rests on the decisions they make (Fraser et al., 2016; Stain et al., 2011). The unique responsibilities that accompany the role of FOs have led researchers to posit that FOs may have different stress experiences than other farm workers (Furey et al., 2016; Kilgannon, 2018; Lovelock, 2012; Reissig et al., 2019; Stain et al., 2011). Health disparities among FOs may result, not from the usual stress associated with farming, but from higher burdens of chronic ORS incurred by FOs in their dual roles as owners and decision-makers of the farming operation (Cuthbertson et al., 2020). The link between chronic stress, pro-inflammatory mechanisms, and pathophysiologic changes that contribute to chronic illness, like cardiovascular disease and cancer, are well established in the literature (Marin et al., 2011; McEwen, 2008, 2017). Therefore, there is compelling evidence to suggest the difference in stress experiences between FOs and farm workers may be a contributing factor to health disparities between these groups (Cuthbertson et al., 2020; Furey et al., 2016).

Protective Factors

Efforts to curtail health disparities among farmers have been largely ineffective, and research to understand protective factors is thin (Blackburn et al., 2009; Habib et al., 2014; Kennedy et al., 2020; Lehtola et al., 2008). The majority of this work has occurred within the field of occupational health and

safety, specifically farm health and safety (Alwall Svennefelt et al., 2019; Sorensen et al., 2017), with interventions focused on use of personal protective equipment (e.g. respirators), implementing administrative and work practice controls (e.g. training, safe work practices), engineering controls (e.g. skill switches or Rollover Protective Structure (ROPS) for tractors), or ultimately, eliminating the hazard (Donham et al., 1990; Langley, 2017; Nova Scotia Federation of Agriculture, n.d.; Storm, 2018). Based on health data, strategies to improve occupational health and safety have not affected health outcomes for farming populations overall (Lehtola et al., 2008). Since the 1980s, numerous interventions that increase access to resources for farmers experiencing stress or distress related to the farm have been implemented (DeLind, 1986; Keating, 1987; Kennedy et al., 2020). Helplines for crisis intervention and access to local health resources, web-based clearinghouses for farmer-specific resources that include information for mental and physical health, and training to increase the capacity of local community members to recognize signs and symptoms of depression or suicide among farmers and to suggest resources have dominated community programming and interventions to support farmers (DeLind, 1986; Hagen et al., 2019). No formal evaluations have been conducted of these interventions, and health metrics of farmers do not indicate they have had a substantive effect (Hagen et al., 2019).

Few studies have empirically studied factors associated with resilience to ORS or other characteristics or behaviors that are predictive of HWB among farmers (Donham et al., 1990; Jones-Bitton et al., 2019; Keating, 1987). Nutrition (Hirotsu et al., 2015; Padhy & Raju, 2018), exercise (Kim & McKenzie, 2014; Moseley, 2000; Tsatsoulis & Fountoulakis, 2006), meditation (Koszycki et al., 2007; Miller et al., 1995), and sleep (Åkerstedt, 2006; Hirotsu et al., 2015; King et al., 2014) have been associated with lower stress in other populations and have been explored with farmers (Brumby et al., 2013; Kliebenstein et al., 1983). One health promotion study among farmers reported significant reductions in weight and sustained improvements in physical activity (Brumby et al., 2013). However, this study and others that focused on farmer health did not integrate stress into the study design (Hagen et al., 2019; Kliebenstein et al., 1983; Leonard, 2015). Healthy relationships with intimate partners, good physical health, and social support have been shown to mitigate the negative effects of stress among

farmers (Daghagh Yazd et al., 2019; Davis-Brown & Salamon, 1987; Fraser et al., 2016; Kallioniemi et al., 2016). Leveraging relationships and social support from within existing social networks of farmers integrates current best evidence for reducing the negative effects of ORS and socioculturally appropriate approaches for delivering care (Brumby et al., 2009; Fuller et al., 2009; Kutek et al., 2011; Takizawa et al., 2006).

Studies show that social support is protective against stress across populations and can mitigate negative health effects from stress (Daniels & Guppy, 1994; Matel-Anderson et al., 2019; Sriram et al., 2018; Takizawa et al., 2006). Social support is a resource that resides within social networks, and is accessed, exchanged, or made available through direct or indirect interactions with others. Studies have shown that targeted network interventions can increase access to or exchange of social support resources and improve health outcomes (Huxhold et al., 2013; Kana'Iaupuni et al., 2005; Smith & Christakis, 2008). Several studies have examined the effect of social support on stress and health among farming populations (Fuller et al., 2009; Kutek et al., 2011; Takizawa et al., 2006). However, social support and social networks among farmers remain understudied, with no studies to date having directly explored the relationship between ORS and HWB for FOs. There is compelling evidence to support the use of social network methodologies to examine the relationship between social support available through social networks, ORS, and HWB among FOs. This is a promising area of study and with the potential to direct future interventions to reduce occupational-related health disparities for FOs.

Chapter Summary

Compared to urban populations and their rural counterparts, individuals who work in production agriculture, farmers, suffer greater health disparities (De Brún & McAuliffe, 2018; Dignard & Leibler, 2019; Guillien et al., 2016). Although the incidence of some chronic diseases, like cardiovascular disease or chronic lower respiratory disease, are declining across populations, the gap continues to widen between farming and non-farming populations (Centers for Disease Control and Prevention, 2017b; Doney et al., 2017; Earle-Richardson et al., 2015). Numerous factors increase the risk to farmers for both injury and illness compared to non-farming populations. The physical nature of farm work, use of heavy machinery,

interaction with livestock, and exposure to hazardous vapors, gases, and dusts are factors known to increase health risks for farmers (Demos et al., 2013; National Institute for Occupational Safety and Health Division of Safety Research, 2018; Stain et al., 2011). Cultural characteristics, time demands, lack of empathetic providers, and cost of care have also been cited as factors that contribute to excess risk for farmers (Drerup et al., 2021; Earle-Richardson et al., 2015; Kilpatrick et al., 2012; Vayro et al., 2021).

FOs are an understudied subgroup of farmers for whom rates of morbidity, mortality, and disability exceed other farm workers (Dhananjayan & Ravichandran, 2018; Dignard & Leibler, 2019; Doney et al., 2017; Earle-Richardson et al., 2015; Guillien et al., 2016; Sekhotha et al., 2016; Wardyn et al., 2015; Yarpuz-Bozdogan, 2018). Some researchers speculate that the cause is related to FO's greater likelihood to engage in risk taking compared to other farm workers (LaBrash et al., 2008; Lovelock, 2012; Voaklander et al., 2019). Others attribute the disparate health outcomes between FOs and other farm works to the high burden of ORS for FOs associated with their dual roles as owners and decision-makers for the farming operation (Furey et al., 2016; Jadhav et al., 2014; Leka & Jain, 2010; Miller & Aherin, 2018). There is a small but growing body of research that demonstrates a relationship between the responsibilities FOs assume while managing a farming operation, levels of stress, and poor physical and mental health outcomes (Cuthbertson et al., 2020; Furey et al., 2016; Stain et al., 2011).

Based on current knowledge of the sociocultural and geographic context within which FOs live, and current evidence of the relationship between stress and health, conceptual models that integrated social support emerged as important lines for studying HWB among FOs. Social support, a resource that resides within social networks, is protective against stress across populations and has been shown to mitigate the negative health effects of stress (Daniels & Guppy, 1994; Matel-Anderson et al., 2019; Sriram et al., 2018; Takizawa et al., 2006). The relationship between social support, stress, and HWB has been studied directly in other populations with conceptual models developed to explain causal pathways. The concepts of social support, stress, and HWB have been studied in farming populations (Fuller et al., 2009; Kutek et al., 2011; Takizawa et al., 2006), however, no studies have examined the relationships among these concepts or causal effects within in the context of ORS for farmers. A body of evidence

supports the use of social network science to explore the relationship between social support available through social networks, ORS, and HWB among FOs (Huxhold et al., 2013; Kana'Iaupuni et al., 2005; Matel-Anderson et al., 2019; Smith & Christakis, 2008; Sriram et al., 2018; Stain et al., 2011) and led to the following research questions:

1. What role do social networks play in strategies to mitigate occupational-related stress for farm owner-operators?
2. What network compositions and structures can be observed among farm owner-operators?
3. How does the context of production agriculture and the role of farm owner-operators influence social networks of farm owner-operators?
4. What social resources do farm owner-operators mobilize through their social networks related to HWB?

Chapter 3: Theoretical and Conceptual Frameworks

Social Networks

Networks, broadly defined, describe a set of objects and the relations between those objects (Kadushin, 2012). In order to describe a social network, the boundary of the network must be specified. The boundary of a social network identifies who or what is included or excluded in a particular network using defining criteria (Robins, 2015). The boundaries of social networks tend to be artificial, are determined empirically or theoretically based on the phenomenon under study and the investigators' conceptualizations of the processes that underlie that phenomenon, and are often limited by practical constraints (Robins, 2015). For example, if investigators were studying bullying among third graders in a designated school district, then the network boundary would be third grade classrooms in that school district, as specified by the criteria "third graders," and "designated school district." Using the prior example, empirical data were used as rationale to target third grade classrooms for a study on bullying. Hypothetically, the study would be limited to a single school district because of an existing collaboration, and the volume of data from this sample could be managed with current infrastructure and resources.

It is not always possible to identify the complete set of objects that comprise a network, and substantial researcher time and burden to participants can limit one's ability to perfectly demarcate network boundaries. When no prior theoretical or empirical research is available to inform social network boundaries, descriptive studies are often conducted to identify the actors included in a specific network and approximate the network boundaries (Freeman et al., 1992). Because the criteria used to define a social network change based on the context or problem under discussion, individuals belong to multiple social networks simultaneously. These networks can overlap, sharing members with other social networks, be nested within larger social networks, include actors at different socioecological levels, or be completely distinct.

Within the discourse of social networks, or social network science, objects take on a specific meaning, and are referred to as social actors, social entities, or, simply, actors. Actors are discrete social units that interact or that have the potential to facilitate social interaction, exchange, or transfer through their relational ties with other actors (Kadushin, 2012; Wasserman & Faust, 1994). Both the phenomenon

under study and the investigators' conceptualizations of the processes that underlie that phenomenon determine the entities that are included as actors in the social network. Typical examples of actors include individuals, groups of individuals, businesses or organizations, and events. However, platforms or systems that serve as repositories or facilitate social exchange, like websites, newspapers, or telephone help lines can also be included as actors in social networks (Kadushin, 2012; Wasserman & Faust, 1994).

Different forces, like shared interests or spatial proximity, function to bring actors together and influence the likelihood that they will form relationships, or social ties (Kadushin, 2012; Wasserman & Faust, 1994). Through these dynamic processes, social networks develop as social ties form. Examining the relational ties between actors in social networks can reveal patterns in the connections among actors across the network (Kadushin, 2012). Patterns created by the social ties between actors define the structure of social networks. Attributes are properties or characteristics of actors (network objects), that influence the likelihood that a tie will form between two actors. Attributes describe a range of actor characteristics, including those that are static, or resistant to social forces, such as age or biological sex, and those that are considered dynamic and susceptible to change in response to social forces, including attitudes or beliefs (Kadushin, 2012). Dynamic attributes are formed and continually revised through social interaction (Kadushin, 2012). It is through this social process of refinement that attributes of one actor can influence the attributes of another (Kadushin, 2012). For example, the attitudes of friends and family toward contraceptive use were found to change attitudes toward contraceptive use among a sample of women in Poland (Colleran & Mace, 2015). Attributes provide researchers insight into the forces that connect actors within social networks, as well as the social processes that underlie the structure of social networks (Kadushin, 2012).

Within social networks, attributes ultimately control social interaction, exchange, or transfer of resources over relational ties within social networks. Attributes of one actor are known to influence attitudes and behaviors of other actors (Kadushin, 2012; Wasserman & Faust, 1994), and attributes influence the formation of relational ties through the forces of propinquity and homophily (Valente, 2010). Propinquity refers to the state being in close proximity, while homophily describes individuals

with characteristics that align to a greater extent than expected by chance alone (Kadushin, 2012). Discrete actors who operate in similar physical spaces, and those with similar attributes are more likely to engage in activities that facilitate social interaction. For example, two individuals who live in the same town and who share an interest in Baroque music are more likely to interact or form relational ties than actors who do not share these similar attributes (Robins, 2015). Position, rank, and role are also attributes that can exert formidable influence on tie formation (Kadushin, 2012). These attributes can function as indicators of social status, or social value, leading to preferential tie formation, or situations where actors have advantage over others and can leverage their status to the benefit or detriment of others (Kadushin, 2012).

Relational ties can also be described using attributes, including descriptors of their quality, type, or function of the relationship between two actors (Wasserman & Faust, 1994). The quality of relational ties indicates the extent to which a tie has a certain characteristic compared to another characteristic. Some common quality tie attributes include evaluations of sentiment (positive or negative), frequency (often or rarely), or strength (strong or weak) (Valente, 2010). The type of tie describes the relationship between the actors who are connected and can include a number of relations like kinship (father and daughter), non-kinship (friends or acquaintances), or formal roles (manager and employee). The function of ties describes the exchange or transfer that occurs through the relational tie (Valente, 2010). For example, if knowledge is exchanged between members of collaborative partnerships, the tie could be described as an informational support (Kadushin, 2012; Valente, 2010). Conversely, if one friend is comforting another friend who experienced a recent loss, this tie could be described as emotional support (Kadushin, 2012; Valente, 2010). Multiple relational ties can occur and be measured between a single pair of actors, and ultimately informed by the phenomenon under study and the investigator's conceptual understanding of the underlying processes (Kadushin, 2012; Valente, 2010).

The structures of social networks are not random, rather they are shaped by social forces and individual agency. The structure of social networks reflects social structures, which are formed as shared values, social norms and expectations are created and enforced through social interactions (Kadushin,

2012). The pattern and strength of ties among actors within a network define the network structure and influence how resources flow, are accessed, or exchanged through the network (Butts, 2008; Hanneman & Riddle, 2005; Kadushin, 2012; Latkin & Knowlton, 2015; Luke & Harris, 2007). Social networks undergo a continuous process of evolution, with actors and the relationships between them changing and new social networks emerging (Robins, 2015). However, social structures develop as patterns of connections form through the process of actors building relationships within social networks (Kadushin, 2012). It is through these social structures that social norms are created and enforced; they are both a cause and consequence of social interactions (Kadushin, 2012). Within social network science, social structures are considered both a cause and consequence of social interactions (Kadushin, 2012), and social networks represent social structures that hold and communicate the shared values, norms, and understandings among a group of connected people (Kilpatrick et al., 2012). Although social networks are dynamic entities, the social processes upon which they are founded result in relative stability of social structures, therefore relative stability of network structures (Kadushin, 2012; Wasserman & Faust, 1994).

Social networks can be described as having four distinct dimensions: a) content, b) structure, c) function, and d) strength (Perry et al., 2018). Content includes the actors and ties between them, as well as the combined resources and opportunities among all network members (Perry et al., 2018; Wasserman & Faust, 1994). As described previously, network structures represent social structures, and are reflected in the patterns created by the social ties between actors in a social network. Network function refers to the specific purpose that the social network fulfills (Perry et al., 2018; Wasserman & Faust, 1994). For example, networks can be accessed for a variety of reasons, like support and motivation to train for a triathlon, or emotional support following the loss of a loved one. Network strength includes both the strength of social ties that form the network, but also the durability of the network (Perry et al., 2018). A network in which members report a high degree of trust between actors is considered “stronger” than a network among whose members there is little trust. Similarly, the greater the number of “strong” ties, the stronger the social network (Wasserman & Faust, 1994). Social networks whose members have long-standing ties that have persisted through social change or disruptive forces are also considered “durable.”

These four dimensions are important to consider in the design and analysis of network studies (Perry et al., 2018) because social networks effects are functions of interactions among these four dimensions.

Social Support

Social support is a multi-dimensional, network-based construct whose introduction to social and health sciences research can be largely attributed to the work of Cassel and Cobb in the 1970s (Liwin & Houle, 2019; Sarason & Sarason, 2009). It has been described as "support accessible to an individual through social ties to other individuals, groups, and the larger community" (Lin et al., 1979, p. 109), and "an objective appraisal of an individual's set of network contacts and the functions that these contacts serve" (Valente, 2010, p. 36). Despite the focus of a large body of research spanning nearly a half century, "social support" lacks conceptual and operational clarity (Song et al., 2011). In fact, Song, Son, and Lin (2011) identified 32 forms of social support as part of a concept review and analysis. For the purposes of this study, social support will be described along three dimensions: a) nature, b) form, and c) function (Cooke et al., 1988; Song et al., 2011). These dimensions are described further below.

The nature of social support is relational and is a product of social structures (Coleman, 1988). Social support resides within social networks, is accessed, exchanged, or made available through direct or indirect social interactions that result from the formation of relational ties (House et al., 1988; Wellman, 1983). Since social networks are dynamic and reflect ongoing social processes, the amount of social support available within a network is continually changing (House et al., 1988; Wellman, 1983). Although the positive aspects of social support are typically emphasized in the literature, social support is neither inherently positive nor negative (House et al., 1988; Wellman, 1983). Rather, the positive or negative quality of social support is determined through the appraisal of the individual, including the influence or appraisal of network members and the evaluation of both the action and the consequence of the action taken (House et al., 1988; Sarason & Sarason, 2009; Wellman, 1983). Appraisals of a single source of social support, or resource, can be varied, and it can have both beneficial and detrimental effects (House et al., 1988; Sarason & Sarason, 2009; Wellman, 1983). In addition, social support is a construct that is broadly defined within research paradigms, whose components may not align with informal

notions of what social support would be (House et al., 1988; Sarason & Sarason, 2009; Wellman, 1983). For example, an individual experiencing extremely high levels of stress may have a chance encounter with a friend or coworker who smokes cigarettes. This individual may try a cigarette, having heard others' claims that they relieve stress. Based on what is known about the health risks of smoking, it would be natural to assume the nature of a cigarette is negative. However, the individual's appraisal of this social support resources, the cigarette, would be based on the experience of smoking the cigarette (the action) and what occurs as a result of smoking it (consequences). Individuals can be embedded within subnetworks or part of a dyad (two individuals connected by a relational tie) in which they are more vulnerable to negative influences via relational ties. In situations where power differentials exist or an individual lacks experience, they may also lack the capacity or ability to remove themselves from the dominating negative influence of another individual or social actor. Relationships characterized by cycles of domestic violence make manifest the both the role of appraisal in the nature of social support, but also the influence of others in one's appraisal of social support.

Social support can take on multiple forms, including the subjective and physical forms. The subjective form of social support can be described as either perceived support, or objective (or actual) support (House, 1981; Langford et al., 1997; Wellman, 1983). Perceived support is a form of social support that is available within a network, one that has not been accessed, and one that may or may not actually exist (House, 1981; Langford et al., 1997). An individual's belief that a resource exists, or knowledge that the resource is available if needed are characteristics of perceived social support. Conversely, objective, or actual social support, are forms of social support that are available within a network, and that have either been accessed or can potentially be accessed because they do exist (House, 1981; Langford et al., 1997). Social support can also be described by its physical form, as either tangible or intangible (Gottlieb & Bergen, 2010). Tangible social support would include those resources available from a social network that can be physically exchanged (Gottlieb & Bergen, 2010). Examples of tangible social supports include clothing, food, or money. Intangible social support resources do not take on a physical form, although exchange can still occur. Examples of intangible social supports include

information learned through a conversation with a friend or colleague, expressed emotions like love or empathy, or expressed opinions or judgments about one's performance (Gottlieb & Bergen, 2010).

The third dimension of social support is the function, or purpose, that the social support is intended to achieve. One way of classifying social support by function, proposed by House (1981), includes emotional, instrumental, informational, and appraisal support. Emotional support is intended to bolster one's feelings or improve one's psychological state through receipt of things like empathy, caring, love, or trust from others (Cooke et al., 1988; Valente, 2010). Instrumental support is intended to assist others, and can include food, money, or a service, such as help carrying groceries. Informational support is intended for use to solve problems (Cooke et al., 1988; Gottlieb & Bergen, 2010). Examples of informational support include information, advice, or suggestions. The feedback received from others in response to one's situation, choices, or behavior is known as appraisal support (Cooke et al., 1988; Gottlieb & Bergen, 2010). Appraisal support is intended to facilitate self-evaluation and social comparison (Cooke et al., 1988; Gottlieb & Bergen, 2010).

Social support can be conceptualized as the functional product of the structural properties of social networks. Patterns of social ties between network members determine the structure of a social network (Kadushin, 2012; Wasserman & Faust, 1994). The structure of a social network represents social processes and structures that influence social behavior, as well as access to resources available from other members within the network (Heenan, 2010). In effect, social networks act as conduits for social support (Cohen, 2004).

Social Networks and Social Support

Studies dating back to 1976 have explored relationships between social support and health (House et al., 1988; Lamu & Olsen, 2016; Sarason & Sarason, 2009). Although findings vary across studies, a preponderance of evidence shows both direct and indirect beneficial effects of social support on HWB (Bjornestad et al., 2019; House et al., 1988; Matel-Anderson et al., 2019). Numerous studies have examined the relationship between social support and stress, concluding that social support has buffering effects on stress, protects against the negative health effects from stress, and is associated with reduced

morbidity and mortality because it mitigates the adverse health effects of stress (Furey et al., 2016; House et al., 1988; Matel-Anderson et al., 2019; Sarason & Sarason, 2009; Takizawa et al., 2006). One study found that the effect of social support on mortality was stronger among men than women (House et al., 1988). There was additional evidence to suggest that the purpose, or function, of the social support, as well as the frequency, source, and perceived usefulness of the social support, may be important for its effect on health (House et al., 1988). These findings emphasized the importance of individual appraisal in evaluating the overall qualities of social support resources. In addition, these findings illustrated the bias among social support literature toward studying the positive effects with little exploration of the negative effects of social support.

Although the biopsychosocial processes through which social support functions are not fully understood, it "is widely recognized that social relationships and affiliation have powerful effects on physical and mental health" (Berkman et al., 2000, p. 843). In fact, the effects of social support on health "rival those of most other known biomedical and psychosocial risk factors" (House et al., 1988, p. 300). There is some evidence that social support promotes HWB by enhancing self-esteem. In a study of college-aged adults, self-esteem, positive thinking, and social support had direct effects on suicide resilience (Latkin & Knowlton, 2015). Self-esteem was also found to have reciprocal, indirect effects on positive thinking and social support (Latkin & Knowlton, 2015). Another mechanism through which social support is hypothesized to improve HWB is through social integration. Social integration refers to the presence and quality of social relationships, including both the type of relational ties and the frequency of social interactions (Gottlieb & Bergen, 2010; House et al., 1988).

It is generally accepted that social support is the mechanism through which social networks influence health, and that the social structures created by social ties are the pathways through which social support exerts its effects (Berkman et al., 2000; Valente, 2010). Therefore, examining the structure of social networks may provide important insights into modifiable features or characteristics of social networks that can facilitate exchange or increase access to social support resources and promote HWB for farming populations (Borgatti et al., 2017; Kadushin, 2012; Wasserman & Faust, 1994). Findings from

prior studies indicate that this is a promising area for exploration and to inform development of interventions to reduce the negative health effects of ORS and promote HWB among FOs.

Conceptual Model

Berkman and colleagues (Berkman et al., 2000) proposed a novel conceptual model to explain how social networks influence health and to guide research using social network methodology (Figure 1). Their model integrates features of the macro-social context with psychobiological processes to explain the pathways through which social support impacts health via social networks. In addition, it emphasizes the "social context and structural underpinnings that may influence the types and extent of social support" (Berkman et al., 2000, p. 846) that social networks provide. Through this work, they sought to embed social networks into a causal chain that integrated multiple socioecological levels and explicitly identified the pathways through which social networks impact health outcomes. According to Berkman and colleagues (2000), it is through the larger macro-social context that individual behavior is shaped by factors that influence social network structure and function. Therefore, modifying the social environment can create structural and functional changes in social networks that facilitate individual behavior change and contribute to improved HWB. Berkman and colleagues' model (2000) describes the causal relationships between social networks, social support, ORS, and HWB that are explored in this study, and helps to position this work within the larger context of existing social network research.

Social Network Methodologies

This study employs social network methodologies, a set of research methods and analytic techniques specifically designed for empirical study of social networks (Kadushin, 2012; Robins, 2015; Savage, 2008; Valente, 2010; Wasserman & Faust, 1994). Social network methodologies fall under the broader umbrella of social network science. Social network science is both an approach, and a set of research methods that grew out of sociology, and has historical roots in psychiatry, psychology, anthropology, mathematics, and epidemiology (Freeman, 2014; Valente, 2010; Wasserman & Faust, 1994; Wellman, 1983). Social network science is founded on the premise that social environments influence individual behavior, and that the structure of relational ties affects the availability of resources

to members within the network (Butts, 2008; Hanneman & Riddle, 2005; Latkin & Knowlton, 2015; Luke & Harris, 2007; Simpson & de Loë, 2017; Wasserman & Faust, 1994). It is used to study transactions or relational events, make conclusions about sequences of events that have implications for or indicate long-term relationships, work structures, or how social systems work. The guiding premise of social network science is that all core concepts are defined and expressed in relational terms (Berkman et al., 2000; Valente, 2010).

Social network science focuses on the relations and patterns of relations among social entities, seeks to determine the conditions under which those patterns arise, and the consequences of those patterns on a variety of socially influenced outcomes (Butts, 2008; Freeman, 2004; Hanneman & Riddle, 2005; Upper Midwest Agricultural Safety and Health Center, 2019; Wasserman & Faust, 1994). Social network science provides insights into the underlying social structures within social networks that shape behavior and provide differential access to resources and opportunities to network members. Methods of social network science are used to empirically study social structures by examining and describing patterns of relational ties that link actors within a social network (Valente, 2010). These qualities make the methodologies of social network science uniquely suited for empirical study of social networks.

Historical Foundations of Social Network Science

Social anthropologist J.A. Barnes first coined the concept of social networks in the 1950s (Barnes, 1954; Pfouts & Safier, 1981). However, many scholars credit sociologist Émile Durkheim with introducing the theoretical concepts upon which social network science was founded (Berkman et al., 2000; Butts, 2008). In his studies of suicide in the late 1800s, Durkheim associated increased rates of suicide with periods of social or political instability, or phases of rapid social change (Berkman et al., 2000; Wray et al., 2011). He argued that these periods of instability and change challenged social norms, weakening alignment of social values and beliefs, ultimately leading to loss of group cohesion, or social integration (Thorlindsson & Bernburg, 2004; Turner, 1981). He went on to hypothesize that social integration and cohesion influenced mortality, positing that individual pathology was a function of social dynamics (Thorlindsson & Bernburg, 2004; Turner, 1981).

In the 1930s and 1940s, Lewin and Moreno moved the field of social networks in new directions (Berkman et al., 2000). Lewin described human behavior on a continuum where individual variations attributed to social norms reflected inconsistencies or tensions between perceptions of the self and the environment (Scott, 1988). According to Lewin, a person's behavior is goal oriented, specifically toward maintaining the status-quo through balancing tensions between social norms (the environment) and personal beliefs (the self) (Berkman et al., 2000; Scott, 1988). When a change or force is introduced into one's environment that conflicts with the status quo, like voting rights for women in the mid-1920s, a person experiences a tension between the self (status-quo) and the environment (new force). The person's behavior will be directed toward resolving the tension between the new force (woman's suffrage) and existing social norms. Lewin also integrated the mathematical concepts of topology and graph theory with network science, allowing researchers to construct statistical models that predicted the spread or reach of social phenomena based on structural features, like position or characteristics of relational ties between actors in social networks (Berkman et al., 2000; Scott, 1988). Moreno is credited with developing visual representations of social networks, known as sociograms (Barnes, 1954; Scott, 1988). The ability to see network structures facilitated new approaches to studying and interpreting social network data.

John Barnes, Elizabeth Bott, and J. Clyde Mitchell added to and expanded the growing body of social network research in the 1950s (Berkman et al., 2000). As part of his work studying social class in a Norwegian community, Barnes noted differences in the nets fisherman used based on where they lived in the local community. These observations led him to hypothesize that behavioral differences are attributed to the structural characteristics of the social context within which people live (Barnes & Harary, 1983; Scott, 1988). Elizabeth Bott developed the Bott Hypothesis from her studies of marital roles and the degree of connectedness between husbands and wives. She observed that the greater the density of the individual networks of husbands and wives, the greater the degree of marital role segregation (Savage, 2008). She extended the application of social network science by theorizing that network methods influence social roles (Pfouts & Safier, 1981; Savage, 2008). Mitchell (1974) added conceptual clarity to social network science in his study of social systems and conditions in Malawi. Through his work, he

delineated structural and interactional characteristics of social networks that could be empirically studied (Pfouts & Safier, 1981), while also examining the structural impact of strength and durability of relational ties (Mitchell, 1974).

Research in the 1970s extended the application of social network science even further. Granovetter (1973) published his seminal work describing the importance of weak ties in micro-level and macro-level network interactions. New information, he argued, is most likely introduced into a network through weak ties than through strong ties. Individuals with regular exposure and interaction, those with strong ties, have a propensity toward shared knowledge, attitudes, beliefs, and values. Conversely, there is a greater likelihood of divergent knowledge attitudes, beliefs, and values among individuals with weak ties, thereby creating opportunities for exchange of novel information or ideas. During this period, network approaches were applied to studies of health states and mortality. In the mid-1970s, Cassel and Cobb posited that social support exerted significant effects on host resistance and stress (House et al., 1988). Their empirical studies demonstrated that social support influenced mortality, laying the foundation for research on the association between resources available through social ties and health (Berkman et al., 2000).

In the following decade, Coleman introduced his theory of social capital to network analysis. He viewed social capital as a product of social structures, an asset that resided within the organization and composition of social relationships between individuals in a network that was available to benefit all members of the network (Coleman, 1988). He argued that it was through social relationships that individuals reciprocally exchange social capital, thereby adding value or benefit to their lives. He described social capital as all aspects of social structure and relations, including social norms, that act to encourage or constrain behavior (Coleman, 1988). He differentiated social capital from human capital, which he described as an individual's skills, knowledge, and experience, qualities that determine a person’s productive value to society. In distinguishing and linking the concepts of social capital and human capital, he bridged macro- and micro- level social network approaches, providing a hypothesis for how resources are positioned and interact within social networks (Williams & Durrance, 2008). Social

network science grew significantly in the 1980s through the work of quantitative sociologists who applied concepts and procedures from mathematics and graph theory to develop predictive models. This work paved the way for empirical tests to examine networks for the existence of groups or communities, and to test hypotheses based on the structural characteristics of networks.

Theoretical Integrations

Theories and conceptual models have been used to describe or explain the mechanisms through which social networks operate and influence individual and group behavior. John Bowlby, through his work with Attachment Theory in the 1960-70s, suggested that early childhood environments facilitated the development of protective social attachments, or bonds (Berkman et al., 2000). Like Cassel and Cobb, Bowlby associated network ties with health status. He hypothesized that secure, intimate bonds were the mechanism through which individuals maintained homeostasis and health throughout the lifespan.

In the 1980s, social scientists, Kahn and Antonucci introduced the Convoy Model (Antonucci et al., 2013). This model described three levels of closeness. Closeness, they argued, was the protective function found within social relations, particularly emotional closeness, that individuals experienced over the course of their lifetime (Antonucci et al., 2013). Based on their observations of differences in mortality, they hypothesized that the exchange of social support and the nature of relationships change over time (Antonucci & Akiyama, 1987) thereby affecting health and longevity (Antonucci et al., 2010).

Social Resource Theory (SRT) was also introduced during this period and integrated with social network methodologies. SRT was based on the assumption that the most important feature of social networks was the social support they provided (Lin et al., 1979). This theory hypothesized that social support was the pathway through which social networks influenced health. In 2000, Berkman, Glass, Brissette and Seeman (2000) developed a conceptual model to explain how social networks influenced health and to guide future research on health that employed social network science (Figure 1). Their framework emphasized the “social context and structural underpinnings that may influence the types and extent of social support provided” to members of networks through social interactions (Berkman et al., 2000, p. 846). They sought to embed social networks into a causal chain that integrated multiple

socioecological levels and explicitly identified the pathways through which social networks impact health outcomes.

Social network science is increasingly used to examine health and health behaviors, in large part, because social network approaches are flexible. Theories from a range of disciplines have been applied to guide study designs, interpret results, and develop interventions based on study findings. Among the most common theories are Social Learning Theory, the Theory of Reasoned Action, Resiliency Theory, and Diffusion of Innovations (DOI). However, Roger's DOI (2003) is the theory most often associated with studies using social network science and is frequently applied for studies related to health or health behavior (Valente, 2010). DOI provides a theoretical explanation for how diseases, behaviors, or new ideas spread between and within groups through social interactions or social forces (Rogers, 2003; Valente, 2010). DOI assumes that diffusion occurs over time and at different rates, starting slowly and then accelerating. The perceived characteristics of the innovation affect its adoption, as do the characteristics of the individuals exposed to the innovation. Through the adoption process, individuals can change or modify the innovation, which also influences its spread. Like social network science, DOI asserts that mathematical models can be constructed to describe the rate and character of spread through a group (Rogers, 2003).

Social network science has a long and rich history, drawing strengths from a range of theoretical and conceptual perspective including sociology, psychology, anthropology, mathematics, and epidemiology. The strength of social network science is its ability to facilitate the study of "the types of relations people have and how these relationships influence behavior" (Valente, 2010, p. 4). Because of its flexibility and adaptability, social network science has been applied to a diverse body of research from economics to infectious diseases, and even to the spread of innovative farming practices. The power to examine the structural and functional influences of social networks on the behavior of network members extends the potential of early network studies that focused solely on the characteristics or attributes of individuals on health behavior (Valente, 2010; Wasserman & Faust, 1994). The potential applications for

social network methodologies continues to grow as the field of social network science develops new ways of exploring social interactions across socioecological levels and over time.

Theoretical Presuppositions and Methodological Assumptions

Despite the co-development of social network science with a number of social and behavioral theories, there is no single grand "social network theory." Rather, a framework of theoretical presuppositions and methodological assumptions has evolved through this body of work upon which social network methodologies are based (Borgatti & Halgin, 2011; Hanneman & Riddle, 2005). The details of this framework vary across social network researchers, however, the methodological issues raised by social network scholars are generally consistent across disciplines (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994).

Six key assumptions about the social processes and social structures form the foundation of social network science (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). First, connections are the key mechanism of social action (Perry et al., 2018). It is through social interactions with others that organized activities, group behaviors, and social norms arise. Second, social networks, comprised of groups of individuals and the ties that connect them, are the fundamental building blocks of social structures (Kadushin, 2012). According to this premise, in the absence of social networks, the many ways that humans organize themselves into groups, like families, religions, political groups, or classes, would not exist. A related premise is that outcomes are affected by the structure that is created by the patterns of social ties among network members (Borgatti & Halgin, 2011; Hanneman & Riddle, 2005). The structure of social networks determines how resources and opportunities flow through the network, and who has access to them. In this way, the network structures can inherently advantage or disadvantage different individuals or groups. Fourth, social networks are dynamic, with both structures and processes undergoing continual change (Valente, 2010). A fifth assumption is that relational ties between network members and the characteristics of network members (attributes) co-evolve (Wasserman & Faust, 1994). In other words, a change in relational ties between network members can both cause and be caused by a change in the one or both individuals. For example, the decision to engage in criminal activity may

disrupt some social relationships, resulting in loss of some friendship ties and formation of others. In this case, a change in an attribute, criminal activity, may lead to a change in relational ties. Finally, actors in social networks have intentionality (Valente, 2010). As in the preceding example, individuals in social networks have agency and can purposively choose their actions.

As described previously, social networks can be characterized as having four distinct dimensions: a) content, b) structure, c) function, and d) strength (Perry et al., 2018). Content includes actors, ties, and the combined resources and opportunities among all network members (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). The network structure is reflected in the patterns created by the social ties between actors in the social network. Network function refers to the purpose that the network fulfills (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). These four dimensions are important to consider in the design and analysis of network studies because social networks effects are functions of interactions among these four dimensions (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994).

Prior Applications of Social Network Science

Social network methodologies have been applied to study the effect of social structures and processes on individual and group behavior for nearly 75 years. Some of the earliest social network studies were conducted among farming populations. In 1943, Ryan and Gross conducted a pioneering study integrating social network methods and DOI theory (Rogers, 2003) to examine the adoption and use of hybrid corn seed (Savage, 2008). Since that time, social network science has been used extensively to explore the spread of innovative farming practices and other agricultural technologies among farming populations (Isaac et al., 2007; Krishnan & Patnam, 2013; Liverpool-Tasie & Winter-Nelson, 2012; Maertens & Barrett, 2012; Simpson & de Loë, 2017; Wood et al., 2014). Through this work, researchers learned that farmers make extensive use of social networks to share information and to learn about new farming products, practices, and technologies (Maertens & Barrett, 2012; Wood et al., 2014).

No studies were identified where researchers compared the social networks of farmers and non-farmers to investigate a phenomenon, therefore it is difficult to directly compare data across populations

or studies. To do so would require, at minimum, consistency of the phenomenon under study, the processes underlying the phenomenon, and the variables collected (adams, 2020; Borgatti et al., 2017; Yang et al., 2017). Despite this limitation, from early social network studies of the spread of innovative farming practices, researchers observed differences between the structural characteristics of farmers' social networks and the social networks of non-farmers (Dunbar, 2018; Simpson & de Loë, 2017; Wood et al., 2014). As research studies of farming populations expanded to topics of social support, connectedness, and health, similar patterns were also observed in this emerging body of work (Cofré-Bravo et al., 2019; Simpson & de Loë, 2017; Wood et al., 2014) (Figure 2a).

Researchers noted that social networks among farmers were large, having a greater number of network members (9-14 people) (Simpson & de Loë, 2017; Wood et al., 2014) on average than observed in studies of non-farming populations (5-15 people) (Dunbar, 2018) (Figure 2a). Farmers' networks had greater density (0.44-0.60 compared to 0.35-0.51), meaning that a greater proportion of all possible ties between network members existed among social networks of farmers than among social networks of non-farmers (Igarashi et al., 2008; Kim, 2015; Valente, 2010). In networks with greater density, information spread or access to resources tends to be accelerated compared to sparse networks (Valente, 2010). For example, in one network study of spread of novel farming practices, information needed to pass, on average, between less than two individuals to reach all other farmers in the network (Wood et al., 2014). A high degree of homophily was also observed in farmers' social networks, with other farmers accounting for at least half of shared contacts, across studies with differing aims (Simpson & de Loë, 2017; Wood et al., 2014). The social networks of farmers were decentralized, meaning no person or group emerged as occupying an important position, such as bridging otherwise disconnected groups or functioning as an opinion leader (Cofré-Bravo et al., 2019; Simpson & de Loë, 2017; Wood et al., 2014). Farmers were more likely to value or trust information about novel farming practices when received from other farmers, particularly those with more experience, and reported greater trust among friends and family members than other types of relations, such as accountants, consultants, or veterinarians (Cofré-Bravo et al., 2019;

Wood et al., 2014). This is consistent with studies of non-farming populations, where trust is greatest between network members who share attributes, particularly values and beliefs (Kim, 2015).

Research on farming populations has increased in recent years, with greater attention focused on stress, social networks, social support, and mental health among farmers and farm families (Fuller et al., 2009; Keating, 1987; Kutek et al., 2011; Stain et al., 2008). The relationships among these concepts, as well as the processes across the socioecological levels at which they function have been studied extensively in non-farming populations (Antonucci & Akiyama, 1987; Berkman et al., 2000; Burt, 2000; Cohen, 2004; House et al., 1988; Kana'Iaupuni et al., 2005; Smith & Christakis, 2008; Valente & Pitts, 2017; Williams & Durrance, 2008), and integrated into the conceptual model developed by Berkman and colleagues (2000) (Figure 1). Many of the concepts related to stress, social networks, social support, and mental health, as well as several relationships between these concepts have been studied within farming populations (Figure 2a). However, the relationships among these concepts and across socioecological levels have not been directly studied or evaluated in farming populations (Figure 2b).

Numerous studies have reported the prevalence of health conditions, or described single concepts including stress and coping, as well as health risks, behaviors, beliefs, and attitudes within farming populations (Figure 2a) (Booth & Lloyd, 2016; Caldwell & Boyd, 2009; Fraser et al., 2016; Guillien et al., 2017; Hull et al., 2017; Keating, 1987; N. King et al., 2014; Kuriger, 2016). In response to the 1980s farming crisis, researchers began studying the nature and sources of occupational stress among farmers (Booth & Lloyd, 2016; Keating, 1987; McShane & Quirk, 2009; Reissig et al., 2019). Other researchers began reporting the prevalence of mental health illness, as well as the prevalence of comorbid physical and mental health conditions (Fraser et al., 2016; Guillien et al., 2017). As awareness of the association between ORS and health risks for farmers grew, investigators conducted research to better understand the health risks, behaviors, beliefs, and attitudes within farming populations (Caldwell & Boyd, 2009; Hull et al., 2017; N. King et al., 2014; Kuriger, 2016; McShane et al., 2016). Numerous studies were conducted to identify factors that increased the risk for ORS (Alpass et al., 2004), illness (Fuller et al., 2007), injury (Thu et al., 1997), or suicide among farmers (Bjornestad et al., 2021; Kim, 2014).

With growing awareness of the negative effects of ORS on the health of farmers, researchers then began to study relationships between risk factors, personal characteristics, and health outcomes (Figure 2b) (Ang, 2010; Armstrong & Schulman, 1990; Berry et al., 2011; Demos et al., 2013; Fraser et al., 2016; Freeman et al., 2008; Jones-Bitton et al., 2019; LaBrash et al., 2008; Rudolphi et al., 2020). Studies also included testing for associations between factors as a means to develop causal pathways and theories to guide future interventions. Researchers explored relationships between levels of ORS and the prevalence of certain mental and physical health conditions (Ang, 2010; Berry et al., 2011; Demos et al., 2013; Fraser et al., 2016; LaBrash et al., 2008; Rudolphi et al., 2020). Other research focused on levels of ORS, characteristics of farmers, and the type of farming operation (Freeman et al., 2008). Resilience and coping were also studied in relation to ORS among farmers, compared to prevalence of mental health disorders (Jones-Bitton et al., 2019) and locus of control (Armstrong & Schulman, 1990). This line of inquiry then began integrating the concepts of social networks and social support. Investigators described the relationship between perceived social supports and reported level of ORS (Stain et al., 2008). They also described the relationships between reported levels of ORS, number of social connections, and the prevalence of mental health disorders among farming populations (Brigance et al., 2018). This drove greater interest in studying protective factors against ORS for farmers (Greenhill et al., 2009).

Several studies have explored the effect of social support among famers relative to self-reported health status in the context of ORS (Kutek et al., 2011; Roy, 2014; Roy et al., 2017a; Takizawa et al., 2006) (Figure 2b). In one study, social support was shown to provide buffering effects against stress and predict well-being among a sample of farmers (Kutek et al., 2011). Another study explored the relationship between social support and mental health, with results showing a positive association between social support and reduction in symptoms of depression (Bjornestad et al., 2019). Social relationships, a form of social support, were found to explain 50% of the variation in self-reports of subjective well-being among a sample of rural men and had the greatest effects on well-being for those individuals with the lowest baseline scores (Lamu & Olsen, 2016).

Studies of stress and health among farming populations have also integrated social network methodologies. Through this work, researchers have shown that social networks can be used effectively for health information sharing and to reinforce health behaviors, like maintaining healthy food choices or sustaining physical activity (Sriram et al., 2018). Although an incidental finding from a study of stress among male farmers, participants shared that an informal network, which developed organically at a local mechanic shop, had become a place where the men came to talk and connect. Many participants reported that these interactions were helpful in dealing with the stress and uncertainly of farming (Kilpatrick et al., 2012). A 2009 study (Fuller et al.) used social network analysis to examine opportunities to identify symptoms of depression and provide mental health assistance to farmers through networks of agricultural-related agencies and local health services in Australia. Jackson-Smith and Gillespie (2005) used social network methodologies to demonstrate that implementing change within social networks that cause structural changes to the network lead to changes in social ties among farmers.

Not all of the relationships between the concepts of stress, social networks, social support, and mental health have been studied, nor have they been fully studied across socioecological levels in farming populations. However, there is compelling evidence to support the use of social network science to investigate the relationship between stress, social support, and health within farming populations (Bjornestad et al., 2019; Kilpatrick et al., 2012; McShane & Quirk, 2009; Roy, 2014; Roy et al., 2017b). Study findings describing the relationships and pathways that have been explored among farmers have been largely consistent with those across other study populations, with social support buffering the negative effects of ORS among farmers (Kutek et al., 2011). In addition, study findings "suggest that social support is…a significant factor in the wellbeing for farm and ranching men and women" (Takizawa et al., 2006, p. 63), and that social networks can be a viable source of health-related social support for farmers (Kilpatrick et al., 2012; Sriram et al., 2018).

Chapter Summary

There are over 3.5 million FOs in the US who are at risk for greater morbidity and mortality than other farm workers (USDA National Agricultural Statistics Service, 2019a), and few studies have directly

studied the factors that underly these disparities (Roy, 2014; Roy et al., 2017b). The negative effects of stress on HWB are firmly established in the literature (Brumby et al., 2012; Caspi, 2003; Farmer & Ferraro, 1997; Turner et al., 1995), and research in both farming and non-farming populations have demonstrated the buffering effects of social support on stress (Bjornestad et al., 2019; House et al., 1988; Matel-Anderson et al., 2019; Sarason & Sarason, 2009). However, no studies have directly examined the relationship between ORS, social support available through social networks, and health outcomes in farming populations. In addition, no studies were found that empirically investigated the role that social support, accessed through social networks, might play in mitigating the negative health effects of ORS.

Social support is a product of social networks (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). Numerous studies have shown that understanding the structural characteristics of social networks can inform network interventions with the potential to improve health outcomes by expanding access to, or exchange of social support resources (Berkman, 2000; Cohen & Syme, 1985; De Brún & McAuliffe, 2018; Huxhold et al., 2013; Kelly et al., 2017). Social network science is a research approach that encompasses a set of methodologies that focus on the relations and patterns of relations among social entities (Borgatti et al., 2017; Hanneman & Riddle, 2005; Wasserman & Faust, 1994). A set of analytical techniques, described as social network analysis, have been developed to empirically study how attributes of network members influence the structure of social networks through formation of social ties, and how the structural characteristics go on to influence the network's function (Borgatti et al., 2017; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). Social network science and social network analysis have been used extensively for descriptive and predictive lines of inquiry and are increasingly used to test theories about relational processes or social structures (Aitkin et al., 2014; Anselin, 1999; Antonucci et al., 2010; Attanasio et al., 2012; Beehr et al., 2010; Conway et al., 2016; Scanfeld et al., 2010; Valente & Vega Yon, 2020; Wasserman & Faust, 1994). However, network science has not been used to study ORS and HWB among farmers, nor among FOs.

Study Aims

The purpose of this descriptive, boundary-approximation study was to use social network methodologies to explore the social networks of farm owner-operators and the social supports available to them for mitigating negative health effects of ORS. The aims of this study were to:

1. Identify the ***actors*** (individuals, groups, organizations, and events) included in the social networks of FOs ***and actors' attributes*** (characteristics);

   Rationale: The boundary of a social network defines the members, or the composition, of that social network. When the boundary of a social network is not known, as was the case with this study, inclusion criteria are specified and the actors with membership in the network are identified.

   Rationale: Attributes influence the likelihood that a tie will form between two actors. The pattern and strength of ties among actors within a network define the network structure and influence how resources flow, are accessed, or exchanged through the network (Butts, 2008; Hanneman & Riddle, 2005; Kadushin, 2012; Latkin & Knowlton, 2015; Luke & Harris, 2007). Therefore, attributes influence access to social support resources within social networks.

2. Describe existing ***sources of social support*** in the social networks of FOs*; and*

   Rationale: Social support resides within social networks, is accessed, exchanged, or made available through direct or indirect social interactions that result from the formation of relational ties (Kadushin, 2012; Perry et al., 2018; Valente, 2010; Wasserman & Faust, 1994). Therefore, social support is a functional product of social networks, and the structural properties of social networks determine the flow of social support through social networks (Cohen, 2004). In order to determine whether FOs have differential access to social support resources within their social networks, the social support resources within their networks must first be described.

3. Relate the ***structural characteristics*** to the ***functional characteristics*** of social networks of FOs that may ***influence access to or exchange of social support***.

   Rationale: The pattern and strength of relational ties within a social network define the network structure. The structure of social networks influences its function, or how resources flow, are

accessed, or exchanged through the network (Butts, 2008; Hanneman & Riddle, 2005; Kadushin, 2012; Latkin & Knowlton, 2015; Luke & Harris, 2007). Understanding the functional characteristics of social networks, or the access to or exchange of social support and resources, requires an exploration of the network's structural characteristics.

Rationale: Understanding the compositional, structural, and functional characteristics of social networks allows researchers to evaluate for opportunities to implement targeted network interventions within the social networks of FOs to improve their HWB. The goal of these interventions would be to increase FO's access to or availability of social support resources in order to mitigate the negative health effects of ORS and to promote their HWB.

Chapter 4: Methods

Methods

This descriptive, cross-sectional, network boundary approximation study used the research methods, and integrated the theoretical presuppositions and assumptions, of social network science (Borgatti et al., 2017; Valente, 2010). In addition, social network analysis, a set of data analytic techniques and methods within social network science, was used to guide the study design, data collection, and approach to data analysis. Social network analysis can quantitatively examine the relationships between actors and the social impact or consequences of those relationships (Borgatti et al., 2017). It is used to study social structures by empirically describing patterns of relational ties that connect actors within a social system (network) (Borgatti et al., 2017; Valente, 2010). Consistent with social network science, all core concepts were defined and expressed in relational terms when using the statistical techniques of social network analysis (Valente, 2010).

Examining network structure provides insights into how social structures influence individual and group behavior, as well as access to, or exchange of, resources within a social network (Borgatti et al., 2017; Kadushin, 2012). Social network analysis allows researchers to empirically study the dynamic interactional effects of both the structural and functional features of social networks (Borgatti et al., 2017; Kadushin, 2012). The statistical methods of social network analysis facilitate quantitative measurement and testing of network effects on individual behavior, as well as effects of individual attributes and behaviors on the structure and function of the network as a whole (Borgatti et al., 2017; Hanneman & Riddle, 2005; Wasserman & Faust, 1994). The power of social network analysis lies in its ability to account for and preserve the dependent nature of network data during statistical analysis, therefore it is uniquely suited for the study of social networks (Borgatti et al., 2017; Valente, 2010).

The boundary of a social network identifies who or what is included in a network and who or what is excluded (Robins, 2015). For networks that have not been studied, there are cases where the network boundary is clear, and others where identifying membership is more challenging. For a social network defined by individuals who participated in a two-day workshop, a roster of all members could be easily generated, and the network boundary clearly defined. However, in situations like this study, where

the FOs and the individuals, groups, and organizations that they access for social support are not known, the network boundary is not clearly defined. Therefore, a geographic boundary was first specified, and then sampling and recruitment strategies were used to identify all FOs and their sources of social support within that area. Since both health and farm-related data are available at the county level (United States Department of Agriculture, 2014, 2017), the social network was defined by county.

Egocentric social network sampling techniques were initially proposed to strategically supplement census-based social network sampling in order to maximize the likelihood of identifying all network members within the county selected (Robins, 2015; Valente, 2010). However, due to limitations imposed by the University's Institutional Review Board (IRB), only egocentric network sampling techniques were employed. Data were collected via self-report using mailed name generators, specialty forms for collecting relational data and constructing social networks (adams, 2020; Robins, 2015; Valente, 2010). Self-report is a method commonly used to collect data for social network studies. The validity and reliability of self-reported data pertaining to alters, the individuals with whom actors report having a relational tie, has been widely contested (adams, 2020; Robins, 2015; Wasserman & Faust, 1994). Concerns relate to the accuracy of reciprocated ties and the ties between alters, unless the presence of these ties is verified with alters (adams, 2020; Corman, 1990; Granovetter, 1976). Reciprocated ties refer to those situations where the actor identifies the alter as a friend, and reports that the alter would also identify the actor as a friend. Ties between alters refer to cases where an actor reports that ties exist between two of their alters. Information about reciprocated ties and ties between alters was not collected for this study due to IRB limitations. To construct the social network of FOs, participants were asked a set of questions about people or organizations within their social network from whom they would seek information or resources related to ORS and HWB (Supplemental Material, Name Generator).

Population and Sampling

The target population for this study was residents of a rural Midwestern County who self-identified as FOs. Non-probability, convenience sampling combined with chain-referral sampling (Valente & Pitts, 2017) was initially proposed for this study. Combining non-probability sampling with

chain-referral sampling is a strategy commonly used to identify individuals who are difficult to locate when attempting to construct a complete list of network members when a network boundary has not been established (Robins, 2015; Valente & Pitts, 2017). Consistent with this method, participants would share the researcher's contact information with potentially eligible individuals in their social network. Those individuals who contacted the researcher to participate in the study would be subsequently reviewed for eligibility and inclusion. If they met eligibility criteria, names would be cross-referenced with the initial sample lists and duplicates identified through the process of cross-matching (Robins, 2015). However, chain-referral sampling was ultimately not used as a sampling method due to limitations imposed by the University's IRB. Therefore, only non-probability, convenience sampling was used.

Complete census data with demographic information for FOs in the sampling frame was not available. Strategies employed by other researchers were used to construct the initial sampling frame (C. Bendixsen personal communication, February 25, 2020; G. Bussler personal communication, March 16, 2020), with information obtained from publicly available databases. Names and addresses for individuals and businesses with farm-related licenses through the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) and those who received federal farm subsidies were requested. Additional contacts were sought through four publicly available state farm market directories. An Internet search using the keywords "farm", "farming", "owner", and "producer" were used in combination with the name of the target county to identify additional eligible participants not obtained through the other two sources. All contact information was combined and sorted, with duplicates removed through cross-matching to create a final list of potentially eligible network members. Oversampling of underrepresented groups, like women and racial or ethnic groups, was not possible with the strategies available for constructing the initial sample of eligible participants.

Inclusion and Exclusion Criteria

Individuals who self-identified as FOs and who were 18 years of age or older at the time of the study were eligible for participation. All identified FOs, including co-owner-operators residing at the same address, were eligible to participate. Additional inclusion criteria were proficiency with spoken and

written English, the physical ability to complete the name generator, and the cognitive ability to identify sources and forms of social support related to ORS and HWB. Individuals who identified as farm workers but were not owner-operators, or those who resided outside the sampling frame were excluded from the study.

Sample Size and Justification

According to the 2017 Census of Agriculture (2019b), approximately 437 FOs resided in the target county. Based on this information and estimates of farmers leaving the occupation, a theoretical sample of all potentially eligible participants was estimated at approximately 425. The initial proposed sampling method of census estimation using non-probability, convenience sampling supplemented by chain-referral sampling (Valente & Pitts, 2017) was expected to identify approximately 80-95% of the theoretical sample, or 340-404 potentially eligible participants (C. Bendixsen personal communication, February 25, 2020; G. Bussler personal communication, March 16, 2020). Prior studies of farmers' social networks showed that farmers are highly connected (Heenan, 2010; Sriram et al., 2018), therefore it was reasonable to expect that the remaining eligible participants (21-85, or 0.05-0.25 per known eligible participant) could be identified via a respondent-driven sampling method. However, chain-referral sampling was not implemented due to limitations imposed by the University's IRB. Despite this limitation, the non-probability sampling methods that were used initially returned 385 potentially eligible participants, or 88.1% of the theoretical sample.

This study was designed to describe characteristics of social networks of FOs related to ORS and HWB, and not to detect differences in exposures to or treatment effects for ORB between FOs and another population. Therefore, a power analysis was not necessary to determine a sufficient sample size (Martínez-Mesa et al., 2014). Rather, a response rate for returned study materials and comparison of the study population to the target population were used to evaluate sufficiency of the sample size. The effect of missing data on results of network studies is less predictable than with other research designs (Kossinets, 2006; Krause et al., 2020). A response rate of 70-75% is considered acceptable for many survey-based studies within the health sciences (Wise et al., 2019), and 60% for more controversial topics

(Sierles, 2003). Researchers who have used mailed surveys among farmers have rarely achieved these rates, with most attaining response rates between 15-23% (Pennings et al., 2002; Tepic et al., 2012), and one study reporting a 39.1% response rate in one population and a 49.5% response rate in another only after employing small monetary incentives (Glas et al., 2019). Few network studies have specifically examined sufficiency of response rates for initial sociometric (whole) network boundary approximation studies, and no network studies have examined response rates for farming networks specifically. Hamilton and colleagues (2000) examined the effect of different rates of participation on sociometric network study findings. With response rates of 75% or lower, significant differences were obtained between the number of observed and actual ties within the social networks of students in grades 2-6. For that reason, 100% participation rates for initial sociometric network studies have been suggested. Although this is rarely possible or feasible, particularly when the network boundary is not known (Hamilton et al., 2000; Robins, 2015). A review of initial network boundary approximation studies with sample sizes similar to that used for this study, and studies that also used mailed name generators to collect data, reported 30-40% response rates (Grossman et al., 2000; Kim, 2007; Piña-García et al., 2016). Additionally, Dr. James W. Dearing (personal communication, November 17, 2020), Brandt Endowed Professor in the Department of Communication at Michigan State University and expert in social network analysis was consulted and confirmed that a response rate of 30%-40% was acceptable for a study of this scope. Therefore, a response rate of at least 30% was used as the threshold for confidence that the sample data were of sufficient quality to accurately represent the larger sampling frame.

Recruitment

Eligible participants were recruited via standard mail using the Dillman Total Design Survey Method (Dillman et al., 2014) with one modification. The Dillman Method has been shown to improve response rates for mailed surveys, and consists of an initial mailing of study materials, a reminder postcard sent to all potentially eligible participants one week after the initial study materials are sent, and a second set of study materials sent three to seven weeks after the initial mailing. For this study, reminder postcards were sent to individuals on the initial participant list who had not returned the study materials or

who had not opted out two weeks after initially mailing the study packets. Four weeks after the initial study packet was mailed, new study packets were sent to the remaining eligible participants. The study packet included a description of the study, an information sheet that addressed all elements of informed consent, investigator contact information, a name generator, local resources for farmer HWB, and a postage-paid return envelope. Eligible participants also received a $5.00 gift card incentive with the study materials which they could keep regardless of study participation. Recruitment occurred over a six-week period, from July through August 2020.

Consent and Study Procedures

The research protocol was reviewed and deemed exempt by the University's IRB. To ensure participants were fully informed about the nature and purpose of the study, the written information sheet included in the study packet integrated all elements of informed consent. In addition, both the information sheet and the name generator included reminders that participants could opt out of participation, choose to not answer any questions on the name generator, or withdraw from participation at any time. Completion and return of the name generator were regarded as informed consent.

Data Collection

Data were collected via paper name generators (Kadushin, 2012; Robins, 2015; Valente, 2010; Wasserman & Faust, 1994) that were distributed via standard mail. Standard mail was chosen for this study due to limited broadband access within the sampling frame (Wisconsin Broadband Office, 2020). Name generators are data collection instruments that are designed to collect information about network members and relational ties for social network studies (Latkin & Knowlton, 2015; Valente, 2010; Wasserman & Faust, 1994). Name generators can include participant demographic questions and a set of questions soliciting information about network members with whom the participant has relational ties (Kadushin, 2012; Robins, 2015; Valente, 2010; Wasserman & Faust, 1994).

The specific questions included on name generators are determined by the study population, the phenomena under study, the processes understood to underly the phenomenon, and the research question (Robins, 2015; Wasserman & Faust, 1994). Specifying the purpose of the network (function) under study

and situating participants within a social context before presenting questions that solicit names of alters has been shown to improve the validity and reliability of network members collected via name generators (Larson & Lewis, 2020). Therefore, the questions included on the name generator for this study were worded specifically to capture information about existing sources of social support available to FOs for preventing the negative health effects from ORS. The name generators also included information about the farming business, such as the commodities produced on the farm and whether the farm had been passed down from another family member (generational farm). These characteristics of the farming business have been identified as factors that contribute to ORS among farmers and FOs (Daghagh Yazd et al., 2019; Freeman et al., 2008; Ringgenberg et al., 2018; Truchot & Andela, 2018). Participants were also presented with an open-ended, narrative question where they were invited to share any information related to ORS and HWB they thought was important and was not solicited via the name generator.

Conducting research with farming populations, particularly related to ORS can be challenging. Several instruments have been developed and validated that evaluate specific domains of stress associated with farming, including the Edinburgh Family Stress Inventory (Deary et al., 1997), the Farmers Stressors Inventory (Truchot & Andela, 2018), Farming Family Stressor scale (McShane, 2016), and the Farm Stress Survey (Eberhardt & Pooyan, 1990). General measures of stress, like the Perceived Stress Scale (Cohen et al., 1983) or measures of psychological distress (Fragar et al., 2010), including the Kessler 10 (Kessler et al., 2002), have been used to evaluate stress and distress of farmers across the globe. The PERI Life Events Scale (Dohrenwend et al., 1978) was adapted for farmers and used in an early study of stress in farmers, though it has not been used since this initial study due to lack of comparability between farming and non-farming populations (Freeman et al., 2008). In more recent studies, proxy measures like the Generalized Anxiety Disorder-7 item scale (GAD-7), the Patient Health Questionnaire (PHQ-9), (Ang, 2010; Rudolphi et al., 2020), and the Maslach Burnout Inventory-General Inventory (Bakker et al., 2002) have been used to study stress and health among farmers. No standardized, validated instrument for assessing overall ORS in farming populations has been developed, making comparisons across studies difficult. To that end, the stress scale used for this study was informed by the literature (Cohen et al.,

1983; Kessler et al., 2002; McShane, 2016; Truchot & Andela, 2018), and designed to evaluate risk for or presence of occupational-related distress.

The name generator for this study was pilot tested among a group of farmers for readability and face validity, with subsequent revisions to improve item wording and reduce systematic response bias (Larson & Lewis, 2020). The most significant contribution from the farmers who pilot-tested the name generator, was the language used to describe the phenomenon of seeking social support in response to ORS. The phrasing initially suggested by, and ultimately endorsed by farmers for use on the name generator was to describe specific people or organizations that "you would go to for information or to make sense of things when things related to the farm weigh heavy on your mind." Based on feedback from farmers, the option of "fiber" was added as a choice for commodities produced, as was the option for "less than HS education" for educational attainment. The questions posed to FOs about broadband and cellular service initially asked a binary question about access. After consulting with farmers, the questions were revised to solicit whether FOs had access to reliable broadband and cellular service, and an answer choice was added for "choose not to use." Several farmers suggested that there was only a need to offer binary options for gender identification, and no need to include questions on race or ethnicity. The population within the sampling frame was predominantly white and tended to support conservative policies. Recognizing the potential implications of both including and removing questions related to gender, racial, and ethnic diversity, the decision was made to include questions on race and ethnicity, and include non-binary gender options on the name generator.

It was estimated to take approximately 20-30 minutes to complete the name generator. Upon completion, participants returned the name generator to the investigator using the self-addressed, stamped envelope provided in the study packet.

Primary Variables

The primary variables collected for this social network study were sources of social support for FOs to mitigate negative health effects from ORS. This included actors (network content), relational ties (to explore network structure), and actor attributes (to explore network structure), as well as other non-

human resources of social support (network content). To elicit data on actors and relational ties, participants were asked to identify other individuals (alters) within their social network from whom they would seek information or resources related to ORS and HWB (tie function or network function). For each nomination, participants were asked to describe the type of tie (can indicate proximity, homophily, or socioecological level), how long they had known this individual (can be a measure of connectedness, social integration, or durability), and their comfort discussing or disclosing issues related to ORS and HWB with this alter (quality or strength of tie). In addition to individual actors, participants were asked to identify organizations within their social network from whom they would seek information or resources related to ORS and HWB (tie function or network function). In a similar fashion as with the alters FOs nominated, participants were asked to provide information about the type of tie (proximity or homophily), the length of their relationship with the organization (can indicate connectedness, social integration, or durability), and their comfort discussing or disclosing issues related to ORS and HWB with representatives from these organizations (quality or strength of tie). Some of the relational and attribute variables that were collected on alters and organizations included the frequency and duration of each contact (connectedness), the mode of contact (connectedness and social integration), and whether the alter was engaged in farming or activities related to farming (can indicate proximity, homophily, or socioecological level). More detailed attribute data were collected on the FOs, such as marital status, educational attainment, commodities produced, number of years farming, and self-reported level of ORS. A complete list of variables by FO, alter, and organization is available in the Supplemental Materials (Table 1).

Information about access to or use of other non-human sources of social support (network content) was collected to understand the breadth of resources available within this social network of FOs. These data also served as proxy measures for certain attitudes, beliefs, and behaviors of the participants (Kossinets, 2006). Examples included stable internet access, reliable cellular service, organizational memberships, attendance at events, conferences, or trainings, use of specific resources such as podcasts, farm magazines, or services offered through Wisconsin Extension. A benefit of collecting this

information was the ability to construct affiliation networks, and to identify existing resources that were underused or not utilized by FOs. Affiliation networks were used to identify indirect connections between FOs through shared resource use and to examine the socioecological levels at which resources were being utilized within this network.

The aims of this study were to identify the actors and sources of social support in social networks of FOs (network content), and to relate the structural and functional characteristics of these social networks that may influence access to or exchange of social support (network structure created via relational ties and explored via attributes). Participants were not asked to appraise the social support they accessed in their social networks (House et al., 1988; Sarason & Sarason, 2009; Wellman, 1983), describe the form of social supports as subjective (House, 1981; Langford et al., 1997; Wellman, 1983) or objective (Gottlieb & Bergen, 2010), or attempt to explain the function the social support served (emotional, informational, instrumental, or appraisal) (House, 1981). Therefore, measures or evaluations for each of the three dimensions of social support (nature, form, and function) (Cooke et al., 1988; Song et al., 2011) were not included in this study (see Chapter 3, Social Support).

Data Analysis

Upon receipt of returned name generators, data were extracted and manually entered into a Microsoft Excel (version 16.47.1) worksheet. A single-entry procedure was used, with no forms for soft or hard validation built into the data entry worksheet. Participant data were saved in a password-protected spreadsheet that was separate from the document used to track eligible participants and was stored on a restricted-access network. A unique ID code was sequentially assigned as participant data were entered into the worksheet and a pre-determined coding scheme was followed for data entry (Supplemental Materials, Coding Scheme).

A systematic process was followed to verify data extraction and entry. All name generators were sorted into groups of five, with one name generator in every group randomly selected for complete review. If an error was found on the name generator reviewed, the data for all name generators in that group were verified. If errors were noted on more than two name generators in any group of five, the five

name generators that preceded and followed that group were also verified. This verification process was repeated a second time. In total, 38 errors were found, for an error rate of 0.22% (36 errors for 15,837 items), twice that for manual data entry error rates reported in the literature (0.1%) (Kirch, 2008). Given this high error rate, and the use of a single-entry process, all data were reviewed and verified, during which three additional errors were noted for an overall error rate of 0.26% (41/15; 837).

Upon completion of data entry and verification, a copy of the original data was made for the purpose of analysis. Data were subsequently cleaned and sorted for import into statistical software programs. Summary statistics, that included the frequency, mean, and range for all variables were computed using Stata Statistical Software, release 16 (StataCorp, 2019), to assess for potential data entry errors. All results were within expected ranges, and no additional errors were detected throughout data analysis. The dataset was next evaluated for missing data. The number and proportion of missing values was calculated for each variable, and for each observation (Bartlett & Carpenter, 2013). The distribution of missing variables was subsequently visualized and evaluated for patterns of missingness (Bartlett & Carpenter, 2013). Two potential sources of systematic bias induced by the design of the name generator were noted. First, approximately 7.0 % (n=5) of participants, skipped demographic questions on page two, beginning with a question on racial identity. These participants had completed half of the demographic questions on page two, skipped the question on racial identity, and subsequently answered questions on page three. Second, a group of 4 participants (5.6%) did not answer question 23 but did go on to answer question 24 on the following page. After evaluating for patterns of missingness, tests were conducted on participant-level variables to determine if data were missing completely at random (MCAR) (Bartlett & Carpenter, 2013). Variables that described characteristics of relational ties and alter attributes were not evaluated for MCAR given their dependent nature. Cases with missing data were retained in the dataset. All data analysis was first conducted with missing data included, and subsequently analyzed excluding cases when observations were missing (Borgatti et al., 2006; Wasserman & Faust, 1994).

Quantitative data analysis progressed through four phases that included calculation of descriptive statistics, creation of network visualizations, computation of inferential statistics, and then network

analyses. Descriptive and inferential statistics were completed using Stata Statistical Software, release 16 (StataCorp, 2019). Visualizations were created with NetDraw, version 2.176 (Borgatti, 2002), and network analyses were conducted in UCINET 6, version 6.718, for Windows, a software package for the analysis of social network data (Borgatti et al., 2002). Thematic analysis of the narrative comments was conducted using the methods of Braun and Clarke (2006). A systematic process was employed to ensure rigor and transparency throughout the analytic process. Narrative comments were abstracted only to levels imposed by the data, keeping results firmly grounded in the data. Methods for both the quantitative and qualitative methods will be described in greater detail in turn.

Descriptive statistics

To determine the most appropriate statistical methods for analyzing the study data, participant variables were subjected to three tests to evaluate whether they were normally distributed. First, histograms with normal distribution curves were constructed for visual inspection of skewness or kurtosis. Next, statistical tests for normality were run using the Shapiro-Wilk test (Supplemental Materials, Table 2). Finally, tests for skewness and kurtosis were conducted to further evaluate the factors affecting normality of the sample distribution (Supplemental Materials, Table 3) (Ghasemi & Zahediasl, 2012; Mishra et al., 2019). Of the 35 participant variables evaluated, 16 (45.7%) were normally distributed. (NIST/SEMATECH, 2013; UCLA: Statistical Consulting Group). Considering that more than half of the sample variables were not normally distributed and given the small sample size (n=71), non-parametric statistical methods were used to analyze the study data (Harwell, 1988; Hopkins et al., 2018; Qualls et al., 2010).

The dataset included nominal, ordinal, and interval level variables. Some nominal variables were initially coded as dichotomous, while other were converted to dichotomous variables to facilitate subanalyses, for example whether participants had a college degree or no college degree. Some nominal variables were collapsed into larger groups, as was the case with some analyses examining relationship status, where participants who were married or lived with a partner were collapsed into a single group. Self-reported levels of ORS were used as proxy measures for detecting risk for or presence of

occupational-related distress (Kessler et al., 2002). Participants with stress levels of 1 or 2 were considered at low risk for developing occupational-related distress, scores of 3 or 4 were considered high risk, and scores of 5 or 6 indicated active occupational-related distress (Le Fevre et al., 2006; McShane, 2016). The association between the presence of distress and characteristics of FOs were tested, based on factors known to increase ORS (Lower et al., 2010; Reissig et al., 2019; Ringgenberg et al., 2018; Stain et al., 2008; Sutherland & Glendinning, 2008; Wessel et al., 2020).

Informed by Berkman and colleagues' conceptual framework (2000) and the literature on social support and health (Alloway & Bebbington, 2009; Barrera Jr., 1986; Berkman, 2000; Gottlieb & Bergen, 2010; M. F. King et al., 2014), composite and indicator variables at the macro, mezzo, and micro levels were constructed from study variables to create distribution estimates of the social features among FOs within this study sample. Since multiple factors interact across the lifespan and socioecological levels to influence health behaviors and health outcomes (Berkman et al., 2000; Berkman, 2000; Bronfenbrenner, 2005; M. F. King et al., 2014), several composite (Table 3) and indicator variables (Table 4) had shared characteristics. However, each variable had a unique construction. Composite variables were developed to estimate constructs such as culture, connectedness, and social integration, since these are social factors known to influence access to social support through social networks (Berkman et al., 2000). Using metrics like attendance at events and memberships, composite measures were created to estimate the extent of FO interaction at different socioecological levels. Indicator variables were also constructed for certain characteristics that influence tie formation and network structure, like proximity and homophily. All original data were retained in the dataset.

Descriptive statistics were carried out using Stata Statistical Software, release 16 (StataCorp, 2019). Frequencies, distributions, measures of central tendency, and measures of variability were calculated for all variables. Two-way frequency tables were then constructed to explore for potential associations or differences between variables that may influence the structural characteristics of the social network. Variables included in the two-way analyses were also informed by Berkman's conceptual model (2000), and findings from previous studies that examined stress, social support, and social networks

among both farming and non-farming populations (Grossman et al., 2000; Klärner & Knabe, 2019; Lombardi et al., 2020; Lower et al., 2010; Meador, 2019; Smith & Christakis, 2008; Stain et al., 2008). For example, prior studies have revealed gender- (Walker & Walker, 1987) and age-related effects associated with ORS (Olowobon et al., 2019), as well as positive correlations between full-time work status and levels of ORS among farmers (Olowobon et al., 2019). These relationships, along with associations between characteristics of the participants, the farm, and self-reported levels of farm stress were explored. Protective features of social networks, including the number of alters that participants named as sources of social support, were also explored in relation to self-reported levels of ORS. Ties between FOs and alters, as well as their attributes were further examined to identify factors that my influence tie formation and access to, or availability of social support within the network.

Descriptive statistics were conducted by group, with calculations informed by results from the two-way frequency tables and the literature (Olowobon et al., 2019; Thu et al., 1997; Truchot & Andela, 2018; Walker & Walker, 1987). Levels of self-reported farm stress were stratified by gender, attainment of a college degree, age group, work status, and number of alters nominated. Additional analyses by group included FO's level of comfort discussing or disclosing issues related to ORS and HWB with alters, type of relational ties with alters, and alters by engagement in farm-related activities. One-way tabulations of composite and indicator variables were created to describe structural features and social processes that have been shown to influence social networks, social support, and health outcomes (Berkman et al., 2000). Finally, the distributions of composite measures and indicator variables were described using histograms with kernel density estimation (KDE) curves to estimate the distribution of these characteristics across the study population. KDEs curves are non-parametric methods to estimate the probability density function of random variables (Węglarczyk, 2018). The Gaussian kernel is distributed across the entire x-axis, is the most commonly used KDE (Węglarczyk, 2018), and was used to construct KDE curves for this study population.

Network visualizations

Visualizations, also called sociograms, are graphic representations of the actors and the ties between actors in a social network (Borgatti et al., 2017). They are useful for revealing social structures created through social processes, like underlying relationships or preferences, that are difficult to detect in numerical data alone (Borgatti et al., 2017; Kadushin, 2012; Robins, 2015; Wasserman & Faust, 1994). When combined with descriptive statistics, visualizations can provide practical guidance for relationships or network features to explore analytically (Borgatti et al., 2017; Perry et al., 2018; Wasserman & Faust, 1994). Specifically, visualizations enable researchers to identify clusters or patterns formed by ties between actors that would not be apparent from data in a tabular or traditional graphic format (Yousefi Nooraie et al., 2020). For example, a network visualization may allow a researcher to observe that a group of six actors cluster in a group and can then explore the attributes of the actors and the relational ties to understand the forces that may have influenced that group of individuals to form ties. To create network visualizations, data were configured and imported into in UCINET 6 for Windows, version 6.718 (Borgatti et al., 2002) and analyzed using the integrated visualization tool NetDraw, version 2.716 (Borgatti, 2002).

Initial visualizations were created to illustrate the relational ties between FOs and the alters they identified within their social network from whom they would seek information or resources related to ORS and HWB. Attribute data for both FOs and alters were then sequentially added to the dataset in NetDraw to explore for potential effects on network structure. Variation among actor attributes can be represented by different colors, sizes, or shapes of the icons (nodes) that are used to represent actors. The color or thickness of the lines that represented ties were used in certain visualizations to indicate tie attribute variation, such as tie quality or strength. Those attributes selected for inclusion in the sociograms were informed by findings from the descriptive statistics, previous studies that examined ORS, social support, and social networks among both farming populations, as well as literature related to factors that influence social network structure (Berkman et al., 2000; Grossman et al., 2000; Klärner & Knabe, 2019; Lombardi et al., 2020; Lower et al., 2010; Meador, 2019; Perry et al., 2018; Person, 1986; Smith & Christakis, 2008; Stain et al., 2008).

A similar process was used to create two-mode visualizations, called affiliation networks. Affiliation networks illustrate indirect connections between FOs that occur through shared experiences, like attendance at events or membership in a group (Borgatti et al., 2017; Valente, 2010; Wasserman & Faust, 1994). Affiliation network visualizations allow investigators to identify opportunities for exchange of social support resources that would not be revealed through analysis of personal networks alone. Sociograms were constructed to illustrate the relational ties between FOs through shared membership in groups, engagement with organizations, and attendance at events. As with the visualizations between FOs and alters, attribute data were sequentially added to reveal clusters or patterns among network ties that would indicate important structural features of the network, like homophily, proximity, or position. The focus in creating sociograms was to reveal characteristics of the network that would otherwise remain undetected, and to identify attributes of actors or ties that may influence the structural characteristics of the social network and create differential access to social support for FOs for ORS and HWB (Berkman et al., 2000; Borgatti et al., 2017; Kadushin, 2012; Robins, 2015; Wasserman & Faust, 1994).

Inferential Statistics

Results from the descriptive statistics and visualizations informed variables included for inferential statistical tests. Inferential statistics were conducted using Stata Statistical Software, release 16 (StataCorp, 2019) to identify statistically significant associations or differences within the data that would indicate variables with potential influence on the structural characteristics of the social network. Four main statistical approaches were used to test for association between variables based on the variable type: a) dichotomous, b) nominal, c) ordinal, or d) interval, and whether the variable was the independent or dependent variable (Harwell, 1988). Chi-squared tests for independence were used to evaluate associations between both dichotomous and nominal dependent variables, and all other independent variable types (Harwell, 1988; Marshall & Boggis, n.d.; Qualls et al., 2010). Chi-squared tests with phi was used for 2x2 dichotomous variables, Chi-squared with Fisher's exact test was used when group sizes were less than five, and Chi-squared tests with Cramer's *V* were used for nominal variables greater than 2x2 (Harwell, 1988; Marshall & Boggis, n.d.; Qualls et al., 2010). When the Chi-squared test was

significant for variables with more than two possible values, pairwise comparison using Chi-squared tests with Bonferroni correction were conducted to test associations between variables (Harwell, 1988; Marshall & Boggis, n.d.; Qualls et al., 2010).

To evaluate for associations between dichotomous independent variables and both ordinal and interval level variables, Mann-Whitney U/Wilcoxon Rank Sum tests were conducted (Fay & Proschan, 2010; Marshall & Boggis, n.d.). Kruskal-Wallis tests were performed to test for significant associations between nominal independent variables and both ordinal and interval dependent variables (Fay & Proschan, 2010; Marshall & Boggis, n.d.). When significant associations were noted, pairwise comparisons were conducted using Mann-Whitney U/Wilcoxon Rank Sum tests with Bonferroni correction (Fay & Proschan, 2010; Marshall & Boggis, n.d.). To evaluate associations between ordinal and interval level variables, Kendall's tau rank correlation coefficients were calculated (Brossart et al., 2018).

Tests for association were first conducted between variables representing characteristics of FOs that have been shown through prior research to affect levels of stress, and self-reported levels of ORS (Berkman et al., 2000; Grossman et al., 2000; Klärner & Knabe, 2019; Lombardi et al., 2020; Lower et al., 2010; Meador, 2019; Perry et al., 2018; Person, 1986; Smith & Christakis, 2008; Stain et al., 2008). Statistical testing was also performed to identify significant differences in levels of ORS by characteristics of FOs, such as gender, work status, or attainment of a college degree. Associations between characteristics of FOs and attributes of both relational ties and alters were tested in order to identify factors that may influence formation of relational ties or access to social support resources within the social network of FOs. Variables included in these analyses were based on factors identified through prior research (Berkman et al., 2000; Grossman et al., 2000; Klärner & Knabe, 2019; Lombardi et al., 2020; Lower et al., 2010; Meador, 2019; Perry et al., 2018; Person, 1986; Smith & Christakis, 2008; Stain et al., 2008).

Network analysis

Social network data can be analyzed at the individual or network level, based on the type of data collected (Valente, 2010). Variables defined at the level of the individual are called egocentric level variables and can include compositional egocentric variables and structural egocentric variables (Valente, 2010). Compositional egocentric variables include individual attributes or affiliations, and structural egocentric variables include measures of relational ties between actors. Egocentric level analyses often include descriptors of network size (number of alters), tie strength (can indicate durability), density (how connected all members of the network are to each other, or cohesion), and centrality (can indicate importance or influence).

Variables defined at the network level are described as either relational or structural (Valente, 2010). Relational network variables are constructed from an actor's set of direct ties, and structural network variables are constructed from the set of actor's direct and indirect ties in the network (Valente, 2010). In order to evaluate structural features of a network, the relational ties between all actors in a social network should be identified based on the function of the network (Borgatti et al., 2017; Wasserman & Faust, 1994). Network-level analyses can include network size, density, reciprocity (can indicate popularity or a hierarchy), transitivity (clustering or cliques), and centralization (an indicator of cohesion around a focal group or actor).

Relational ties form the basis for network level analyses. Due to limitations imposed on data collection, information about the ties between alters could not be collected. Therefore, sociometric (whole) network consisted of multiple "star" networks (egocentric), with FOs at the center and lines (relational ties) connecting them only to individuals with whom they would discuss ORS and HWB. No data were available to connect the individual networks of FOs to each other, which is needed for constructing structural network variables. As a result, most analyses of FOs' social networks were descriptive. However, indirect connections between FOs were identified through memberships, organizations, and events. Evaluation of structural characteristics of FOs social networks were conducted on these affiliation networks. Few analytic procedures were conducted on the affiliation networks due to their high degree of fragmentation. Networks that are highly fragmented are considered "disconnected"

and characterized by individuals or groups that are not connected to each other. Since relational ties are needed to perform network level analyses, few network level analyses could be conducted on the affiliation networks.

The effect of missing data on network analyses is difficult to predict and remains an active focus within the field of social network science research (Kossinets, 2006; Krause et al., 2020). When little is known about the structural features of a particular social network, particularly the underlying social processes that influence tie formation, analysis of available data without imputation of missing data is recommended (Huisman, 2009). Since this is the case with social networks of FOs for mitigating the negative health effects of ORS, cases with missing data were retained in the dataset, and analyses focused on advancing what is known about the content of FO social networks, how this influences the structure of their social networks, and ultimately availability of, or access to social support resources.

To ensure reproducibility of results, code was written and saved as ".do files" for all analyses in Stata (StataCorp, 2019) and output files saved to a folder on a password-protected networked computer. Output files for all analyses conducted in UCINET (Borgatti et al., 2002) and NetDraw (Borgatti, 2002) were also saved to a networked computer. A written log was maintained that chronicled the data analysis process, including rationale supporting decisions made.

Thematic Analysis

The systematic method of thematic analysis developed by Braun and Clark (2006) for analyzing qualitative data was used to analyze participant responses to the open-ended, narrative question: "If something came to mind that you think is important, or there is something that you think I should be thinking about but didn't ask about, please let me know." This six-phase approach facilitates the identification and organization of shared meanings or experiences through patterns that are observed across the dataset (Braun & Clarke, 2006, 2014). To that end, thematic analysis has been used extensively in the health and social sciences to understand what is important in a particular area of research, from the perspectives of the individuals who experience the phenomenon under study (Braun & Clarke, 2012; Dennison et al., 2013; Kenny et al., 2016; Wiles et al., 2011). The process of thematic analysis has a

degree of flexibility based on the epistemological perspectives of the investigator. Therefore, the methods of thematic analysis can accommodate the depth of analysis and level of abstraction that aligns with and is most appropriate for the breadth and depth of the narrative data collected (Braun & Clarke, 2006, 2019). While thematic analysis can be used for inductive or deductive analysis, these approaches are often used in combination (Braun & Clarke, 2006, 2014). For example, investigators bring prior knowledge and experiences to the research, even with inductive analysis where a coding scheme is not used (Braun & Clarke, 2019; Graneheim et al., 2017). Likewise, inductive reasoning can be used to expand or extend a theory or framework, particularly when salient participant data do not align within the existing coding schema (Braun & Clarke, 2019; Graneheim et al., 2017; Reichertz, 2004). For this study, an inductive approach was used. Presuppositions brought into the analytic process by the researcher included the ontological assumption that multiple realities co-exist (Weaver & Olson, 2006; Young & Ryan, 2020), and the epistemological assumption that meaning is socially constructed, so must be understood through those who have experienced the phenomenon under study (Weaver & Olson, 2006; Young & Ryan, 2020). Consistent with the perspectives of symbolic interactionism, the researcher also took the position of the participants as part of the analytic process, as part of identifying relevant features and patterns in the narrative data (Blumer, 1969).

Braun and Clarke's process of thematic analysis includes five phases that culminate in a final narrative interpretation (Braun & Clarke, 2006). The five analytic phases include: 1) familiarizing oneself with the data; 2) initial coding; 3) generating themes; 4) reviewing themes; and 5) defining and naming themes. Data analysis began with multiple readings of the narrative data to consider the data within the larger context of the study, the question that elicited the data, and the data as a whole (Braun & Clarke, 2006). Memos were maintained throughout the analytic process to capture ideas, rationale for particular coding, theme development, and decision points (Braun & Clarke, 2006; Saldaña, 2016). Initial coding followed, and was facilitated using Microsoft Excel, version 16.47.1. Initial coding was inclusive, and began with word-by-word coding, where discrete words and phrases were extracted and labeled with a descriptive provisional code (Braun & Clarke, 2006; Miles et al., 2014; Saldaña, 2016). This was a

recursive process, where early coding focused on semantic codes that described explicit meanings, and later cycles included latent codes that described underlying ideas or assumptions that were not immediately evident (Table 5). This interpretive process of latent analysis was informed by prior knowledge gained through the literature in order to identify broader meanings and implications from the participant narratives across the data set (Braun & Clarke, 2006). Throughout this process, codes were revised and modified to best reflect the meanings expressed by participants. Codes were then reviewed and organized based on similarities or patterning around broader concepts or ideas (Table 6) (Braun & Clarke, 2006; Saldaña, 2016). Through this active process, themes were generated based on coherence of codes around shared meanings (Braun & Clarke, 2006; Ryan & Bernard, 2016). Relationships between themes were explored throughout the analytic process to contribute to the construction of a thematic map (Braun & Clarke, 2006; Miles et al., 2014; Saldaña, 2016). After themes were developed, they were first reviewed in relation to the coded data and then the set of narrative data as a whole (Braun & Clarke, 2006). The initial review was to verify that the integration of codes into themes was both evident and cogent. The second review was to ensure that the themes captured the most important and relevant aspects of the data as expressed by the FOs to the question posed. In addition, returning to the larger research question driving this study and the question that generated the narrative data, as well as reflecting on prior knowledge gained through existing literature were strategies used throughout the analytic process to remain focused on pertinent aspects of the data (Braun & Clarke, 2006). Finally, each theme was named, and a definition developed (Braun & Clarke, 2006). As part of this process, salient quotes were extracted from the narrative to support the analytic interpretation. These provisional themes, definitions, and de-identified illustrative quotes were shared with select participants to ensure participants' meanings were represented in the findings through a process called member checking (Birt et al., 2016; Creswell & Miller, 2000). Member checking is a strategy to assess trustworthiness and to improve credibility of findings (Birt et al., 2016). Based on feedback from participants, codes were reviewed, and provisional themes were revised, resulting in the final themes, definitions, and thematic map.

Chapter 5: Results

Descriptive Statistics

The initial sampling pool of FOs was 385. Of those, six were later identified as duplicates and an additional 251 were deemed ineligible (Table 7), leaving a final sample size of 128. Of those, 16 declined to participate, 41 did not respond, and 71 returned completed name generators for an overall response rate of 55.5%. The majority of the sample identified as white (84.5%) and non-Hispanic (87.3%), were married (71.8%) and had children (80.3%) (Table 8). Nearly three-quarters identified as male (74.7%) and 14.1% as female. The remaining participants either chose not to disclose (1.4%) or did not answer the question about (9.9%) their gender. The average age of study participants was 59.4 years with a range of 23-90 years. When divided by group, the largest proportion of participants were aged 61-75 years (36.5%) followed by those aged 45-60 years (26.8%). Approximately half of participants (50.7%) earned a post-secondary degree, with 25.4% earning an Associate degree, 7.0% a bachelor's degree, and 18.3% a graduate degree.

Over half of participants were sole owner-operators (56.3%), 42.3% were co-owner operators, and 1.4% of participants did not report their role (Table 9). Nearly equal proportions of participants were employed as FOs full-time (52.1%) and part-time (47.9%), and worked an average of 43 hours weekly. Approximately half of the sample worked up to 40 hours weekly (50.7%) during usual production times, while nearly a fifth (19.7%) worked between 41-60 hours weekly, and 29.6% worked more than 60 hours weekly. During peak production times, 29.6% of participants worked up to 40 hours per week, 16.9% worked 41-69 hours weekly, and 53.5% worked over 60 hours weekly. The largest proportion of FOs (38.0%) reported working more than 80 hours per week during peak production. The top commodities produced across the sample included grains (76.1%), beef (52.1%), dairy (26.8%), alfalfa (26.7%), and fruits or vegetables (18.3%). On average, participants had farmed for 47 years, with approximately a third farming for 20-45 years (33.8%), and an additional third farming for 47-60 years (33.8%). Nearly two-thirds of participants operated generational farms (64.8%), and all FOs who did indicated that the intent to transition the farming operation upon their retirement. Data from the Census of Agriculture (United States Department of Agriculture National Agricultural Statistics Service, n.d.) allowed for comparisons

between the study sample and FOs within the sampling frame. The study sample differed from the actual population of FOs only by relationship status, (Table 10), with greater proportions of study participants who were married (z-score=2.09; p=0.037) (United States Department of Agriculture National Agricultural Statistics Service, n.d.). All commodities produced in the sampling frame were observed in the study sample, though the ability to conduct statistical comparisons was not possible due to how data are reported by the USDA.

Comparing participants by gender, male FOs (60.1 years) were, on average, 5 years older than female FOs (55.6 years) and had worked in farming for 5 years (47.7 years) longer than female FOs (42.9 years) (Table 11). Male FOs reported working 16.6 hours longer per week during usual times of production than female FOs, though this difference was not significantly different. The difference in number of usual hours worked between males and females was significant for FOs employed full-time (z=2.128; p=0.031). Additional gender differences were noted during peak production times by work status (full- or part-time), and for levels of self-reported ORS. Male FOs worked more hours than female FOs during peak production times overall (z=2.602; p=0.045). This difference was maintained for male and female FOs employed full-time during peak production times (z= -2.504; p=0.009), but not for those employed part-time during peak production. The mean stress level for the sample of FOs was 3.9 (range 1-6), with a statistically significant difference between the level of 3.7 reported by male FOs and 4.8 reported by female FOs (z= -2.216; p=0.027). A gender difference in ORS was also noted for FOs who were employed part-time (z=2.219; p=0.045), but not for FOs working full-time.

The relationship between ORS, attributes of the FOs, and characteristics of the farm were explored, with stress reported on a Likert scale from 1 indicating “no stress”, to 6 indicating “extreme stress” (Table 12). The greatest proportion of FOs reported a stress level of 4 (32.3%) followed by a stress level of 5 (23.5%). Female FOs reported higher levels of ORS on average than male FOs (z=-2.216; p=0.0217), and dairy farmers had higher levels of ORS on average than FOs who produced other agricultural commodities (z=-2.297; p=0.0215). ORS was stratified into three categories to describe FO’s risk for developing occupational-related distress, with low-risk comprised of stress ratings of 1 and 2,

high-risk comprised of stress ratings of 3 and 4, and active distress ratings of 5 or 6. Almost half (45.5%) of FOs were at high risk for distress, and 35.2% were actively experiencing occupational-related distress (Table 13). There was no difference in the risk of experiencing of occupational-related distress by gender.

FOs were surveyed about their use of and access to several different technologies both at their place of residence and on their farm (Table 14). The majority of participants (71.8%) reported stable Internet service at their residence, and 18.3% did not, while 4.2% chose not to use the Internet at home. Just over one-third of FOs had stable Internet at their farms (35.2%), 43.7% did not, and 12.7% chose not to have Internet at their farms. Among farmers with reliable cellular service (80.3%), 57.8% used smartphones. Nearly half of FOs had a desktop (43.7%) or a laptop computer (49.3%), while only 28.2% used tablets. Male (M=3.4; *SD*=1.8) and female (M=3.3; *SD*=2.1) FOs used approximately the same number of technologies.

Presented with a list of 12 resources (network content) known to be used by, or targeted for use by farmers (Chiu et al., 2015; Fuller et al., 2007; Hendrickson, 2018), participants were asked if they "had used," were "likely to use," or "would never use" these resources for information related to ORS and HWB (Table 15). The three most commonly used resources by FOs included farm magazines (80.6%), farm papers (77.4%), and local cooperatives (63.3%). Half of participants indicated that they used resources from the University of Wisconsin Extension (UW Extension) (50.8%) and 50.0% used YouTube. The resources that the greatest proportion of FOs indicated they "would never use" for information related to ORS and HWB included AgrAbility (76.6%), Podcasts (67.9%), the National Farm Medicine Center (66.7%), and the Wisconsin Department of Health Services (65.3%). Gender variation in resource use was noted, with a greater proportion of females who had used podcasts (42.9%) than males (9.5%), and a greater proportion of females who had used the National Farm Medicine Center (28.6%) than males (5.0%). Conversely, more males indicated that they had used National Public Radio (52.2%), broadcast radio (39.5%), and YouTube (52.4%) for information related to ORS and HWB than females (22.2%; 12.5%; 37.5% respectively), though the differences were not statistically significant.

FOs were asked to identify four actor types: a) individuals (alters), b) groups to which they were members, c) organizations, and d) events they attended; from whom they would seek information related to ORS and HWB (Table 16). Participants identified between one to 16 alters with an average of 2.4 (*SD 2.6)* alters in their network with whom they would discuss or disclose issues related to ORS and HWB. Nearly a quarter of FOs reported no alters (22.5%), while the majority of FOs who reported alters, indicated between one to four (66.2%). FOs reported seeking information related to ORS and HWB from an average of 1.1 (*SD 1.4)* membership groups, with 40.6% of participants reporting no membership connections and 36.2% reporting one. Among organizations and events from which FOs reported seeking information related to ORS and HWB, participants reported an average of 0.6 (*SD 1.1*; range 0-4*)* organizations and 1.0 (*SD 1.3*; range 0-5*)* event. For both organizations and events, the greatest proportion of FOs indicated no connections (73.2%, 54.4% respectively). Using a composite measure of the 12 resources (network connections) often used by farmers, FOs in this sample reported using an average of 6.1 resources (*SD 3.2*). FOs had an average of 8.8 (*SD 4.9*) connections when these resources were combined each of the four actor types.

The number of connections that participants reported for each actor type were compared by FO gender (Table 17). Male FOs reported an average of 2.1 (*SD 2.1*) alters and female FOs reported an average of 4.3 (*SD 4.5*) alters. No statistically significant differences in number of connections by actor and gender of FOs were detected. The relationship between number of connections by actor type and work status of FOs was explored, with no notable or significant differences found (Supplemental Materials, Table 4). No statistically significant differences were found when comparing FOs with and without connections by alter type and gender, (Table 18).

The relationship between levels of ORS and numbers of connections with the four actor types were explored and stratified by level of risk for occupational-related distress (Table 19). No consistent pattern was noted across the four actor types. Among FOs who reported connections with alters, greater proportions of participants with no connections or the most connections (n=5, 6, 7, & 16) experienced distress compared to other FOs. However, there was a medium, positive association between the number

of connections with alters and self-reported levels of stress (tau b=0.220, p=0.022). Distress was highest among FOs with the greatest number of memberships (n=5 or 6) and who interacted with more organizations (n=3 or 4). These data were also examined using a heat map to visually examine the relationship between number of connections and farm stress (Supplemental Material, Figure 1). A heat map was used to evaluate whether FOs who indicated no or low stress levels reported greater numbers of connections with the four actor types than FOs who reported high or extreme stress levels. In this sample, the data did not follow this pattern of distribution.

The alters that FOs identified as those they would seek information from related to ORS and HWB were primarily family members (40.8%) and friends (36.1%) (Table 20). Most alters were male (70.2%) and ranged in age from 45-64 years (48.8%). The majority of alters were also famers (85.0%) and had been known by the participants for 10 years or more (80.0%). Half of FOs contacted these alters between one and five times (79.0%) on either a weekly (50.3%) or monthly (31.6%) basis to discuss issues related to the farm. Over half of these contacts lasted between 30 to 60 minutes (55.8%), with the majority occurring in person (86.8%) or by phone (67.7%). The greatest proportion of FOs reported a moderate (42.9%) or high (31.7%) level of comfort discussing ORS or issues related to the farm and their health with alters.

Generally, FOs engaged in greater contact with alters in-person and by phone, than via email or text (Table 21). FOs used texting as a method of communication with alters ages 25-44 years more than alters of other age groups (χ^2=6.79; p=0.009). When alters were also farmers, FOs communicated in-person more than other modes of contact (χ^2=2.219; p=0.027). The type of relational tie between FO and alter was associated with different modes of communication. Communication by phone was used more often by FOs when alters were family members (χ^2=10.04; p=0.001) or friends (χ^2=4.77; p=0.021) than with alters of other relational ties. Email communication was only associated with communication between FOs and friends (χ^2=13.33; p=0.021). No significant differences were found in mode of contact between FOs and alters based on duration of the relationship.

Differences between the frequency of contact with alters, characteristics of the alters and the relational ties with FOs were also explored (Supplemental Material, Table 5). Male and female FOs contacted alters with the same frequency across modes of communication. Additional testing explored relationships between the gender of alters, characteristics of FOs, types of relational ties, and comfort discussing information related to ORS and HWB (Table 22). No associations were noted between the gender of FOs and that of their alters. Differences by alter gender were detected by type of relational tie and level of comfort. FOs reported more female alters who were family members (χ^2=3.75; p=0.040) than other relations. FOs also reported greater rates of both low comfort (χ^2=3.38; p=0.050) and high comfort (χ^2=8.37; p=0.004) when seeking information or support related to ORS and HWB from female alters than from male alters. The association between relationship status of FOs and relational tie types were also explored with no significant findings noted (Supplemental Materials, Table 6).

Statistically significant differences were found when examining the relationships between characteristics of alters and FO's level of comfort discussing ORS and HWB (Table 23). FOs reported the highest comfort overall discussing ORS and HWB with female alters (z=-3.189; p=0.0013). No differences by age range of alters or whether the alter was engaged in farming were found. Differences were observed by type of relational tie and level of comfort. FOs reported least comfort discussing ORS and HWB with neighbors (χ^2=5.82; p=0.027), and highest comfort with family members (χ^2=12.61; p=0.000). A clear pattern was noted between the duration of relationships with alters and reported levels of comfort discussing ORS and HWB. Relationships with alters of less than one year were associated with low comfort (χ^2=8.009; p=0.005), whereas relationships of more than 10 years were associated with high comfort (χ^2=9.084; p=0.003). Email use by FOs was significantly associated with high comfort discussing ORS and HWB (χ^2=6.60; p=0.012).

Among the organizations identified by participants within their social network from whom they would seek information or resources related to ORS and HWB, 82.5% were engaged in farm-related activities and 81.6% had a physical location (Table 24). Just over 20 percent of the organizations

identified by FOs were consultants or educators (22.2%), 13.3% were farming businesses, and another 13.3% were cooperatives. FOs learned of these organizations largely through referrals (31.0%) or at events or meetings (23.8%), and had knowledge of, or a relationship with the organization for 10 or more years (62.5%). Participants reported in-person (75.0%) or phone communications (67.5%) most frequently, and 42.5% of FOs communicated using email. Most contact with organizations occurred monthly (42.2.%) or yearly (42.4%). FOs rated their comfort discussing ORS and HWB with organizations most frequently as not comfortable (32.4%) or moderate comfort (35.1%).

Exploring characteristics of organizations and levels of comfort discussing issues related to ORS and HWB revealed few statistically significant associations (Table 25). Whether an organization engaged in farm-related activities did not influence ratings of comfort discussing ORS and HWB. No relationships were found between the frequency of contact or mode of contact with organizations and level of comfort. There was a statistically significant association by duration of relationship with organizations and comfort level discussing ORS and HWB. Organizations with whom FOs reported high comfort with the greatest frequency were those with relationships of less than one year (χ^2=16.87; p=0.003) and those with relationships greater than 10 years (χ^2=7.30; p=0.014). The type of organization did not have an effect on ratings of comfort discussion ORS and HWB.

Network Visualizations and Analyses

Personal (Egocentric) Networks

Network visualizations were constructed to illustrate patterns created by relational ties within the networks of FOs using NetDraw, version 2.176 (Borgatti, 2002). Initial visualizations were of personal social networks of FOs and their alters. Figure 4 illustrates the 345 relational ties that connect the 71 participating FOs and the 172 alters with whom they discussed ORS and HWB. Using UCINET 6 for Windows (Borgatti et al., 2002), the average degree for FOs was 1.42. This means that FOs in this network had, on average, ties with 1.42 other alters in their network with whom they would discuss or disclose issues related to ORS and HWB. This figure differs from the 2.4 alters reported with the

descriptive statistics because the values were calculated differently. Average degree is the mean number of ties per actor in a network (# ties/(# FOs + # alters)), whereas the average number of alters is the mean number of alters per ego (# alters/# FOs) (Valente, 2010). Node shape and color were used to distinguish FOs from alters and to indicate their gender. Visual inspection revealed that of the nine female FOs in the network, three had exclusively or predominantly female alters. This observation prompted a statistical analysis of the mix of alters among FOs by gender, which revealed several important relationships as reported previously.

The next visualization illustrated FOs with generational farms, their level of stress, and their comfort discussing ORS and HWB with alters (Figure 5). There appeared to be an association between the stress levels reported by FOs who ran generational farms and those who did not, as well as levels of stress with level of comfort discussing ORS and HWB. However, statistical testing did not demonstrate significant associations when these relationships were tested. Work status, as either a part-time or full-time FO, replaced generational farm for next visualization (Supplemental Materials, Figure 2). No additional insights were gained, or statistical analyses prompted by this sociogram.

A visualization that integrated farm stress, comfort discussion ORS and HWB with alters, and type of relational tie between FOs and alters was also constructed (Figure 6). This visualization prompted the statistical analyses between these variables and revealed that relational tie type and comfort were associated as was previously described. The final sociogram of personal social networks examined gender of both FOs and alters, as well as farm stress and comfort discussing ORS and HWB (Figure 7). The visualization was suggestive that gender of FOs and farm stress were associated, which was confirmed through statistical testing.

Affiliation Networks

Visualizations that represented affiliation networks between FOs through shared membership groups, organizations, and events were constructed using NetDraw, version 2.176 (Borgatti, 2002). Measures of network cohesion and centrality were calculated using UCINET (Borgatti et al., 2002). The membership affiliation network of FOs had low density, with only 3.4% of all possible ties existing

between FOs via their membership groups. The sociogram of the membership affiliation network (Figure 8) revealed one cluster and four disconnected FOs, also called isolates. Each of these disconnected groups is called a component, and networks with multiple components are described as fragmented. When networks have more than one component, some network measure calculations are only computed within components, and do not analytically reflect fragmentation. For example, the average distance for this network was 3.64 (Table 26) and was calculated by taking the average of the shortest paths (fewest number of ties) between every set of two nodes (actors). Average distance means that it would take an average of 3.64 relational ties to connect two nodes within the large component (Cluster A) of this network. The diameter, which describes the greatest path length needed to connect any two nodes in a network, was eight.

The Farm Bureau (#612) was a central actor in this network, with the highest scores for degree, closeness, betweenness, and eigenvector centrality of all nodes (Table 27). In the absence of the Farm Bureau, a majority of the FOs would no longer remain connected, although three clusters would remain (Figure 9). Among the remaining clusters, the Farmers Union (#613) and the Future Farmers of America Alumni (#615) would be necessary to retain indirect connections between the FOs in Cluster 3, and in Cluster 1, the electric cooperative (#610), the Wisconsin Corn Growers Association (#626), and the Wisconsin Potato and Vegetable Growers Association (#628) maintained network cohesion.

Examining the affiliation network of FOs through organizations revealed a sparse network (density 1.4%) with two clusters and nine isolates (Figure 10). The smaller cluster, Cluster A, consisted of two FOs indirectly connected through the Farm Service Agency (#420). The larger cluster, Cluster B, connected a total of eight FOs through indirect ties. The UW Extension (#434) was the most central actor in this affiliation network, with four direct ties to FOs and indirect ties with the remaining four FOs in Cluster B. The Farm Bureau (#417) and local cooperatives (#412) formed direct ties with three FOs and indirect ties with the remaining FOs in the network. The clusters in this affiliation network were linear, therefore removal of any of these four organizations would further disconnect FOs.

Like the other affiliation networks examined, the affiliation network for FOs via events was sparse (density 2.0%), and fragmented, with six small clusters and five isolates (Figure 11). Of the six clusters, three (Clusters C, D and F) were formed by indirect ties between two FOs through only one event. Two of the remaining clusters (B and E) were linear, with agricultural classes from the technical college (#703) and fairs (#723) indirectly connecting five FOs. Attendance at the fair linked FO #53 with this cluster, who would otherwise have been an isolate without fair attendance. Agricultural classes from the technical college (#723) directly connected four FOs and would leave three FOs as isolates if removed from the network. Cluster A included four events that indirectly connected the nine FOs included in this group. The Corn and Soybean Growers Convention (#715) and the WPS Farm Show (#748), if removed, would create three isolates. However, due to shared attendance at Farm Technology Days (#726) and the county fair (#717), the remaining six FOs would retain their indirect connections if one of these events was removed.

Estimates From Composite and Indicator Variables

The distributions for each composite and indicator variable were described using histograms with Gaussian KDE curves (Węglarczyk, 2018). Distribution estimates for the twelve components across the four levels of Berkman and colleagues' conceptual model (2000) were created to describe shared characteristics of the study population that may influence social networks, social support, and HWB within the context of ORS (Supplemental Material, Table 7). Culture, socioeconomic factors, and politics and policy were among the social structural conditions factored at the mezzo level that were estimated (Figure 12). Culture represented the range of social interactions, personal relationships, and type of farms across the sample population (Figure 12a). The distribution estimate was normal, suggesting relative similarity across the group, with small numbers of FOs who had few characteristics associated with culture, and another small group of FOs with more factors than most. Socioeconomic factors included factors like education and commodity production (Figure 12b). The distribution estimate was bimodal and slightly skewed right, indicating that the social and economic factors that influence FOs in this sample varied considerably. The distribution for politics and policy was highly skewed left (Figure 12c). Based

on the factors reflected in this metric, this result indicated that most FOs in the sample did not engage in activities with strong political or policy-related ties. Further analysis was conducted to explore engagement in social activities at the local, state, and national levels (Figure 13). As expected from the politics and policy distribution, the KDE curves at each socioecological level were highly skewed left. The distribution estimate at the local level (Figure 13a) was notable, as it had a bimodal curve, indicating greater involvement at the local level than at the state and national levels within this population.

Components at the mezzo level, social networks, included composite measures of social network structure, characteristics of network ties, and characteristics of network members (Figure 14). These estimates could provide a different perspective on the data than results from the network analyses. The distribution estimate for the social network structure (Figure 14a) reflected network durability, and included factors related to network size, tie type, and duration of relationships. The curve was slightly skewed left, indicating that social networks among FOs were durable, or long lasting. Characteristics of network ties (Figure 14b) reflected more than one type of relational tie. Additional factors included in this composite measure were the frequency and mode of contact, as well as comfort discussing ORS and HWB. This distribution estimate was highly skewed left, suggesting a great deal of similarity in the number of and type of relational ties, as well as FOs' use of relational ties for social support. The distribution estimate of characteristics of network members (Figure 14c) reflected shared characteristics between FOs, particularly factors that may influence shared activities or beliefs. The distribution was slightly skewed right and bimodal, indicating that there were potentially two groups of FOs in the study sample with divergent ideas or priorities.

Distributions for all five components comprising psychosocial mechanisms at the micro level were estimated (Figures 15 and 16). Social support included connections and level of comfort discussing HWB and ORS (Figure 15a). The distribution estimate was skewed left and bimodal, indicating that a majority of the sample population had low levels of social support for mitigating ORS, and that high levels were not typical. Social influence and social engagement, though closely related, included different factors. Social influence emphasized factors associated with longevity in the community and

opportunities to share experiences or knowledge, whereas social engagement focused on factors that influenced a FO's ability to participate in activities with other FOs. The distribution estimate for social influence was skewed right, suggesting that many FOs in this sample had the potential to influence or be influenced by their peers, while others did not (Figure 15b). Conversely, the distribution estimate for social engagement was skewed left with a very long tail, indicating that most FOs spent their time doing activities that did not allow for social engagement, they choose not to engage in social activities, or opportunities were not available in their community (Figure 15c).

Person-to-person contact was divided into non-intimate and intimate contacts in order to evaluate the difference between contacts for FOs who had a partner or children, and those who did not. The distribution estimates for non-intimate person-to-person contact were a measure of in-person contact, frequency, and duration of contact, and whether relational ties were kin or non-kin. This distribution was bimodal with a long right tail depicting two large groups of FOs with very different person-to-person contacts (Figure 16a). Moving left to right, the figure illustrated that one group had very little, another group had a moderate amount (in comparison), and a smaller cluster of FOs had more person-to-person contact. Intimate person-to-person contact was highly skewed left, indicating few opportunities for interaction among FOs who were married and had children (Figure 16b). The measure of access to resources included factors like resources usage, access and use of technology, educational attainment, and number of contacts. The distribution estimate for access to resources (Figure 16c) was slightly skewed left, suggesting a disproportionate proportion of FOs may have limited access to resources compared to their counterparts.

Distribution estimates for an additional four indicator variables were constructed: a) homophily, b) proximity, c) connectedness, and d) social integration (Figure 17). Homophily reflected the number of shared characteristics (Table 28) between FOs in the sample (Figure 17a). The distribution estimate was skewed left, signifying that a low degree of homophily (high diversity) among this population of FOs. Proximity was constructed using homophily and taking into consideration any event or opportunity that would bring FOs together in similar physical spaces (Figure 17b). Proximity was skewed left which was

evidence that, despite having many shared characteristics, FOs engaged in few, or perhaps select activities, which brought them together in the same physical spaces with other FOs. The indicator variable for connectedness was a measure of the total number of ties FOs identified in their networks and reflected their relative connectedness within the network (Figure 17c). Connectedness was skewed left and appears leptokurtic which was evidence of a wide range of connections across the sample population, and a tendency for a greater proportion of FOs to have fewer numbers of connections. Proximity and connectedness were then combined to form the indicator variable, social integration (Figure 17d). Given that the distribution estimates for each of those measures were skewed left, it was not surprising that the estimate for social integration was also skewed left, and that FOs demonstrated few characteristics consistent with social integration.

Thematic Analysis

Using thematic analysis, three themes were generated from the participants' responses to the open-ended, narrative question (Table 29). The first theme, "*the reality of ag today",* described FOs' perceptions of agriculture in the current economic and political environment. FOs noted that the challenges they face have remained unchanged for decades.

> *"Probably the usual. Low prices - operating at a loss - lack of hired help - no one will work on farm - cannot afford new equipment - high repair costs - long hours - no help - cannot afford to hire - too much stress and work"* (P65)

FOs acknowledged that this stress contributes to poor mental health.

> *"There is a lot of stress out there, and the mental health out there with farmers is not good." (P52)*

Several FOs recognized that the work of farm women has remained invisible, and largely underappreciated for its contribution to the success of farms.

> *"Farm wife, farm women, this came clear to me as I completed this." (P34)*

This "reality" as it was described, foreshadowed a division that has occurred among FOs; a group that was historically united by their profession.

"It is stressful as a young family farmer to compete against corporate farms, investor farms, and "outside income" farms." (P37)

The second theme, "being torn apart", described the division that has occurred among FOs as a result of changing market forces within the agricultural industry. It highlighted participants' concerns regarding structural inequities introduced by market prices and financial support programs that disproportionately advantage large farms.

"There…needs to be more oversight on the USDA on how they figure crop production, cattle numbers, etc. Their math is in favor of big business, ag, retail, etc. and not the farmers." (P59)

FOs acknowledged how shifts in agricultural technology and pressures to expand farming operations have effectively disempowered small family farmers. FOs of "family farms" suffer from artificially depressed commodity prices and strategies, like working harder and putting in longer hours that worked decades ago to increase income, are no longer effective.

"Too many farmers in a world of hurt, being torn up. Mostly because of the financial situation. We feel like failures and it's not our fault." (P8)

Large, "corporate farms" were at an advantage when applying for subsidies or other programs that provided financial support to farmers because they could offset high overhead and machinery costs.

"Too many of the BIG farmers are becoming LLCs and figuring out how to manipulate their income. They get all the subsidies, grants, stimulus, tax write-offs. We go in to see if we can get a little something and we don't quality." (P3)

"Being torn apart" illustrated the effects of shifting economic forces and changing priorities in agriculture, where farmers were competing against each other for income, which created a division within a historically unified industry between those who identify as "family farmers" and "corporate farmers."

"There are too many programs for big farms so they can put family farms out of business." (P1)

The third theme, "being pushed out", described participants' experiences trying to remain in farming, and their ongoing concerns that they would not be able to despite a desire to remain in the agricultural industry.

> *"The gap is getting larger between investor/corporate farms and family farming and it leaves family farms, like us, getting pushed out."* (P37)

FOs emphasized that competition between family farms and corporate farms drives FO's inability to generate income on their farms, leaving them to do the best with what is left over, and feeling as if they have no options left.

> *"It is stressful as a young family farmer to compete against corporate farms, investor farms, and "outside income" farms. The gap is getting larger between investor/corporate farms and family farming and it leaves family farms, like us, getting pushed out. I speak for the remaining family farms that are still hanging on. WE FLAT OUT CANNOT COMPETE and still generate income." (P37)*

For at least one FO, the need to earn income by renting prime land has undoubtedly impacted earnings from crop yields.

> *"[I farm] "on some fields that no one else wants." (P44)*

These losses have taken a considerable toll on FOs, as one commented:

> *"We feel like failures and it's not our fault" (P8)*

The sentiment among FOs was that no change in economic conditions is expected. Consequently, FOs live with the constant worry of losing their farming operation.

> *"The reality of ag right now is that there will be less farmers and nobody knows who will be the next one outta business."* (P59)

The three themes generated through thematic analysis of the narrative data were arranged in a thematic map (Figure 26). The thematic map communicated the shared meanings expressed by FOs in this study pertaining to information they deemed important to understand about ORS and HWB among FOs that was not captured by questions included on the name generator. "*The reality of ag[rigculture] today,"* as described by participants, is an environment within which "family farms" cannot compete with "corporate farms." FOs feel as if they are "*being torn apart."* and competition has replaced camaraderie within their profession, and business operations have replaced their way of living. They expressed a sense

of powerless and "*being pushed out"* of an industry in which they retain a strong sense of ownership and self.

Chapter 6: Discussion and Conclusions

Discussion

Farmers have higher rates of morbidity and mortality than rural residents who are not employed in farming as well as individuals living in urban communities (Blackburn et al., 2009; Brumby et al., 2011; Carley, 2015; De Brún & McAuliffe, 2018; Donham et al., 2019; Earle-Richardson et al., 2015). However, FOs suffer even higher rates of physical and mental health ailments, and premature death compared to other farm workers (Dhananjayan & Ravichandran, 2018; Dignard & Leibler, 2019; Doney et al., 2017; Earle-Richardson et al., 2015; Guillien et al., 2016; Sekhotha et al., 2016; Wardyn et al., 2015; Yarpuz-Bozdogan, 2018). The cause of these disparities has been attributed to adverse health effects associated with role-based, differential exposures to ORS. Specifically, FOs experience excess stress related to decision-making and financial liability in their occupational roles (Furey et al., 2016; Jadhav et al., 2014; Leka & Jain, 2010; Miller & Aherin, 2018). A body of research demonstrates that social support, accessed through social networks, can buffer stress, and protect against the negative health effects from stress (Daniels & Guppy, 1994; Matel-Anderson et al., 2019; Sriram et al., 2018; Takizawa et al., 2006). However, these relationships have not been studied among farmers or FOs. Therefore, the purpose of this study was to explore the social networks of farm owner-operators and the social supports available to them for mitigating negative health effects of ORS.

The personal social networks of FOs in this study were smaller than comparable types of networks (trust networks) that have been described in previous studies of farmers, and the general population (Berkman, 2000; Hill & Dunbar, 2003; Kallioniemi et al., 2016; Wood et al., 2014). On average, FOs identified, or nominated, 2.4 individuals from whom they would seek information regarding ORS and HBW, or with whom they would discuss “issues related to the farm that weigh heavy on their minds.” No prior network studies have specifically studied the social networks that farmers use for ORS or HWB. However, findings from studies of other social networks of farmers, which included trust networks, reported sizes ranging from 9-14 members (Kallioniemi et al., 2016; Wood et al., 2014). In general populations, studies of personal social networks comprised of trusted individuals ranged in size from 5-15 members (Berkman, 2000; Hill & Dunbar, 2003).

FOs reported low engagement and low levels of comfort within affiliation networks, with ties to an average of 1.1 membership groups, 0.6 organizations, and 1.0 event. This was consistent with the analysis of the composite variables which indicated that FOs had low engagement at all socioecological levels. Resource use was greater than social connections, with FOs using an average of 6.1 of the 12 resources (network content) to obtain information about ORS. A notable proportion of FOs had empty personal or affiliation networks, meaning they did not have ties to at least one of the four alters types (individuals, memberships groups, organizations, or events). Nearly a quarter (22.5%) of FOs reported no alters in their personal networks and 40.6 - 73.2% reported no ties with membership groups, organizations, or events. Farmers have been described as stoic and self-reliant (Fuller et al., 2009; Kennedy et al., 2014; Rosenblatt, 2000), but also as a population that is tight knit with a shared agrarian culture and stewards of the land (Kilgannon, 2018). That any FOs, especially the proportions reported in this study, had empty networks was unexpected, particularly given descriptions of farmers' social networks from prior research as large, dense, and cohesive (Berkman, 2000; Hill & Dunbar, 2003; Kallioniemi et al., 2016; Wood et al., 2014). Narrative data from one participant illustrated that some FOs do, in fact, choose not to discuss ORS with others stating, "*We don't go to other people*" (P52). FOs had small personal networks, and even smaller affiliation networks that were characterized by low levels of comfort discussing ORS and HWB. Given this, the proportion of FOs who did not use the any of the 12 resources, or name other resources beyond those listed for information related to ORS was surprising. These findings may indicate that FOs experience social isolation, which supports the need for continued lines of research exploring connectedness, social isolation, and depression among farming populations (Parent, 2012; Roy et al., 2017; Truchot & Andela, 2018). This could also indicate that affiliation networks are not appropriate for targeted interventions to address health disparities among FOs. No prior studies describing the composition or size of farmers' affiliation networks were available against which to evaluate the quality of the questions that elicited these data or the findings they generated.

Gender differences, similar to those reported in network studies of farming and non-farming populations in prior studies, were also found in this study (Ang et al., 2013; Mailfert, 2007; McDonald &

Mair, 2010). Patterns of resource use (network content) differed between male and female FOs, though results did not reach statistical significance. As in prior studies, female FOs reported larger personal networks than males (Hofstra et al., 2021), though the difference was not statistically significant. Among full-time FOs, males worked more hours per week during both usual and peak hours than female FOs. Women often secure off-farm employment in order to obtain health benefits for farm families (Bharadwaj et al., 2013; Bharadwaj & Findeis, 2003). It is common for farm wives to do so while retaining responsibilities for raising children and maintaining the household (Brasier et al., 2014; Gasson, 1981; Swendener, 2015). FOs were not asked to report hours worked in all paid and unpaid roles, so it is not known how accurately the reported hours worked reflected the actual hours that female FOs worked weekly on the farm across all roles. As women take on more diverse roles in farming, including increasing numbers as owners and operators (Brasier et al., 2014; O'Neill et al., 2020), the responsibilities that accompany dual roles as parents or partners should be considered in research agendas. Female FOs reported higher levels of ORS than male FOs, which is largely consistent across studies of farmers and non-farmers (Booth & Lloyd, 2016; Freeman et al., 2008; Jones-Bitton et al., 2019; Kallioniemi et al., 2016). The differences in patterns of resources use in network structure by gender found in this study signify that male and female FOs may use different sources for information or access different social support related to ORS and HWB. These findings highlight potential differences by gender that may be important for engaging FOs in health promotion activities or interventions. Investigators should consider gender differences in social network utilization and how these differences may shape interventions to reduce ORS and improve HWB, and to reduce health disparities among FOs.

The majority of FOs in this study were either at high risk for distress or currently experiencing symptoms of distress. The proportion of FOs in active distress was consistent with the majority of prior studies of farmers that reported levels of distress that ranged from 34.2% - 42% of the study population (Bondy & Cole, 2019; Fragar et al., 2010; Kallioniemi et al., 2016). One study (Jones-Bitton et al., 2019) in which 61% of farmers displayed symptoms of psychological distress acknowledged that inflated distress scores were possible based on the measures they used to assess overall psychological distress.

Farmers who screened positive for occupational distress in another study reported functional disruptions consistent with mental health disorders (Frager et al., 2010). Stress of this magnitude can negatively impact social function, straining both intimate and non-intimate relationships (Bondy & Cole, 2019), and has been associated with increased rates of alcohol use, anxiety, depression (Bondy & Cole, 2019), and suicide (Alpass et al., 2004). Participants in this study were not asked specifically about the effects of ORS on their relationships, coping responses they used for ORS, or other behavioral risk factors associated with maladaptive coping. However, several statements from participating FOs illustrated the magnitude of ORS on their lives:

- *"The last five years have been a struggle. So I found myself not taking care of my body, which in turn made me feel terrible"* (P59).
- *"Too much stress, too much work"* (P64).
- *"…too much stress and work"* (P65).
- *"We feel like failures and it's not our fault"* (P8).

Findings from the analysis of the narrative comments from participants captured how economic and technological shifts in farming and consequent changes in the scale of farms over recent decades have affected the nature of ORS within farming, and how changes in ORS have altered the everyday experiences of FOs (Ang, 2010; Bondy & Cole, 2019; Kearney et al., 2014).

Features of homophily and propinquity were observed in the social networks of participants in this study. FOs and alters were of similar age (homophily), most were also engaged in farming (homophily), and had known each other for 10 or more years (propinquity). These patterns of homophily were consistent with prior research of farmers' social networks (Deseran, 1985; Stain et al., 2008 Wood et al., 2014). In studies of trust networks, men and women tended to form ties with alters of the same gender (Borgatti & Cross, 2003; Burk et al., 2007; Dunbar & Spoors, 1995). There was a tendency, though not significant, for FOs to nominate female alters. However, FO's level of comfort discussing ORS and HWB was significantly higher with female alters than male alters. This finding may be due to spousal effects, as

the majority of the sample was married, the greatest proportion of alters were family members, and FOs reported high comfort discussing ORS and HWB with family members. Although the specific context and meaning are not certain, some FOs indicated that farm wives play important, but underappreciated, roles in the farming operation, as indicated by one participant, *"Farm wife, farm women, this came clear to me as I completed this"* (P34). Data limits prevented further analysis to assess for spousal effects and no comparison studies were identified.

The type of relational ties between FOs and alters, and the level of comfort FOs had discussing ORS with them influenced communication patterns. When alters were also engaged in farming, FOs were more likely to discuss ORS in person than by phone, email, or text message. This may have been a product of the nature of their farm work and the places or spaces that FOs inhabited during their workdays, or it could have been a preference in communication mode. FOs talked with family members and friends about ORS most often on the telephone, and email was rarely cited as form of communication except with friends. The ease of contacting an alter by telephone, especially given the prevalence of cell phones in the community, and high degree of comfort or trust FOs reported with family and friends may have been a contributing factor (Frias-Martinez & Virseda, 2012). This interpretation was consistent with the finding that FOs contacted family and friends more often than other alters types. An expected finding was that email was infrequently used to communicate with alters, and only associated with those friends with whom FOs had high comfort. Few farming tasks are conducted on computers, so farmers likely have limited access to email throughout the workday. Even if FOs had the ability to read email on a smartphone, it is a relatively impersonal mode of communication and requires a greater time commitment than either in-person or phone communications (Beaudoin, 2008; Selwyn, 2003). These conclusions remain speculative, as no prior studies were found to explain these patterns in communication for FOs.

Duration of relationships and alter status as a farmer have been associated with high levels of trust (Wood et al., 2014). In this study, relationships of 10 or more years were associated with higher comfort levels discussing ORS and HWB, though whether alters worked in farming was not. Findings from the narrative analysis suggested that shifts in farming may have changed relationships between

farmers and their propensity to turn to each other in times of stress. In an environment defined by competition, struggle, and fear of going out of business (Baur, 2020; Sutherland et al., 2012), FOs may be skeptical of sharing any negative information about their farming operation with other farmers especially other FOs. The statement, "*We don't go to other people,*" (P52) could be interpreted both as keeping business to oneself but may also reflect decreasing levels of trust in the intentions of fellow farmers. Larger social support networks have been associated with lower stress in other populations (Lee et al., 2016). Yet, FOs in this study who had more alters had significantly higher levels of ORS than FOs with fewer, or even no alters. It is not known whether an erosion in trust between farmers contributed to high levels of ORS for those FOs with larger social networks, if FOs with high levels of ORS were building their social networks, or if other forces were in play. This would be an important line of inquiry given the high rates of distress and risk for distress in this group and the effect of historical changes within farming communities that participants emphasized through their narrative comments.

FOs' affiliation networks provided additional insights for understanding how social networks may, or may not, be useful for addressing ORS and promoting HWB within this population. Generally, the affiliation networks for FOs were small, sparse, and fragmented. These findings may not be representative of affiliation networks of the larger population, because alter-alter relational data were not collected. Within the organization and event affiliation networks, no single actor was identified as more central or influential than others in the networks. Rather, several actors shared prominence and was reflected in similarities across measures of centrality. Within the membership affiliation network, the Farm Bureau emerged as a central, and a potentially influential membership group for FOs (Kim, 2007). Centrality measures for the Farm Bureau indicated importance in the network (degree centrality), bridging of otherwise disconnected FOs within the network (betweenness centrality), and potential to influence FOs (eigenvector centrality) given numbers of direct and indirect connections (Faust, 1997). These measures indicated that the Farm Bureau may hold a position of advantage or be an organization with whom researchers could collaborate, or through whom to implement targeted interventions to reduce ORS and improve HWB among FOs. However, a recent study (Rudolphi et al., 2019) reported that over one

third (35%) of farmers did not want to receive information about stress and mental health from the Farm Bureau. Consistent with the findings from Rudolphi and colleagues, (2019) all FOs in this study rated their comfort in discussing ORS with the Farm Bureau as "low." There may be a potential to leverage the relationships between FOs and the Farm Bureau in this community to address health risks from ORS, but additional information is needed to fully understand the social dynamics that could influence the effectiveness of interventions coordinated through or implemented in partnership with the Farm Bureau.

The Farm and Ranch Stress Assistance Network (FRSAN) was reauthorized in 2018, with nearly $4.5 million in grant funding earmarked to "to establish a Farm and Ranch Stress Assistance Network that provides stress assistance programs to individuals engaged in farming, ranching, and other agriculture-related occupations" (National Institute of Food and Agriculture, n.d.). Funding was directed toward creating help lines, developing online repositories for resources and information, and creating or providing training for individuals working in occupations that support or interface with farmers (National Institute of Food and Agriculture, n.d.). Findings from this study and others (DeLind, 1986; Eberhardt & Pooyan, 1990; Hagen et al., 2019; Kubat Willette, 2020) indicated that these programs may have limited impact for farmers. Among FOs in this study who contacted organizations for ORS and HWB, few (9.5%) did so by an Internet search, and no FOs reported seeking information or support from a farm-specific organization or group with only an online presence (e.g., AgriSafe Network or Farm Aid). The Wisconsin Department of Agriculture, Trade and Consumer Protection has dedicated resources (Department of Agriculture Trade and Consumer Protection, n.d.-a, n.d.-b) to support farmers experiencing ORS and stress-related problems, yet a fifth of male FOs (20.8%) and twice the percentage of female FOs (42.9%) would not consider using these services. In a recent study by Rudolphi et al (2019), over half of farmers did not want to receive information about stress or mental health over the phone or via hotlines (51.7%), from the Internet or websites (56.0%), and a majority (71.4%) were not interested in receiving mental health information through social media channels. FOs in this study preferred to receive information about ORS and HWB from farm newspapers and magazines, which is consistent with findings reported in prior studies (Chiu et al., 2015; Rudolphi et al., 2019).

A close examination of findings from this study may explain why past interventions have not been effective at improving health outcomes for farmers and farm families and raises concerns about the focus of programming for current grant funding to support research aimed at improving the HWB of farmers and farm families. The bulk of existing knowledge about social networks of farmers has been gained through investigating the spread of innovative farming practices (Almeida et al., 2019; Cofré-Bravo et al., 2019; Rockenbauch et al., 2019; Wood et al., 2014), and not from exploring specific issues related to farmer HWB. In addition, the majority of what is known about health behaviors of farmers and FOs has been obtained through research focused on occupational health and safety, specifically reducing exposures, injuries, and death from work conducted on the farm (Arora et al., 2020; Brumby et al., 2009; Donham et al., 2019; Dosman, 2015; Lee et al., 2017; Rudolphi et al., 2019; Stallones & Beseler, 2004; Van den Broucke, 2011). Findings from studies of occupational health and safety among farmers have been broadly applied to the health behavior and practices of farmers across both their personal and work lives. This may be attributed to the significant overlap between the farm as a family business and place of residence, or that ORS stems from farm-related issues (Ang, 2010; Daghagh Yazd et al., 2019; Kilgannon, 2018). The body of knowledge gained through studies of occupational practices of farmers has become the foundation upon which contemporary research of farmer health was built. However, the assumptions translated to health research of farmers and farm families from the occupational health and safety literature have not been directly studied or challenged.

The major presuppositions that underpin health disparities research among farming populations are that a) farmers' social networks are stable across functions, and b) farmers conceptualize personal HWB in the same way as they do occupational (farm) health and safety. The majority of prior research on social networks of farmers has concluded that their social networks are large, dense, homogenous, cohesive, and decentralized (Deseran, 1985; Stain et al., 2008; Wood et al., 2014; Ziegenhorn, 1999). With few exceptions (Cofré-Bravo et al., 2019; Sligo et al., 2005), prior network studies among farmers have not emphasized how the composition of social networks vary by network function or purpose. Network function is one of the four distinct dimensions that determine network effects (Perry et al.,

2018), and failure to acknowledge or explore network function or its contributing factors severely limit study findings. This study revealed important variations in the composition and structure of farmers' social networks based on a clearly stated network function, or purpose, and confirmed the importance of specifying the phenomenon of study. Future research in farming populations that integrate social support or social networks should be informed by theoretical frameworks or conceptual models that align with the phenomenon of interest and the function of social networks within that context (Robins, 2015).

Among FOs, ORS and the adverse health effects associated with it typically stem from issues related to the farm. It may follow logically, that ORS reduction and HWB promotion efforts be offered through the same platforms or mechanisms as occupational (farm) health and safety. Findings from this study highlighted that farmers accessed different social networks and resources for issues related to occupational health and safety than for personal HWB. For example, the National Farm Medicine Center is a well-respected resource for agricultural health and safety information and resources (Small, 2013), yet was not cited as a major resource among FOs for ORS and HWB. In addition, FOs' social networks were smaller, with different relational characteristics than reported in studies of farmers social networks related to occupational health and safety (Berkman, 2000; Hill & Dunbar, 2003; Kallioniemi et al., 2016; Wood et al., 2014). Collectively, these findings suggest that farmers conceptualize farm health and safety differently than personal HWB. Therefore, the same research approaches and targets that guide occupational health and safety research may not be appropriate for personal HWB among farmers and FOs. These findings have significant implications for resource allocation and future research agendas focused on addressing health disparities among FOs, farmers, and farm families.

Limitations

The findings from this study should be weighed within the practical limitations of the study design and methods. Caution should be taken in generalizing findings from this study beyond the geographical area studied. Social, economic, and political conditions vary dramatically across regions, social forces differ by locality, and soil and weather conditions influence agricultural commodities produced, thereby local economic conditions (Besser et al., 2017; Kilpatrick et al., 2012; Sligo et al.,

2005). Although the sample was representative of the larger study population with the exception of marital status, only 17.6% of FO in the sampling frame (77/437) participated. The sampling and recruitment methods used did not allow oversampling for gender diversity, and the study population did not permit oversampling for racial or ethnic diversity (Table 10). As such, this study could not detect potentially important differences in ORS by race, ethnicity, or gender. Another important subpopulation that was excluded from this study was the Amish. The Amish community in the target county had been victims of identity theft, and church leaders counseled members to refrain from providing unsolicited information requested through the mail. To respect their personal privacy and the wishes of their church, all individuals from the Amish community were removed from the list of eligible participants. As a result, important differences that may exist within this group that affect ORS and HWB remain unknown.

Two sampling-related issues may have limited the data collected and study findings. The initial method for identifying eligible participants, though recommended by other researchers, ultimately yielded more ineligible individuals than potentially eligible participants. In fact, only 29.3% (128/437) of the theoretical sample was identified. Access to the names and addresses of FOs in the target area were not available from the USDA (G. Bussler personal communication, March 16, 2020), although the USDA Farm Services Agency in another state provided similar data to another researcher (Khan et al., 2018). Had the names and addresses of FOs been available for this study, more FOs may have participated, potentially improving overall participation and the quality of data representing FOs in the sampling frame. Chain-referral sampling had been proposed to supplement convenience sampling to increase identification of potentially eligible participants, but also to identify hard-to-reach FOs (Valente & Pitts, 2017). The IRB did not approve the use of chain-referral sampling, and initial conversations with the IRB indicated that the issue would not be resolved quickly, if at all. Consultants expressed high confidence in the other sampling methods ultimately used (C. Bendixsen personal communication, February 25, 2020; G. Bussler personal communication, March 16, 2020), therefore chain-referral sampling was not implemented for this study.

Missing data, both from missing cases and missing observations, imposed limits on the study findings. Nearly 70% of the theoretical sample was not identified and recruited, and 41 potentially eligible participants did not respond. Data collected on reciprocal relationships and alter-alter ties can offset non-response bias (Kossinets, 2006). However, these data were not collected for this study, so the network level measures of cohesion and centrality could have bias. The sample did not include Amish FOs, and oversampling by gender, race, or ethnicity was not possible. Therefore, some differences or associations that may prove important for access to social support for ORS and HWB within social networks of FOs were not identified by this study.

The survey design may have induced systematic response bias thereby limiting confidence in the study findings (Larson & Lewis, 2020). It is unknown whether response bias played a role in the patterns observed with the questions related to race and ethnicity, or resources used. The name generator had been pilot tested with farmers and recommendations were made to remove questions on race and ethnicity. The decision to retain those questions was based on health disparities linked to race and ethnicity (Antonucci et al., 2013; Berkman, 2000). Data quality could also be affected if participants interpreted questions differently than intended. In addition, some questions lacked specificity, so it was not possible to conduct more granular level analyses. For example, alters could not indicate more than one kind of relational tie (family member and friend), or specify the kind of family member (mother, spouse, etc.) with whom they were connected. FOs were not asked specific reasons for seeking social support, the type of the social support sought (emotional, instrumental, informational, and appraisal), or their appraisal of it (positive, negative, or neutral). Therefore, this study may not have detected certain patterns associated with different characteristics of ego-alter ties or social support.

Limitations due to data entry and computational errors were possible. As noted previously, the initial data entry error rate was higher than typically reported in the literature (Kirch, 2008). This was likely due to the use of a single-entry procedure and could have been reduced by a double-entry procedure (Reynolds-Haertle & McBride, 1992; Schneider & Deenan, 2004). A thorough and systematic process was used to verify data entry and ensure entry errors were identified and corrected prior to data analysis.

The methods used in this study to develop the measures for stress and distress, as well as the composite and indictor variables were informed by the literature but were not validated. Therefore, interpretations from these data should be made cautiously and with knowledge of the variables and calculations from which they were constructed.

It is possible that the analysis and interpretation of the narrative data did not accurately represent the meanings of participants. The narrative data were read and analyzed through the lens of a farming family member, of someone who understands agricultural commodity pricing, and how technology and industrialization has changed farming in recent decades. In addition, analysis was conducted by a single investigator. Strategies, like memoing and member checking (Birt et al., 2016; Creswell & Miller, 2000), were employed to retain the perspective of FOs throughout the data analysis. However, one's prior knowledge and experiences cannot be completely bracketed throughout the analytic and interpretive process and is a potential source of bias.

In the absence of alter-alter relational ties, certain structural analyses were not possible. Despite these limitations, the composite and indicator variables provided additional perspectives on structural features of FOs' social networks that could influence FOs access to, or exchange of social support within their social networks at and across the macro, mezzo, and micro levels. These measures combined variables in different ways and facilitated examination from different perspectives than the analytic techniques used to that point. For example, focusing on shared characteristics between FOs highlighted the diversity within this group that may otherwise have remained undetected. The KDE curves suggested that FOs had low levels of connectedness and social engagement, despite long-standing relationships within the community and substantive institutional knowledge of farming that typically translate into high levels of potential social influence (Ajrouch et al., 2005; Heenan, 2010; Warriner & Moul, 1992). FOs accessed a greater number of resources within their social networks, such as farm papers or farm magazines, than human social supports for ORS and HWB. This may indicate that FOs wanted to obtain information anonymously, without assistance, at their convenience, or to avoid stigma or judgment from others (Hull et al., 2017; Kennedy et al., 2020; Roy, 2014; Rudolphi & Barnes, 2020).

Implications

Contemporary descriptive and intervention research on farmers has been largely based on two main premises, a) that the size of farmers' social networks is stable across functions; and b) that farmers conceptualize personal HWB in the same way as occupational health and safety. Results from this study challenge these foundational assumptions and have significant implications for how researchers approach the study of FOs personal HWB, as well as intervention development to improve health outcomes among this population. Additional research is needed to better understand how farmers conceptualize personal HWB, and how that differs from farm health and safety. Carefully examining the presuppositions that underly the study of farmer health and development of health interventions is critical to ensure research efforts align with the needs of farmers and farm families. Doing so also ensures that investigators are ethical stewards of scarce resource funding. It is essential to understand how FOs construct their social support networks and access the resources within their social networks for personal HWB in order to develop effective network interventions.

In recent years, millions of dollars have been earmarked for programing to support farmer health. Of concern, is that findings from this study, along with others (DeLind, 1986; Hagen et al., 2019; Kennedy et al., 2020; Rudolphi et al., 2019), indicate that many funded initiatives have not met the needs of farmers. There is an urgent need to align research and program funding with current evidence, and to engage farmers as partners in identifying research priorities and strategies. For example, based on collaborative efforts between the Federal Communications Commission, HRSA, and the USDA, funding is currently being funneled into rural communities to support broadband infrastructure (Federal Communications Commission, n.d.; Health Resources and Services Administration, 2021b; United States Department of Agriculture, n.d.). Many rural health providers and rural health advocates laud these efforts because increasing access to health services for rural residents, including farmers, via telemedicine is a major factor driving these initiatives (Federal Communications Commission, n.d.; Health Resources and Services Administration, 2021b; Sallet, 2019; Townsend et al., 2013; United States Department of Agriculture, n.d.). Early data from the COVID-19 pandemic does indicate these measures could improve

health access in rural communities (Hirko et al., 2020; Kronenfeld & Penedo, 2020; Shipchandler et al., 2020), although no data specific to access for farmers or farm families was available. A search for literature supporting broadband expansion for farmers focused almost exclusively on the technological innovations broadband service could bring to farming operations and potential economic impacts, and little attention was given to improved health care access (Broadband Connects America, n.d.; United States Department of Agriculture, 2019; United States Department of Agriculture, n.d.). Policy makers must recognize that messaging, especially from government organizations such as the USDA, have significant influence on research agendas, how grant funding is allocated, and evaluations of programs or initiatives developed with grant funds. If improved access to health care services for rural communities via broadband is truly a priority, public messaging should communicate both the health benefits potential operational benefits for farmers and farm families. Failure to do so could undermine public confidence in efforts to reduce health disparities for rural and farming populations.

Study findings provide an opportunity to rethink approaches to health disparities for farming populations. Social support accessed through social networks may not be an effective or efficient approach to address ORS and HWB for FOs and other farm workers. FOs had small personal networks, and the size of FOs' networks was positively associated with ORS levels. Group membership and engagement at the local, state, and national levels showed no association with lower levels of ORS for FOs. It is possible that farmers experience ORS differently than explained by current theories and models, or that FOs do not use their social networks as described in the current by the body of literature. Findings also suggest that FOs are at risk for social isolation. Studies have shown that in general, individuals with higher numbers of social contacts report lower levels of social isolation and loneliness than those with fewer numbers of social contacts (Domènech-Abella et al., 2017; Henning-Smith et al., 2019; Santini et al., 2020; van Tilburg, 1990). Recent studies have refuted prior study findings that rurality predicted social isolation and loneliness (Abshire et al, 2020; Buecker et al, 2021; Cudjoe et al., 2020; Holt-Lunstad et al., 2017; Kelly et al., 2019; Menec et al, 2019; Parent, 2012; Victor & Pikhartova, 2020; Warr et al., 2021). Rather, social conditions and contextual factors, including economic instability, lack of reliable

transportation, and limited local services, create the conditions in which some rural residents feel disempowered and disconnected from their communities (Abshire et al, 2020; Buecker et al, 2021; Kelly et al., 2019; Menec et al, 2019; Victor & Pikhartova, 2020). Narrative statements from participants reinforced the value of quantitative data in conveying how the competitive environment in which FOs function may exacerbate their risk for social isolation.

Findings from the thematic analysis of participants' narrative responses illustrated the importance of considering the historical context within which phenomena occur. Decades-long changes in economics, policy and politics within the agricultural industry were described by participants as a shared history of disrupted lives. Market forces and technical innovations have created artificial distinctions between "family farms" and "corporate farms," and have changed relationships between farmers and FOs from those of cooperation to competition. Cross sectional studies cannot capture longitudinal change, and it is challenging to operationalize or account for the effects of occupational and economic shifts within agriculture on social determinants of health over chronological time. Findings from this study illustrate the importance for health researchers to examine processes of social change within farming that have occurred over decades given the considerable effects they have had on farmers' lives.

Future Directions

Conducting a longitudinal social network study could explore the effects of social changes over time on both the levels of ORS among FOs and the structure of their social networks. Such a study could explore causality in the significant relationships found through this study, as well as insights into the coevolution of social networks in response to social and contextual change. There remains a need to identify and test the assumptions that underpin research and funding priorities for farmers and farm families. Affiliation networks provide access to resources, without which network members may be disadvantaged (Klärner & Knabe, 2019). However, questions remain about the effectiveness of using affiliation networks to address ORS or promote personal HWB for FOs. Structural changes in rural communities, like those driven by economic and technological shifts in agriculture, can alter social networks (Klärner & Knabe, 2019). As a result, relationships leveraged in the past may no longer be

effective for targeted network interventions. For example, the Farm Bureau may be a central member of FOs' social networks, but low levels of comfort and a preference against receiving information about ORS and HWB from them, raise concerns about the appropriateness of the Farm Bureau for targeted network interventions. Social network research has focused nearly exclusively on positive ties, and there is a need to fully explore negative ties within social networks of farmers and FOs. Soliciting negative ties provides researchers a more robust understanding of social network structure and function, both of which influence resource access and flow (Everett & Borgatti, 2014). Research is also needed to differentiate how FOs conceptualize personal HWB and occupational health and safety. This may be a critical point for advancing the science of HWB among farming populations, as interventions to date have been largely focused on occupational health and safety, and had little impact on health disparities (Hagen et al., 2019). Lack of clarity for such a foundational concept undermines the credibility and applicability of study findings, while limiting the effectiveness of health improvement interventions.

Berkman and colleagues' (2000) model provided conceptual guidance for the design of this study. To date, this model has been neither studied nor tested in farming populations. Missing data for the study sample were MCAR, therefore data can be imputed, and statistical modeling conducted to test the conceptual model in this population. This process is in its early phases, and this will be the first study to empirically test Berkman and colleagues' conceptual model (2000) within this population of FOs.

Standardized measures should be developed for use across study populations, particularly related to ORS and HWB among farmers (Kagawa Singer et al., 2016). No single measure of stress or distress has been validated in this population, and no standardized measures existed for the composite or indicator variables that were described by the KDE curves. Without standardized instruments to assess stress and distress in farmers, or measures for the various social factors and processes integrated into Berkman's model (2000) researchers cannot compare findings across studies and populations, making it difficult to advance the science. Measures of stress and distress will not only allow researchers to compare findings across study populations, but also to improve our understanding of the burden of stress and distress among farmers. Developing metrics for the composite and indicator variables could allow researchers to

quantify the degree or extent to which these factors exist within a specific population and their patterns of distribution. This information could provide additional insights into the relationships of social determinants of health within and across socioecological levels, as well as contextual effects on health outcomes. Combined with spatial analysis, such metrics could provide a better understanding of how place, space, and sociocultural conditions, including the social determinants of health and policies at different socioecological levels, both shape and are shaped by the natural and built environment (including climate change), contribute to structural inequities, and influence attainment of optimal health across the lifespan. This information could also provide important insights for dissemination and implementation research whereby interventions could be tailored for local contextual conditions.

Several researchers have expressed interest in replicating this study in other settings. Study materials and procedures could be revised to improve the rigor and quality of data, and collaboration with other researchers would expand data collection to more diverse populations. The opportunity to include reciprocal relationships, alter-alter ties, and more detailed information about ORS could add substantially to the science. Improved data could address many of the limitations identified in this study, and expose important differences in network structure by racial, ethnic, and gender identify. The study design could also be strengthened using a mixed-methods approach. For example, using grounded theory to understand the perspectives of FOs that explains their responses to ORS, including the sociocultural conditions that shape farmers' responses would fill an important gap in the current literature. Not only could the findings provide insight into how FOs experience ORS, but also how they use their social networks related to ORS and HWB.

Biomarkers and epigenetics have evolved as area of interest based on findings from this study. The influence of social factors on biological processes and heritability of changes in gene expression is well-documented (McEwen, 2017). The nature of production agriculture exposes farmers to chronic, unpredictable stress, children of farmers often begin working on farms at a young age, and transition of farm ownership between generations is common. Given the high rates of occupational distress and risk for occupational distress among this study population, as well as the burden of anxiety, depression, and

suicide among FOs, investigating the biopsychosocial consequences of chronic ORS among farmers and the potential for transgenerational health inequities and is an important area for exploration.

Conclusion

The 1980s farming crisis, the Great Recession of the 2000s, and the recent financial crises due to COVID-19, brought the economic challenges farmers face into public awareness (Davis-Brown & Salamon, 1987; DeLind, 1986; Olowobon et al., 2019; Olson & Schellenberg, 1986; Rostamabadi et al., 2019; Van Hook, 1990; Walker & Walker, 1987). What researchers discovered in the wake of these financial crises, was that health disparities were found not only between rural and urban populations, but within rural populations as well (Daghagh Yazd et al., 2019; Donham et al., 2011; Donham et al., 2019; Douglas et al., 2018; Essien et al., 2018; Guillien et al., 2019; Variyam & Mishra, 2005). Higher rates of morbidity and mortality exist between farmers and their rural counterparts, attributable to the hazardous conditions, physical demands, and risks associated with production agriculture (De Brún & McAuliffe, 2018; Dhananjayan & Ravichandran, 2018; Dignard & Leibler, 2019; Doney et al., 2017; Earle-Richardson et al., 2015; Guillien et al., 2016; Sekhotha et al., 2016; Wardyn et al., 2015; Yarpuz-Bozdogan, 2018). More recent research findings indicate that disparities in health are found within farming populations, with FOs suffering higher rates of physical and mental health ailments, as well as premature mortality compared to other farm workers (Daghagh Yazd et al., 2019; Kilpatrick et al., 2012; Miller & Aherin, 2018; Ringgenberg et al., 2018). The cause of these disparities has been linked to role-based differences in ORS associated with decision-making and financial liability for the farming operation (Cuthbertson et al., 2020; Furey et al., 2016). In times of chronic or unrelenting ORS, a state of distress can result, prompting a self-perpetuating and mutually reinforcing cycle of maladaptive behavior that negatively affects physical, mental, and emotional health, and contributes to physiological changes that increase risk for chronic disease (Farmer & Ferraro, 1997; Gouin et al., 2008; Marin et al., 2011; McEwen, 2008, 2017). A growing body of research has attempted to identify and describe the risk factors for developing ORS among farmers, as well as those factors that increase farmers' risks for adverse health effects from ORS (Brumby et al., 2009; Fuller et al., 2009; Kutek et al., 2011; Takizawa et al., 2006).

Less is known about protective factors against ORS for farmers, and far less is known about ORS among FOs.

Strong, healthy relationships with intimate partners, good physical health, and social support have been shown to buffer the negative effects of stress among farmers (Daghagh Yazd et al., 2019; Davis-Brown & Salamon, 1987; Fraser et al., 2016; Kallioniemi et al., 2016). Other strategies to mitigate the adverse effects of ORs have been explored, like good nutrition, exercise, meditation, and sleep (Âkerstedt, 2006; Hirotsu et al., 2015; Kim & McKenzie, 2014; King et al., 2014; Moseley, 2000; Padhy & Raju, 2018; Tsatsoulis & Fountoulakis, 2006). The designs and methods used for these studies were such that the relationships with stress could not be tested. Few studies have empirically studied the effect of social support on ORS and HWB among farmers and those that have, found that farmers with greater social support resources rated their general health status higher than farmers with fewer social support resources (Fuller et al., 2009; Kutek et al., 2011; Takizawa et al., 2006). Outside of farming, numerous studies have examined the relationship between social support and stress, concluding that social support has buffering effects on stress and protects against the negative health effects from stress (Daniels & Guppy, 1994; Matel-Anderson et al., 2019; Sriram et al., 2018; Takizawa et al., 2006). The evidence shows both direct and indirect beneficial effects of social support on HWB (Bjornestad et al., 2019; Furey et al., 2016; House et al., 1988; Matel-Anderson et al., 2019; Sarason & Sarason, 2009; Takizawa et al., 2006). Therefore, the purpose of this study was to use social network methodologies to understand the characteristics of FOs' social networks that may influence their access to social support resources related to ORS and HWB.

FOs in this study reported a number of characteristics to indicate they had potential for high levels of engagement within their local farming communities. Composite measures for FOs showed high social influence, but low connectedness and low social integration. These findings suggest that social networks of FOs for ORS and HWB would be small, sparse, and fragmented, and this was confirmed through social network analysis (Berkman, 2000; Hill & Dunbar, 2003; Kallioniemi et al., 2016; Wood et al., 2014). FOs had a preference to form ties with alters who were engaged in farming or farm-related

activities, and with whom they had long-standing relationships. Greater comfort discussing ORS and HWB was observed among members of personal networks than affiliation networks, with FOs reporting the greatest comfort with female alters. FOs also reported a preference for family members and friends in their personal networks. Inconsistent with prior study findings (Cofré-Brown et al., 2019; Mailfert, 2007), status as a farmer was not associated with high levels of comfort discussing ORS and HWB, and the number of alters was positively associated with levels of ORS.

Narrative responses from participants intimated that decades-long shifts in the agricultural industry have contributed to rising levels of ORS and negatively affected their HWB. It was not possible from the study data to determine whether these factors have eroded the historically strong bonds between farmers, leading to lower levels of social engagement and connectedness. Findings show that FOs access information related to ORS and HWB from only a few friends or family members, and a spousal effect is possible. Both male and female FOs access more sources of support through resources, such as farm papers and farm magazines, than through alters in the four social networks studied, and may indicate a reluctance to talk with other farmers. The resources used by FOs differed by gender, and suggest different approaches for by gender may be most appropriate for addressing health disparities among farmers and FOs.

Based on these findings, several features of FOs' social networks may be suitable to inform targeted interventions to improve access to social support for mitigating ORS. FOs had greater comfort discussing ORS and HWB with females, family members or friends, and those who are also engaged in farming. Designing interventions for female farmers and FOs that include deliberate plans for diffusing the intervention to male FOs may be an effective means for introducing health promotion activities or programs into this population. Engaging female FOs or female leaders in trusted local farming organizations in the development of interventions may increase access to farmers and FOs and improve cultural relevance of interventions. Farm papers and farm magazines could be leveraged to reach FOs with information and messaging, or to recruit participants for research studies. Based on communication preferences, work demands, and lack of conceptual clarity between personal HWB and occupational

health and safety, interventions should allow for face-to-face interactions, be offered locally and at a convenient time for the FOs, and focus specifically on personal HWB. Knowing the intense competition that exists between farmers, interventions should be developed such that FOs do not have to share information about their HWB or their farm with other participants. It may also be beneficial to organize intervention implementation and dissemination based on farm size to reduce potential tensions between "family farmers" and "corporate farmers" if interactions among participants is expected.

Investigators have studied ORS in farmers for over four decades, including the sources, nature, and health effects of stress. Study results show that little has changed over this time. Economic concerns, high workloads, time pressures, and the unpredictable nature of farming remain sources ORS for FOs in this study, and farmers across the globe (Alpass et al., 2004; Ang, 2010; Bondy & Cole, 2019; Fragar et al., 2010; Kallioniemi et al., 2016; Kearney et al., 2014). In more recent years, with agriculture more dependent on global markets, shifts to industrialization of farming practices, implementation of technology, and greater extremes in weather due to climate change, new stressors have emerged (Ang, 2010; Inwood et al., 2021; 2020; Kennedy et al., Klärner & Knabe, 2019; Sligo & Massey, 2007). Some researchers have posited that the nature of stress in farming has changed (Besser et al., 2017; Inwood et al., 2021).

Findings from this study have significant potential to change how investigators approach research among farming populations. Assumptions about farmers' social networks that are based on prior research underpin contemporary approaches toward farmer HWB. However, social networks of FOs for ORS and HWB have a unique composition and structure (Deseran, 1985; Dubar & Spoors, 1995). This is a fundamental premise of social network science (Perry et al., 2018), was supported by a 2019 study of farmers' social networks (Cofré-Bravo et al., 2019), and affirmed by findings from this study. A closely related assumption refuted by findings from this study, was that FOs conceptualize personal HWB in the same manner as occupational health and safety. Differences in network size, composition, structure, and resource use by FOs challenge this assumption and provide rationale for researchers to pursue conceptual clarity, without which interventions may lack significant impact.

Different approaches are needed to address health disparities research among farming populations, and assumptions about how farmer and farm families conceptualize and approach their personal HWB must be challenged. Greater attention should be given to the social, economic, and political history that underly the current context of production agriculture. Farming is often described as a way of life, with the difficulty of separating work and home emphasized (Roy et al., 2017; Kunde et al, 2018; Sorensen et al., 2017; Wilson & Tonner, 2020). Perhaps these notions conflated researchers' understandings of farmer's personal HWB and occupational health and safety. Study findings support the value of working collaboratively with farmers and farm families to identify priority areas for research and confirm the importance of grounding health promotion programing and research in the current science. Doing so will expose assumptions that underly conceptualizations of farmer HWB, prompt researchers to test those presuppositions, ground interventions in historical contexts, and advance the state of the science (Kagawa Singer et al., 2016; Lombardi et al., 2020). Aligning research funding and priorities with empirical evidence ensures interventions are culturally appropriate and increases the impact interventions are likely to have on health disparities among FOs.

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Appendices

Appendix A
Tables

Table 1
Definition of Terms

Term	Definition
Farm	"Any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year" (USDA National Agricultural Statistics Service, 2019, p. VII)
Farming	Engagement in activities on a farm that result in the production of agricultural commodities (USDA National Agricultural Statistics Service, 2019)
Farmer	Anyone who self-identifies as employed in production agriculture on a farm (as defined by the USDA) (USDA National Agricultural Statistics Service, 2019)
Farm worker	An individual who is paid to work on a farm, including paid family members
Farm owner-operator	An individual who operates land that they own and who is responsible for making decisions for the farming operation
Distress	Stress that is perceived as negative, threatening, or harmful, or stress that elicits a maladaptive response
Farmer health and well-being	A state of being in which a farmer rates their health (as defined by the WHO) as good or better, is able to engage in the work of the farm, and is free of farm-related distress.

Table 2
Mental Health Providers by Rural-Urban Designation

Counties Without Mental Health Providers						
Provider type	United States		Urban counties		Rural counties	
	n	%	*n*	%	*n*	%
Psychiatrists	1,606	51	315	27	1,291	65
Psychologists	1,153	37	218	19	935	47
Social Workers	641	20	102	9	539	27
Psych-Mental Health NP	2,092	67	491	42	1,601	81
Counselors	430	14	67	6	363	18
All mental health care providers	284	9	32	3	252	13
Mental Health Providers per 100,000 Population						
Provider type	United States		Urban counties		Rural counties	
	Rate	*n*	Rate	*n*	Rate	*n*
Psychiatrists	15.6	50,232	17.5	47,530	5.8	2,702
Psychologists	30.0	96,307	33.2	89,985	13.7	4,604
Social Workers	61.5	197,813	66.4	179,831	38.9	12,336
Psych-Mental Health NP	2.1	6,772	2.2	6,014	1.6	580
Counselors	112.1	360,217	118.1	320,116	86.7	27,457

Note. Source (Larson et al., 2016)

Table 3
Composite Variable Descriptions

Composite Variable	Brief Description of Factors Included
Culture	Memberships; organizations; events; commodities; generational farm; relationship status; children
Socioeconomic status	Commodities; education
Politics	Memberships; organizations; events; work status; primary role
Socioecological levels	
Local	Local memberships; local organizations; local events
State	State memberships; local organizations; local events
National	State memberships; local organizations; local events
Network structure	Memberships; organizations; events, alters; gender of FO and alter; kin and non-kin relational ties; years in farming; commodities
Network ties	Frequency and duration of contacts by tie type; comfort by tie type
Network members	Primary role; commodities; memberships; organizations; events; relationship status; generational farm; relationship status; children
Social support	Alters; memberships; organizations; events; commodities; comfort by tie type
Social influence	Memberships; organizations; events; commodities; generational farm; age; total years farming work
Social engagement	Frequency of connection by tie type; memberships; events; children
Person-to-person contact (intimate)	Relationship status; children; kin ties
Person-to-person contact (non-intimate)	Mode of contact by frequency; children
Access to resources	Education; technology use; memberships; organizations; events; alters
Distress	Risk by self-rated level of occupational stress
Connectedness	Number of connections; use of technology
Proximity	Closeness; shared experiences, gender, and age with alters; kin ties
Social integration	Connectedness and proximity

Table 4
Indicator Variable Descriptions

Indicator Variables	Brief Description of Proxy Indicator
Social Support	
Nature	Relational tie types
Appraisal	Comfort discussing ORS and HWB
From: objective and subjective	Not measured
Function: Emotional, instrumental, informational, appraisal	Not evaluated
Social Networks	
Content	FOs, alters, memberships, organizations, events, resources
Structure	Relational ties
Resource flow	Via relational ties
Function	Specified: information or resources related to ORS and HWB
Strength	
Durability	Duration of relational ties and type of relational tie
Stability	Duration of relational ties
Strength	Comfort discussing ORS and HWB
Ties	
Sentiment	Comfort discussing ORS and HWB
Frequency	Frequency of contact
Strength	Duration of relational tie and type of relational tie
Type	Relationship between FO and alter
Function	Comfort discussing ORS and HWB
Network Measures	
Degree	Number of connections by alter type and overall
Density	Calculated for affiliation networks only
Centrality	Calculated for affiliation networks only
Position	Based on calculations for affiliation networks only

Table 5

Example of Development of Qualitative Codes and Themes

Narrative Response of Participant							
"It is stressful as a young family farmer to compete against corporate farms, investor farms, and "outside income" farms. In this area at least, I speak for the remaining family farms that are still hanging on. The gap is getting larger between investor/corporate farms and family farming and it leaves family farms, like us, getting pushed out. *WE FLAT OUT CANNOT COMPETE and still generate income." (P37)							
Initial Words and Phrases Extracted					Provisional Semantic Codes		Provisional Latent Codes
competition against corporate farms is stressful	part of "remaining" family farms "still hanging on"	growing gap	getting pushed out	cannot compete and generate income (one or the other)	competition *against*		futility: hard work and desire isn't enough
	stressful				stressful		
	farmer	young family farmer			farmer	young family farmer	who you are, what kind of farm matters
		family farmer			family farmer		
	farms	family farms	remaining	still hanging on	farms	family farms	
			(like) us		remain/hang on	us/them	Irreconcilable?
		corporate farms			corporate farms		
		investor farms					
		"outside income" farms					foreign, different, other, not from here
	compete				compete		
	in this area	at least	I speak for	remaining family farms	here/belonging (?)	identify as "remaining"/ part of this group "remaining	sense of belonging or membership
	gap	getting larger			growing gap		

			between	investor/corporate farms	us/them	corporate vs family farms	
			family farms				
		leaves	family farms		family farms pushed out		
			pushed out		corporate farms push family farms out		no options; can't stay even if we want to
	WE				us/them		
	FLAT OUT	CANNOT	COMPETE		cannot compete		
	still	generate	income		cannot compete AND generate income	one or the other	frustration; either or, no middle ground

Table 6
Final Coding Scheme with Aggregation and Generation into Themes

Themes	Semantic Codes	Latent Codes
The reality of ag right now	Too much work	Sense of futility
	Problems don't change	Unseen farm women
	Making ends meet	Division among farmers
	Stressful	
	Poor mental health	
Being torn apart	Market prices	Structural inequalities
	Public awareness	Eligibility vs. deserving
	Family vs. corporate farms	Agency and empowerment
Being pushed out	Competition	No options
	Income and profit	What's left over
	Out of business	
	Hanging on	

Table 7
Participant Recruitment and Sample Size

Measure	*n*
Initial sample size	385
Duplicates	6
Ineligible	251
Deceased	11
Not farmer	29
Not Adams resident	135
Amish	7
Retired	50
Mail returned	19
Final sample size	128
Declined	16
Returned	71
No response	41
Rates	%
Opt-out rate	12.5
Response rate	55.5
Non-response rate	32.0

Table 8
Farm Owner-Operator Demographic Information

Demographics (*n*=71)	*n*	%
Age (range 23-90 years)		
23-44 years	11	15.5
46-60 years	19	26.8
61-75 years	26	36.6
76-90 years	9	12.7
Not reported	6	8.5
Race		
White	60	84.5
More than one race	1	1.4
Not disclosed	1	1.4
Not reported	9	12.7
Ethnicity		
Hispanic or Latino	1	1.4
Not Hispanic or Latino	62	87.3
Not reported	8	11.3
Gender		
Female	10	14.1
Male	53	74.7
Not disclosed	1	1.4
Not reported	7	9.9
Relationship status		
Live-in partner	1	1.4
Married	51	71.8
Widowed	3	4.2
Separated	1	1.4
Divorced	2	2.8
Never married	7	9.9
Not reported	6	8.5
Has children (range 1-4)	57	80.3
Educational attainment		
Some high school	2	2.8
High School graduate or GED	2	2.8
Some college	24	33.8
Associate degree	18	25.4
Bachelor's degree	5	7.0
Graduate degree	13	18.3
Choose not to disclose	3	4.2
Not reported	4	5.6

Table 9

Characteristics of Farm Owner-Operators

Characteristics (*n*=71)	*n*	%
Primary role		
Sole owner-operator	40	56.3
Co-owner-operator	30	42.3
Not reported	1	1.4
Work status		
Full-time	37	52.1
Part-time	34	47.9
Usual hours worked weekly		
1-20 hours	21	29.6
21-40 hours	15	21.1
41-60 hours	14	19.7
61-80 hours	12	16.9
81+ hours	9	12.7
Hours worked weekly at peak		
1-20 hours	9	12.7
21-40 hours	12	16.9
41-60 hours	12	16.9
61-80 hours	11	15.5
81+ hours	27	38.0
Commodities produced*		
Beef	37	52.1
Dairy	19	26.8
Goats	1	1.4
Poultry	5	7.0
Fruits or vegetables	13	18.3
Grains	54	76.1
Horses	4	5.6
Alfalfa	19	26.7
Total Years farming		
<20 years	7	9.9
20-45 years	24	33.8
46-60 years	24	33.8
61+ years	13	18.3
Not reported	3	4.2
Generational farm		
Yes**	46	64.8
No	23	32.4
Not reported	2	2.8
Farm stress		
1-No stress	4	5.6
2	9	12.7
3	9	12.7
4	22	31.0
5	16	22.5
6-Extreme stress	8	11.3

*Participants could select more than one response

**All participants reported having a transition plan

Table 10

Comparison of Demographic Characteristics Between Study Sample and Farm Owner-Operators in County and State and County

Characteristics	Study Sample (*n*=71)		County (*n*=437)		State (*n*=88,022)	
	n	%	*n*	%	*n*	%
Gender identity						
Males	53	74.7	320	73.2	64,515	73.3
Females	10	14.1	117	26.8	23,507	26.7
Work Status						
Full-time	37	52.1	223	51.0	42,678	48.5
Number years farming (mean)	47.0		25.5		NR	
<6 years	0	0.0	44	10.1	8,292	9.4
6-10 years	3	4.2	32	7.3	8,889	10.1
11+ years	65	91.5	361	82.6	70,841	80.5
Age (mean)	59.4		58.7		57.1	
<25 years	2	2.8	0	0.0	722	0.8
26-34 years	2	2.8	27	6.2	5,660	6.4
35-44 years	7	9.9	42	9.6	9,971	11.3
45-54 years	10	14.1	81	18.5	17,522	19.9
55-64 years	20	28.2	110	25.2	27,232	30.9
65-74 years	14	19.7	136	31.1	18,743	21.3
75+ years	10	14.1	41	9.4	8,172	9.3
Racial and ethnic identity						
American Indian or Alaska Native	0	0.0	0	0.0	144	0.2
Asian	0	0.0	0	0.0	371	0.4
Black or African American	0	0.0	0	0.0	62	0.07
Native Hawaiian or Other Pacific Islander	0	0.0	0	0.0	11	0.01
White	62	84.5	433	99.1	87,325	99.2
More than one race	1	1.4	1	0.9	109	0.1
Race not reported	10	14.1	NA		NA	
Hispanic	1	1.4	1	0.2	4720	0.5

Relationship status						
Single	14	19.7	191	43.8	42,603	48.4
Married**	51	71.8	245	56.0	45,419	51.6
Educational attainment						
Less than high school	2	2.8	55	12.5	7,658	7.8
High school	2	2.8	186	42.6	26,935	30.6
Some college	24	33.8	136	31.1	27,727	31.5
Bachelor's degree	23	32.4	41	9.3	17,340	19.7
Graduate degree	13	18.3	20	4.6	9,154	10.4
Technology use or access						
Internet access for farm	51	71.8	358	82.0	NR	
Desktop or laptop access for farm	54	76.1	336	77.0	NR	
Smartphone or tablet for farm	61	85.9	197	45.0	NR	

Note. Significance testing only between county and study data. NA=Not applicable; NR=Not reported. $p \leq 0.05$

Table 11
Summary Characteristics of Farm Owner-Operators Overall and by Gender

Descriptor (*n*=71)	*n*	Mean	*SD*	Range
Age	65	59.4	*15.1*	23-90
Males	55	60.1	*13.5*	23-90
Females	10	55.6	*22.3*	23-83
Usual work hours per week	65	43.0	*26.7*	1-135
Males	57	45.0	*27.3*	1-135
Full-time**	28	62.2	*25.3*	12-135
Part-time	29	28.4	*17.1*	1-70
Females	8	28.4	*16.1*	16-55
Full-time	4	36.5	*17.1*	16-55
Part-time	4	20.3	*11.8*	16-55
Busy work hours per week	66	64.6	*31.6*	1-140
Males†	58	68.3	*30.9*	1-140
Full-time†	29	86.3	*25.5*	16-140
Part-time	29	50.3	*24.9*	1-98
Females	8	37.8	*24.0*	6-75
Full-time	4	44.0	*26.2*	16-75
Part-time	4	31.5	*23.6*	6-60
Total years farming	68	47.0	*18.3*	6-82
Males	58	47.7	*17.1*	10-78
Females	10	42.9	*24.8*	6-82
Farm stress	68	3.9	*1.4*	1-6
Males	58	3.7	*1.4*	1-6
Full-time	30	4.0	*1.1*	2-6
Part-time	28	3.4	*1.6*	1-6
Females**	10	4.8	*1.0*	1-6
Full-time	6	4.5	*1.0*	3-6
Part-time**	4	5.5	*1.0*	4-6

Note. Statistical testing between gender includes males and females only.
**$p \leq 0.05$; †$p \leq 0.01$

Table 12

Farm Owner-Operator Characteristics by Level of Stress Overall

Characteristic	None 1		2		3		4		5		Extreme 6	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Farm owner-operators (*n*=68)	4	5.9	9	13.2	9	13.2	22	32.3	16	23.5	8	11.7
Age range (*n*=68)												
20-44 years	0	0.0	0	0.0	0	0.0	4	5.9	6	8.8	1	1.5
46-60 years	1	1.5	2	2.9	3	4.4	7	10.3	2	2.9	4	5.9
61-75 years	2	2.9	5	7.3	3	4.4	8	11.7	4	5.9	3	4.4
76-90 years	1	1.5	2	2.9	3	4.4	3	4.4	4	5.9	0	0.0
Gender (*n*=68)												
Female**	0	0.0	0	0.0	1	1.5	3	4.4	3	4.4	3	4.4
Male	4	5.9	9	13.2	8	11.8	19	27.9	13	19.1	5	7.4
Relationship status (*n*=64)												
Married or live-in partner	4	6.2	7	10.9	8	12.5	16	25.0	11	17.2	5	7.8
Widowed	0	0.0	0	0.0	1	1.5	2	3.1	0	0.0	0	0.0
Divorced or separated	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	2	3.1
Never married	0	0.0	1	1.5	0	0.0	3	4.7	2	3.1	1	1.5
Educational attainment (*n*=65)												
High school/GED or less	0	0.0	0	0.0	0	0.0	1	1.5	3	4.6	0	0.0
Some college	2	3.1	3	4.6	5	7.7	7	10.8	6	9.2	1	1.5
Associate degree	1	1.5	2	3.1	2	3.1	5	7.7	2	3.1	4	6.1
Bachelor's degree	0	0.0	1	1.5	0	0.0	1	1.5	1	1.5	2	3.1
Some graduate school	1	1.5	2	3.1	1	1.5	6	9.2	2	3.1	1	1.5
Primary role (*n*=65)												
Sole owner	3	4.6	4	6.1	5	7.7	14	21.5	8	12.3	5	7.7
Co-owner	1	1.5	5	7.7	4	6.1	6	9.2	7	10.8	3	4.6
Work status (*n*=68)												
Full-time	0	0.0	3	4.4	7	10.3	12	17.6	11	16.2	3	4.4
Part-time	4	5.9	6	8.8	2	2.9	10	14.7	5	7.3	5	7.3
Usual weekly hours (*n*=68)												
40 hours or less	4	5.9	7	10.3	3	4.4	12	17.6	4	5.9	5	7.4
41-60 hours	0	0.0	0	0.0	5	7.3	4	5.9	4	5.9	1	1.5
60+ hours	0	0.0	2	2.9	1	1.5	6	8.8	8	1.7	2	2.9
Generational farm (*n*=68)												
Yes	2	2.9	6	8.8	4	5.9	16	23.5	11	16.2	7	10.3
No	2	2.9	3	4.4	5	7.3	6	8.8	5	7.3	1	1.5
Commodities* (*n*=68)												
Beef	0	0.0	6	8.8	6	8.8	12	17.6	7	10.3	5	7.3
Dairy**	0	0.0	1	1.5	2	2.9	6	8.8	6	8.8	4	5.9
Fruits or vegetables	0	0.0	2	2.9	1	1.5	5	1.3	4	5.9	1	1.5
Field crops	2	3.0	10	14.7	7	10.3	28	41.1	16	23.5	9	13.2
Total years farming (*n*=68)												
< 20 years	0	0.0	0	0.0	0	0.0	2	2.9	4	5.9	1	1.5
20-45 years	0	0.0	3	4.4	2	2.9	12	17.6	6	8.8	1	1.5
47-60 years	4	5.9	2	2.9	4	5.9	4	5.9	4	5.9	5	7.3
62+ years	0	0.0	4	5.9	3	4.4	4	5.9	2	2.9	1	1.5

*Participants could select more than one response; **$p \leq 0.05$

Note. Shaded areas represent greatest proportion by group. Cell percentages reported

Table 13

Occupational-Related Distress Among Farm Owner-Operators (n=68)

Risk level	*n*	%
Low risk: Self-reported stress of 1-2	13	18.3
Males	13	21.3
Females	0	0
High risk: Self-reported stress of 3-4	31	43.7
Males	27	44.3
Females	4	40.0
Distressed: Self-reported stress of 5-6	24	33.8
Males	18	29.5
Females	6	60.0
Characteristics of farm owner-operators by distress	**Mean**	***SD***
Usual hours worked weekly		
Distressed	53.4	*30.6*
Not distressed	38.5	*23.6*
Hours worked weekly during peak production		
Distressed	70.4	*33.6*
Not distressed	61.7	*30.6*
Number of alters		
Distressed	3.2	*3.5*
Not distressed	2.0	*1.9*
Number of memberships		
Distressed	1.5	*1.7*
Not distressed	0.9	*1.1*
Number of organizations		
Distressed	0.9	*1.5*
Not distressed	0.5	*1.0*
Number of events		
Distressed	1.1	*1.5*
Not distressed	0.9	*1.3*
Number of total sources		
Distressed	6.8	*2.9*
Not distressed	5.8	*3.3*

Table 14
Use of Technologies by Farm Owner-Operators

Broadband and cellular (*n*=71)	Yes		No		Choose not to use		Use an alternate		Not reported	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Stable internet access										
At home	51	71.8	13	18.3	3	4.2	0	0	4	5.6
On farm	25	35.2	31	43.7	9	12.7	1	1.4	5	7
Cellular service	57	80.3	5	7.0	4	5.6	1	1.4	4	5.6

Devices in use (*n*=71)	Yes		No		Not reported	
	n	%	*n*	%	*n*	%
Desktop	31	43.7	36	50.7	4	5.6
Laptop	35	49.3	32	45.1	4	5.6
Tablet	20	28.2	47	66.2	4	5.6
Smartphone	41	57.8	26	36.6	4	5.6

Number of technologies* used by gender (*n*=64)	Male		Female		Not disclosed	
	n	%	*n*	%	*n*	%
	3.4 (*1.8*)	M (*SD*)	3.3 (*2.1*)	M (*SD*)		
0	2	3.1	2	3.1	0	0.0
1	3	4.7	0	0.0	0	0.0
2	7	10.9	1	1.6	0	0.0
3	14	21.9	1	1.6	0	0.0
4	11	17.2	3	4.7	0	0.0
5	9	14.1	2	3.1	0	0.0
6	7	10.9	1	1.6	1	1.6

*Includes: Internet at home, Internet on farm, cellular service, desktop computer, laptop computer, tablet, or smartphone; Cell percentages reported

Table 15

Resource Use by Farm Owner-Operators Overall and by Gender

Resource (*n*=71)	Would never use		Likely to use		Have used	
	n	%	*n*	%	*n*	%
Podcast	36	67.9	10	18.9	7	13.2
Male	33	71.7	9	19.6	4	8.7
Female	3	42.9	1	14.3	3	42.9
National Public Radio	24	40.7	7	11.9	28	47.5
Male	18	36.0	6	12.0	26	52.0
Female	6	66.7	1	11.1	2	22.2
Radio	23	41.8	14	25.4	18	32.7
Male	17	36.2	13	27.7	17	36.2
Female	6	75.0	1	12.5	1	12.5
YouTube	18	33.3	9	16.7	27	50.0
Male	16	34.8	6	13.0	24	52.2
Female	2	25.0	3	37.5	3	37.5
Farm Magazines	4	6.4	8	12.9	50	80.6
Male	3	11.1	7	13.2	43	81.1
Female	1	11.1	1	11.1	7	77.8
Farm Papers	3	4.8	11	17.7	48	77.4
Male	2	3.7	10	18.5	42	77.8
Female	1	12.5	1	12.5	6	75.0
Cooperatives	7	11.7	15	25.0	38	63.3
Male	5	9.4	14	26.4	34	64.2
Female	2	28.6	1	14.3	4	57.1
UW Extension	12	19.1	19	30.2	32	50.8
Male	10	18.5	17	31.5	27	50.0
Female	2	22.2	2	22.2	5	55.6
DATCP	13	23.6	17	30.9	25	45.4
Male	10	20.8	16	33.3	22	45.8
Female	3	42.9	1	14.3	3	42.9
DHS	32	65.3	15	30.6	2	4.1
Male	27	64.3	14	33.3	1	2.4
Female	5	71.4	1	14.3	1	14.3
NFMC	34	66.7	13	25.5	4	7.8
Male	29	65.9	13	29.6	2	4.6
Female	5	71.4	0	0.0	2	28.6
AgrAbility	36	76.6	10	21.3	1	2.1
Male	31	77.5	8	20.0	1	2.5
Female	5	71.4	2	28.6	0	0.0

Note. UW Extension=University of Wisconsin Extension; DATCP=Department of Trade and Consumer Protection; DHS=Wisconsin Department of Health Services; NFMC=National Farm Medicine Center

Table 16
Number of Connections by Actor Type

Type of actor (*n*=71)	*n*	%
Number of alters	2.4 (*2.6*)	M (*SD*)
0	16	22.5
1	14	19.7
2	12	16.9
3	11	15.5
4	10	14.1
5	2	2.8
6	2	2.8
7	2	2.8
9	1	1.4
16	1	1.4
Number of memberships	1.1 (*1.4*)	M (*SD*)
0	28	40.6
1	25	36.2
2	5	7.3
3	6	8.7
4	3	4.4
5	1	1.5
6	1	1.5
Number of organizations	0.6 (*1.1*)	M (*SD*)
0	52	73.2
1	4	5.6
2	7	9.9
3	5	7.0
4	3	4.2

Number of events	1.0 (*1.3*)	M (*SD*)
0	37	54.4
1	13	19.1
2	7	10.3
3	6	8.8
4	4	5.9
5	1	1.5
Number of resources	6.1 (*3.2*)	M (*SD*)
0-3	13	18.3
4-6	24	33.8
7-9	25	35.2
10-12	9	12.7
Total number of connections	8.8 (*4.9*)	M (*SD*)
0-3	11	15.5
4-6	11	15.5
7-9	15	21.1
10-12	21	29.6
13-16	10	14.1
17-23	3	4.3

Table 17

Number of Connections by Actor Type and Gender of Farm Owner-Operator

Type of actor	Male		Female	
	n	%	*n*	%
Number of alters (*n*=71)	2.1 (*2.0*)	M (*SD*)	4.3 (*4.5*)	M (*SD*)
0	15	21.1	1	1.4
1	13	18.3	1	1.4
2	9	12.7	3	4.2
3	11	15.5	0	0.0
4	9	12.7	1	1.4
5	0	0.0	2	2.8
6	1	1.4	1	1.4
7	2	2.8	0	0.0
9	1	1.4	0	0.0
16	0	0.0	1	1.4
Number of memberships (*n*=69)	1.0 (*1.3*)	M (*SD*)	1.8 (*1.6*)	M (*SD*)
0	26	37.7	2	2.9
1	21	30.4	4	5.8
2	5	7.2	0	0.0
3	3	4.3	3	4.3
4	3	4.3	0	0.0
5	0	0.0	1	1.4
6	1	1.4	0	0.0
Number of organizations (*n*=71)	0.6 (*1.2*)	M (*SD*)	0.7 (*1.3*)	M (*SD*)
0	45	63.4	7	9.8
1	3	4.2	1	1.4
2	6	8.4	1	1.4
3	5	7.0	0	0.0
4	2	2.8	1	1.4
Number of events (*n*=68)	0.9 (*1.2*)	M (*SD*)	1.5 (*1.8*)	M (*SD*)
0	33	48.5	4	5.9
1	10	14.7	3	4.4
2	7	10.3	0	0.0
3	5	7.3	1	1.5
4	3	4.4	1	1.5
5	0	0.0	1	1.5
Number of resources (*n*=71)	2.4 (*0.9*)	M (*SD*)	2.2 (*1.0*)	M (*SD*)
0-3	10	14.1	3	4.2
4-6	21	29.6	3	4.2
7-9	22	31.0	3	4.2
10-12	8	11.3	1	1.4
Total number of sources (*n*=71)	6.3 (*3.2*)	M (*SD*)	5.2 (*3.0*)	M (*SD*)
0-3	9	12.7	2	2.8
4-6	9	12.7	2	2.8
7-9	13	18.3	2	2.8
10-12	20	28.2	1	1.4
13-16	8	11.3	2	2.8
17-23	2	2.8	1	1.4

Table 18
Comparison of Farm Owner-Operators with and Without Connections by Actor Type and Gender

Type of actor	Males (*n*=61)				Females (*n*=10)			
	Connections		No Connections		Connections		No Connections	
	n	%	*n*	%	*n*	%	*n*	%
Alters	46	64.8	15	21.1	9	12.7	1	1.4
Memberships	33	46.5	28	39.4	8	11.3	2	2.8
Organizations	16	22.5	45	63.4	3	4.2	7	9.9
Events	25	35.2	36	50.7	6	8.4	4	5.6

Table 19

Number of Connections by Actor Type and Level of Farm Stress

Type of actor	None 1		2		3		4		5		Extreme 6	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Number of alters (*n*=68)**												
0	3	4.4	3	4.4	0	0.0	3	4.4	3	4.4	1	1.5
1	0	0.0	2	2.9	4	5.9	3	4.4	5	7.3	0	0.0
2	0	0.0	3	4.4	1	1.5	5	7.3	3	4.4	0	0.0
3	0	0.0	1	1.5	1	1.5	5	7.3	1	1.5	3	4.4
4	1	1.5	0	0.0	3	4.4	3	4.4	1	1.5	2	2.9
5	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0	1	1.5
6	0	0.0	0	0.0	0	0.0	1	1.5	1	1.5	0	0.0
7	0	0.0	0	0.0	0	0.0	0	0.0	2	2.9	0	0.0
9	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0	0	0.0
16	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5
Number of memberships (*n*=68)												
0	2	2.9	4	5.9	4	5.9	9	13.2	6	8.8	2	2.9
1	2	2.9	4	5.9	2	2.9	9	13.2	6	8.8	2	2.9
2	0	0.0	1	1.5	1	1.5	2	2.9	0	0.0	1	1.5
3	0	0.0	0	0.0	1	1.5	1	1.5	2	2.9	2	2.9
4	0	0.0	0	0.0	1	1.5	1	1.5	1	1.5	0	0.0
5	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0
6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5

Number of organizations (*n*=68)												
0	4	5.9	7	10.3	7	10.3	14	20.6	12	17.6	5	7.3
1	0	0.0	0	0.0	0	0.0	4	5.9	0	0.0	0	0.0
2	0	0.0	2	2.9	1	1.5	2	2.9	1	1.5	1	1.5
3	0	0.0	0	0.0	1	1.5	1	1.5	1	1.5	2	2.9
4	0	0.0	0	0.0	0	0.0	1	1.5	2	2.9	0	0.0
Number of events (*n*=67)												
0	3	4.5	5	7.4	4	5.8	12	17.9	8	11.9	5	7.4
1	1	1.5	1	1.5	1	1.5	5	7.4	4	5.9	0	0.0
2	0	0.0	2	3.0	1	1.5	2	3.0	2	3.0	0	0.0
3	0	0.0	0	0.0	2	3.0	1	1.5	1	1.5	2	3.0
4	0	0.0	0	0.0	1	1.5	2	3.0	0	0.0	1	1.5
5	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0
Number of resources (*n*=68)												
0-3	2	2.9	2	2.9	0	0.0	3	4.4	3	4.4	0	0.0
4-6	2	2.9	2	2.9	5	7.3	8	11.7	5	7.3	2	2.9
7-9	0	0.0	4	5.9	3	4.4	7	10.3	8	11.7	3	4.4
10-12	0	0.0	1	1.5	1	1.5	4	5.9	0	0.0	3	4.4
Total number of sources (*n*=68)												
1-3	2	2.9	2	2.9	0	0.0	2	2.9	2	2.9	0	0.0
4-6	1	1.5	1	1.5	2	2.9	2	2.9	4	5.9	1	1.5
7-9	1	1.5	2	2.9	2	2.9	6	8.8	4	5.9	0	0.0
10-12	0	0.0	4	5.9	3	4.4	9	13.2	2	2.9	3	4.4
13-16	0	0.0	0	0.0	1	1.5	3	4.4	3	4.4	3	4.4
17-23	0	0.0	0	0.0	1	1.5	0	0.0	1	1.5	1	1.5

Note. Shaded areas greatest proportion by group; ***p* ≤0.05

Table 20
Characteristics of Alters and Alter Ties

Characteristics	*n*	%
Gender of alter (*n*=161)		
Female	48	29.8
Male	113	70.2
Age range (*n*=166)		
18-24 years	4	2.4
25-44 years	38	22.9
45-64 years	81	48.8
65+ years	43	25.9
Alter is a farmer (*n*=167)	142	85.0
Male (*n*=112)	95	59.4
Female (*n*=48)	41	25.6
Type of relational tie (*n*=169)		
Family	69	40.8
Friend	61	36.1
Neighbor	19	11.2
Coworker	7	4.1
Other	13	7.7
Duration of relationship (*n*=165)		
1-5 years	18	10.9
6-10 years	15	9.1
10+ years	132	80.0
Mode of contact* (*n*=167)		
Face-to-face	145	86.8
Phone	113	67.7
Text	58	34.7
Email	19	11.4
Number of contacts (*n*=143)		
1-5	113	79.0
6-10	24	16.8
12-25	3	2.1
30-100	3	2.1
Frequency of contact (*n*=155)		
Weekly	78	50.3
Monthly	49	31.6
Yearly	24	15.5
Varies	4	2.6
Average minutes per contact (*n*=138)		
3-10	16	11.6
15-25	15	10.9
30-60	77	55.8
90-180	25	18.1
240-600	5	3.6
Level of comfort with alter (*n*=161)		
Not comfortable	15	9.3
Low comfort	26	16.1
Moderate comfort	69	42.9
High comfort	51	31.7

*Participants could select more than one response

Table 21
Characteristics of Alters and Alters' Ties by Mode of Contact

Characteristic	Face-to-face		Phone		Text		Email	
	n	%	*n*	%	*n*	%	*n*	%
Alter sex (*n*=159)								
Male	94	59.1	79	49.7	38	23.9	9	5.7
Female	44	27.7	31	19.5	20	12.6	9	5.7
Age range (n=166)								
18-24 years	4	2.4	2	1.2	1	0.6	0	0
25-44 years	32	19.3	27	16.3	20	12.1†	8	4.8
45-64 years	69	41.6	55	33.1	27	16.3	7	4.2
65+ years	39	23.5	29	17.5	10	6.0	4	2.4
Alter is farmer (*n*=166)								
Yes	126	75.9**	97	58.4	49	29.5	15	9.0
No	18	10.8	15	9.0	9	5.4	4	2.4
Type of relation (*n*=165)								
Family	62	37.6	37	22.4‡	20	12.1	7	4.2
Friend	48	29.1	46	27.9**	24	14.6	6	35.8**
Neighbor	18	10.9	13	7.9	4	2.4	0	0.0
Coworker	7	4.2	5	3.0	1	0.6	1	0.6
Other	8	4.9	10	6.0	7	4.2	5	3.0
Duration of relationship (*n*=163)								
1-5 years	15	9.2	10	6.1	7	4.3	2	1.2
6-10 years	13	8	10	6.1	6	3.7	2	1.2
10+ years	113	69.3	93	57.1	45	27.6	15	9.2

Note. Participants could select more than one mode of contact
**$p \leq 0.05$; †$p \leq 0.01$; ‡$p \leq 0.001$

Table 22
Characteristics of Farm Owner-Operators and Their Ties by Alter Gender

Characteristic	Alters			
	Male		Female	
Farm Owner-Operators	*n*	%	*n*	%
Sex (*n*=159)				
Male	84	52.8	36	22.7
Female	28	17.6	11	6.9
Relation with alter (*n*=159)				
Family	41	25.8	25	15.7**
Friend	43	27.0	13	8.2
Neighbor	15	9.4	3	1.9
Coworker	7	4.4	0	0.0
Other	6	3.8	6	3.8
Comfort (*n*=161)				
Not comfortable	12	7.8	2	1.3
Low comfort	22	14.3	4	2.6**
Moderate comfort	46	29.8	18	11.7
High comfort	27	17.5	23	14.9†

*$p<0.05$; †$p\leq0.01$

Table 23
Characteristics of Alters and Alters' Ties by Level of Comfort

Characteristic	Level of comfort							
	Not comfortable		Low comfort		Moderate comfort		High comfort	
	n	%	*n*	%	*n*	%	*n*	%
Alter sex (*n*=154)								
Male	12	7.8	22	14.3	46	29.9	27	17.5
Female†	2	1.3	4	2.6	18	11.7	23	14.9†
Alter is a farmer (*n*=159)								
Yes	11	6.9	22	13.8	56	35.2	46	28.9
No	3	1.9	4	2.5	12	7.5	5	3.1
Age range (*n*=159)								
18-24 years	0	0.0	0	0.0	2	1.3	2	1.3
25-44 years	2	1.3	7	4.4	16	10.6	13	8.2
45-64 years	7	4.4	13	8.2	36	22.6	22	13.8
65+ years	6	3.8	6	3.8	13	8.2	14	8.8
Type of relation (*n*=159)								
Family	6	3.8	8	5.0	21	13.2	31	19.5†
Friend	4	2.5	7	4.4	33	20.7	16	10.1
Neighbor	3	1.9	6	3.8**	6	3.8	1	0.6
Coworker	1	0.6	2	1.3	2	1.3	0	0.0
Other	0	0.0	3	1.9	7	4.4	2	1.3
Duration of relationship (*n*=157)								
1-5 years	0	0.0	7	4.4†	10	6.4	1	0.6
6-10 years	1	0.6	3	1.9	9	5.7	2	1.3
10+ years	14	8.9	1	9.5	50	31.8	45	28.7†
Mode of contact (*n*=159)								
Face-to-face	13	0.2	25	15.7	55	34.6	44	27.7
Phone	10	6.3	17	10.7	46	28.9	33	20.7
Text	4	2.5	12	7.5	22	13.8	20	12.6
Email	0	0.0	3	1.9	5	3.1	11	6.9**

*Participants could select more than one response
**$p \leq 0.05$; †$p \leq 0.01$

Table 24

Characteristics of Organizations and Ties Between Farm Owner-Operators and Organizations

Characteristics of organizations	*n*	%
Has physical location (*n*=38)	31	81.6
Farm-related (*n*=40)	33	82.5
Type of organization (*n*=45)		
Farm businesses	6	13.3
Consultants or educators	10	22.2
Cooperatives	6	13.3
State or federal agencies	4	8.9
Retail or equipment sales	3	6.7
Other	5	11.1
Not stated	11	24.4
Characteristic of ties	***n***	**%**
How learned about (*n*=42)		
Referral	13	31.0
TV or radio	0	0.0
Direct mail	5	11.9
Magazine or newspaper	1	2.4
Email	1	2.4
Internet search	4	9.5
Event or meeting	10	23.8
Other	8	19.1
Duration of relationship (*n*=40)		
< 1 year	3	7.5
1 - 5 years	4	10.0
6 - 10 years	8	20.0
10+ years	25	62.5
Frequency of contact (*n*=33)		
Weekly	4	12.1
Monthly	14	42.4
Yearly	14	42.4
Varies	1	3.0
Mode of contact* (*n*=40)		
Face-to-face	30	75.0
Phone	27	67.5
Text	13	32.5
Website	10	25.0
Email	17	42.5
Level of comfort (*n*=37)		
Not comfortable	12	32.4
Low comfort	6	16.2
Moderate comfort	13	35.1
High comfort	6	16.2

*Participants could select more than one response

Table 25
Characteristics of Relational Ties with Organizations by Level of Comfort

Characteristics	Not comfortable		Low comfort		Moderate comfort		High comfort	
	n	%	*n*	%	*n*	%	*n*	%
Is farm-related (*n*=37)								
Farm-related	11	29.7	5	13.5	11	29.7	3	8.1
Not farm-related	1	2.7	1	2.7	2	5.4	3	8.1
Duration of relationship (*n*=37)								
< 1 year	0	0.0	0	0.0	0	0.0	3	8.1**
1 - 5 years	1	2.7	0	0.0	1	2.7	1	2.7
6 - 10 years	2	5.4	2	5.3	2	5.4	1	2.7
10+ years	9	24.3	4	10.8	10	27.0	1	2.7
Frequency of contact (*n*=32)								
Weekly	1	3.1	0	0.0	0	0.0	3	9.4
Monthly	4	12.5	2	6.2	7	21.9	1	3.1
Yearly	4	12.5	3	9.4	5	15.6	2	6.2
Mode of contact* (*n*=37)								
Face-to-face	10	27.0	3	8.1	10	27.0	5	13.5
Phone	8	21.6	6	16.2	8	21.6	3	8.1
Text	2	5.4	3	8.1	7	18.9	1	2.7
Website	3	8.1	2	5.4	5	13.5	0	0.0
Email	7	18.9	2	5.4	7	18.9	1	2.7
Type of organization (*n*=37)								
Farm organizations	0	0.0	1	2.7	4	10.8	1	2.7
Consultants or educators	4	10.8	3	8.1	3	8.1	0	0.0
Cooperatives	2	5.4	1	2.7	2	5.4	0	0.0
State or federal agencies	1	2.7	0	0.0	1	2.7	1	2.7
Retail or equipment sales	2	5.4	0	0.0	0	0.0	0	0.0
Other	1	2.7	0	0.0	1	2.7	0	0.0
Name not provided	2	5.4	1	2.7	2	5.4	4	10.8

*Participants could select more than one response.
**$p \leq 0.05$

Table 26
Measures of Cohesion for Farm Owner-Operator Affiliation Networks

Network	Density	Average Distance	Diameter
Memberships	0.034	3.64	8
Organizations	0.014	1.47	2
Events	0.020	2.92	8

Table 27

Measures of Centrality for Farm Owner-Operator Affiliation Networks

Characteristic	Actor Number	Degree Centrality	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
Memberships					
Electric cooperative	610	0.042	0.228	0.020	0.063
Farm Bureau	612	0.352	0.264	0.291	0.961
Farmer's Union	613	0.070	0.225	0.066	0.049
Future Farmers of America Alumni	615	0.042	0.222	0.012	0.084
Wisconsin Corn Growers Association	626	0.056	0.228	0.031	0.118
Wisconsin Potato and Vegetable Growers Assoc.	628	0.056	0.229	0.018	0.161
Organizations					
Cooperatives	412	0.043	0.172	0.020	0.536
Farm Bureau	417	0.002	0.168	0.013	0.203
University of Wisconsin Extension	434	0.057	0.173	0.025	0.627
Events					
Corn and Soybean Growers Association Conference	715	0.028	0.171	0.005	0.259
County Fair	717	0.042	0.173	0.007	0.486
Farm Progress Days	726	0.070	0.174	0.013	0.732
WPS Farm Show	748	0.042	0.171	0.007	0.286

Note. Degree centrality can indicate importance; Closeness centrality can indicate broadcasters

Table 28
Shared Attributes Among Farm Owner-Operators

Attributes Shared	M	*SD*	Range
Commodities	2.01	*1.02*	0-4
Memberships	0.70	*0.92*	0-4
Organizations	0.17	*0.45*	0-2
Events	0.39	*0.57*	0-2
Resources	4.20	*2.32*	0-8
Socioecological Level	M	*SD*	Range
Local			
Memberships	1.00	*0.74*	0-4
Organizations	1.10	*0.70*	0-2
Events	1.00	*0.95*	0-3
State			
Memberships	1.26	*0.85*	0-4
Organizations	0.82	*0.87*	0-3
Events	0.97	*0.99*	0-3
National			
Memberships	0.15	*0.37*	0-1
Organizations	0.40	*0.70*	0-2
Events	0.30	*0.18*	0-1

Table 29
Labels, Definitions, and Exemplars for Themes Generated from Thematic Analysis

Label	Definition	Exemplars
The reality of ag right now	Describes FOs' perceptions of agriculture in the current economic and political environment. FOs acknowledge a sense of futility in their profession, with the inability to make ends meet and their work demands causing stress that contributes to poor mental health. FOs noted that the challenges they face have remained unchanged for decades, including the invisible work of farm women. This "reality" as it is described, foreshadows a division within FOs; a group that was historically united by their profession.	*"Farm wife, farm women, this came clear to me as I completed this."* (P34) *"It is stressful as a young family farmer to compete against corporate farms, investor farms, and "outside income" farms."* (P37) *"I have a very good wife!"* (P49) *"We don't go to other people. There is a lot of stress out there, and the mental health out there with farmers is not good."* (P52) *"The last five years have been a struggle. So I found myself not taking care of my body, which in turn made me feel terrible. The reality of ag right now is that there will be less farmers and nobody knows who will be the next one outta business."* (P59) *[We're] "operating at a loss, no one will work on the farm, cannot afford new equipment – too much stress and too much work."* (P64) *"Probably the usual. Low prices - operating at a loss - lack of hired help - no one will work on farm - cannot afford new equipment - high repair costs - long hours - no help - cannot afford to hire - too much stress and work"* (P65)
Being torn apart	Describes a division that has occurred among FOs as a result of changing market forces within the agricultural industry. Highlights participants' concerns regarding structural inequities introduced by market prices and financial support programs that disproportionately advantage large farms. Historically, strategies like working harder and putting in longer hours could increase income. Generally, farms were smaller, "family farms" and FOs were on equal footing when it came to applying for subsidies or other programs that provided financial support to	*"How milk prices are decided."* (P1) *"There are too many programs for big farms so they can put family farms out of business."* (P1) *"Too many of the BIG farmers are becoming LLCs and figuring out how to manipulate their income. They get all the subsidies, grants, stimulus, tax write-offs. We go in to see if we can get a little something and we don't quality."* (P3) *"Too many farmers in a world of hurt, being torn up. Mostly because of the financial situation. We feel like failures and it's not our fault."* (P8) *"There…needs to be more oversight on the USDA on how they figure crop production, cattle numbers, etc. Their math is in favor of big*

	farmers. In current times, large "corporate" farms dominate agriculture which keeps food prices relatively low. FOs expressed that the lack of public awareness of how agricultural market prices are determined and the shift toward corporate farming has disempowered them among their farming colleges. "Being torn apart" illustrates the effect of shifting economic forces and changing priorities in agriculture, where farmers are competing against each other for income, creating a division, within a historically unified industry, between family farmers and corporate farmers.	*business, ag, retail, etc. and not the farmers."* (P59)
Being pushed out	Describes the participants' experiences trying to remain in farming and their ongoing concerns that they will not be able to do so despite a desire to remain in the agricultural industry. Emphasizes that competition between family farms and corporate farms drives FO's inability to generate income on their farms, leaving them to do the best with what is left over, and feeling as if they have no options left.	*"Does anyone in your household have to work off the farm to make ends meet? How many years did you make a profit?"* (P1) *"We feel like failures and it's not our fault."* (P8) *"I have learned to do my best at managing the resources given me."* (P15) *"It is stressful as a young family farmer to compete against corporate farms, investor farms, and "outside income" farms. The gap is getting larger between investor/corporate farms and family farming and it leaves family farms, like us, getting pushed out. I speak for the remaining family farms that are still hanging on. WE FLAT OUT CANNOT COMPETE and still generate income."* (P37) *"Too many programs for big farms so they can put family farms out of business."* (P39) *[I farm] "on some fields that no one else wants."* (P44) "*…nobody knows who will be the next one outta business."* (P59)

Appendix B
Figures

Figure 1

Conceptual Model Based on Berkman and Colleagues (2000)

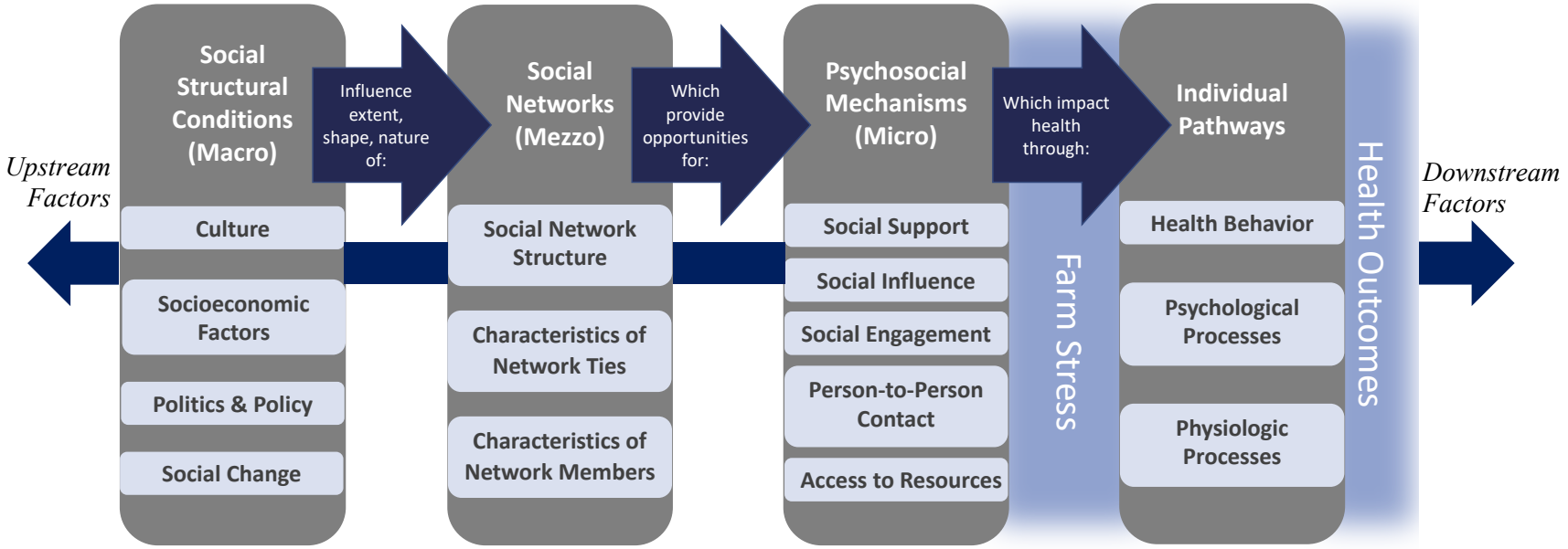


Figure 2

Prior Research of Stress, Social Networks, Social Support, and Health and Well-Being Among Farmer Using Berkman's Conceptual Model (2000)

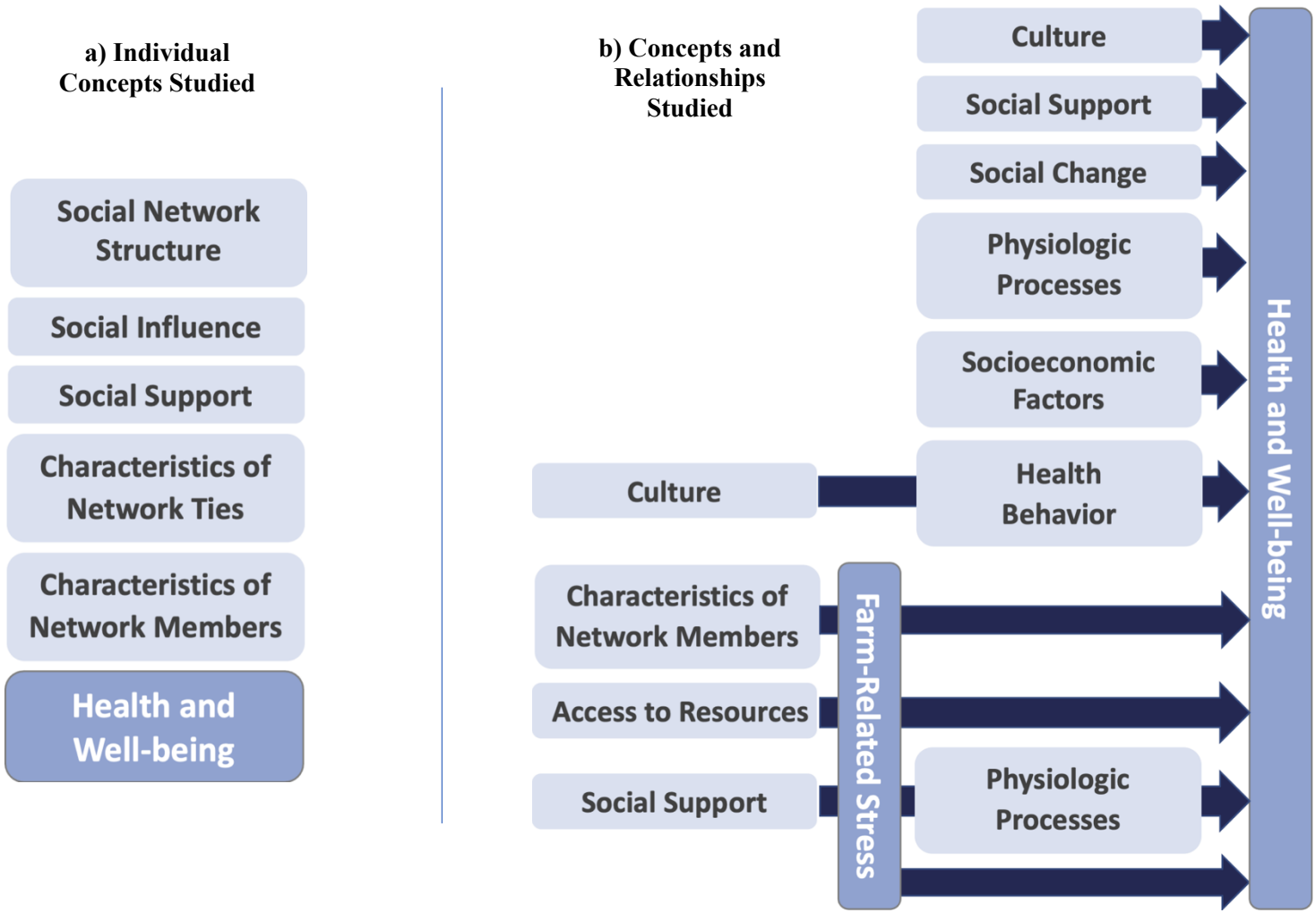


Figure 3

Concepts and Relationships from Berkman's Conceptual Model (2000) Included in Current Study

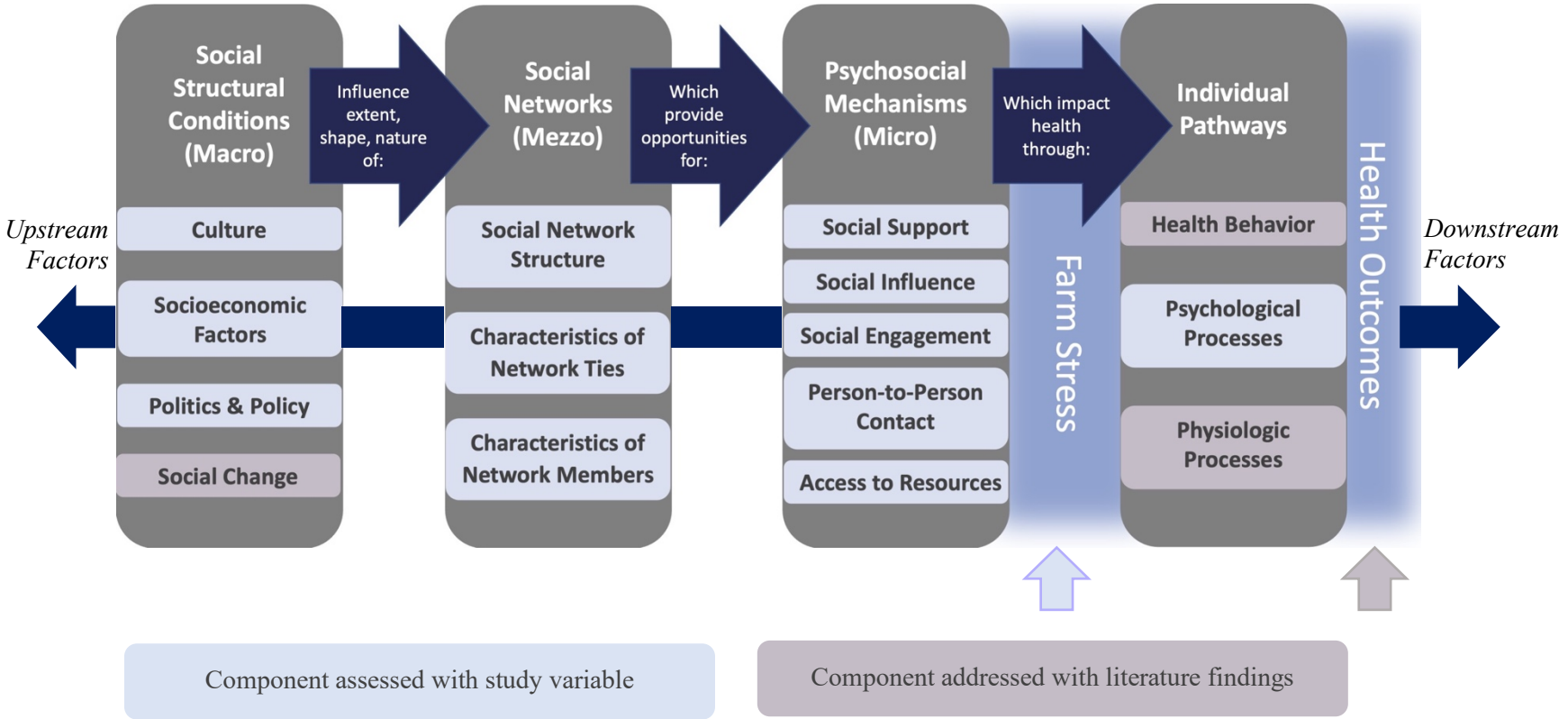


Figure 4

Social Networks of Farm Owner-Operators with Alters by Gender

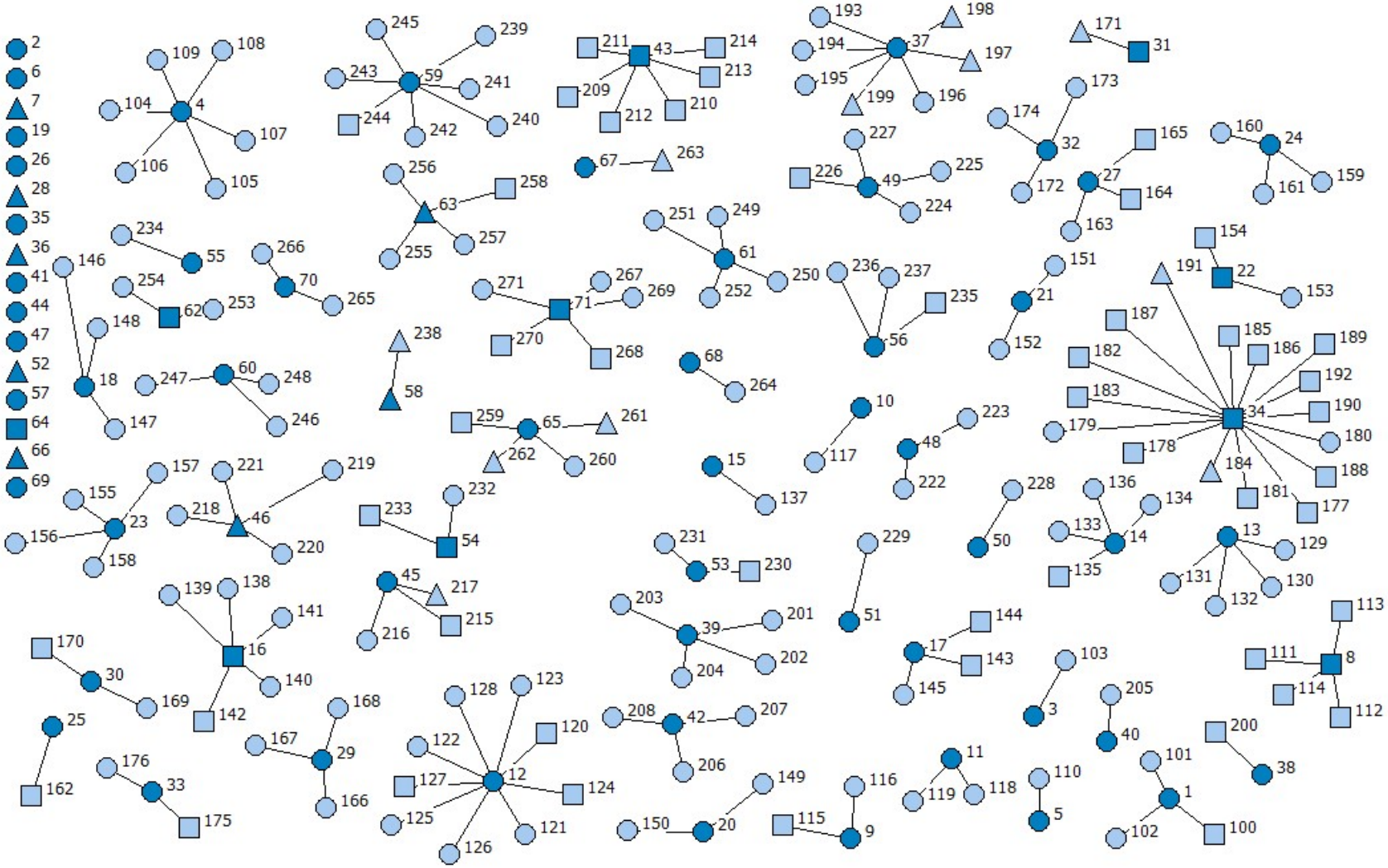


Figure 5

Social Networks of Farm Owner-Operators with Alters with Stress and Comfort Levels and Generational Farm Status

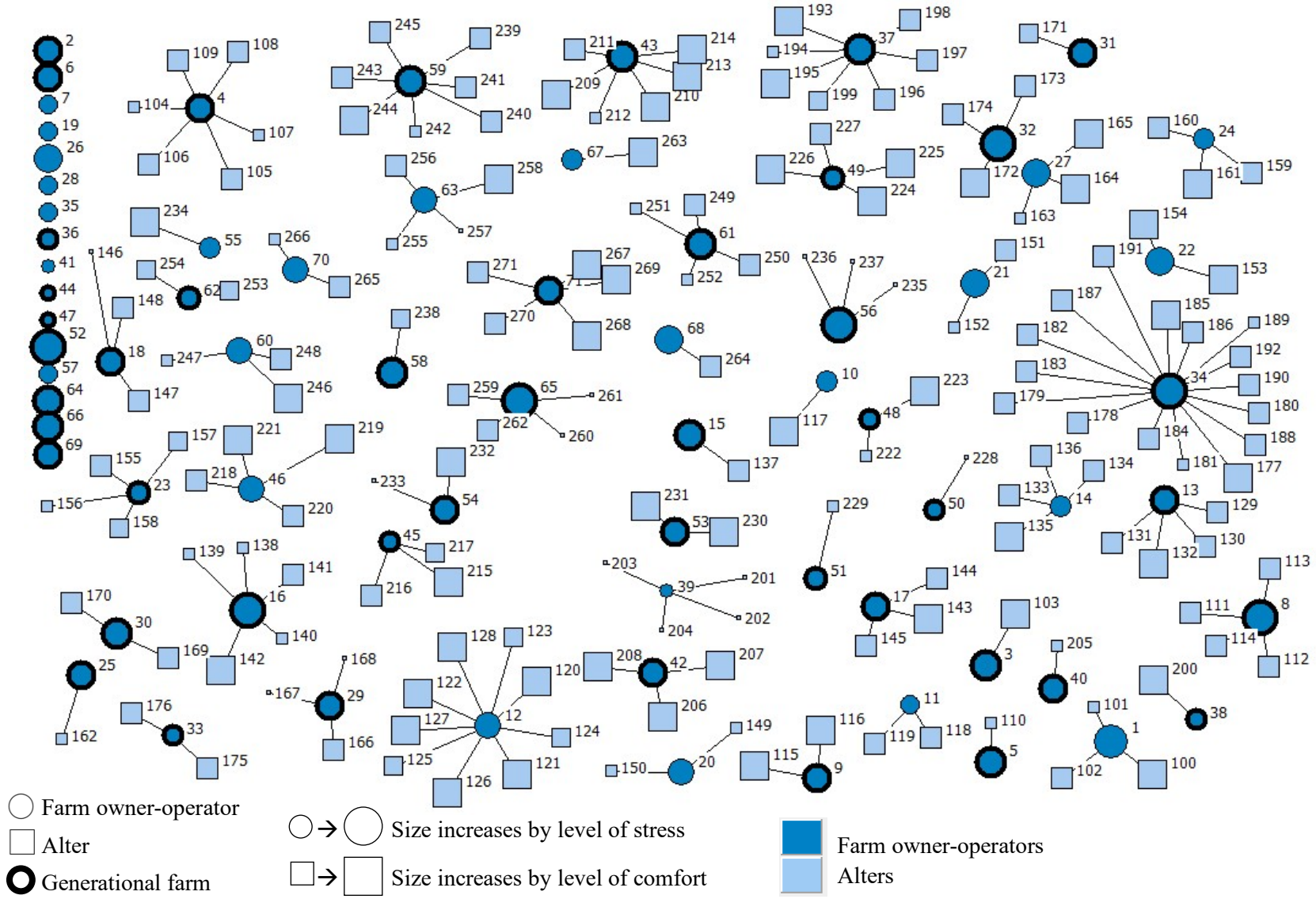


Figure 6

Social Networks of Farm Owner-Operators with Alters with Stress and Comfort Levels and Tie Type

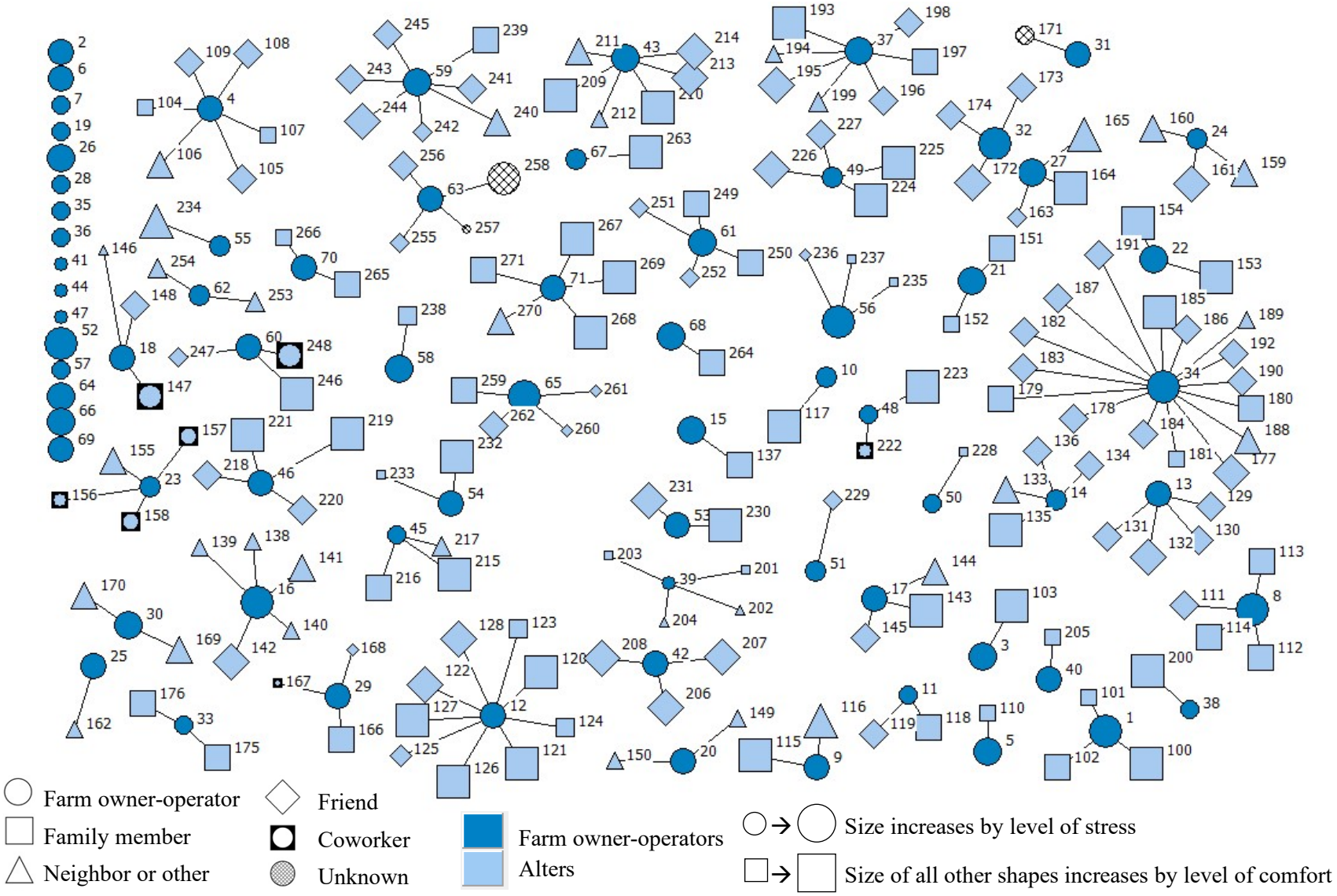


Figure 7

Social Networks of Farm Owner-Operator and Alters by Gender, Farm Stress, and Comfort

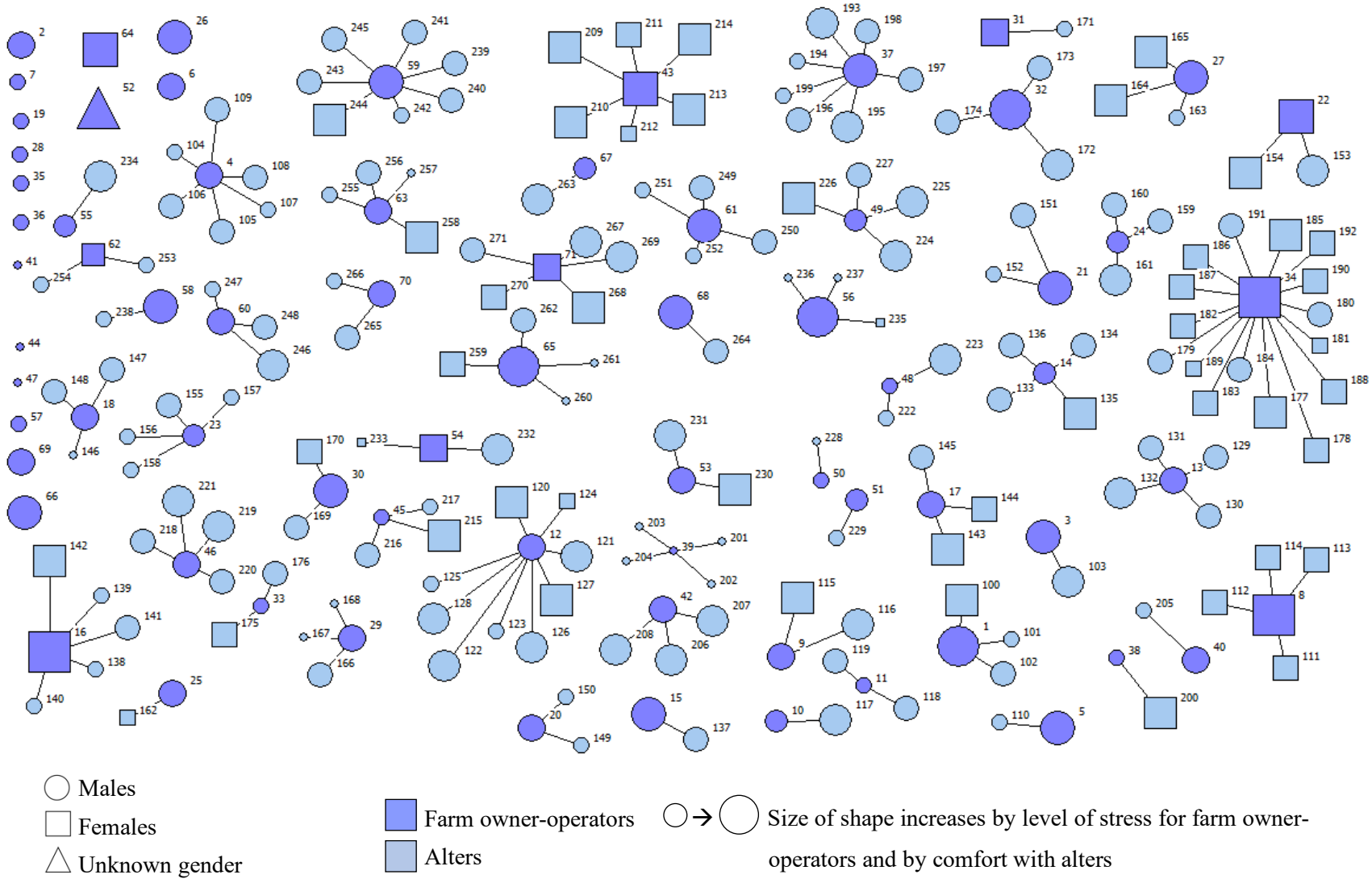


Figure 8

Membership Affiliation Network of Farm Owner-Operators by Gender, Work Status, Stress Level and Generational Farm Status

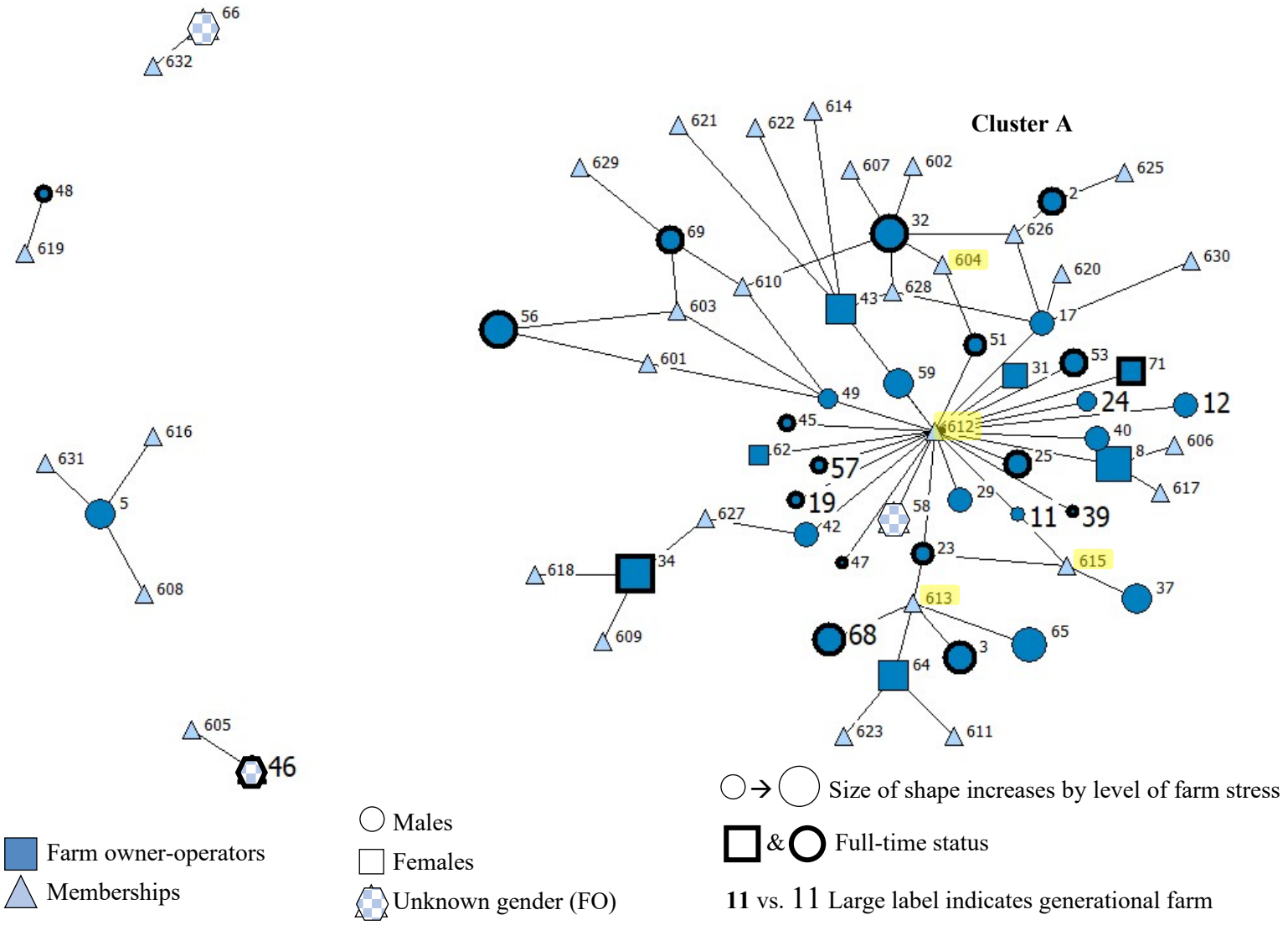
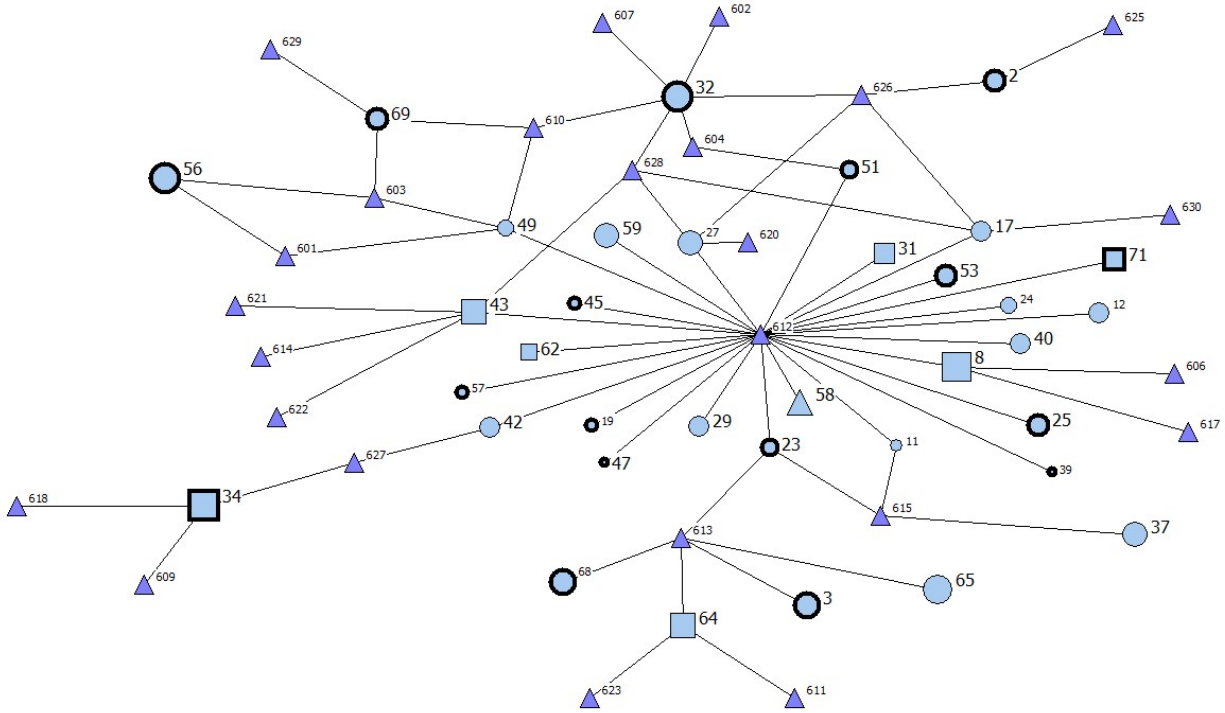


Figure 9

Membership Affiliation Cluster a With and Without Farm Bureau

Cluster A with Farm Bureau



Cluster A without Farm Bureau

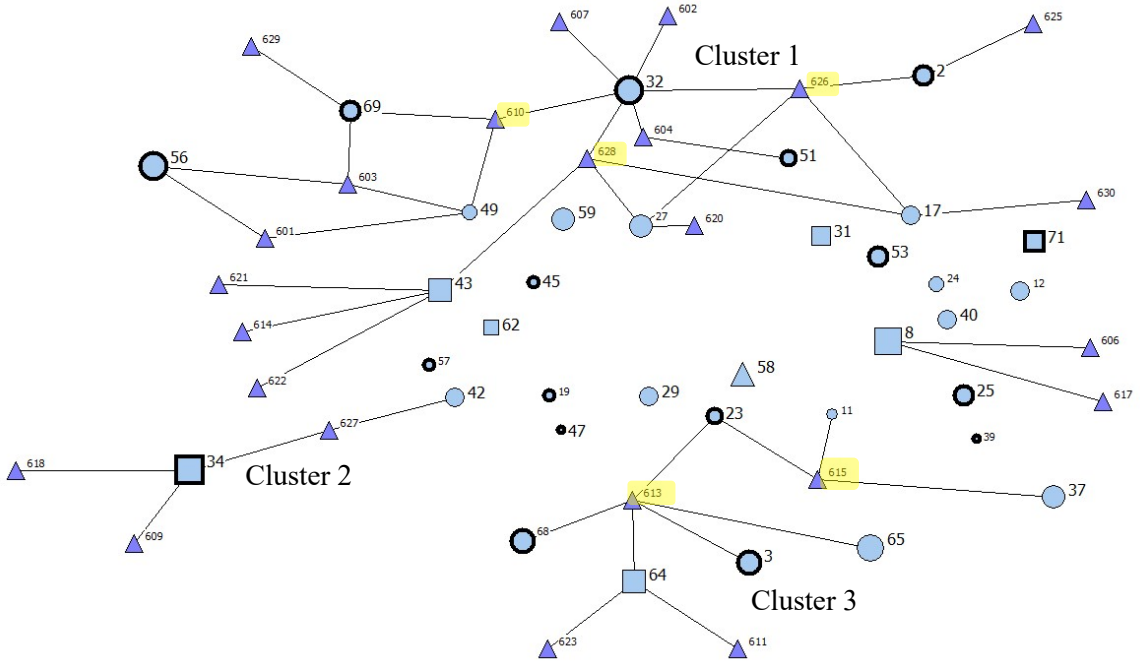


Figure 10

Organization Affiliation Network of Farm Owner-Operators by Gender, Work Status, Stress Level and Comfort Level

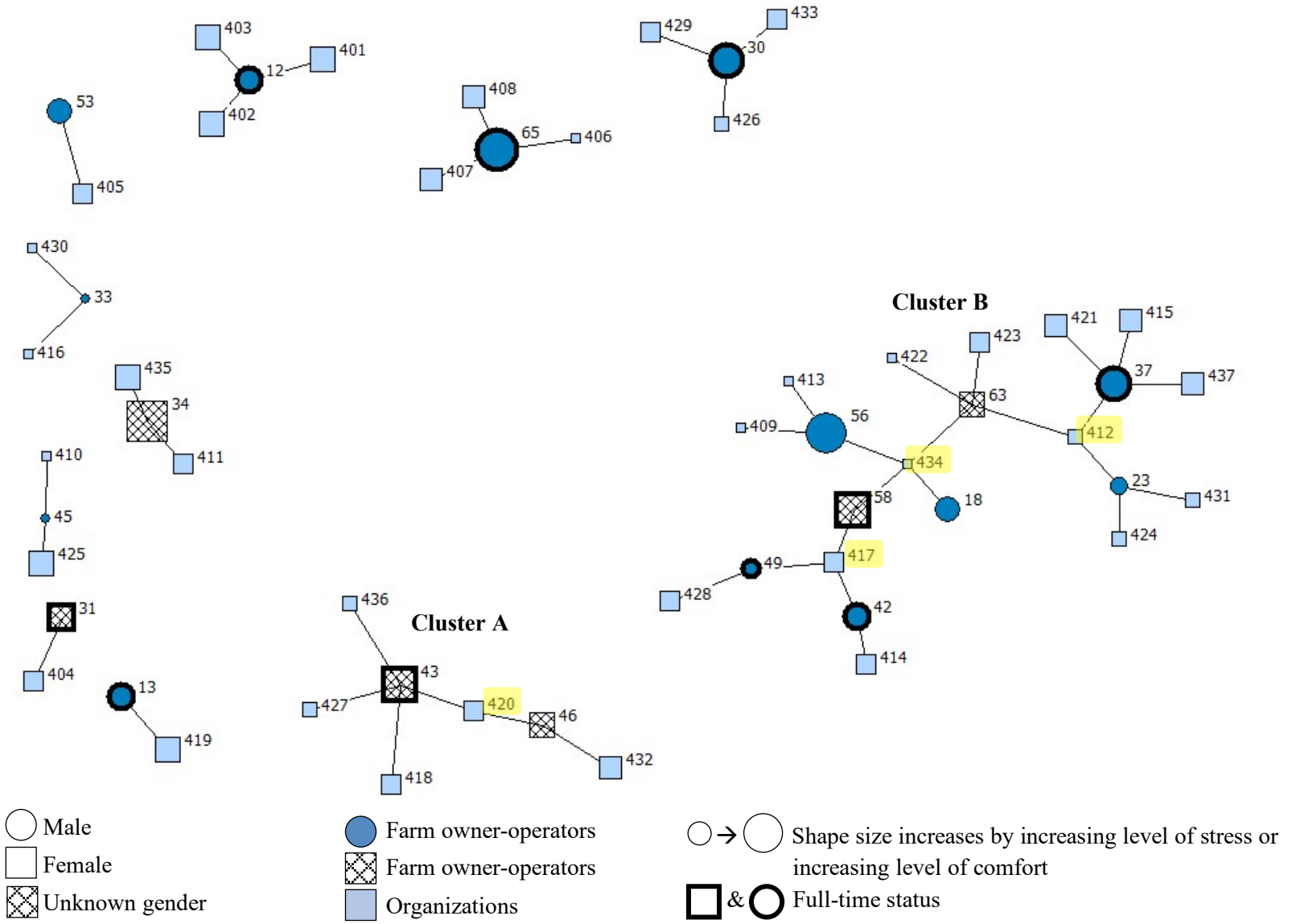


Figure 11

Event Affiliation Network of Farm Owner-Operators by Gender, Work Status, Stress Level and Generational Farm Status

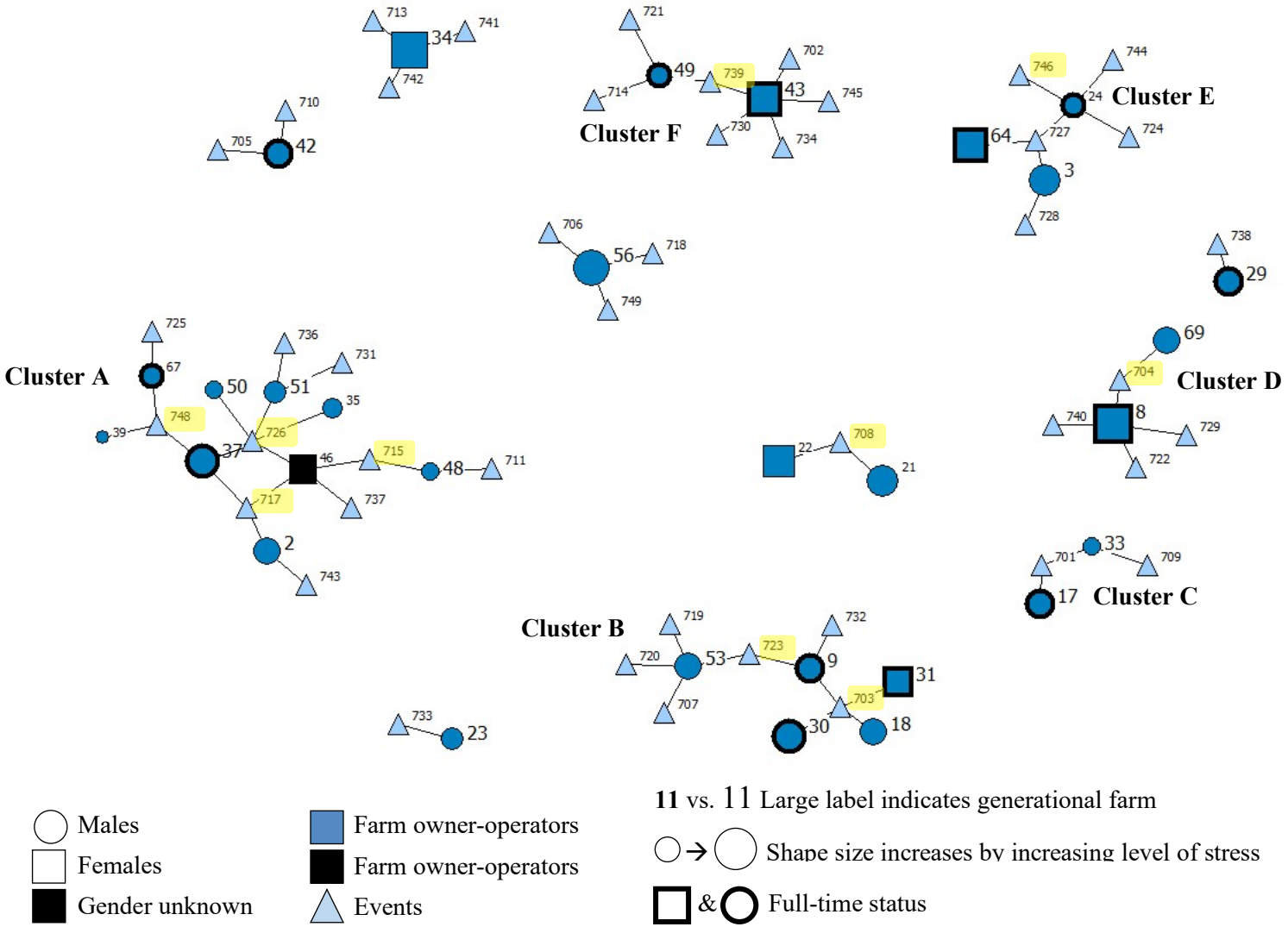


Figure 12

Histograms with Kernel Density Estimation Curves for Macro Level Composite Measures for Farm Owner-Operators

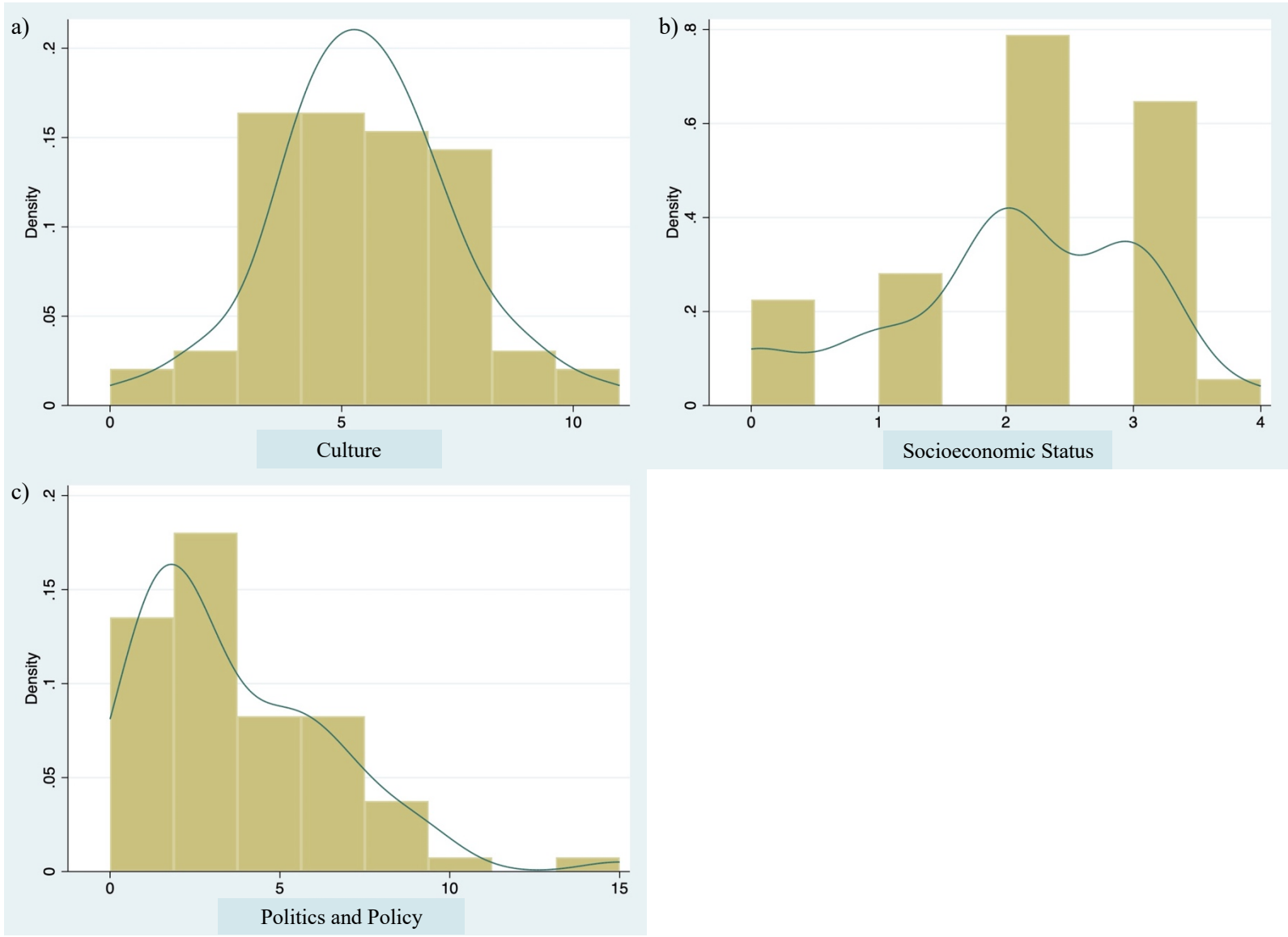


Figure 13

Histograms with Kernel Density Estimation Curves for Involvement of Farm Owner-Operators at Different Socioecological Levels

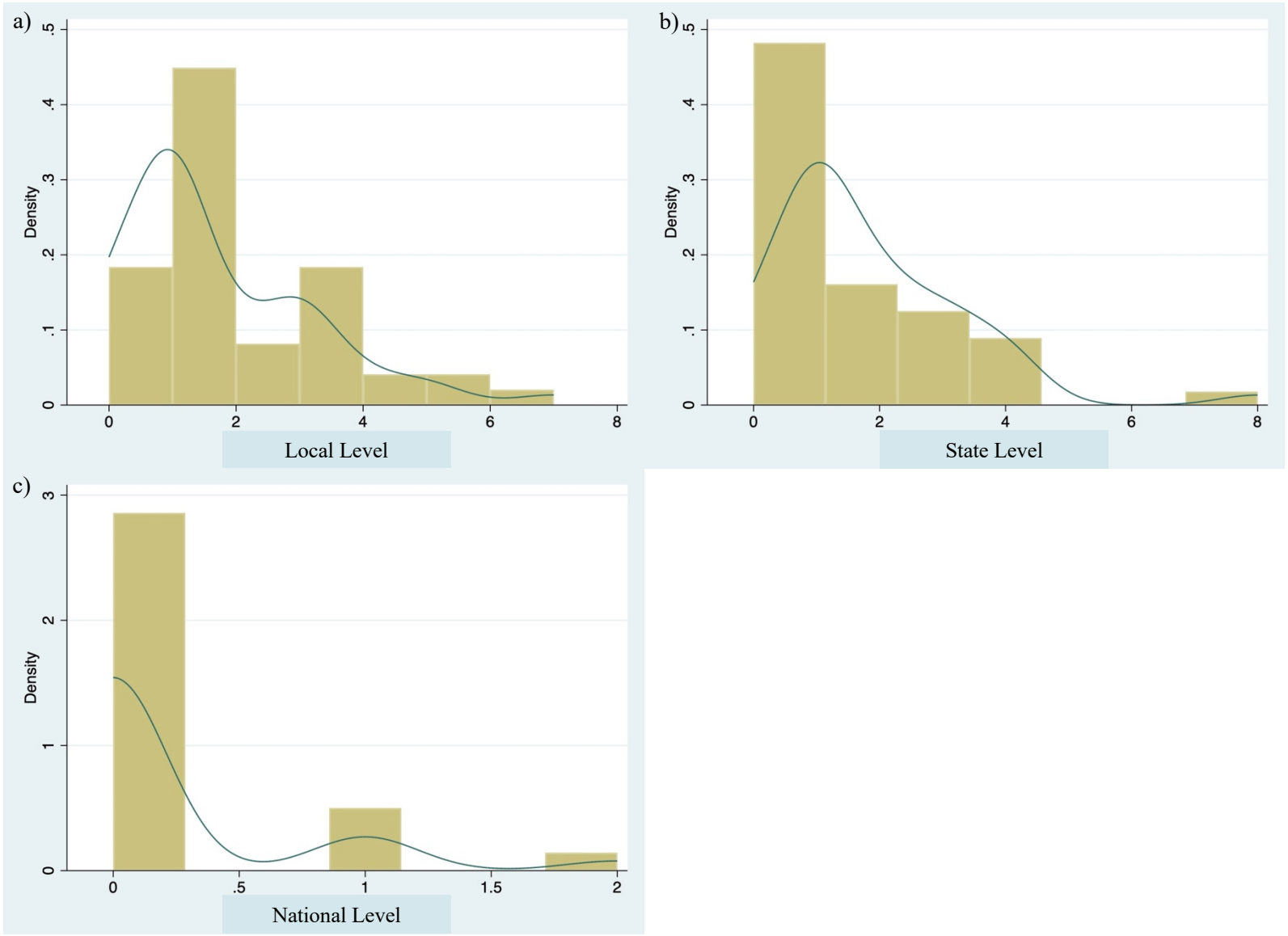


Figure 14

Histograms with Kernel Density Estimation Curves for Mezzo Level Composite Measures for Farm Owner-Operators

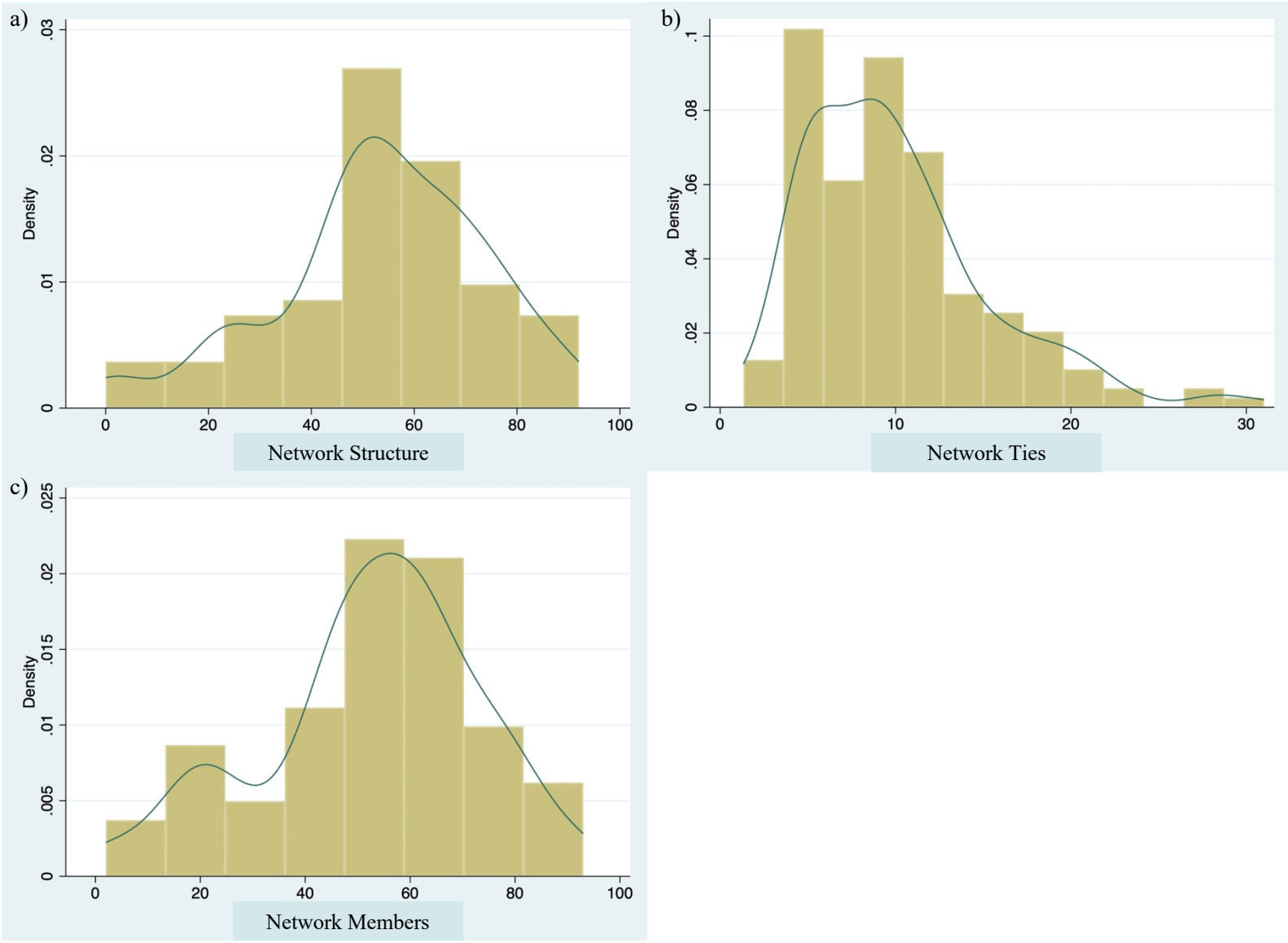


Figure 15

Histograms with Kernel Density Estimation Curves for Micro Level Composite Measures for Farm Owner-Operators

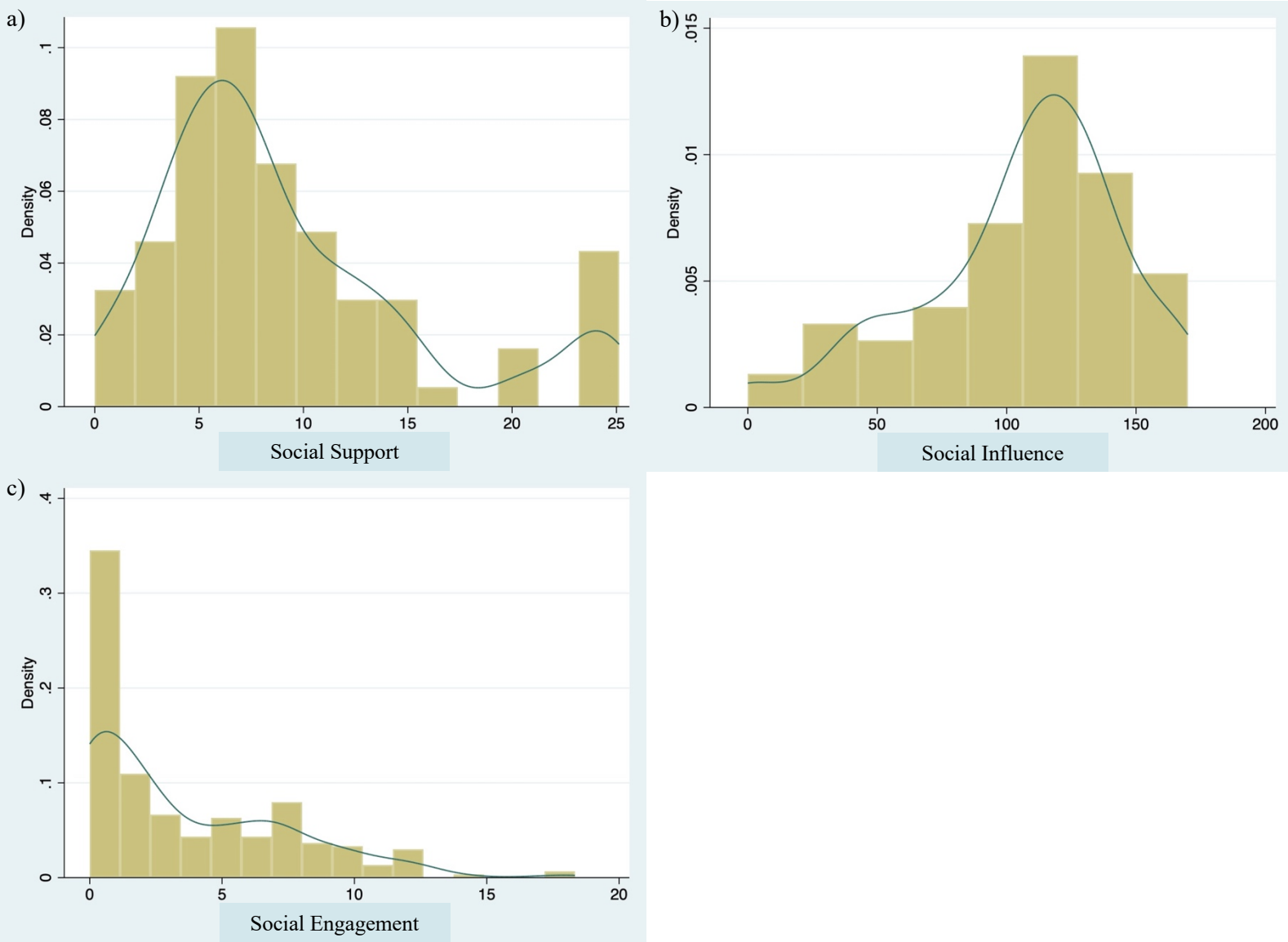


Figure 16

Histograms with Kernel Density Estimation Curves for Micro Level Composite Measures for Farm Owner-Operators (Cont.)

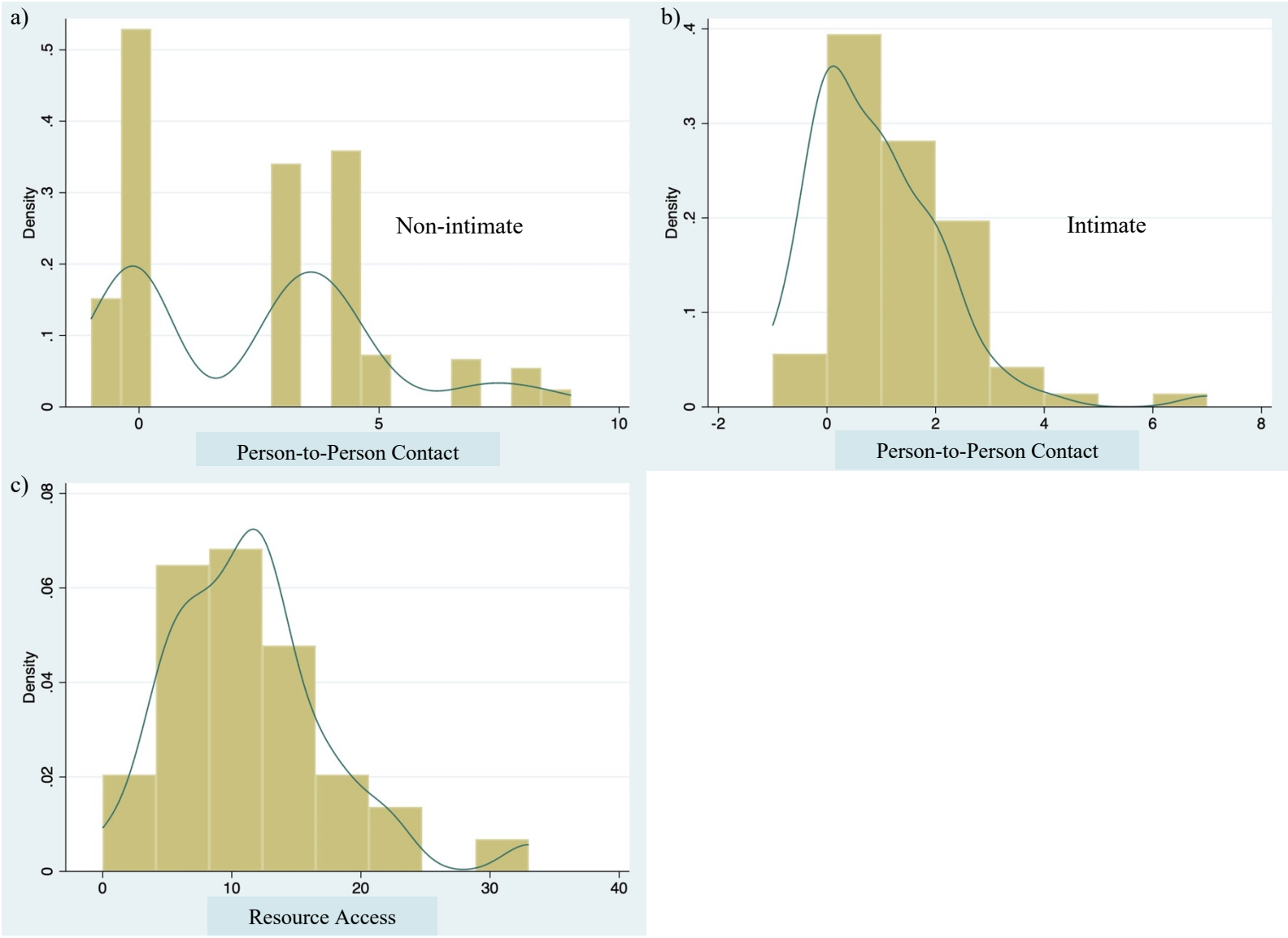


Figure 17

Histograms with Kernel Density Estimation Curves for Measures of Social Connectedness for Farm Owner-Operators

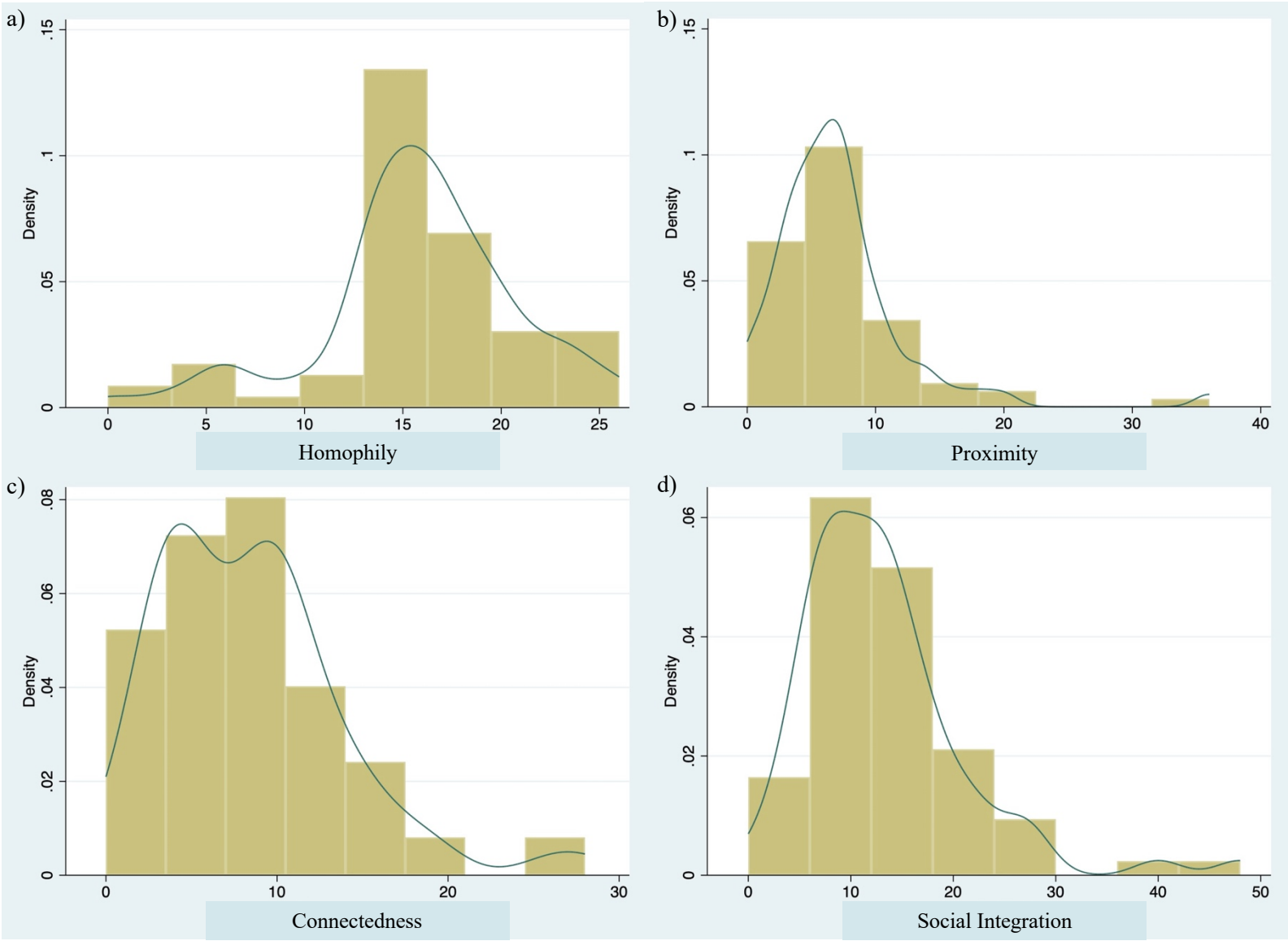
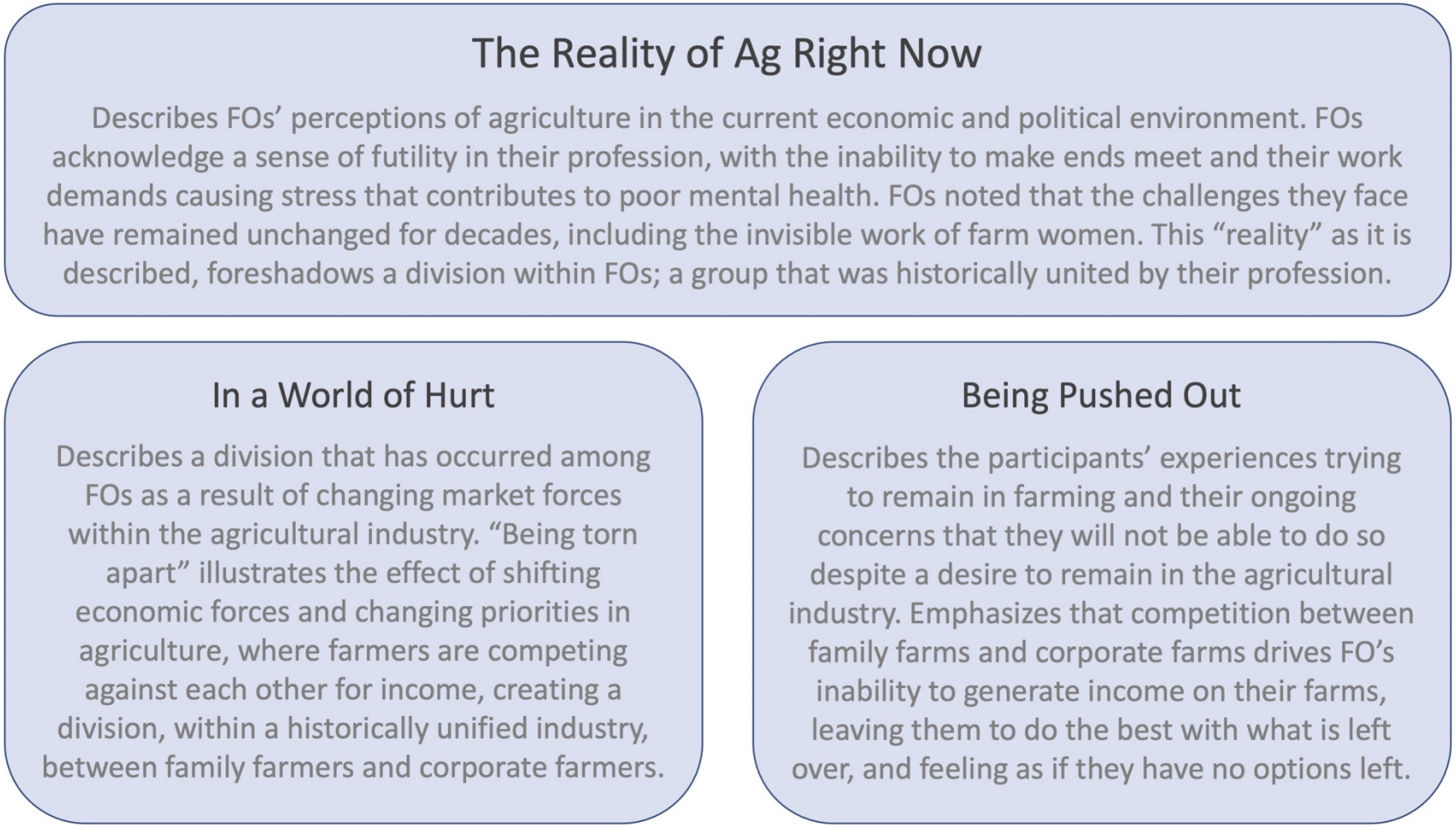


Figure 18
Thematic Map



Appendix C
Supplemental Materials

Supplemental Table 1

Attribute Variables by Actor Type and Actor Ties

Farm owner-operators	Alters	Organizations
Age	Age range	How learned about
Race	Gender	Physical location
Ethnicity	If farmer	If farm-related
Gender	Type of relation	Type of organization
Relationship status	Duration of relationship	Type of relation
Children	Mode of contact	Duration of relationship
Educational attainment	Frequency of contact	Mode of contact
Primary role	Number of contacts per period	Frequency of contact
Work status	Duration of contacts	Number of contacts per period
Usual hours worked weekly	Level of comfort	Duration of contacts
Weekly hours peak production		Level of comfort
Number of years farming		
Level of farm stress (ORS)		
Technology use		
Broadband at home		
Broadband on farm		
Desktop		
Laptop		
Tablet		
Smartphone		
Resources		
Podcasts		
National Public Radio		
Radio		
YouTube		
Farm magazines		
Farm papers		
Cooperatives		
UW Extension		
DATCP		
DHS		
NFMC		
AgrAbility		
Sources of social support		
Alters		
Memberships		
Organizations		
Events		

Note. UW Extension=University of Wisconsin Extension; DATCP=Department of Trade and Consumer Protection; DHS=Wisconsin Department of Health Services; NFMC=National Farm Medicine Center

Supplemental Table 2

Shaprio-Wilk W Test for Normality of Sample Distribution

Variable name	*n*	W	V	*z*-score	Prob>z
PrimRole	70	0.81509	11.381	5.289	0.000‡
WorkStatus	71	0.9983	0.106	-4.893	1.000
UsualHrs	65	0.95045	2.872	2.285	0.011*
BusyHrs	66	0.98416	0.93	-0.158	0.563
Beef	71	0.99927	0.046	-6.717	1.000
Cows	71	0.95778	2.629	2.103	0.018*
Goats	71	0.51431	30.241	7.42	0.000‡
Poultry	71	0.72457	17.15	6.185	0.000‡
FrtVeg	71	0.91177	5.494	3.708	0.000‡
Grains	71	0.95429	2.846	2.276	0.011*
Equine	71	0.99951	0.031	-7.593	1.000
Alfalfa	71	0.95778	2.629	2.103	0.018*
TotYrsFarm	68	0.97486	1.512	0.897	0.185
YrsThisFarm	69	0.97107	1.76	1.228	0.110
GenFarm	69	0.98475	0.928	-0.163	0.565
GenFarmStart	64	0.88141	6.789	4.144	0.000‡
GenFarmYrs	54	0.96344	1.827	1.291	0.098
Age	65	0.97345	1.539	0.934	0.175
Race	62	0.5296	26.251	7.057	0.000‡
Latinx	63	0.51624	27.346	7.152	0.000‡
Gender	64	0.67914	18.369	6.297	0.000‡
MarStatus	65	0.86403	7.882	4.471	0.000‡
Kids	67	0.87602	7.365	4.331	0.000‡
NumKids	57	0.94721	2.754	2.177	0.015*
Kids18	57	0.85228	7.707	4.389	0.000‡
KidsFarm	57	0.92382	3.975	2.966	0.002
Edu	67	0.97257	1.63	1.059	0.145
WebHome	67	0.96966	1.802	1.278	0.101
WebFarm	66	0.92545	4.375	3.199	0.001*
Cell	67	0.96272	2.215	1.725	0.042*
Desktop	67	0.99727	0.162	-3.949	1.000
Laptop	67	0.99923	0.046	-6.681	1.000
Tablet	67	0.96697	1.962	1.462	0.072
Smartphone	67	0.99368	0.375	-2.125	0.983
FarmStress	68	0.98494	0.905	-0.216	0.586

*$p<0.05$; †$p<0.01$; ‡$p<0.001$

Supplemental Table 3

Tests for Skewness and Kurtosis

Variable name				Joint Test	
	n	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
PrimRole	70	0.0000‡	0.0000‡	34.63	0.0000‡
WorkStatus	71	0.7523	.	.	.
UsualHrs	65	0.0185*	0.2084	6.56	0.0376*
BusyHrs	66	0.9869	0.1375	2.30	0.3172
TotYrsFarm	68	0.2645	0.6319	1.53	0.4661
YrsThisFarm	69	0.9212	0.0438*	4.21	0.1217
Age	65	0.0876	0.8549	3.08	0.2142
MarStatus	65	0.0000‡	0.0106*	23.22	0.0000‡
Kids	67	0.0000‡	0.0134*	23.93	0.0000‡
Gender	64	0.0000‡	0.0000‡	62.62	0.0000‡
Race	62	0.0000‡	0.0000‡	73.72	0.0000‡
Edu	67	0.0332*	0.5454	4.86	0.0879
NumAlters	71	0.0000‡	0.0000‡	42.10	0.0000‡
NumOrgs	71	0.0000‡	0.0339*	20.03	0.0000‡
NumOrgMems	69	0.0000‡	0.0083†	20.10	0.0000‡
NumEvents	68	0.0001‡	0.2389	12.86	0.0016†
Beef	71	0.7523	.	.	.
Cows	71	0.0007	0.0172*	13.72	0.0010†
Goats	71	0.0000‡	0.0000‡	103.72	0.0000‡
Poultry	71	0.0000‡	0.0000‡	50.68	0.0000‡
FrtVeg	71	0.0000‡	0.1594	18.20	0.0001‡
Grains	71	0.0002‡	0.3941	12.31	0.0021†
Equine	71	0.0000‡	0.0000‡	58.16	0.0000‡
Alfalfa	71	0.0007‡	0.0172*	13.72	0.0010†

*$p<0.05$; †$p<0.01$; ‡$p<0.001$

Supplemental Table 4

Number Connections by Actor Type and Work Status

Type of actor	Part-time		Full-time	
	n	%	*n*	%
Number of alters (*n*=71)	2.1 (*2.9*)	M (*SD*)	2.7 (*2.2*)	M (*SD*)
0	12	35.3	4	10.8
1	5	14.7	9	24.3
2	6	17.7	6	16.2
3	4	11.8	7	18.9
4	4	11.8	6	16.2
5	2	5.9	0	0.0
6	0	0.0	2	5.4
7	0	0.0	2	5.4
9	0	0.0	1	2.7
16	1	2.9	0	0.0
Number of organizations (*n*=71)	0.6 (*1.1*)	M (*SD*)	0.7 (*1.2*)	M (*SD*)
0	25	73.5	27	73.0
1	2	5.9	2	5.4
2	4	11.8	3	8.1
3	2	5.9	3	8.1
4	1	2.9	2	5.4
Number of memberships (*n*=69)	1.1 (*1.3*)	M (*SD*)	1.1 (*1.4*)	M (*SD*)
0	12	36.4	16	44.4
1	14	42.4	11	30.6
2	3	9.1	2	5.6
3	3	9.1	3	8.3
4	0	0.0	3	8.4
5	0	0.0	1	2.8
6	1	3.0	0	0.0
Number of events (*n*=68)	1.0 (*1.3*)	M (*SD*)	0.9 (*1.4*)	M (*SD*)
0	15	46.9	22	61.1
1	8	25.0	5	13.9
2	4	12.5	3	8.3
3	3	9.4	3	8.3
4	2	6.3	2	5.6
5	0	0.0	1	2.8
Number of resources (*n*=71)	2.3 (*0.9*)	M (*SD*)	2.5 (*0.9*)	M (*SD*)
0-3	7	20.6	6	16.2
4-6	13	38.2	11	29.7
7-9	10	29.4	15	40.5
10-12	4	11.8	5	13.5
Total number of sources (*n*=71)	3.1 (*1.4*)	M (*SD*)	3.3 (*1.4*)	M (*SD*)
0-3	6	17.6	5	13.5
4-6	6	17.6	5	13.5
7-9	6	17.6	9	24.3
10-12	10	29.4	11	29.7
13-16	5	14.7	5	13.5
17-23	1	2.9	2	5.4

Supplemental Table 5

Characteristics of Alters and Alters' Ties by Frequency of Contact

Characteristic	Frequency of contact							
	Weekly		Monthly		Yearly		Varies	
	n	%	*n*	%	*n*	%	*n*	%
Alter sex (*n*=147)								
Male	53	36.1	33	22.4	15	10.2	2	1.4
Female	20	13.6	15	10.2	7	4.7	2	1.4
Age rage (*n*=152)								
18-24 years	3	2.0	0	0.0	1	0.7	0	0.0
25-44 years	18	11.8	12	7.9	3	1.9	0	0.0
45-64 years	35	22.0	24	15.8	13	8.5	4	2.6
65+ years	21	13.8	11	7.2	7	4.6	0	0.0
Alter is farmer (*n*=153)								
Yes	67	43.8	42	27.5	22	13.4	3	1.9
No	10	6.5	6	3.9	2	1.3	1	0.7
Type of relation (*n*=153)								
Family	44	28.7	7	4.6	4	2.6	4	2.6
Friend	24	15.7	21	13.7	12	7.8	0	0.0
Neighbor	6	3.9	11	7.2	1	0.6	0	0.0
Coworker	2	1.3	2	1.3	3	1.9	0	0.0
Other	0	0.0	8	5.2	4	2.6	0	0.0
Duration of relationship (*n*=151)								
1-5 years	6	3.9	10	6.6	1	0.7	0	0.0
6-10 years	5	3.3	7	4.6	1	0.7	0	0.0
10+ years	64	42.4	31	20.5	22	14.6	4	2.6
Mode of contact* (*n*=153)								
Face-to-face	72	47.1	37	24.2	20	13.1	4	2.6
Phone	51	33.3	33	21.6	19	12.4	3	1.9
Text	27	17.6	17	11.1	7	4.6	1	0.7
Email	5	3.3	7	4.6	5	3.3	0	0.0

*Participants could select more than one response

Supplemental Table 6

Relationship Status of Farm Owner-Operator by Relational Tie Types

Relationship status (*n*=164)	Family		Friend		Neighbor		Coworker		Other	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Live-in partner	2	1.2	0	0.0	2	1.2	0	0.0	0	0.0
Married	49	29.9	43	26.2	12	7.3	6	3.7	11	6.7
Widowed	4	2.4	0	0.0	2	1.2	0	0.0	1	0.6
Separated	3	1.8	1	0.6	0	0.0	0	0.0	0	0.0
Divorced	1	0.6	3	1.8	0	0.0	0	0.0	0	0.0
Never married	7	4.3	12	7.3	3	1.8	1	0.6	1	0.6

Supplemental Table 7
Construction of Composite and Indicator Variables

Composite Variable	Calculation
Culture	= (shared organizations + shared events + shared memberships + shared commodities + generational farm + have kids + shared relationship status + shared educational attainment)
Socioeconomic status	= (shared commodities + shared educational attainment)
Politics	= (# organizations + # memberships + # events + role)
Socioecological levels	
Local	= (# local events + # local memberships + # local organizations)
State	= (# state events + # state memberships + # state organizations)
National	= (# national events + # national memberships + # national organizations)
Network structure	= (# organizations + # memberships + # events + # alters + # shared gender with alters + # kin ties + # years farming + shared commodities)
Network ties	= [(frequency contact x duration of contact/# organizations) + (frequency contact x duration of contact/# alters) + (# in-person alters x 4) + (# phone alters x 3) + (# text alters x 2) + (# email alters) + (# in-person organizations x 4) + (# phone organizations x 3) + (# text organizations x 2) + (# email organizations) + (# website organizations x 0.5) + (∑ alter comfort/# alters) + (∑ organization comfort/# organizations)]
Network members	= (role + commodities + shared organizations + shared events + shared memberships + relationship status [weighted] + # years farming) – have children
Social support	= [# alters + # organizations + # events + # memberships + # resources + (∑ alter comfort/# alters) + (∑ organization comfort/# organizations)]
Social influence	= (shared organizations + shared events + shared memberships + shared commodities + # alters + generational farm + age + # years farming)

Social engagement	= (have kids + (frequency contact x duration of contact/# organizations) + (frequency contact x duration of contact/# alters) + # events + # memberships)
Person-to-person contact (intimate)	= (in a relationship + # kin ties) – have kids
Person-to-person contact (non-intimate)	= [(# in-person alters x 4) + (# in-person organizations x 4) + # kin ties] – have kids
Access to resources	= (educational attainment + total technology use + # organizations + # memberships + # events + # alters)
Distress	= (self-reported stress 5 or 6)
Connectedness	= (# memberships + # events + # organizations + # alters + total technology use)
Proximity	= (share organizations + shared events + shared membership + shared commodities + # alters + shared gender with alters + shared age with alters + # kin ties)
Social integration	= connectedness + proximity

Supplemental Figure 1

Heat Maps: Percent of Total Connections by Source and Level of Farm Stress

	None					Extreme
Alters	1	2	3	4	5	6
0	4.2	4.2	4.2	4.2	4.2	1.4
1	0.0	2.8	5.6	4.2	7.0	0.0
2	0.0	4.2	1.4	7.0	4.2	0.0
3	0.0	1.4	1.4	7.0	1.4	4.2
4	1.4	0.0	4.2	4.2	1.4	2.8
5	0.0	0.0	0.0	1.4	0.0	1.4
6	0.0	0.0	0.0	1.4	1.4	0.0
7	0.0	0.0	0.0	0.0	2.8	0.0
9	0.0	0.0	0.0	1.4	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	1.4

Memberships	1	2	3	4	5	6
0	2.9	5.9	5.9	13.2	8.8	2.9
1	2.9	5.9	2.9	13.2	8.8	2.9
2	0.0	1.5	1.5	2.9	0.0	1.5
3	0.0	0.0	1.5	1.5	2.9	2.9
4	0.0	0.0	1.5	1.5	1.5	0.0
5	0.0	0.0	0.0	0.0	1.5	1.5
6	0.0	0.0	0.0	0.0	0.0	0.0

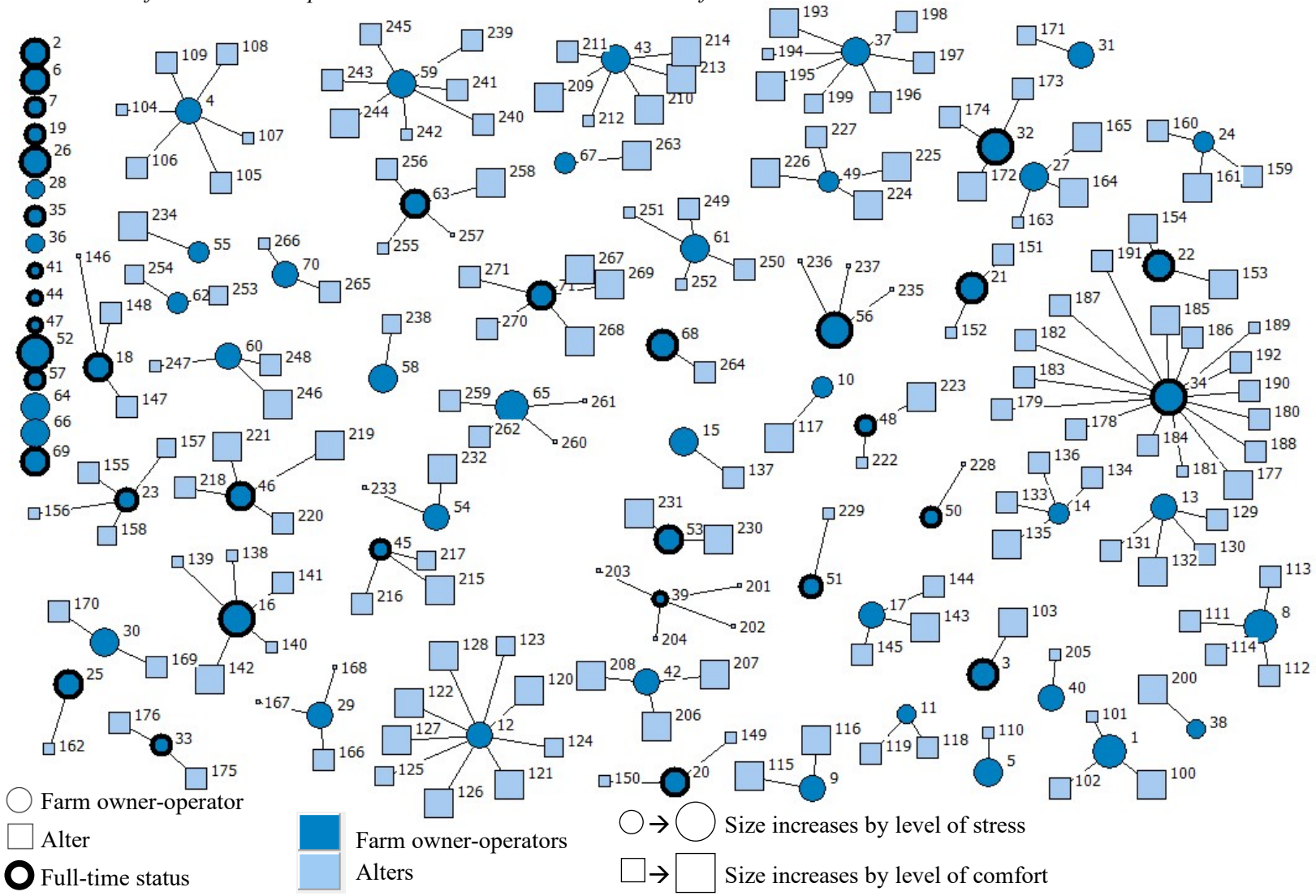
Organizations	1	2	3	4	5	6
0	5.9	10.3	10.3	20.6	17.6	7.4
1	0.0	0.0	0.0	5.9	0.0	0.0
2	0.0	2.9	1.5	2.9	1.5	1.5
3	0.0	0.0	1.5	1.5	1.5	2.9
4	0.0	0.0	0.0	1.5	2.9	0.0

Events	1	2	3	4	5	6
0	4.5	7.5	6.0	17.9	11.9	7.5
1	1.5	1.5	1.5	7.5	6.0	0.0
2	0.0	3.0	1.5	3.0	3.0	0.0
3	0.0	0.0	3.0	1.5	1.5	3.0
4	0.0	0.0	1.5	3.0	0.0	1.5
5	0.0	0.0	0.0	0.0	1.5	0.0

% of total contacts	0	1.4-2.9	3.0-4.5	5.6-6.0	7.0-8.8	10.3	11.9	13.2	17.6-17.9	20.6

Supplemental Figure 2

Social Networks of Farm Owner-Operators with Alters with Stress and Comfort Levels and Work Status



Supplemental Materials

Name Generator

Project Title: Resources for Health and Well-being Among Farm Owner-Operators

Thank you for taking the time to participate in this study and to support Wisconsin farmers. Your responses provide important information that will be used to help nurses and other health care providers support farmers in maintaining their health and well-being in the communities where they live. If you have more than one farm owner-operator living at your address and need additional surveys, please contact Jennifer Kowalkowski.

Section 1: Information about you and your farm

Answers to these questions will only be used to describe the participants in the survey. Please write in your responses to questions where there is a line provided (Example: Print name). For questions with answer choices listed, please mark the box ☒ next to your choice(s).

1. What is your **primary role** on the farm? (*Please choose one*)
   - ☐ Sole owner-operator/producer
   - ☐ Co-owner-operator/producer
   - ☐ Hired operator/producer
   - ☐ Non-paid family worker
   - ☐ Other: _____(*write in*)

☐ I do not want to participate in this study
-or-
this study does not apply to me.

Please return this survey so we know not to contact you in the future about this study.

2. Do you work on the farm full-time or part-time? (*Please choose one*)
   - ☐ Full-time
   - ☐ Part-time

3. In a **usual week**, about how many hours do you work on the farm?
   _____ hours

4. At your **busiest times** of the year, about how many hours do you work in a week on the farm?
   _____ hours

5. What are the main crops produced or animals raised on your farm? (*Choose all that apply*)
   - ☐ Beef
   - ☐ Dairy-cows
   - ☐ Dairy-goats
   - ☐ Poultry
   - ☐ Fruit/Vegetable
   - ☐ Grains
   - ☐ Fiber (for example: wool, alpaca, hemp)
   - ☐ Tobacco
   - ☐ Equine
   - ☐ Other: _____ (*write in*)

6. How many **years in total** have you worked in farming in your life?
   _____ years

7. How many years have you worked on **this farm**?
   _____ years

8. Was the farm you **currently work/live on** started by someone in your family? (*Please choose one*)
   - ☐ No
   - ☐ Yes

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a. If so, who **originally** started the farm? (*Please choose one*)
- ☐ Parents
- ☐ Grandparents
- ☐ Spouse/Partner
- ☐ Spouse/Partner's Parents
- ☐ Spouse/Partner's Grandparents
- ☐ Other: _____ (*write in*)

b. How many years has the farm been in the family?
_____ years

c. Do you intend to transition the farm to someone in your family when you retire? (*Please choose one*)
- ☐ No
- ☐ Yes

9. What is your **age**?
_____ years

10. Which of the following best describes your **racial** background? (*Please choose one*)
- ☐ Asian
- ☐ American Indian or Alaskan Native
- ☐ Black or African American
- ☐ Caucasian/White
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ More than one race
- ☐ Prefer not to disclose

11. Are you of Hispanic or Latin descent? (*Please choose one*)
- ☐ No
- ☐ Yes
- ☐ Prefer not to disclose

12. What is your **gender**? (*Please choose one*)
- ☐ Female
- ☐ Male
- ☐ Other
- ☐ Prefer not to disclose

13. What is your current marital/relationship status? (*Please choose one*)
- ☐ Live-in partner
- ☐ Married
- ☐ Widowed
- ☐ Separated
- ☐ Divorced
- ☐ Never married
- ☐ Other: _____ (*write in*)
- ☐ Prefer not to disclose

14. Do you have **children**? (*Please choose one*)

- ☐ No
- ☐ Yes

a. How many? _____ How many under age 18? _____

b. Do any of your children **currently** help with the work on the farm? (*Please choose one*)

- ☐ None work on the farm
- ☐ Yes – Only those under age 18
- ☐ Yes – Only those over age 18
- ☐ Yes – Both under age 18 and over age 18

15. What is the highest level of **education** you have completed? (*Please choose one*)

- ☐ Some high school (1 to 3 years)
- ☐ High school graduate or GED (4 years)
- ☐ Some college or university – no degree (1 to 3 years)
- ☐ Associate Degree
- ☐ Bachelor Degree
- ☐ Some graduate school (1 to 2 semesters)
- ☐ Graduate degree
- ☐ Prefer not to disclose

16. Do you have reliable high-speed **broadband** service **at your home** to access the Internet (This includes services like cable, satellite, and DSL)? (*Please choose one*)

- ☐ No: Not available, not reliable, or slow speeds (includes dial-up)
- ☐ Yes
- ☐ We choose not to or do not use Internet at home
- ☐ Use different means to access the Internet at home

17. Do you have reliable high-speed **broadband** service at a location on your farm **other than your home** to access the Internet (This includes services like cable, satellite, and DSL)? (*Please choose one*)

- ☐ No: Not available, not reliable, or slow speeds (includes dial-up)
- ☐ Yes
- ☐ We choose not to or do not use Internet for the farm
- ☐ Use different means to access the Internet for the farm

18 Do you have **reliable cellular phone service** in the area where you live and farm? (*Please choose one*)

- ☐ No: Not available or not reliable
- ☐ Yes
- ☐ We choose not to use cellular services
- ☐ Does not apply

19. Do you use any of the following devices for personal **or** farm-related activities? (*Choose all that apply*)

- ☐ Desktop computer
- ☐ Laptop computer
- ☐ Tablet (for example: iPad, Amazon Fire, Surface, Galaxy Tab, Kindle, or other eReader)
- ☐ Smartphone

20. Are you a member of any farm-related organizations? (*Please choose one*)

☐ No
☐ Yes

a. If so, what organizations are you a member of? (*Please write in*)

1. _____ 8. _____
2. _____ 9. _____
3. _____ 10. _____
4. _____ 11. _____
5. _____ 12. _____
6. _____ 13. _____
7. _____ 14. _____

21. Do you attend any farm-related events, conferences, meetings, social events, or trainings? (*Please choose one*)

☐ No
☐ Yes

a. If so, what events, conferences, and trainings do you regularly attend? (*Please write in*)

1. _____ 8. _____
2. _____ 9. _____
3. _____ 10. _____
4. _____ 11. _____
5. _____ 12. _____
6. _____ 13. _____
7. _____ 14. _____

22. In the **past year**, how would you rate the amount of stress in your life **related to the farm?**

☐	☐	☐	☐	☐	☐
1	2	3	4	5	6
no stress					extreme stress

Section 2: Sources of Information and Resources

The following three questions are going to focus on the resources that farm owner-operators use or have available to them in times of stress, frustration, concern, or worry associated with the farm. The resources you may use to make sense of things related to the farm when they begin to weigh heavy on your mind can include a wide range of things, from websites, courses, people, or even events.

23. The following is a list of **sources** some farmers use to obtain information or to make sense of things related to the farm when they begin to weigh heavy on your mind. For each source, please indicate whether you have used the source, are likely to use it, or would not use it.

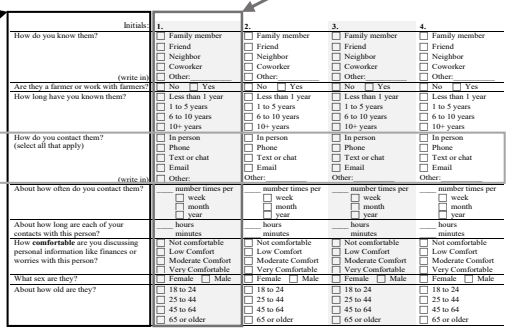
	Have Used	Likely to Use	Would not Use
Podcasts	☐	☐	☐
Public radio stations	☐	☐	☐
Commercial radio stations	☐	☐	☐
YouTube videos	☐	☐	☐
Farm magazines	☐	☐	☐
Farm newspapers	☐	☐	☐
Local tractor supply or Co-op	☐	☐	☐
UW Extension	☐	☐	☐
Farm Center - WI Dept of Ag, Trade and Consumer Protection (DATCP)	☐	☐	☐
WI Dept of Health Services (DHS)	☐	☐	☐
Marshfield Clinic/National Farm Medicine Center	☐	☐	☐
AgrAbility	☐	☐	☐
Please include other sources not listed above:	**Have Used**	**Likely to Use**	**Would not Use**
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

The next two questions ask first about **people** and then about **organizations, groups, or businesses** that you go to for information or to make sense of things related to the farm when they begin to weigh heavy on your mind. For each question, there is space to enter 16 names, though you only need to enter as many as you recall. The example below shows how to fill out the tables for these two questions.

In each *column*, enter the first and last initials of a person (question 24) or the name of an organization, group, or business (question 25) next to each number in the top row of the table. Please include people who live with you and who live outside of your home, including family members.

The first *column* lists the questions to answer for each set or initials or name that you enter.

The question in each *row* is answered for each name that you enter.



Initials:	1.	2.	3.	4.
How do you know them?	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:
(write in)				
Are they a farmer or work with farmers?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (select all that apply)	☐ In person ☐ Phone ☐ Text or chat ☐ Email ☐ Other:	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:
(write in)				
About how often do you contact them?	___ number times per ☐ week ☐ month ☐ year	___ number times per ☐ week ☐ month ☐ year	___ number times per ☐ week ☐ month ☐ year	___ number times per ☐ week ☐ month ☐ year
About how long are each of your contacts with this person?	___ hours ___ minutes	___ hours ___ minutes	___ hours ___ minutes	___ hours ___ minutes
How **comfortable** are you discussing personal information like finances or worries with this person?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable
What sex are they?	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male
About how old are they?	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older

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24. Are there specific **people** that you go to for information or to make sense of things related to the farm when they begin to weigh heavy on your mind? (*Enter the initials for as many people as you recall*)

Initials:	**1.**	**2.**	**3.**	**4.**
How do you know them? (*Please write in*)	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____
Are they a farmer or do they work with farmers?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Email ☐ Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
About how long are each of your contacts with this person?	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes
How **comfortable** are you discussing personal information like finances or worries with this person?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable
What sex are they?	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male
About how old are they?	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older

24. Continued – People

Initials:	**5.**	**6.**	**7.**	**8.**
How do you know them? (*Please write in*)	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____
Are they a farmer or do they work with farmers?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Email ☐ Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
About how long are each of your contacts with this person?	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes
How **comfortable** are you discussing personal information like finances or worries with this person?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable
What sex are they?	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male
About how old are they?	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older

24. Continued – People

Initials:	**9.**	**10.**	**11.**	**12.**
How do you know them? (*Please write in*)	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____
Are they a farmer or do they work with farmers?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Email ☐ Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
About how long are each of your contacts with this person?	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes
How **comfortable** are you discussing personal information like finances or worries with this person?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable
What sex are they?	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male
About how old are they?	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older

24. Continued – People

Initials:	**13.**	**14.**	**15.**	**16.**
How do you know them? (*Please write in*)	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____	☐ Family member ☐ Friend ☐ Neighbor ☐ Coworker ☐ Other:_____
Are they a farmer or do they work with farmers?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Email ☐ Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____	☐ In person ☐ Phone ☐ Text or chat ☐ Email Other:_____
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
About how long are each of your contacts with this person?	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes	____ hours ____ minutes
How **comfortable** are you discussing personal information like finances or worries with this person?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable
What sex are they?	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male	☐ Female ☐ Male
About how old are they?	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older	☐ 18 to 24 ☐ 25 to 44 ☐ 45 to 64 ☐ 65 or older

25. Are there specific **organizations, groups, or businesses** that you go to for information or to make sense of things related to the farm when they begin to weigh heavy on your mind? This can include things like websites, telephone calls, or in-person visits. (*Enter as many names as you recall)*

Name(s):	**1.**	**2.**	**3.**	**4.**
How did you learn about them? (*Please write in*)	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________
Is this a farm-specific organization, group, or business?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Do you know if they have an office or a physical location?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known about them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email ☐ Other:__________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:______________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:______________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:______________
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
How **comfortable** are you discussing personal information like finances or worries with them?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable

25. Continued – Organizations, groups, or businesses

Name(s):	**5.**	**6.**	**7.**	**8.**
How did you learn about them? (*Please write in*)	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________
Is this a farm-specific organization, group, or business?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Do you know if they have an office or a physical location?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known about them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email ☐ Other:___________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
How **comfortable** are you discussing personal information like finances or worries with them?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable

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25. Continued – Organizations, groups, or businesses

Name(s):	**9.**	**10.**	**11.**	**12.**
How did you learn about them? (*Please write in*)	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________
Is this a farm-specific organization, group, or business?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Do you know if they have an office or a physical location?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known about them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email ☐ Other:___________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:_____________
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
How **comfortable** are you discussing personal information like finances or worries with them?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable

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25. Continued – Organizations, groups, or businesses

Name(s):	**13.**	**14.**	**15.**	**16.**
How did you learn about them? (*Please write in*)	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________	☐ Someone told me ☐ Television or radio ☐ Direct mailing ☐ Magazine/Newspaper ☐ Email ☐ Internet search ☐ Event/Meeting ☐ Other:__________
Is this a farm-specific organization, group, or business?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Do you know if they have an office or a physical location?	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
How long have you known about them?	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years	☐ Less than 1 year ☐ 1 to 5 years ☐ 6 to 10 years ☐ 10+ years
How do you contact them? (*Choose all that apply*) (*Please write in*)	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email ☐ Other:__________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:__________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:__________	☐ In person ☐ Phone ☐ Text or chat ☐ Website ☐ Email Other:__________
About how often do you contact them?	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year	____ number times per ☐ week ☐ month ☐ year
How **comfortable** are you discussing personal information like finances or worries with them?	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable	☐ Not comfortable ☐ Low Comfort ☐ Moderate Comfort ☐ Very Comfortable

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Your participation is appreciated!

Thank you for sharing your valuable time and insights to help improve the health and well-being of farmers and their families.

If something came to mind that you think is important, or there is something you think I should be thinking about but I didn't ask about, please let me know:

_____

_____

_____

_____

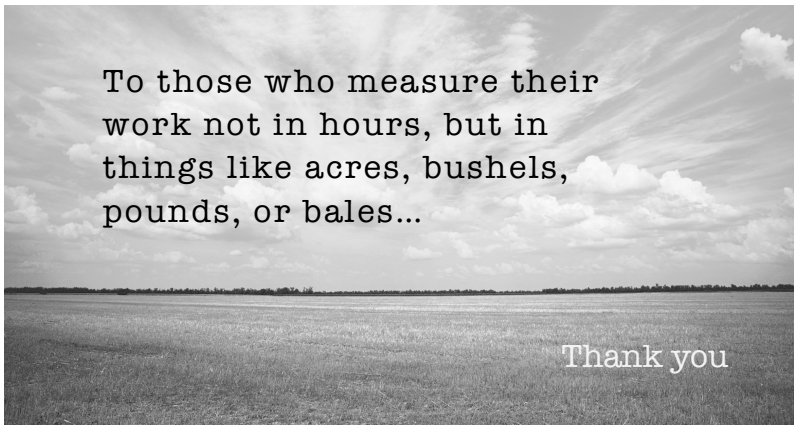
_____

_____

_____

_____

Please return your completed form in the pre-addressed, stamped return envelope.



Supplemental Materials
Coding Scheme

Question	***Question Text***	***Answer Choices***	***Coding***
1	*What is your primary role on the farm? (Please choose one)*	*Sole owner-operator/producer*	*1*
		Co-owner-operator/producer	*2*
		Hired operator/producer	*3*
		Non-paid family worker	*4*
		Other: (write in)	*5*
		Other [text]	*[text]*
2	*Do you work on the farm full-time or part-time? (Please choose one)*	*Full-time*	*1*
		Part-time	*2*
3	*In a usual week, about how many hours do you work on the farm?*	*Hours*	*[numerical]*
4	*At your **busiest times** of the year, about how many hours do you work in a week on the farm?*	*Hours*	*[numerical]*
5	*What are the main crops produced or animals raised on your farm? (Choose all that apply)*	*Beef*	*1=Yes; 0=No*
		Dairy-cows	*1=Yes; 0=No*
		Dairy-goats	*1=Yes; 0=No*
		Poultry	*1=Yes; 0=No*
		Fruit/Vegetable	*1=Yes; 0=No*
		Grains	*1=Yes; 0=No*
		Fiber (e.g., wool, alpaca, hemp)	*1=Yes; 0=No*
		Tobacco	*1=Yes; 0=No*
		Equine	*1=Yes; 0=No*
		Other: (write in)	*1=Yes; 0=No*
		Other [text]	*[text]*
6	*How many **years in total** have you worked in farming in your life?*	*years*	*[numerical]*
7	*How many years have you worked on **this farm**?*	*years*	*[numerical]*
8	*Was the farm you **currently work/live on** started by someone in your family? (Please choose one)*	*No*	*0*

		Yes	*1*
8a	*If so, who **originally** started the farm? (Please choose one)*	*Parents*	*1*
		Grandparents	*2*
		Spouse/Partner	*3*
		Spouse/Partner's Parents	*4*
		Spouse/Partner's Grandparents	*5*
		Other: (write in)	*6*
		Other: (write in)	*[text]*
8b	*How many years has the farm been in the family?*	*years*	*[numerical]*
8c	*Do you intend to transition the farm to someone in your family when you retire? (Please choose one)*	*No*	*0*
		Yes	*1*
9	*What is your **age**?*	*years*	*[numerical]*
10	*Which of the following best describes your **racial** background? (Please choose one)*	*Asian*	*1*
		American Indian or Alaskan Native	*2*
		Black or African American	*3*
		Caucasian/White	*4*
		Native Hawaiian or Other Pacific Islander	*5*
		More than one race	*6*
		Prefer not to disclose	*7*
11	*Are you of Hispanic or Latin descent? (Please choose one)*	*No*	*0*
		Yes	*1*
		Prefer not to disclose	*2*
12	*What is your **gender**? (Please choose one)*	*Female*	*1*
		Male	*0*
		Other	*2*
		Prefer not to disclose	*3*
13	*What is your current marital/relationship status? (Please choose one)*	*Live-in partner*	*1*
		Married	*2*

		Widowed	*3*
		Separated	*4*
		Divorced	*5*
		Never married	*6*
		Other: (write in)	*7*
		Other [text]	*[text]*
		Prefer not to disclose	*8*
14	*Do you have **children**? (Please choose one)*	*No*	*0*
		Yes	*1*
14a_1	*How many?*	*[number]*	*[numerical]*
14a_2	*How many under age 18?*	*[number]*	*[numerical]*
14b	*Do any of your children **currently** help with the work on the farm? (Please choose one)*	*None work on the farm*	*0*
		Yes-Only those under age 18	*1*
		Yes-Only those over age 18	*2*
		Yes-Both under age 18 and over age 18	*3*
15	*What is the highest level of **education** you have completed? (Please choose one)*	*Some high school (1-3 years)*	*1*
		High school graduate or GED (4 years)	*2*
		Some college or university - no degree (1-3 years)	*3*
		Associate degree	*4*
		Bachelor's degree	*5*
		Some graduate school (1-2 semesters)	*6*
		Graduate degree	*7*
		Prefer not to disclose	*8*
16	*Do you have reliable high-speed **broadband** service **at your home** to access the Internet (This includes services like cable, satellite, and DSL)? (Please choose one)*	*No: Not available, not reliable, or slow speeds (includes dial-up)*	*0*
		Yes	*1*

		We choose not to or do not use Internet at home	*2*
		Use different means to access the Internet at home	*3*
17	*Do you have reliable high-speed **broadband** service at a location on your farm **other than your home** to access the Internet (This includes services like cable, satellite, and DSL)? (Please choose one)*	*No: Not available, not reliable, or slow speeds (includes dial-up)*	*0*
		Yes	*1*
		We choose not to or do not use Internet at farm	*2*
		Use different means to access the Internet at farm	*3*
18	*Do you have **reliable cellular phone service** in the area where you live and farm? (Please choose one)*	*No: Not available or not reliable*	*0*
		Yes	*1*
		We choose not to use cellular services	*2*
		Does not apply	*3*
19	*Do you use any of the following devices for personal **or** farm-related activities? (Choose all that apply)*	*Desktop computer*	*1*
		Laptop computer	*2*
		Tablet (e.g., iPad, Amazon Fire, Surface, Galaxy Tab, Kindle or other eReader)	*3*
		Smartphone	*4*
20	*Are you a member of any farm-related organizations? (Please choose one)*	*No*	*0*
		Yes	*1*
20a	*If so, what organizations are you a member of? (Please write in)*	*[text]*	*[text]*
21	*Do you attend any farm-related events, conferences, meetings, social events, or trainings? (Please choose one)*	*No*	*0*
		Yes	*1*

21a	*If so, what events, conferences, and trainings do you regularly attend? (Please write in)*	*[text]*	*[text]*
22	*In the **past year**, how would you rate the amount of stress in your life **related to the farm?***	*1 no stress*	*1*
		2	*2*
		3	*3*
		4	*4*
		5	*5*
		6 extreme stress	*6*
23	*The following is a list of **sources** some farmers use to obtain information or to make sense of things related to the farm when they begin to weigh heavy on your mind. For each source, please indicate whether you have used the source, are likely to use it, or would not use it.*		
23a	*Podcasts*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23b	*Public radio stations*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23c	*Commercial radio stations*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23d	*YouTube videos*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23e	*Farm magazines*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23f	*Farm newspapers*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23g	*Local tractor supply or Co-op*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23h	*UW Extension*	*Have Used*	*2*

		Likely to Use	*1*
		Would not Use	*0*
23i	*Farm Center - WI Dept of Ag, Trade and Consumer Protection (DATCP)*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23j	*WI Dept of Health Services (DHS)*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23k	*Marshfield Clinic/National Farm Medicine Center*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
23l	*AgrAbility*	*Have Used*	*2*
		Likely to Use	*1*
		Would not Use	*0*
	Please include other sources not listed above:		
23x	*(Please write in)*	*[text]*	*[text]*
		Have Used	*2*
		Likely to Use	*1*
		Would not Use	*0*
24	*Are there specific **people** that you go to for information or to make sense of things related to the farm when they begin to weigh heavy on your mind? (Enter initials for as many people as you recall)*	*[text]*	*[text]*
24a	*How do you know them?*	*Family member*	*1*
		Friend	*2*
		Neighbor	*3*
		Coworker	*4*
		Other: (write in)	*5*
		Other [text]	*[text]*
24b	*Are they a farmer or do they work with farmers?*	*No*	*0*
		Yes	*1*
24c	*How long have you known them?*	*Less than 1 year*	*1*
		1 to 5 years	*2*

		6 to 10 years	*3*
		10+ years	*4*
24d	*How do you contact them? (Choose all that apply)*	*In person*	*1*
		Phone	*2*
		Text or chat	*3*
		Email	*4*
		Other: (write in)	*5*
		Other [text]	*[text]*
24e_1	*About how often do you contact them? (# times)*		*[numerical]*
24e_2	*(frequency of contact)*	*week*	*1*
		month	*2*
		year	*3*
24f	*About how long are each of your contacts with this person?*	*[number]*	*[numerical]*
		[number]	*[numerical]*
24g	*How **comfortable** are you discussing personal information like finances or worries with this person?*	*Not comfortable*	*0*
		Low comfort	*1*
		Moderate comfort	*2*
		Very comfortable	*3*
24h	*What sex are they?*	*Female*	*1*
		Male	*0*
24i	*About how old are they?*	*18 to 24*	*1*
		25 to 44	*2*
		45 to 64	*3*
		65 and older	*4*
25	*Are there specific **organizations, groups, or businesses** that you go to for information or to make sense of things related to the farm when they begin to weigh heavy on your mind? This can include things like websites, telephone calls, or in-person visits. (Enter as many names as you recall)*	*[text]*	*[text]*
25a	*How did you learn about them?*	*Someone told me*	*1*
		Television or radio	*2*
		Direct mailing	*3*
		Magazine/Newspaper	*4*

		Email	*5*
		Internet search	*6*
		Event/Meeting	*7*
		Other: (write in)	*8*
		Other [text]	*[text]*
25b	*Is this a farm-specific organization, group, or business?*	*No*	*0*
		Yes	*1*
25c	*Do you know if they have an office or a physical location?*	*No*	*0*
		Yes	*1*
25d	*How long have you known about them?*	*Less than 1 year*	*1*
		1 to 5 years	*2*
		6 to 10 years	*3*
		10+ years	*4*
25e	*How do you contact them? (Choose all that apply)*	*In person*	*1*
		Phone	*2*
		Text or chat	*3*
		Website	*4*
		Email	*5*
		Other: (write in)	*6*
		Other [text]	*[text]*
25f	*About how often do you contact them? (# times)*	*[number]*	
	(frequency of contact)	*week*	*1*
		month	*2*
		year	*3*
25g	*How **comfortable** are you discussing personal information like finances or worries with them?*	*Not comfortable*	*0*
		Low comfort	*1*
		Moderate comfort	*2*
		Very comfortable	*3*
26	*If something came to mind that you think is important, or there is something you think I should be thinking about but I didn't ask about, please let me know:*	*[text]*	*[text]*