

INVESTIGATING THE RELATIONSHIP BETWEEN WELLBEING AND GRAZING  
MANAGEMENT DECISIONS ON MICHIGAN'S PASTURE-BASED BEEF FARMS

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## ABSTRACT

### INVESTIGATING THE RELATIONSHIP BETWEEN WELLBEING AND GRAZING MANAGEMENT DECISIONS ON MICHIGAN'S PASTURE-BASED BEEF FARMS

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Livestock producers around the world are concerned about land degradation and the increase in extreme weather events such as more frequent flooding and droughts, as well as current rates of biodiversity loss, soil erosion, and desertification. One suggested change that could improve grassland sustainability is the use of adaptive grazing management approaches, however the ramifications of using an adaptive grazing approach have been understudied from a social perspective. In this dissertation I used a social-ecological systems approach to investigate the relationship between grazing management style and farmer wellbeing in Michigan's pasture-based beef farms. I created a novel theoretical framework which integrated the Theory of Planned Behavior with the Theory of Basic Human Values at an individual farm scale to understand why farmers manage their animals the way they do. Further,. I explored the relationship between management style and the physical, psychological, and social wellbeing of farmers to better understand if certain management practices result in higher farmer wellbeing. I investigated wellbeing from a benefits-challenges perspective to acknowledge there will always be tradeoffs in the system. This focus on wellbeing is necessary because farmers often suffer from higher-than-average rates of mental illness and are one of the top three occupations most likely to die by suicide. Thus, it is imperative we determine if there are any management techniques that bolster wellbeing.

I used a sequential mixed methods approach by coupling an online survey with follow up

interviews from a subsample of the participants to better understand the range of grazing management practices being used on Michigan's pasture-based beef farms, particularly how perceptions of control, attitudes, norms, and values influence the farmer's choice of grazing management behaviors. I found pasture-based beef farmers managed their grazing animals either rotationally or adaptively, and that my theoretical framework can explain why there are differences in what drives the adoption of different grazing management styles. If we want to understand the adoption of adaptive grazing management as a tool for grassland restoration it is important to know what management strategies are used on the ground. Farmers who were managing rotationally were more likely to be a generational, family farm and the adaptive farmers were more likely to be an independent startup farm. Additionally, there were differences in the role of diversification between the two groups, mainly, adaptive farmers are more confident in their ability to create a highly diversified farm than their rotational counterparts I also found that Michigan's pasture-based beef farmers did not report the low levels of wellbeing I expected, rather farmers across the management spectrum have high physical and psychological wellbeing. The largest challenge to wellbeing was in the social dimension where many farmers expressed feeling isolated. However, when the COVID-19 pandemic emerged farmers coped in ways that supported their wellbeing, including receiving financial support and spending additional time outdoors.

These findings and my theoretical framework serve as an initial exploration into the wellbeing and management decisions of pasture-based beef farmers in Michigan that will hopefully be useful for future research on the wellbeing of farmers across the state and beyond.



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# 1 INTRODUCTION

Animal producers around the world are concerned about land degradation and the increase in extreme weather events such as more frequent flooding and droughts (Godde et al., 2020). These factors may not be new concerns, but recent research in ecology suggests that the current rate of degradation through loss of biodiversity, soil erosion, and desertification is not tenable long-term (Joyce & Marshall, 2017). Therefore, some producers are searching for management systems that can mitigate or reverse grassland degradation and they are turning to adaptive management to mitigate the environmental risks of farming or ranching (Joyce & Marshall, 2017). Much of the original research on adaptive grazing was solely focused on the ecological aspects of animal production (Augustine et al., 2020; Teague & Barnes, 2017), but grazing management research acknowledging the social facets of animal production has increased in the last five years (Bruno et al., 2020; Derner, Budd, et al., 2021; Wilmer et al., 2019). The turn to social factors of grazing is partially driven by the research documenting higher than average rates of mental illness and death by suicide in producer populations (Hagen et al., 2019; Klingelschmidt et al., 2018; Ringgenberg et al., 2018), but is also related to the sustainability and resilience of the farm. Studying the social factors of farm systems to date has primarily focused solely on the individual perceptions of the system (Gosnell et al., 2020; Mann & Sherren, 2018; Sherren & Kent, 2017; Teague & Barnes, 2017; Wilmer, Derner, et al., 2018) and does not investigate the relationship between livestock management systems and farm resilience and sustainability. To better understand the difficulties faced by farmers it is necessary to use a social-ecological systems approach, so my research investigates some of the social factors of grazing, primarily relationships between management systems, behavioral decisions, and wellbeing in small to medium sized pasture-based beef farms in Michigan, USA.

## 1.1 Grassland Degradation and Restoration

Grasslands cover 40% of the global land mass (Noojipady et al., 2017) and act as both a source and sink of greenhouse gases (Intergovernmental Panel on Climate Change, 2019). Some scientists have demonstrated grasslands may be a larger sink of carbon than forests (Dass et al., 2018); however, degraded grasslands are not as effective at carbon sequestration as healthy grasslands (Davies et al., 2012), particularly when they become denuded of vegetation (Intergovernmental Panel on Climate Change, 2019). Conservative estimates suggest globally 20% of grasslands are severely degraded, with some degradation estimates as high as 70%, and an additional 12 million hectares are being degraded each year (Davies et al., 2012; Middleton et al., 2011). In the United States grasslands cover nearly 40% of land area and soil health has been severely impacted by mismanagement, although objective assessments of degradation are lacking (Food and Agriculture Organisation, 2018; Noojipady et al., 2017; Suttie et al., 2005). Despite not having a measurement of the extent of grassland degradation, we must address degradation. One way to do this is conservation strategies, particularly grazing styles (Teague & Barnes, 2017; Teague et al., 2008), that promote grassland restoration and health, which are necessary for combatting global climate change.

Historically, grasslands co-evolved with large herds of grazing ruminants. These animals would migrate across the savannas and prairies grazing, fertilizing, and breaking up the soil while they moved (Savory & Butterfield, 2016) and the ecosystem depended on these high-intensity, short-duration herd movements for regeneration and revitalization through the aeration, fertilization, and grazing (Liebig et al., 2010; O'Mara, 2012; Provenza, 2003). However, when movement is limited, ruminants repeatedly graze certain grass species to the extent that the landscape plant composition

changes and the inability of the plants to recover before being grazed again results in overgrazing of preferential species (Provenza, 2003). The combination of overgrazing and changing plant composition results in a decrease in biodiversity (Provenza, 2003) and leads to grassland degradation where these soils fail to sequester carbon and infiltrate water as effectively as healthy soils with diverse plant cover (Lal, 2011; Liebig et al., 2010; O'Mara, 2012; Provenza, 2003). Therefore, it is important that we continue to promote the symbiotic relationship between grasslands and grazing ruminants.

Livestock producers can mimic natural migration patterns by managing animals in a variety of ways, including using grazing as a method for regenerating (Clark & Tilman, 2017; Teague & Barnes, 2017) or inadvertently degrading (Altieri, 1999; Heitschmidt & Taylor, 1991; Holechek et al., 2000; Huntsinger & Hopkinson, 1996; Taylor et al., 1993) the soils. Given the interactions between livestock grazing management, ecological outcomes, and human wellbeing, grassland degradation is a complex problem that requires a social-ecological system approach (Food and Agriculture Organisation, 2018; Suttie et al., 2005). Grazing management styles exist on a spectrum and differ in levels of grazing intensity. Historically, this spectrum has been infrequently documented by academics because studying two dichotomous groups is preferred (Heitschmidt et al., 1987; Heitschmidt & Taylor, 1991; Taylor et al., 1993). On one end of the spectrum is continuous grazing, where cattle spend the entire grazing season in the same pasture and are returned to that pasture year after year, which often results in degradation (Heitschmidt & Taylor, 1991; Rowntree et al., 2016; Stanley et al., 2018; Teague et al., 2008; Wang et al., 2021). The other extreme is where cattle are rotated through pastures rapidly and at high densities depending on the health (e.g., regrowth) of the forage (Heitschmidt & Taylor, 1991). The latter has the capacity to

regenerate the grassland (Becker et al., 2017; Dass et al., 2018; Stanley et al., 2018; Teague & Barnes, 2017) and has many names including adaptive multi-paddock, mob grazing, management intensive grazing, and holistic planned grazing. The commonality between these methods is that farmers are making decisions about cattle movements and grassland needs on a daily basis, responding to current conditions to improve the health of the landscape and adapting their grazing plan accordingly. Therefore, I shall refer to this style under the umbrella term adaptive grazing management (Teague & Barnes, 2017). Overall, estimates regarding the use of adaptive grazing management range from about 5% of ranches in California and Wyoming use adaptive approaches identified by Roche et al. (2015) to about 10% adoption rate identified in Australia (Sherren et al., 2012). However, there is no database currently collecting these data at a local, state, national, or international level.

Not all producers who rotate their cattle are intentionally working to improve the health of grasslands, rather some are simply moving their cattle based on the amount of forage available such that cattle are moved between paddocks based on length of time based on consumption of the majority of forage in each paddock (Heitschmidt et al., 1987; Undersander et al., 2002). While a form of rotational grazing, this mid-spectrum practice differs from adaptive grazing because the focus is on the forage as a resource instead of forage as a tool for soil regeneration. Most research on grazing styles focuses on the two extremes – either continuous or adaptive (Briske et al., 2011; Teague & Barnes, 2017), but probability suggests that it is likely that many producers are using practices nearer the middle of the spectrum (de Villiers et al., 2014). The breakdown from continuous to rotational to adaptive is becoming more common in rangeland grazing research, suggesting many producers are moving their cattle to some extent (Gosnell et al., 2020; Teague et



al., 2016).

Recent research has shown adaptive grazing approaches improve ecosystem services by sequestering carbon (Stanley et al., 2018), increasing the biodiversity of both plants and animals (Russell & Bisinger, 2015), and increasing water infiltration (Lawrence et al., 2019), which results in higher quality forage (Oates et al., 2011) and a healthier ecosystem overall (Janzen, 2011; Lal, 2011; Lawrence et al., 2019; Liebig et al., 2010; Teague & Barnes, 2017). Therefore, an increasingly common call is to increase the adoption of adaptive grazing management styles to improve degraded grasslands. However, within the ecological literature on these grazing systems there is a clear divide that results in some scientists suggesting that grazing continuously is at least as beneficial to the natural environment as adaptive grazing (Augustine et al., 2020; Briske et al., 2008; Wilmer, Augustine, et al., 2018). For example, Briske and colleagues (2008) and Holechek and colleagues (2000) found no difference in the forage and animal productivity between the two systems. One potential reason for this dichotomy is that Briske et al. (2008) base their studies in a traditional experimental agriculture design, in which variation is controlled for by using test plots. In doing so, this research often does not address management at the whole-farm scale (Laca, 2009) and they often do not include the role of humans and the social systems in which they participate (Bruno et al., 2020).

However, while the ecological benefits are still being debated, there is more consistency in the social benefits. Recent farm-scale studies in the Western USA have investigated the role of Collaborative Adaptive Management for improving grasslands by increasing forage diversity through cattle grazing (Derner, Augustine, et al., 2021; Wilmer, Derner, et al., 2018). The studies

found that collaborative adaptive management has the potential to positively impact the social system factors by increasing management flexibility and allowing ranchers to determine what their management objectives are such as improving habitat for bird species or other wildlife (Augustine et al., 2020; Derner, Budd, et al., 2021; Porensky et al., 2022). Similarly, Sherren and Kent (2017) reviewed the literature on Holistic Management (Savory & Butterfield, 2016), a specific form of adaptive grazing management, and similarly found that social scientists who engage with Savory's work largely view the practice in a positive light despite the polarizing debates happening in experimental agricultural research. Thus, because of the observed social benefits and potential ecological benefits, there is a reason to be optimistic about the outcomes of adaptive grazing, but further study is required from a social-ecological systems perspective before advocating for its adoption.

#### 1.1.1 Humans within a Social-Ecological System

Given the importance of social factors related to grazing management styles in the existing literature, beginning with a social-ecological systems (SES) approach is critical. Through cattle management, farmers drive land use patterns and changes, including regeneration or degradation. However, the impacts of the grazing system on the farmer are not often considered. One such outcome is farmer wellbeing. Anecdotal evidence from farmers that have switch to adaptive grazing report having higher and more stable incomes, an increase in happiness, and a heightened sense of fulfillment due to being part of something greater (Gosnell et al., 2020). However, there is little research on these possible differences in wellbeing outcomes related to grazing management style. Currently the only research I have found that focuses on the wellbeing of farmers comes from Australia and indicates that pasture-based farmers suffer from higher rates of

poor mental health due to isolation, lack of access to healthcare, and social stigma (Kelly et al., 2010). These mental health challenges are often cited as a main reason for Australian farmers' decision to quit farming (Peel et al., 2016).

Investigating wellbeing outcomes is vitally important because currently farmers are facing a mental health crisis, resulting in farmers being in the top three occupations most likely to commit suicide (Klingelschmidt et al., 2018; Milner et al., 2013; Ringgenberg et al., 2018). However, pathway analysis literature in psychology notes that suicide is not the first step for people, rather it is the last resort often following periods of prolonged depression, low self-esteem, dissatisfaction with life, and feelings of isolation (Dieserud et al., 2001; Player et al., 2015; Thatcher et al., 2002). These are common problems for farmers because they are facing increasing land degradation, finding their livelihoods threatened, lack control over commodity and input prices, perceive they have little social value, and are impacted by the number and availability of processing facilities (Baines, 2013; Intergovernmental Panel on Climate Change, 2014; Ringgenberg et al., 2018). Additionally, due to the rural nature of farming many farmers' lack of access to healthcare facilities and face stigma for their use (Kelly et al., 2010; Ringgenberg et al., 2018).

Michigan State University Extension has developed a 'Managing Farm Stress' team which notes farmers in Michigan also suffer from depression and isolation, and the team is working to combat this problem through teletherapy, mental health workshops, and mentorships to help farmers manage unusually high stress levels when they occur. While MSU-E works on the mental health and social work side of wellbeing, I work to understand wellbeing holistically. Ultimately, wellbeing is supported by the interplay between the ecological and social factors of farming. On a

farm, particularly in degraded environments, the optimal grazing system is one that promotes farmer wellbeing, enhances farm economics, and regenerates grasslands, often referred to as ‘triple bottom line sustainability’ (Elkington, 1999). If wellbeing is in fact higher among populations that practice adaptive management, encouraging the uptake of adaptive grazing management will improve the social, economic, and environmental sustainability of pasture-based beef farms.

### 1.1.2 Social-Ecological Systems Thinking

To address sustainability problems, it is important to take a SES approach and investigate both the social and ecological factors as well as their interconnections, as shown in Figure 1. A social-ecological system includes any system in which the social and ecological processes are integrated and impact each other. By investigating problems from this perspective, one can account for the complexities that are embedded within a dynamic system and thus begin to explain previously unanticipated changes. In an SES, the social elements of the system are interconnected with the ecological elements to an extent that separating them will not allow us to effectively study either sub-system (Berkes & Folke, 2000; Resilience Alliance, 2007) (Figure 1). The ecosystem factors such as climate change and weather impact the ecosystem services available to the social system, and social factors such as commodities and treaties in turn impact global ecosystem service requirements (Berkes & Folke, 2000; Resilience Alliance, 2007). These interactions are cyclical such that making changes to the ecological sub-system has ramifications for the social sub-system and vice versa. Figure 1 demonstrates that human activities such as farming, logging, or fishing impact the entire SES because humans change the systems structure and function. The changes in the ecosystem impact the availability of ecosystem services such as food production, and these changes impact the human system because humanity relies on ecosystem services for survival

(Resilience Alliance, 2007). However, this cyclical pattern makes it difficult to know the direct impact of any pro-environmental action and is something that scholars are actively researching (Allen et al., 2014; Berkes et al., 2008; Holling, 2001; Holling & Meffe, 1996; Pereira et al., 2018; Quinlan et al., 2016). In any SES study, the first step is to bound the system. For my research, this means solely focusing in on ecosystems that are used for grazing beef cattle. This bounding will limit the number of variables in play and make it easier to analyze the system.



Figure 1. A social-ecological system includes any system in which the social and ecological processes are integrated and impact each other. When humans change the ecosystem about them, the ecosystem responds with changes in ecosystem services, which in turn impacts the resources available to humans (Resilience Alliance, 2007).

### 1.1.3 Grazing as a Social-Ecological System

Because a grazing system is based on both social and ecological processes, it is important to investigate the relationships through a social-ecological system framework. Hruska et al. (2017) position livestock grazing within an SES framing by adding a consideration of the relationships across multiple spatial scales. Nested within the global system are local system dynamics

illustrating how land use patterns and micro-economics impact the demand for local ecosystem services. These local, social factors in turn impact species composition and soils, which feedback on the provisioning of the ecosystem services for this system (Hruska et al., 2017). Inspired by Hruska et al. (2017) and that of Lubell et al. (2013), Figure 2 presents a novel framework for understanding the individual pasture-based beef farm system variables, specifically the social components, as part of a social-ecological system. Figure 2 also shows the links between various global system factors identical to Figure 1.

The specific grazing-based social-ecological system I am interested in studying is pasture-based beef production systems in Michigan. In beef production systems there are three main enterprises: cow-calf, backgrounding/stocking, and finishing (National Agricultural Statistics Service, 2017). Cow-calf operations raise cows who are giving birth to and raising a calf, backgrounding/stocking operations keep the calves once weaned while they are putting on weight, and finishing is the final stage before slaughter where the last amounts of body mass are put on and the cattle are prepared for processing. While cow-calf and backgrounding production are always carried out on pasture and, therefore, the farmers are implementing grazing management strategies (Barkley, 2012), the finishing stage of the beef value chain can be done on pasture or in feedlots, the latter of which do not necessarily require grazing management plans. Given my interest in using grazing management to address grassland degradation, I limit my study to pasture-based systems, not feedlot-based finishing enterprises. To ensure consistency and understanding in my language, I refer to the overall group of crop and livestock farmers as producers, and when I am specifically addressing the farms in which cows and/or calves are being raised on pasture for beef I will refer to them as pasture-based beef farms or farmers. When specifically focusing on a beef farm as a social-

ecological system, Figure 2 shows there are several unique factors that we need to consider including grazing management goals, practices and decisions, adaptations, as well as land use distribution, livestock species composition, livestock number, and livestock grazing patterns (Hruska et al., 2017; Lubell et al., 2013; Reid et al., 2014).

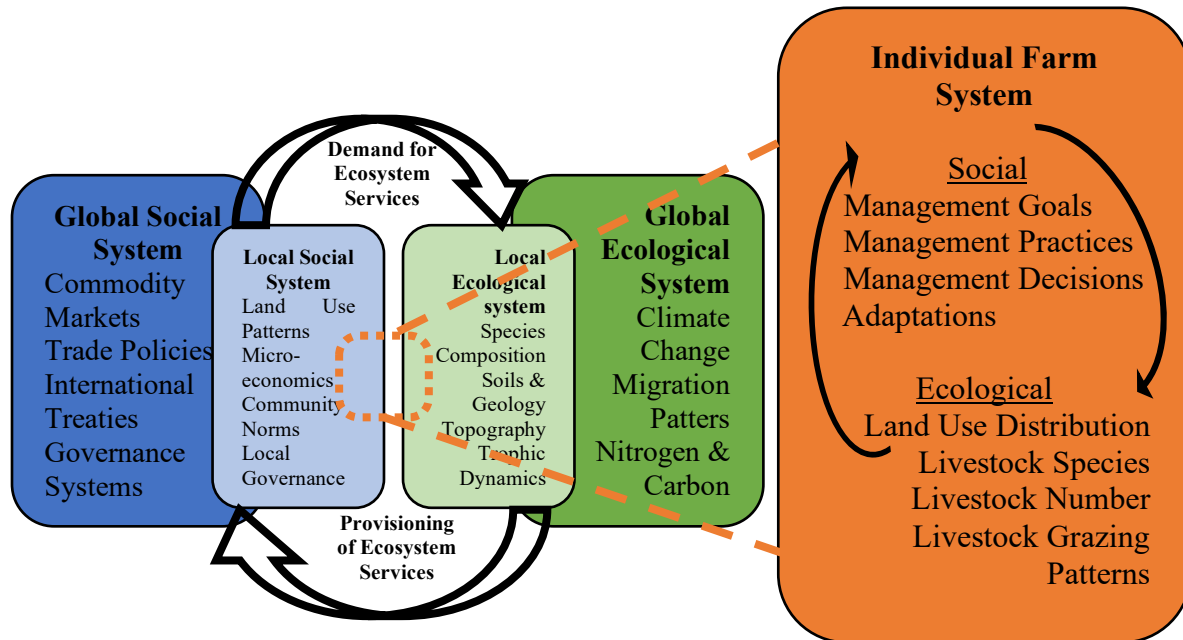


Figure 2. This novel framework illustrates the position of an individual farm within a social-ecological system. Nested in global and local systems, the individual farm is also dependent on social (i.e., management decisions, practices, and goals, adaptations) as well as ecological (i.e., land use distribution, and livestock species composition, number, and grazing patterns) factors.

In summary, the study of the social factors related to grazing management systems is necessary to explore through a social-ecological systems perspective because of the interdependencies between the social and ecological systems (Roche et al., 2015). Further, much of the research on the social impacts of grazing has been conducted in Australia and the Great Plains, United States, and it is

important to gather data about the Midwest U.S. because of role of animal agriculture in midwestern pasture-based beef productions. To understand the social system factors such as management goals, management practices, management decisions, and adaptations I developed a framework that integrates grassland ecological systems with the social system factors of management goals, practices, and decisions, as well as adaptations to understand the factors in social-ecological systems that can improve the lives of farmers and contribute to grassland restoration.

## 1.2 Understanding Behavior in Grazing Social-Ecological Systems

As depicted in Figure 2, an individual farm is a social-ecological system that is dependent on interactions between social factors, in this case management goals, management practices (behavior), management decisions (behavioral decisions) as well as adaptations (responses to shocks that go beyond coping) and the ecological factors such as land use distribution, and livestock species composition, number, and grazing patterns. To understand behavior and behavioral decisions I used the Theory of Planned Behavior (Ajzen & Fishbein, 1972) and the Schwartz Theory of Basic Human Values (Schwartz, 1992). Both address factors related to decision making, a factor that is sometimes understated when studying farm management systems (Prokopy et al., 2019).

### 1.2.1 The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) first developed by Ajzen and Fishbein (1972) is a commonly used conceptual model in social psychology research for understanding the various factors that influence behavior. The TPB demonstrates that understanding an individual's attitudes,



subjective norms, and perceptions of control over a particular behavior (i.e., behavioral antecedents) help explain the behavioral actions an individual takes. Integrating TPB allows the exploration of multiple behavioral antecedents and how they interact in different ways to result in particular grazing management outcomes. Figure 3 illustrates the relationship between these components and shows that behavioral antecedents both influence behavioral intentions as well as impact other behavioral antecedents (Ajzen & Fishbein, 1972).

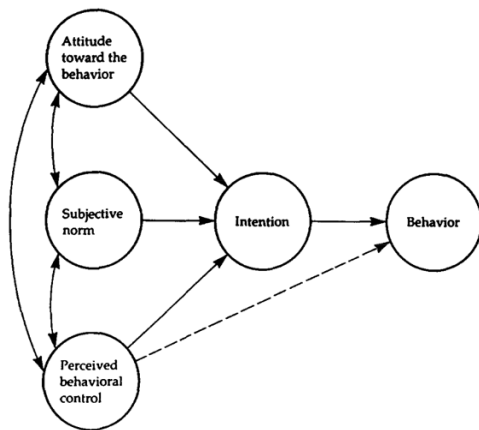


Figure 3. The Theory of Planned Behavior (TPB) (Ajzen & Fishbein, 1972) shows that an individual's beliefs, attitudes, and norms will impact their behavioral intentions, and the intentions are impacted by an individual's agency. The culmination of these factors is a behavioral outcome.

According to Ajzen and Fishbein (1972), attitudes are affective, emotional evaluations an individual makes about participating in a certain behavior (i.e., how do I feel about a particular action). Subjective norms are the internalized notions about what is right and wrong according to society (i.e., what behaviors are acceptable according to my community), and perceived behavioral control refers to an individual's opinions about whether or not they will be able to conduct the behavior (i.e., do I have the resources I need to do this) (Ajzen & Fishbein, 1972). To explain this for livestock farmers, one example is the behavior of giving vaccinations to the herd. An attitude

would be whether the farmer feels like vaccinating is a good thing to do, a social norm is whether the farmer's peers say vaccinating is beneficial, and the perceived behavioral control is whether the farmer believes they have the resources to vaccinate their animals. Figure 3 by Ajzen and Fishbein (1972) shows these three elements occur simultaneously and interact with each other. For example, if the farmer has been socialized to believe that vaccinating the livestock is the right thing to do, they are likely to have the attitude that vaccinating animals is a beneficial action. However, if this farmer perceives that they don't have the equipment to vaccinate the livestock, they might change their attitude to an evaluation that vaccinating is neither beneficial nor necessary, which may influence the farmer to build community with other individuals who hold a similar set of norms and attitudes about cattle vaccinations. As the behavioral antecedents interact with each other in a bidirectional manner, research is often unable to determine causal relationships. Rather, the relationships within the behavioral antecedents are correlational at most, and directionality is indiscernible (Ajzen, 1991). Taking all of these factors into account, according to Ajzen and Fishbein (1972) and Fishbein and Raven (1972), the result is a behavioral intention (i.e., a plan to conduct a behavior) decided upon based on the behavioral antecedents (i.e., attitudes, social norms, and perceptions of control). The behavioral intention can either be executed, leading to a behavior, or it can be thwarted because of outside influence or changes in the behavioral antecedents. This is the basis for the Theory of Planned Behavior as shown in Figure 3 (Ajzen & Fishbein, 1972).

There are alternate theories of environmental action that could be used to explore behavior, several of which highlight the role of behavioral decisions in conservation by focusing on the goals and outcomes rather than the behavioral antecedents found in the TPB. As suggested by Goralnik and Nelson (2011), attention to the differences in philosophies of action, particularly theories of

environmental actions, should focus on the interconnectedness of the system - the established relationships and how these relationships impact value-driven actions. These authors suggest that theories of environmental action must integrate emotional connections to the environment if they are to be successful in promoting conservation and sustainable environmental behaviors. Goralnik and Nelson (2011) suggest the most effective action-based theory of environmental best suited to promoting positive and desirable changes in behavior is Aldo Leopold's environmental philosophy, which suggests having relationships with nature will drive environmentally responsible behaviors (ERB), is more likely to result in meaningful and lasting changes in an individual's ERB. I do not contest that relationships with nature are a necessary factor, I agree completely, however farmers often identify as land stewards and therefore already have emotional attachments to their physical landscape and animals (Rivera et al., 2018; Thompson et al., 2014). Further, one other factor highlighted by Goralnik and Nelson (2011) was the need for emotional connections to the environment, which they argue is not effectively captured in Muir's action-based model of decision making. Muir's philosophy of environmental action suggests knowledge is the catalyst for emotional attachment to a place or landscape and that by learning about a place and being exposed to it (Goralnik & Nelson, 2011), and Goralnik and Nelson (2011) suggest that it is the emotional attachment to, not just knowledge of, a place that will promote adopting ERB over time.

Further investigation into theories of environmental action by Okumah et al. (2020) who used a Meta-Analytic Structural Equation Model demonstrates that the Theory of Planned Behavior (Ajzen, 1991) and other action-based theories that are highly context-dependent are more likely to correctly predict pro-environmental land management behaviors than low-context theories such as

the Values-Belief-Norm Theory (Stern et al., 1991) and the Norm Activation Theory (Schwartz, 1973). While it is true that action-based theories cannot predict specific behaviors due to individual differences in perceptions of control, attitudes, and norms, the Theory of Planned Behavior has demonstrated its applicability and usefulness many times over in conservation decision making (DeDecker et al., 2022; Karimi & Saghaleini, 2021; Maleksaeidi & Keshavarz, 2019; Rezaei et al., 2019; Tama et al., 2021) and specifically in agriculture as reviewed by Sok et al. (2020) who summarized 124 quantitative, peer-reviewed journal articles measuring the role of the TPB in predicting farmer behavior and found that the TPB was reliable and consistent in determining behavioral outcomes based on pre-decisional factors. Therefore, I based my theoretical framing of behavior in this study around a modified Theory of Planned Behavior to account for the current gap in research about the role of values as a direct behavioral antecedent integrated into the TPB framework.

### 1.2.2 Role of Values in Behavioral Decisions

To combat the perceived lack of values and emotional evaluations in the TPB I chose to integrate it with Schwartz (1992) Theory of Basic Human Values. The integration of values into theories of environmental action is not novel in and of itself, however the integration of Schwartz (1992) and Ajzen (1991) is a new framework. I note that values can be defined several ways relevant to SES research such as instrumental, intrinsic, relational, and held as explained by Chan et al. (2018). Goralnik et al. (2014) advocate for values-based decisions built on an ethic of care which suggests that building or changing relationships with nature catalyzes a change in values due to a desire to protect the wellbeing of the environment. An ethic of care and building relationships with nature that will cause humans to interact with nature differently, which I argue is a predecessor to the

behavioral antecedents in the TPB. Thus, I focus on values as reasonably stable over time taking a social-psychological approach in which values are described as, “trans-situational goals and principles that guide human behavior” (Manfredo et al., 2017, p. 773).

Values are defined as concepts or beliefs about desirable end states or behaviors that transcend specific situations, guide selection or evaluation of behavior and events, and have an order of relative importance (Schwartz & Bilsky, 1987). Values have also been described as the factor that unifies the sciences interested in human behavior because people use their values to guide behavioral decisions (Feather, 1992; Rokeach, 1973; Schwartz, 1973) and in the early 1970s there was a substantial amount of research being conducted in social psychology about why humans act the way they do. Until this point there were no cohesive theories on values, but Rokeach (1973) and Schwartz (1973) used interviews and surveys to determine that values are vitally important to understanding behavioral decisions.

Schwartz (2012) explains values are defined based on six main features from his research: 1. Values are beliefs; 2. Values refer to desirable goals; 3. Values transcend specific actions and situations; 4. Values serve as standards or criteria; 5. Values are ordered by importance; and 6. The relative importance of multiple values guides action. The latter point is critical, because if we want to understand behavioral decisions, it is important to study values in a way that accounts for multiple values being held simultaneously, not as values in competition with each other (Schwartz, 2016; Strydom, 2018; Ye et al., 2017). In the Schwartz theory some values are more closely related to each other and can be met simultaneously, while others are in opposition (Schwartz, 2012). Figure 4 shows the ten values determined by Schwartz (1992) through empirical research in over

50 countries inside the circle: universalism, benevolence, conformity, tradition, security, power, achievement, hedonism, stimulation, and self-direction. These ten values split into four value categories: self-transcendence, self-enhancement, openness to change, and conservation. Using this framing, if we were to explain values within the previous vaccination example, a value would be the farmer's openness to change and trying new things such as a new vaccination schedule or new type of vaccination. Beef farmers who value openness to change would be more likely to experiment with new vaccines or adopt a new vaccination schedule.

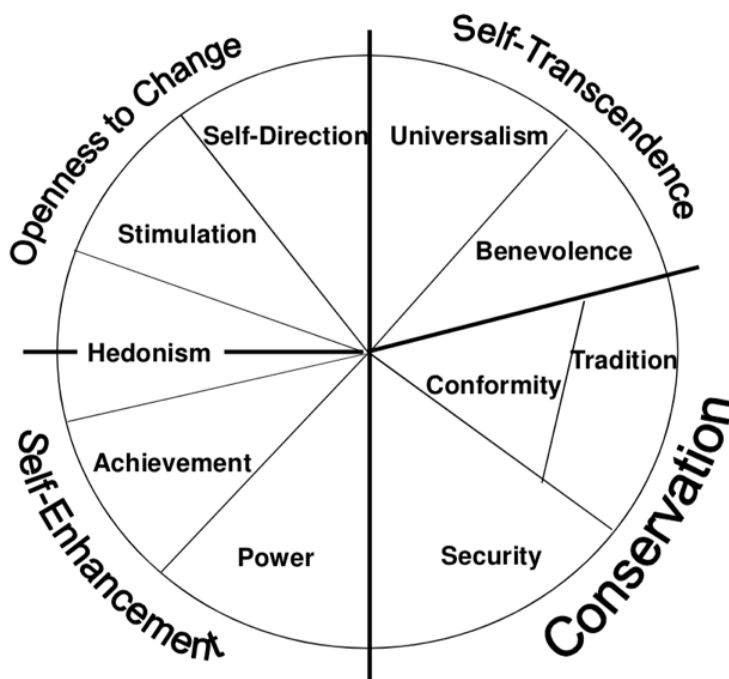


Figure 4. The Schwartz Theory of Basic Human Values (2012) depicts ten held values that guide decision making, which can be divided into four value categories titled openness to change, self-transcendence, conservation, and self-enhancement. Image from (Schwartz, 1992).

In a revised version of the Theory of Basic Values, Schwartz et al. (2012) explained that much of the research conducted involving the 10 values and four value categories (Figure 4) does not capture the heart of the theory: values are not distinct entities, rather they form a continuum of motivation. To combat this misinterpretation of the foundation of the theory, the authors expanded the 10 values to a continuum of 19 values to enhance the accuracy and reliability of statistical analyses including multidimensional scaling analyses and modeling (Schwartz et al., 2012). The authors acknowledge that the ten basic values are still at the foundation of the theory, and the 19 values can be reduced back into the 10 values if desired. Because the main motivation for expanding the 10 values into 19 was to enhance the accuracy of statistical analyses, and the survey construct required the rating of 57 value statements rather than 10 value statements, which would take significantly more time for participants to complete, I chose to work with the original depiction of the 10 Basic Human Values (Schwartz, 1992; Schwartz et al., 2012). Additionally, Schwartz et al. (2012) explains that due to the extensive testing and replication of the survey across a range of contexts the categorization of different values into the four value categories is acceptable regardless of whether reliability analyses are internally consistent or not, and for those that are not it is an important finding to explore further.

One of the reasons for using Schwartz's values theory instead of another theory of environmental action or a relational values approach was it has already been used in a series of foundational farm management contexts, primarily commercial crop systems (i.e., see review by Sok et al. (2020)). Further, as stated by Vaske et al. (2018) investigating deeply held values can improve conservation behavior adaptations. An early work to integrate values into farm management research, without the TPB, was Parminter and Perkins (1997) who measured farmers' values using a survey of 50

goal statements they determined from semi-structured interviews with 20 New Zealand farmers. The authors measured values as per Schwartz (1992) as a method for predicting farm management styles and found that there were differences in held values and management outcomes, but did not integrate the TPB. In a second study, the Edinburgh Study of Decision Making on Farms, Willock et al. (1999) noted that there are four dominant values in farming: instrumental, intrinsic, social, and financial. While this research does not reflect the language found in work by Schwartz, their integration of values, attitudes, and behavioral outcomes was a novel concept at the time of publishing and facilitated the inclusion of the TPB and values in the study of farm system behavioral decision making.

### 1.2.3 Applications of the Theory of Planned Behavior to Farmers

Using the Theory of Planned Behavior to study producers is well documented - a search in Scopus in February 2022 using the terms: (TITLE-ABS-KEY ("Theory of Planned Behavior" OR "Theory of Planned Behaviour") AND TITLE-ABS-KEY (grazier OR grazing OR farm OR ranch)) returned 161 journal articles with the majority investigating conservation agriculture practices in the United States. These articles primarily focused on cropping systems, rather than livestock, and the influence off-farm actors have on farm conservation opinions and therefore as desirable outcomes and consumer purchasing preferences. These are a mix of quantitative, qualitative studies, and studies based on secondary data models. Most frequently these studies contained a survey component either independently or paired with interviews which informed my methods. Within the literature identified above (n=161), there were 67 articles that also contain the additional search parameters TITLE-ABS-KEY(Schwartz OR "theory of basic human values", but in my interpretation, only two articles fully integrate Schwartz (1992) and the TPB (Ajzen, 1991)



to investigate conservation behavioral decisions in animal production. (Coon et al., 2020; Small & Maseyk, 2022).

Coon et al. (2020) investigated the role of the TPB in determining land owners' management goals for grazing lands in the Great Plains, USA and found that social norms are most influential in changing management behaviors that align with sustainable farm management. Maseyk et al. (2021) determined that the TPB accurately captured differences in biodiversity-promoting behavioral adoption in New Zealand's sheep and beef farmers and found that attitudes were the most influential factor, which lends support to theories regarding an ethic of care because - decisions based on farmer-nature relationships were the predominant factor in determining biodiversity enhancing management practices. Research by Price and Leviston (2014) states attitudes and norms are drivers of behavior in Australian grazing management systems. A study conducted by Willcox et al. (2012) concluded attitudes and subjective norms best explained farmers' behavioral intentions and research by Maleksaeidi and Keshavarz (2019) and Tama et al. (2021) found that attitudes were the most important variable for determining the likelihood of farmers adopting conservation management techniques. These findings are primarily based on structural equation models and suggest the Theory of Planned Behavior is useful for understanding what motivates farmers' behavioral decisions regarding sustainable agricultural practices. It is worth noting that while some factors were found to be statistically more impactful, a literature review by Biesheuvel et al. (2021) found the three original pre-decisional factors listed by Ajzen and Fishbein (1972) (Figure 3) were all positively and significantly correlated with behavioral intentions. Differences in research outcomes can be explained, at least in part, by the complex interdependencies between norms, attitudes, and perceptions of control depicted in Figure 3 that

will change according to the research population and location.

In more recent versions of the Theory of Planned Behavior, Ajzen and Fishbein (2005) note that there are a host of individual, demographic, and societal background factors (e.g., age, gender, ethnicity, socioeconomic status, education, nationality, religious affiliation, personality, mood, emotions, exposure to information, social support, coping skills) that impact an individual's behavioral intentions. The authors include values as an individual factor. Background factors are proposed to impact beliefs, which in turn influence attitudes, norms, and perceptions of behavioral control. The background factors and concept of beliefs are predecessors to behavioral antecedents but do not directly impact behavioral intentions as seen in Figure 3 (Ajzen & Fishbein, 2005), and Ajzen and Fishbein (2005) note that these background factors are not always present nor do all of them influence each behavioral decision in the same manner. Therefore, behaviors are not dependent on these factors the way they are dependent on attitudes, norms, and perceptions of behavioral control. However, because of the research by Schwartz (1973), Feather (1992), Stern et al. (1991), and other social psychologists that have built upon this foundation, I argue that values are a direct antecedent to behavioral intentions not just a background factor and thus should be integrated when investigating behavioral outcomes, which I illustrate in **Error! Reference source not found.**, a conceptual model that builds on TPB and reflects my theoretical framing for chapter one.

According to Ajzen (2011), the Theory of Planned Behavior was intended to grow and change as research better understood human behaviors and neuroscience. They also note that the study of certain populations may require certain background factors be explicitly studied as direct

behavioral antecedents. These modifications should be replicated and checked for reliability and accuracy if the goal is to alter the theoretical foundation. However, if the changes are specific to a case study population the authors encourage their inclusion but caution against generalizing to the broader theory so that the TPB can be used in various applied research settings including agriculture, medicine, and gerontology (Ajzen, 2011). Since conducting this research, there have been some studies published that have also included Schwartz's values as a behavioral antecedent, though not dealing with livestock production, including Prime et al. (2021) and Ahmad et al. (2020). Prime et al. (2021) explain integrating held values and the TPB more accurately accounts for differences in humans' willingness to use pro-environmental behaviors. Similarly, Ahmad et al. (2020) investigated tourists willingness to visit an eco-tourism destination and found that values, attitudes, and social norms are drivers of behavioral decisions to participate in eco-tourism.

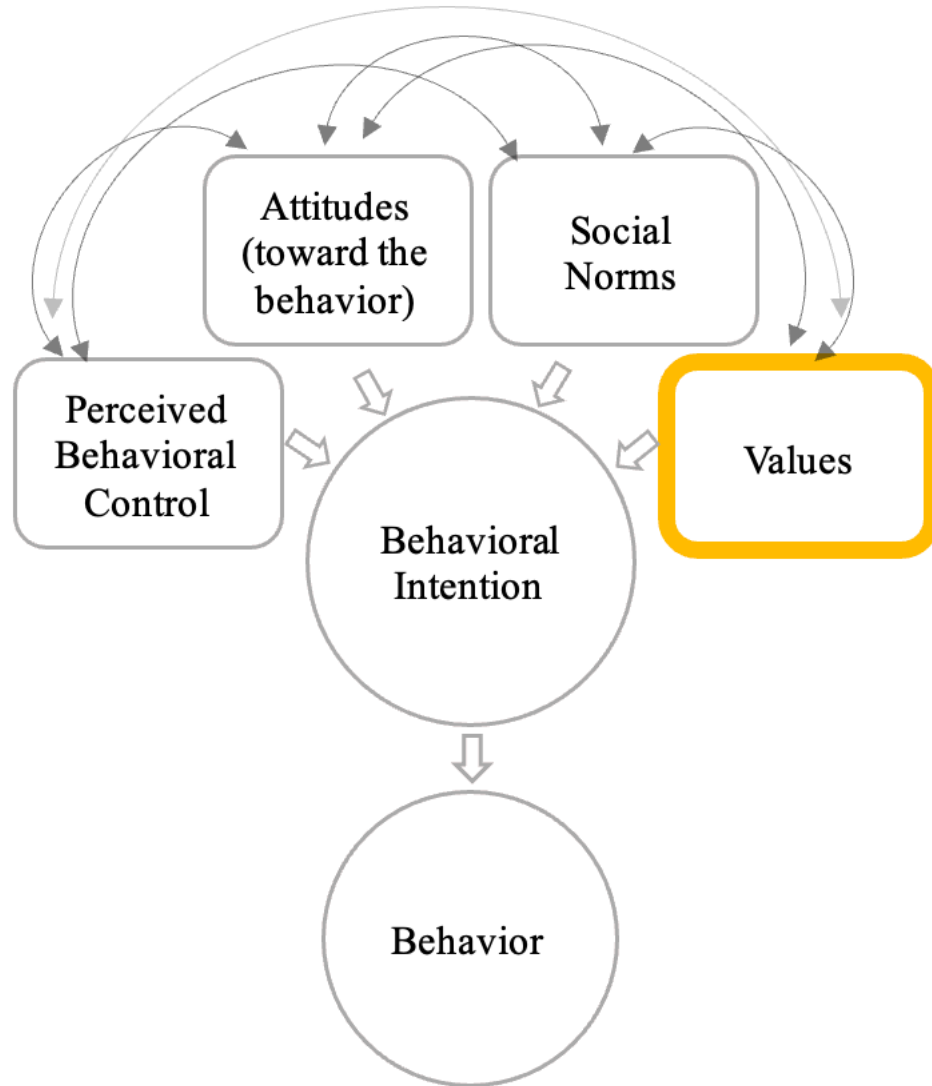


Figure 5. This diagram illustrates the flow of perceptions of behavioral control (i.e., whether the individual thinks they can participate in the behavior), attitudes (i.e., emotional evaluation of a behavior), social norms (i.e., opinions of the social network), and values (i.e., core life-guiding principles), which influence whether and individual intends to act a certain way. If the intention is strong and they have the capacity to do so, the individual will follow through on the intention and behave a certain way. The addition of values (in gold box) to the TPB is a novel addition to this theoretical framework.

Ultimately, if the main goal is understanding what drives management behaviors, it is necessary to investigate the pre-decisional factors shown in Figure 6 superimposes the individual farm social system factors from Figure 2 with my framework for understanding behavioral outcomes in section 3.2 Behavioral Factors for Management. By understanding differences in these factors, it is possible to identify potential strategies to better communicate with farmers about management practices that promote sustainability. If values differ across groups who practice different types of grazing management (e.g., do they tend to be more open to risk or more risk averse), the management goals, decisions, and practices are impacted (Figure 6). One example of this would be farmers who are more risk averse will create management goals that do not require risks and are familiar to the farmer. Alternatively, if a farmer is open to change, they may be more willing to experiment with new management goals. Values will influence the type of information a farmer decides to pursue, specifically if are they looking to learn more about maintaining their current system (i.e., risk averse) or are they are interested in learning about new management practices and how to implement them (i.e., open to risk). The study of pre-decisional factors and specifically including values as a direct antecedent to behavioral decisions in livestock production systems (i.e., the farmer's adaptations, management goals, decisions, and practices) is a novel theoretical framing and will be used to frame the results and discussion for section 3.2 Behavioral Factors for Management.

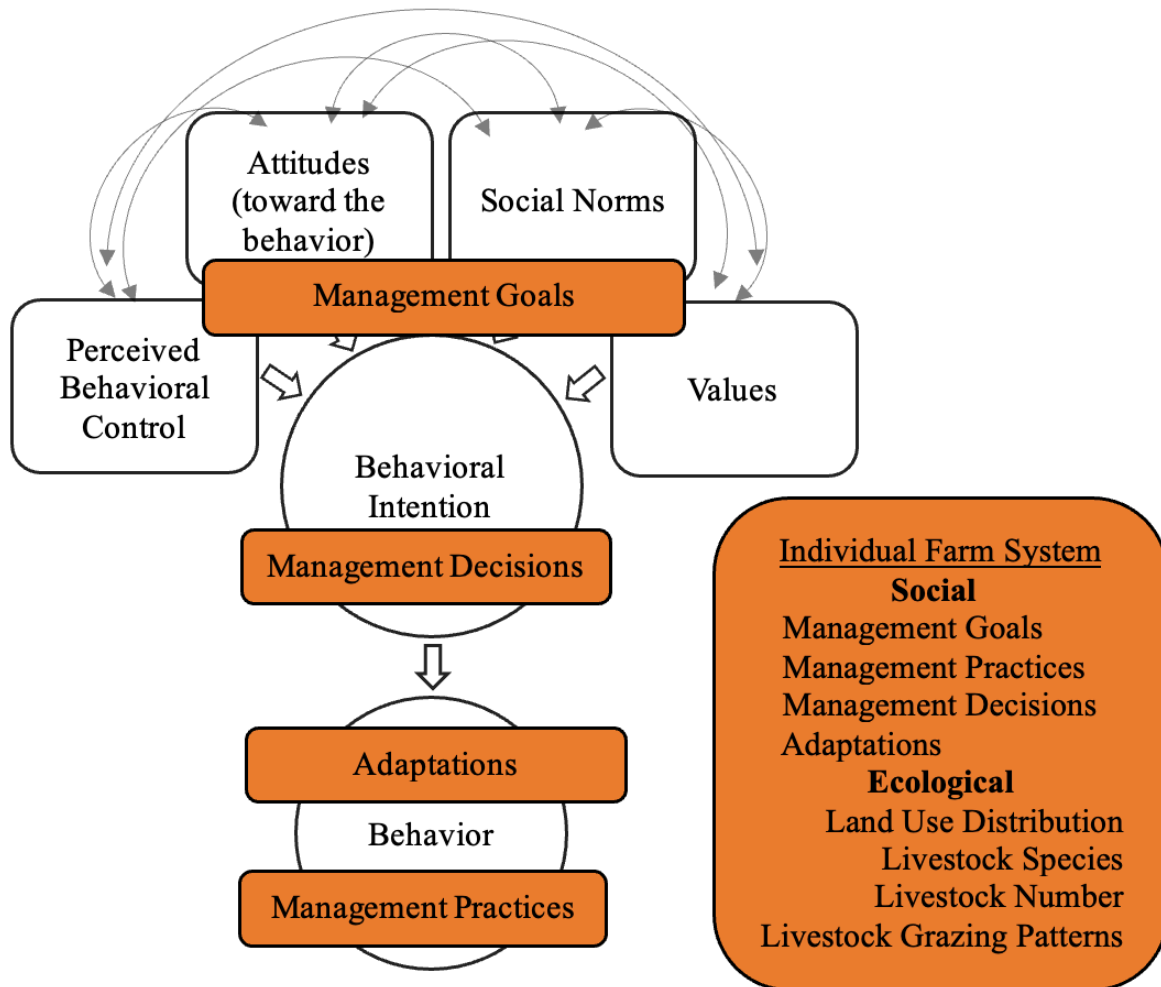


Figure 6. Behavioral antecedents address the individual farm social systems factors as well as management goals which ultimately inform management decisions and practices.

### 1.3 Outcomes of Management in Grazing SES: Assessing Producer Wellbeing

In the Brundtland Report (Brundtland et al., 1987) sustainable development was defined as development that meets the needs of current generations without compromising future generations' ability to meet their needs. Since this pivotal moment in sustainability discourse a variety of definitions have spawned, but at the core all definitions are concerned with limiting degradation or negative outcomes for ecological and social systems. Specifically, sustainability accounts for both short and long-term changes or impacts.

### 1.3.1 Social Sustainability in Farming Systems

According to Fischer et al. (2012), effective sustainability initiatives require empirical and theoretical engagement with social systems, particularly social norms and civil society. Tailoring sustainability research to the social aspects of farming systems (i.e., management goals, practices, and decisions as well as adaptations) can help humanity achieve large-scale behavioral changes related to enhanced sustainability (Fischer et al., 2012). One goal of social sustainability is to improve the holistic wellbeing of the individuals in the system, as stated by Barrington-Leigh (2017, p. 1) “We need not accept the message that painful cuts to our quality of life are necessary in order to achieve sustainability. Indeed, an optimistic, win-win message concerning society and environment is not only compelling, but also essential.” To make grazing systems more ecologically sustainable, the literature suggests pasture-based beef farms change from continuous grazing styles to adaptive management (Janzen, 2011; Lal, 2011; Lawrence et al., 2019; Liebig et al., 2010; Teague & Barnes, 2017), however, within an SES framing it is also necessary to consider social outcomes including the relationships between different grazing management styles and producers’ wellbeing. This optimism that sustainability will benefit ecological and social systems is compelling and further supports the argument for taking a SES approach to understanding the sustainability of grazing systems and the impacts on human wellbeing.

### 1.4 The Necessity of Studying Wellbeing

According to Helne and Hirvilammi (2015) human wellbeing is dependent on the functioning of ecosystems such that they can provide ecosystem services that support healthy, thriving humans who will in turn take care of the environment instead of exploiting natural resources. During the Green Revolution in the 1960s agriculture became even more focused on maximizing production

through genetic modification and chemical applications to agricultural lands (Rivera et al., 2018). This shift to intensification and chemical applications is part of the loss of sustainability both ecologically and socially (Rivera et al., 2018). Transitioning from an agricultural productivist culture to focusing on social connection and psychological wellness in addition to physical health and economics is reflected in the conceptualization of wellbeing provided by Dodge et al. (2012), although they are not specifically defining wellbeing for sustainability or social-ecological systems. Reversing this degradation and/or increasing the sustainability of an SES will require focusing on the wellbeing of people, place, and planet (Bennett et al., 2015; Helne & Hirvilammi, 2015).

#### 1.4.1 Defining Wellbeing

However, one challenge of studying wellbeing stems from disparate definitions originating from different academic disciplines including philosophy and social psychology. Overall, there tend to be two broad approaches to defining and understanding wellbeing either through a hedonic or eudemonic approach. While there is not a universally agreed upon definition of wellbeing to draw from for social-ecological systems and sustainability research, there is a consensus that human wellbeing includes a range of factors from focusing on happiness and other positive emotions (i.e., hedonic approach) to focusing on an individual's perceptions of self-fulfillment and pride (i.e., eudaemonic approach). Research in sustainable development and/or sustainability historically took a livelihoods approach where wellbeing was measured by attainment of material goods and economic goals, however Helne and Hirvilammi (2015) highlight the need for considering holistic wellbeing in sustainability studies. As stated by Kjell (2011), sustainability studies should focus on "how current hedonic and eudaemonic well-being approaches can be seen as isolating;



investigating well-being individualistically and in a decontextualized way.” Therefore, sustainability research must include various approaches to understanding wellbeing and should strive to increase overall wellbeing (Kjell, 2011).

To be more inclusive of a range of academic disciplines and sustainability science, Dodge et al. (2012) state that wellbeing is the result of finding a balance between social, physical, and psychological resources and challenges (Figure 7). Thus, the study of wellbeing needs to focus on the balance between benefits and challenges inherent in farming systems. The intricate relationships between these three factors and the balance between positive and negative impacts are not well studied in farmer populations at large, and, specifically, have not been studied in the pasture-based beef farmers of Michigan.

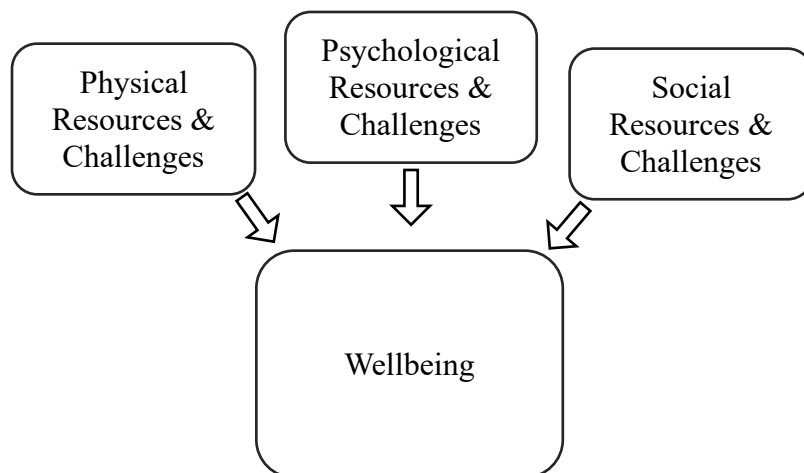


Figure 7. Dodge et al. (2012) define wellbeing as the balance between psychological, social, and physical resources and challenges.

Physical, psychological, and social wellbeing components are often evaluated independently, rather than considered holistically. The definition provided by Dodge et al. (2012) was based on a

review and integration of cross-disciplinary literature about human wellbeing, but had not been used empirically. Therefore, I integrated Dodge et al. (2012) with tools from empirical studies on human wellbeing including the Gross National Happiness Index (Royal Government of Bhutan, 2014), European Social Survey (European Social Survey, 2016), Personal Wellbeing Index (International Wellbeing Group, 2013), and Australian Rural Mental Health survey (Kelly et al., 2010) to investigate the three components (i.e., physical, psychological, and social wellbeing) holistically in pasture-based beef farms. This integration of international wellbeing tools and theoretical framing are novel contributions to grassland livestock production and have the potential to mitigate some of the negative wellbeing impacts farmers currently face in animal production systems.

Social wellbeing is subjective and focuses on the outcome of interactions between positive emotions, negative emotions, and long-term life satisfaction (Diener, 1994). This sub-field is primarily focused on feelings and emotions, with current definitions addressing happiness, joy, and feeling good (i.e., wellbeing is the maximization of pleasure and the decrease of malaise). This model aligns with hedonic approaches to understanding wellbeing (Dodge et al., 2012). In this case the benefits and challenges are the positive and negative emotions, respectively. Diener (1994) established several surveys that measure social wellbeing outlined in the book “Assessing Subjective Wellbeing: Progress and Opportunities,” including iterations of the General Satisfaction with Life Survey which were part of the Australian Rural Mental Health (ARMH) survey.

Physical wellbeing is the combination of meeting basic needs, supporting physical health, and

attaining material assets and economic wellbeing such as having a livelihood that is profitable and stable (Gillett-Swan & Sargeant, 2014 ). Having a variety and abundance of assets and being physically healthy benefit physical wellbeing; situations or problems that result in few assets, poor health, or being unable to meet basic needs challenge physical wellbeing. This is perhaps the sub-field with the most validated survey methods as these data have long been collected in international development research (European Social Survey, 2016; International Wellbeing Group, 2013; Linton et al., 2016), and the ARMH (Kelly et al., 2010) survey, which included sections for physical wellness and economics.

Psychological wellbeing is the relationship between real and imagined self (Ryff, 1989), which aligns with a eudaemonic approach to studying wellbeing. It requires understanding whether or not an individual is living within their values and/or meeting their goals (Lockwood, 1999). Here, the focus is on how you measure up to the person you want to be - living up to an individual's potential and enjoying a life that is close to the perceived ideal (Dodge et al., 2012; Ryff, 1989). Anything that promotes positive psychological functioning is beneficial, and situations that support a negative outlook are damaging. Survey questions established by Ryff (1989) are commonly used to measure psychological wellbeing from this perspective (i.e., as reviewed by King et al. (2013)), however this was not the case in the ARMH survey which instead relied largely on measures of mental health and stress rather than the Psychological Wellbeing Survey created by Ryff (1989).

As demonstrated above, there are multiple tools that assess these elements separately, but to date the only tool I have found that addresses all three components in a livestock producer population

is the Australian Rural Mental Health survey (Kelly et al., 2010). This survey included components for physical and mental health, satisfaction with relationships, general functioning, community satisfaction and perceived ‘stress’, which overlap with the categories proposed by Dodge et al. (2012) for holistic understanding of human wellbeing, however Dodge et al. (2012) is not cited by Kelly et al. (2010). Due to the focus on mental health rather than holistic wellbeing I did not adopt the Kelly et al. (2010) ARMH survey construct, which seeks to address the unique mental health challenges farmers and rural dwellers face in Australia, but I did use it for inspiration in designing my survey questions.

As reflected in the ARMH findings, farmers are facing a mental health crisis demonstrated by high rates of depression and anxiety (Kelly et al., 2010; Ringgenberg et al., 2018). Pathway analysis literature in psychology notes that periods of prolonged depression, low self-esteem, dissatisfaction with life, and feelings of isolation can result in people dying by suicide (Dieserud et al., 2001; Player et al., 2015; Thatcher et al., 2002). These are common problems for farmers who face increased land degradation, find their livelihoods threatened, lack control over commodity and input prices, perceive they have little social value, and are impacted by the number and availability of processing facilities (Baines, 2013; Intergovernmental Panel on Climate Change, 2014; Ringgenberg et al., 2018). Additionally, due to the rural nature of farming, many producers lack access to healthcare facilities and face stigma if they do use them (Kelly et al., 2010; Ringgenberg et al., 2018). The combination of these negative impacts and the higher than average depression and anxiety farmers face contributes to farming being listed as one of the top three occupations in the United States most likely to die by suicide (Klingelschmidt et al., 2018; Milner et al., 2013; Ringgenberg et al., 2018).

Michigan pasture-based beef farmers are not immune to this phenomenon, and within Michigan, there are groups working to combat this mental health crisis. These groups focus on improving the mental health of producers who are already struggling and providing resources to learn more about farm stress and mental health challenges. Alternatively, I focus on wellbeing from a social-ecological systems and sustainability perspective, particularly how wellbeing is related to management behaviors, including studying the relationships between wellbeing and behavior systematically. Ultimately, wellbeing is influenced by the interplay between the ecological and social factors of farming (Bennett et al., 2015; Biggs et al., 2015). On a farm, particularly in degraded landscapes, the optimal grazing management system is one that encourages farmer wellbeing, enhances a farm's financial situation, and improves the forage in grazing spaces. As described at the beginning of this section, if wellbeing is in fact higher among populations that practice adaptive grazing management, encouraging the uptake of these practices will improve the social, economic, and environmental sustainability of pasture-based beef farms.

#### 1.4.2 Relationship between Wellbeing and Behavioral Decisions

Research in psychology shows that the behaviors a person participates in can influence their emotional wellbeing (Hazlett-Stevens & Craske, 2002). Most frequently the relationship between behavior and wellbeing is investigated in social work and psychology in terms of behavioral therapies (i.e., see review by Ost (2008)). Social work and social psychology research has established that the behavior-wellbeing relationship exists and is bidirectional and is not specific to a certain behavior or system, however this work is tied to mental health and not more general wellbeing outcomes (Ost, 2008). In summary, performing a given behavior will impact an individual's wellbeing, and as research on behavioral therapies (Ost, 2008) shows, an individual's

wellbeing will also impact the behaviors they perform. According to Bruno et al. (2021), despite the bidirectional relationship being an established construct, social-ecological research typically focuses on the impact of behaviors on wellbeing, and they challenge this approach suggesting wellbeing is also an input for behavioral outcomes.

This is similar to recent research suggesting wellbeing and resilience are related, both psychologically and social-ecologically (Breslow et al., 2016; Brew et al., 2016; Brown et al., 2021; Fattore & Agostoni, 2016; Misso et al., 2013; Newton, 2007; White, 2018). The TPB does not account for the behavioral impacts of certain management strategies, particularly the bidirectional relationship between behavior and wellbeing depicted in Figure 8. This behavior-wellbeing relationship is not present in other theories of decision making or within research on the management of agricultural production systems. Further, the literature on wellbeing does not investigate the relationship with behavioral antecedents or how behavioral outcomes might be impacted by an individual's wellbeing. Therefore, I propose a new theoretical framework to investigate relationships between behavioral antecedents, behavioral intention, behavior, and wellbeing, as depicted in Figure 8, which also shows how wellbeing is both impacted by and a driver of behaviors.

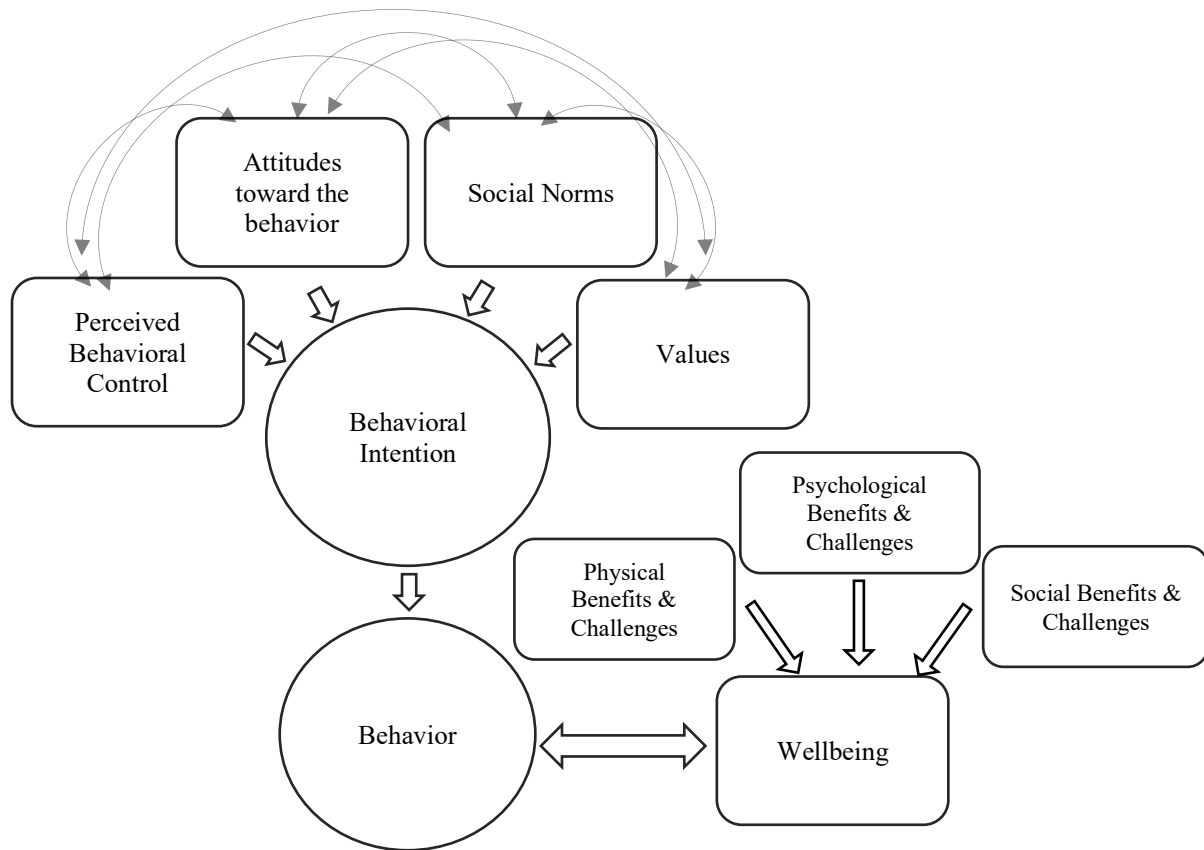


Figure 8. The theoretical framework driving my research shows that there are antecedents (perceived behavioral control, attitudes, social norms, and values) that lead to behavioral intentions, which then lead to behaviors.

As per Ost et al. (2008), the relationship between wellbeing and behavior is not unidirectional. Rather this relationship is an iterative process in which changes in a farmer's wellbeing impact their management practices, which in turn impact the farmer's wellbeing, as shown in Figure 8. The lack of research on wellbeing in grazing systems can be bolstered by expanding the investigation to include literature on the adoption of sustainable practices, often referred to as best management practices (Church et al., 2020; Floress et al., 2018; Prokopy, 2008; Reimer et al., 2014). Historically best management practices regarding social system factors have focused on increasing profitability (i.e., a facet of physical wellbeing) and developing a focus on

environmental stewardship (i.e., a facet of psychological and social wellbeing) (Reimer et al., 2014; Reimer et al., 2012; Thompson et al., 2014).

Anecdotal evidence from my personal conversations with pasture-based beef farmers that have switched from continuous to adaptive grazing, as well as work by Savory and Butterfield (2016) and other Holistic Management organizations (e.g., Holistic Management International, Savory Network), suggests that adaptive farmers experience higher wellbeing due to an increase in happiness (i.e., social wellbeing), more stable incomes (i.e., physical wellbeing), a heightened sense of fulfillment (i.e., psychological wellbeing), and the belief they are part of a larger movement to sustainable agriculture. The basis for these improvements in farmer wellbeing due to using Holistic Management are often tied to the use of a ‘holistic context’ (Savory & Butterfield, 2016) in which farmers outline their management goals how these goals will help them accomplish broader life goals such as financial independence, improved physical health, and greater joy (Nordborg & Roos, 2016). However, I was unable to uncover empirical research confirming or refuting these claims. The research regarding the social impacts of Holistic Management suggests changes in management occur due to changes in thinking patterns, particularly a shift from reductionist thinking to systems thinking (Fazey et al., 2007; Gosnell et al., 2020; Mann et al., 2019; Mann & Sherren, 2018). Despite the historic lack of investigation into the behavior-wellbeing relationships, nascent literature published on adaptive grazing management and wellbeing shows adaptive grazing is related to higher self-reported subjective wellbeing, however the authors conflate subjective wellbeing with psychological wellbeing in this paper (Brown et al., 2021). Therefore, the results can be expanded to suggest that the holistic wellbeing of farmers practicing adaptive grazing management is higher than their non-adaptive counterparts.



Even with the recent study by Brown et al. (2021), there remains a gap in our understanding about how grazing management decisions impact the social, psychological, and physical wellbeing of Michigan's pasture-based beef farmers. The relationships between management style and wellbeing will be addressed in results section 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers.

### 1.5 Adaptation: The Impacts of COVID-19 on Michigan's Pasture-based Beef Farmers

Conducting research on wellbeing in the middle of a global pandemic requires paying attention to how the pandemic has impacted the farmers. Due to the high transmission rates of the COVID-19 virus during 2020 and 2021 much of the world entered a state of lockdown and isolation, which had negative impacts to wellbeing (Zheng et al., 2021 ). Although individuals with different personality types (Luo et al., 2022; Naidu et al., 2022) and occupations (Leon-Perez et al., 2021) were impacted in diverse ways, humans broadly faced decreases in their holistic wellbeing and found themselves struggling to maintain or re-establish their wellbeing amidst the uncertainty of pandemic life (Ford, 2021). Despite natural social distancing being a normal part of farming, farmers were not immune to decreases in wellbeing. Therefore, it was necessary to further investigate the impacts the pandemic had the social, psychological, and physical wellbeing of pasture-based beef farmers.

#### 1.5.1 Impacts of COVID-19 on the U.S. Livestock Sector

Across the approximately 730,000 farms in the United States producers raise more than 80 million beef cattle (National Agricultural Statistics Service, 2017). One unexpected situation caused by the pandemic was the closure of several major meat processing facilities due to outbreaks of

COVID-19 in the workforce (Douglas, 2020; Douglas & Marema, 2020). For context, in the United States the four largest processing companies in the beef, poultry, and pork sectors process 55% to 85% of the meat produced, and 50% of the country's beef is processed across only 12 processing facilities (Hendrickson et al., 2020; Taylor et al., 2020). In Michigan, the majority of the 402 processing facilities are small in size and each processes an average of 250 finished beef cattle per year, which is significantly less cattle than their larger counterparts, which process more than 1,000 finished beef cattle each year (Schweihofer et al., 2014).

The impacts of processor closures, restaurant closures, and price or availability changes concerning inputs and supplies impacted farms of different sizes in diverse ways, but according to Lopez-Ridaura et al. (2021) the largest farms and the smallest farms fared best. The authors explained that large farms with enterprise diversity and integration at multiple points along the supply chain had more control over processing and retail, and small farmers had a higher capacity to adapt because they had fewer animals needing care (Lopez-Ridaura et al., 2021). Another factor farmers faced due to the pandemic was resource shortages like building materials, social implications of lockdowns and a move to work-from-home, and physical health concerns for humans and animals. Farmers faced these challenges and simultaneously managed market and processor closures, rapid changes in meat supply and demand, and lack of access to veterinary services as depicted in Figure 9 (Ijaz et al., 2021; Lopez-Ridaura et al., 2021).

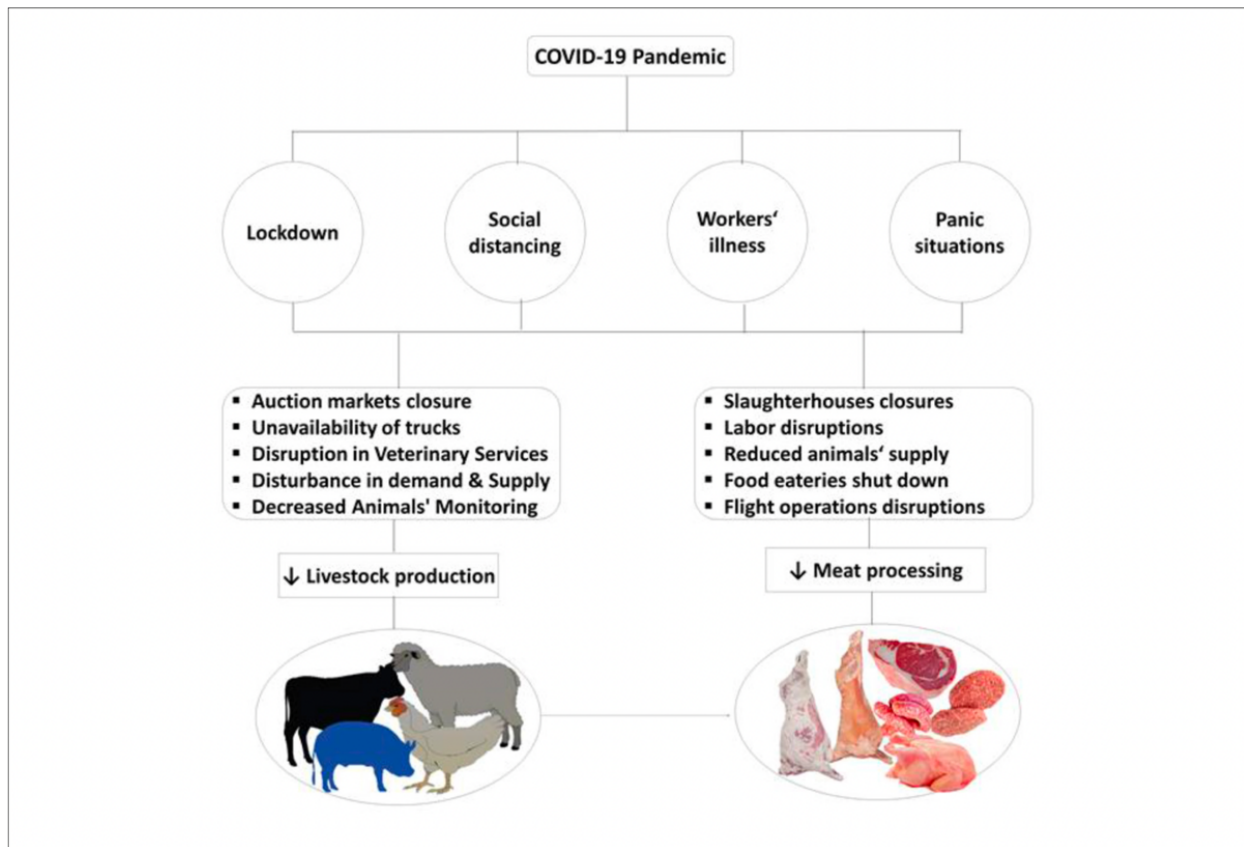


Figure 9. Ijaz et al. (2021) diagramed some of the ways the meat production industry was impacted by the COVID-19 pandemic such as auction closures, disruptions to veterinary services, restaurant shutdowns, and labor disruptions.

Processing facility closures limited beef farmers' ability to prepare and sell their products, and despite the reopening of processing facilities (McCarthy & Danley, 2020) the backlog created by the shutdown was still impacting production and meat available to the public two years later. These impacts influence social system variables shown in Figure 10 such as management decisions, management goals, and management practices, and managing these closures required adaptations. When the farmers were unable to process their products, they were forced to make difficult management decisions about how to maintain their herd such as: will there be enough food for all the animals; how large can the herd grow before they outgrow the space available; and should

some animals be culled to limit the negative impacts on the rest of the herd. Therefore, it is important to investigate the COVID-19 pandemic as a major system shock and explore the ways farmers handled this unique challenge.

### 1.5.2 Impacts of the COVID-19 Pandemic on Farmer Wellbeing

Investigating wellbeing during an on-going, global pandemic poses unique challenges for understanding “normal wellbeing” versus “pandemic wellbeing”. Thus, an opportunity arose to use the concept of adaptation to understand the variety of ways farmers worked to ensure they maintained acceptable levels of social, psychological, and physical wellbeing while facing such a rare, global system shock with major local-farm-system implications (Lopez-Ridaura et al., 2021; Meuwissen et al., 2021). Adaptations were defined per Smit and Wandel (2006) as a process, action or outcome that helps the system to better cope with, manage or adjust to some changing conditions and shocks. The role of adaptations in farm systems contains a well-established field of literature and was foundational for their inclusion in this research (de Villiers et al., 2014; Gosnell et al., 2019; Hodbod et al., 2016; Hodbod & Eakin, 2015; Skog et al., 2018; Soubry & Sherren, 2022).

Research on the impacts of the pandemic, and farmers’ adaptations to it conducted by Meuwissen et al. (2021) discusses the role of connectivity and diversity on farms successfully navigating the COVID-19 pandemic. As the authors stated, having a social network already in place with other producers and consumers buffered against the shocks of the pandemic such as market loss and isolating social lockdowns (Meuwissen et al., 2021). Further, the authors found that farms with greater diversity of enterprises, including animals, vegetables, fruits, and more tended to have more

stability during the pandemic because of the number of income streams available to the farmer (Meuwissen et al., 2021). One challenge to understanding the impacts of the pandemic on the United States agricultural production system is a lack of resources that address topics beyond the economic impacts of the pandemic (Hashem et al., 2020; Ijaz et al., 2021; Lusk et al., 2020; Peel et al., 2020; Ramsey et al., 2021; Taylor et al., 2020). Therefore, I used international to gain a broader perspective (Lopez-Ridaura et al., 2021; Meuwissen et al., 2021; Zhan & Chen, 2021). The role of adaptation for managing the COVID-19 pandemic and the impacts it had on farmers is discussed in section 3.4 Michigan's Farmers and the First Year of the COVID-19 Pandemic.

## 1.6 Research Questions

This project set out to address four research gaps and answer four research questions:

Research gap 1: Currently there is no system for tracking the distribution of different grazing management styles in Michigan, nor at the national or international level. If we want to understand the adoption of adaptive grazing management as a tool for grassland restoration it is important to know what management strategies are used on the ground.

Research Question 1: What is the distribution of grazing styles in Michigan?

Research gap 2: Literature has shown the utility of the TPB and values for determining behavioral outcomes, however the integration of these topics into one theoretical framework specifically for understanding grazing management decisions is novel. That said, livestock farmers' behavioral decisions are understudied regarding their motivations for management decisions.

Research Question 2: Why do farmers choose to manage their beef herd the way they do?

Research gap 3: Farmers are facing major challenges to their mental health and overall wellbeing. Literature shows that wellbeing and behaviors are related, but there is little information about the

role of management choices impacting wellbeing. If the goal is to increase the adoption of sustainable management, we must ensure social sustainability as well.

Research Question 3: How do management choices impact the wellbeing of the farmer?

Research gap 4: Throughout the first year of the pandemic society faced a barrage of shocks at all levels of social systems. Farmers faced these societal shocks as well as unique stressors related to animal management, which inevitably influenced their wellbeing. However, we have no information about the specific shocks for pasture-based beef producers and little data about how they coped.

Research Question 4: What were the impacts of the first year of the COVID-19 pandemic on farmers and their wellbeing?

## 2 METHODS

To investigate these four research questions, I used a sequential mixed methods approach. It was important to use both quantitative and qualitative methodologies because they created a more holistic picture and were used to give more context to the one-the-ground situation. I conducted a survey and then followed up with interviews from a subset of the survey sample who volunteered to be interviewed on their survey. The benefits of using a survey included reaching a broader audience, gathering a wide variety of information, and being able to make statements about the population (Dillman et al., 2009; Field, 2013) unlike when conducting in-depth interviews which result in more specialized knowledge about the sample (Patton, 2015; Rubin & Rubin, 2012). Generally, with a survey there is little information about the reasoning behind any given response, while interviews allow a deeper insight of the phenomena being explored. Further, the survey responses were used to help inform the interview protocol, especially in the COVID-19 section because the interviews were conducted in the Spring of 2021 and little research had been published on the impacts of COVID at the farm scale. The explicit descriptions and rationale for answers given by farmers to the interview questions provided context, deeper understanding, and clarification for why each farmer chose the survey response they did. In summary, as suggested by Sayre (2004), research into grazing management decision making would benefit from more qualitative data that can provide deeper insights and understanding of the quantitative research.

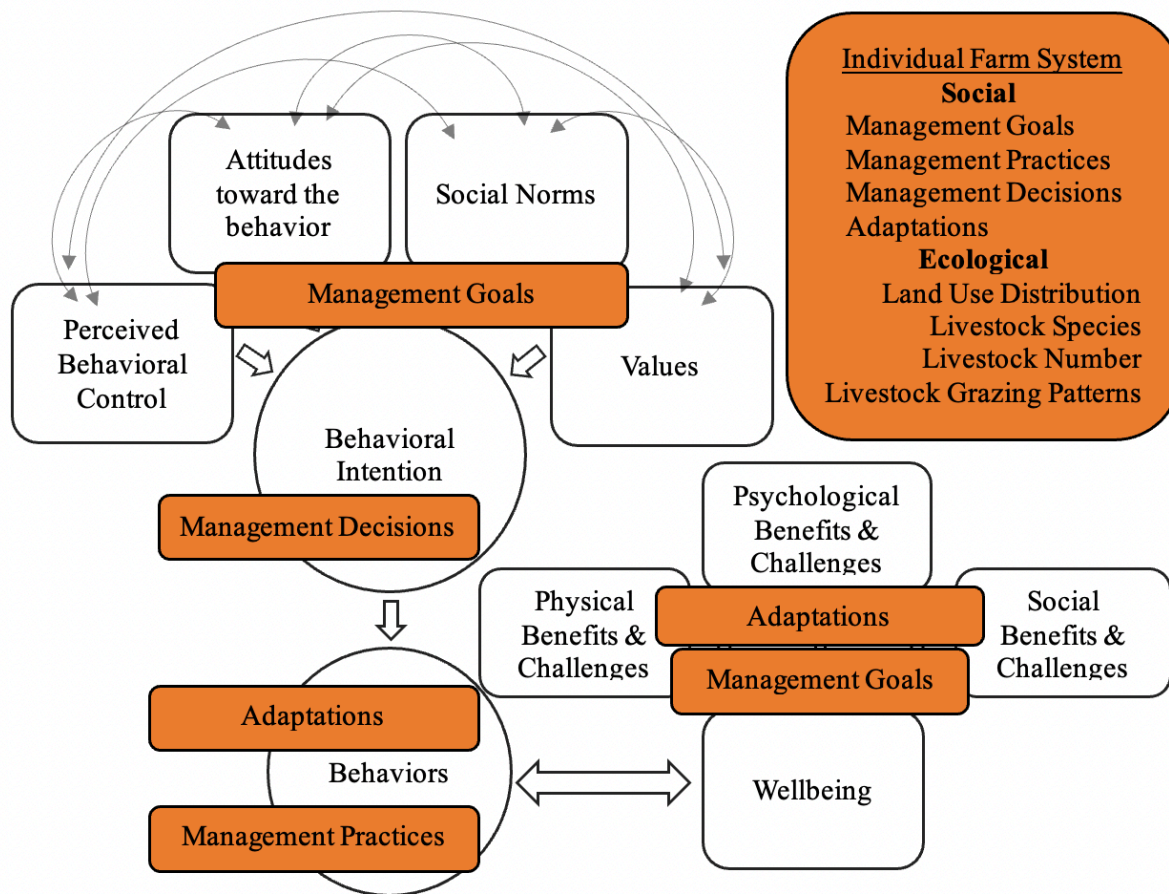


Figure 10. This figure shows how the individual farm social system factors (e.g., management goals, management practices, management decisions, and adaptations) are superimposed on my theoretical framework depicting the relationships between behavioral antecedents, behaviors, and wellbeing.

## 2.1 Research Design

My high-level framing is the social-ecological systems framework presented in Figure 10. This framework shows the cyclical relationships between the social and ecological factors in a pasture-based beef farm ranging from global systems to local systems to individual farm systems. As a social scientist, I focused on an individual farm system's social system factors including management goals, management practices, management decisions, and adaptations as depicted in



Figure 10, and collected data on grazing patterns, livestock species, livestock number, and land use patterns. To investigate these social factors I used a novel theoretical framework I created, presented in Figure 8, to understand the relationships between perceptions of behavioral control, norms, attitudes, and values (i.e., pre-decisional factors) on management behaviors and the role of social, psychological, and physical wellbeing as an influence on and outcome of different grazing management behaviors.

A mixed methods approach was well suited to understanding the relationships within this framework. The answers to the quantitative survey questions were part of an ANOVA to clarify the role of behavioral antecedents in different grazing management outcomes, and the factors of wellbeing were analyzed for reliability among the sub-constructs of physical, psychological, and social wellbeing. The qualitative interview was used to cross-check the information gathered in the survey and ensure it was adequately representing the sample; it also facilitated a deeper understanding of the practices in play. One section that benefited greatly from a mixed methods approach was the investigation of the impacts of the pandemic on the wellbeing and management choices of the pasture-based beef farmers in Michigan. Through the interview I gained a deeper understanding of what decisions were made, why the decisions were made, how different behavioral decisions impacted the farmer's wellbeing, and how their wellbeing in turn impacted their behavioral decisions. All research was conducted with the approval of the Institutional Review Board (IRB) at Michigan State University. The research project (STUDY00005070) was determined to be exempt under 45 CFR 46.104(d) 2(ii).

## 2.2 Population Characteristics

According to the USDA agricultural census in 2017, there were 7,445 pasture-based beef farms in Michigan, which ranged in size from less than 10 cattle to more than 500, as shown in Figure 11. Of these 7,445 farms, 4,341 of them have fewer than 10 head of cattle - this is more than half of the beef operations in Michigan.

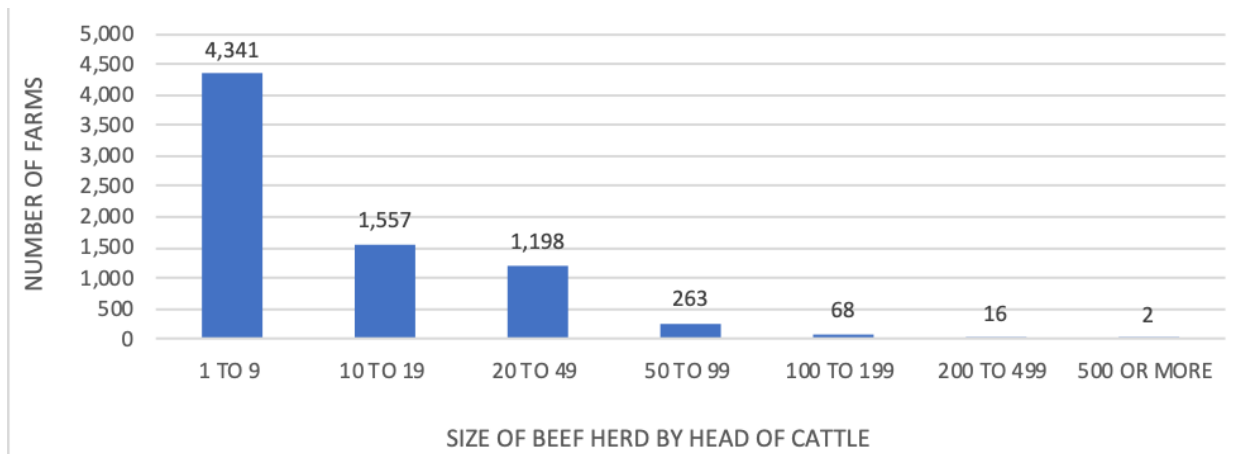


Figure 11. The distribution of grass-based herd inventories across Michigan shows that of the 7,445 total farms, more than half (4,341) have fewer than 10 head of cattle, and 95% have fewer than 50 head (National Agricultural Statistics Service, 2017).

## 2.3 Methodology - Survey

The survey consisted of seven sections: (1) grazing management styles, (2) behavioral antecedents, (3) social wellbeing, (4) physical wellbeing, (5) psychological wellbeing, (6) perceptions of COVID-19 implications, and (7) demographics and operation descriptions. The specific protocol can be found in Appendix A.

The first survey section about management style was a series of multiple-choice questions that

described the various styles of grazing management to help categorize the pasture-based beef farmers into one of three different management behavior cohorts – continuous, rotational, or adaptive. Inspiration for these questions came from another research project I participated in, and the questions were developed through conversations with four MSU-Extensions grazing specialists as well as two Holistic Management (HM) trainers. According to these experts, the two variables they try to instill in pasture-based farmers in Michigan is that animals need to be moved according to forage health, every four days at a minimum, but daily is ideal. Second, in Michigan it is recommended that pastures sit empty for 45-60 days, which is also known as a rest period. Therefore, I developed four questions to probe these factors:

1. Which grazing style is most similar to how you are grazing your cattle this year?
2. How often are cattle moved between pastures during the grazing season?
3. If you add up all the time from each visit to any given pasture this season, what is the average length of time the cattle spend in each pasture?
4. Do you use an adaptive approach?

I followed these questions with one that asked for the farmer to choose their top two motivations for farming with the methods they do. This focus on why, or what motivates, was used to investigate behavioral antecedents, particularly values related to income, animal health, and soil health, all of which are known to be very important to farmers

The questions on behavioral antecedents were inspired by Borges and Oude Lansink (2016) who surveyed of beef farmers in Brazil, because their study was one of two I found that looked at behavioral antecedents in a beef production setting. However, it was not adopted as is for this

project due to differences in analyses and goals, specifically that Borges and Oude Lansink (2016) were using structural equation modeling to determine the relative influence of the different behavioral antecedents.

The survey contained two sections dedicated to understanding the role of pre-decisional factors (i.e., perceptions of behavioral control, attitudes, social norms, and values), including questions on environmental stewardship inspired by the Bhutan Gross National Happiness questionnaire (Royal Government of Bhutan, 2014) and questions about financial motivations, including changes in farm income over time and having multiple enterprises. Both the environmental and enterprise questions were used to investigate perceptions of control, individual attitudes, social norms, and values because these two concepts, financials and environmental concerns, are particularly important to farmers (Rivera et al., 2018). Further, research by Bruno et al. (2021) found financial, ecological, and social factors are foundational to all livestock producers' livelihood. Questions about values and behavioral intentions were taken from the Schwartz Short Value Survey (Schwartz, 1992) and applied to livestock farmers, which is a new population to study using the Short Value Survey.

The questions on all three types of wellbeing contain Likert questions on a 1-7 scale with the goal of creating wellbeing indices for each of the factors. Two of the three wellbeing types have validated tools that were used in their entirety: psychological wellbeing (Ryff, 1989) and social wellbeing (Diener, 1994; Diener et al., 1985), and the questions for physical wellbeing were modeled after the European Social Survey (2016). Each of these wellbeing facets will be measured independently, as shown in Figure 8. The responses to these questions determine the overall

wellbeing of the pasture-based beef farmers as well as in a comparison between different management styles. The comparison between management styles is particularly important because it will be used to explore the claims adaptive management practitioners make regarding improvements to their wellbeing because of managing adaptively.

The survey contained five questions which were used to explore some of the baseline management and wellbeing impacts the COVID-19 pandemic had on Michigan's pasture-based beef farmers. Three questions were Likert scales from 1 (i.e., most negative) to 5 (i.e., most positive), and two were 'select all that apply' questions about how the pandemic was impacting the farm and the farmer. The three scale questions were used to gather information about the overall impact of the pandemic on farmer wellbeing.

The final section of the survey includes demographic information such as farm size, gender, age, and education level. This information was used to compare my sample to the population to determine representativeness, and these factors are used in the analyses to determine if they have any impact on behavioral intentions, grazing management style, or wellbeing.

### 2.3.1 Survey Distribution and Sample

The MSU Beef Team has an electronic mailing list of beef producers in the state, all of whom signed up for the mailing list independently, but it does not contain information regarding herd size, management style, or any variables beyond name and email address. Therefore, I could not use quota sampling to ensure a representative sample. Because there is not a list of every pasture-based beef producer in the state that I have access to, I used a convenience sampling strategy in

which I sent the survey to every farmer on the Beef Team mailing list and accepted every response I received. Using a convenience sample benefited my project because it was accessible and cost-free, however, having a convenience sample instead of a purposive sample limited my ability to generalize the results.

I piloted the survey with three MSU Extension forage and grazing specialists, three members of the MSU Agriculture and Agribusiness Institute, and four members of the MSU Extension Beef Team. The recommended changes pertained to the wording of the questions and improving clarity of twelve questions. Once I addressed these suggestions the survey was distributed through six different electronic mailing lists:

- Michigan Cattleman's Association (N=350)
- MSU-Extension's Beef Production Digest (N=2913)
- Great Lakes Grazing Network (N=694)
- MSU-Extension's Grazing School (N=70)
- Gladwin/Clare Grazing Network (N=69)
- Mid-Michigan Livestock Network (N=106)

These mailing lists were chosen based on two factors. First, I needed to be able to access the recipients quickly and repeatedly, and secondly, I needed lists that contained a range of producers, from those managing adaptively to those managing more rotationally and continuously.

By sending emails through the Beef Production Digest, I targeted a broad range of producers along the spectrum from continuous to rotational to adaptive. This list was expected to have the widest spread of grazing management styles. The individuals who are part of the Michigan Cattleman's

Association were anticipated to be closer to the rotational-continuous end of the grazing management spectrum. The individuals who subscribed to the Great Lakes Grazing Network, MSU-Extension Grazing School, the Gladwin/Clare Grazing Network, and the Mid-Michigan Livestock Network were compiled by MSU-Extension's forage-based beef production educators and contained individuals who participated in MSU Extension programs related to grazing management techniques, often focused on the adaptive end of the grazing management spectrum. To target more rotational and continuous farmers I also distributed my list via the Michigan Beef Industry Commission and the MSU-E Beef Production Digest, discussed below. The names and email addresses on the different mailing lists do have overlap, and therefore the total number of possible participants is less than 4,202, but ultimately unknown due to the lack of identifying information collected.

The four mailing lists received from the forage-based beef production educators (i.e., lists 3-6) included 939 independent email addresses which were imported directly into Qualtrics. The internal tracking system in Qualtrics then distributed follow up emails to participants individually as needed. The survey was available beginning October 20, 2020, which is near the end of the grazing season for many of Michigan's beef farmers. Individuals in the direct mailing lists received a personalized link in the initial email and two prompts to finish the survey, which was managed through Qualtrics so only those who have not completed the survey receive a prompt. The first prompt happened two weeks after the initial email and the second prompt one week later.

The survey link that was shared through the MSU-Extension's Beef Production Digest and the Michigan Beef Industry Commission's (MI Beef) e-newsletter (i.e., lists 1 and 2, respectively)

involved distributing the request for survey participants as part of their monthly e-newsletter. The survey was advertised as part of the October and November emails for both organizations. Additionally, MI Beef also sent out an independent email with a link to the survey and a request for individuals to participate directly from the organization four days after the November e-newsletter had been sent to subscribers. There was no direct follow up through the Beef Production Digest newsletter.

### 2.3.2 Survey Analysis

On December 10, 2020, the survey was closed, and no further responses were collected. For my survey sample to be representative at a 95% confidence interval (i.e., a 5% margin of error), given the population of 7,445, as per the 2017 United States Department of Agriculture (USDA) Agricultural Census (National Agricultural Statistics Service, 2017), I required 366 responses (Raosoft Inc, 2004). Upon closing the survey, I had received 201 responses of which 114 were more than 90% completed, which was my criteria for inclusion. The remaining surveys were all less than 40% complete and did not respond to the questions that allowed for sorting farmers into management groups. A sample size of 114 resulted in a 2.7% response rate and 7.46% margin of error which suggests my sample may not be generalizable to the beef grazing population of Michigan. When surveying farmers via the mail, studies report a 20%-50% response rate (Mullendore et al., 2015; Pennings et al., 2002); the response rate for online surveys ranges from <1%-50%, but frequently is around 10% (Dumbrell et al., 2016; Hijbeek et al., 2018; Richens et al., 2018; Vira et al., 2014). Therefore, my 2.7% response rate is low, but not unusual given the nature of email and newsletter distribution (Dillman, 2009). Nevertheless, this data is an important starting point, and helped illuminate what questions should be asked to determine grazing



management practices in the future.

The survey was analyzed in IBM SPSS (IBM Corp., 2020) through a series of means comparisons to compare the responses by grazing management type. Most analyses were ANOVAs which are reported as mean scores and the corresponding 90% confidence intervals. The seven survey sections (i.e., grazing management styles, behavioral antecedents, social wellbeing, physical wellbeing, psychological wellbeing, perceptions of COVID-19 implications, and demographics) were analyzed both for differences and similarities that could help explain the grazing management behavior choices and wellbeing outcomes.

To begin the survey farmers were asked to choose which on-farm enterprises they have such as beef, dairy, or crops, then they were asked the four questions relating to grazing management to determine which grazing management strategy most closely resembled each farmer's grazing management behaviors. These four questions were the foundation for answering my first research question: 'What is the distribution of grazing styles in Michigan?' in 3.1 Overview of the Distribution of Grazing Styles in Michigan.

The survey sections pertaining to behavioral antecedents, environmental stewardship, and farm enterprises, were analyzed via means comparisons by grazing management type. These stewardship and economics sections were also analyzed via a reliability analysis to determine if it was possible to create a scale from the independent questions in each section with a score equal to or greater than 0.70, the generally accepted minimum score for scale creation (Cortina, 1993). The Cronbach's Alpha was 0.79 for the three environmental stewardship questions and the Alpha score

for a financial wellness scale was 0.71 for four questions, so each section was summed independently to create an environmental stewardship scale and a financial wellness scale. These data were used to address my second research question: ‘Why do farmers choose to manage their beef herd the way they do?’ in 3.2 Behavioral Factors for Management Decisions.

The values behavioral antecedent was captured in the Schwartz Short Value Survey (SSVS) and means comparisons of each individual value as well as reliability analyses for value category creation happened by dividing the ten values into four value categories detailed by Schwartz (1992) (Figure 4). When the data for values was analyzed, I expected to find the same four value categories as other research using the SSVS, however the reliability analysis was inconsistent and the only values that clustered in the agreed upon way were tradition, conformity, and security which fall into the three-item conservation value category with a Cronbach’s Alpha of 0.75. The value categories openness to change (Alpha=0.56), self-enhancement (Alpha=0.66), and self-transcendence (Alpha=0.39) were not divided therefore due to low Alpha scores which indicate that it is unlikely the values in each category are addressing a similar construct as interpreted by my sample (Cortina, 1993). These data were also discussed in section 3.2 Behavioral Factors for Management Decisions to answer my second research question.

The sections related to social, psychological, and physical wellbeing benefits and challenges were also analyzed through means comparisons between grazing management groups to determine if there were similarities in the levels of wellbeing. Reliability analyses were conducted to determine if scale creation was possible for a holistic wellbeing index (Alpha=0.65) as well as for each subscale with the following internal reliability scores: social wellbeing Alpha of 0.59,

psychological wellbeing Alpha of 0.61, and physical wellbeing Alpha of 0.65. Due to none of the subscales having sufficient internal reliability the questions were analyzed individually, not as scales or indices. These data were discussed in 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers to address research question 3: 'How do management choices impact the wellbeing of the farmer?'

The second to last section of the survey asked about the impacts the first year of the COVID-19 pandemic had on the farmer and the farm. The primary goal for these five questions was to inform the interview protocol and discussions regarding the coping skills and adaptations the farmers used to manage the farm during a pandemic. This survey was conducted during Fall 2020, so there was little data available about COVID-19's disruptions to agricultural production systems and therefore the survey was my initial source of data for the scope of impact and what to explore in more depth in the interview. Three Likert scale questions were used to determine the intensity of the impact the pandemic had on day-to-day operations, farmers' optimism about the farm surviving the negative impacts of the pandemic, and the extent the pandemic impacted the wellbeing of the survey sample. The remaining two questions were 'select all that apply' questions that illuminated some of the possible factors influencing the farmers' wellbeing during the first year of the pandemic. These data are discussed in 3.4 Michigan's Farmers and the First Year of the COVID-19 Pandemic and address the fourth research question 'What were the impacts of the first year of the COVID-19 crisis on farmers and their wellbeing?'.

### 2.3.3 Limitations

According to the 2018 Agricultural Census (National Agricultural Statistics Service, 2017), more

than 50% of farms in Michigan have less than ten head of cattle and more than 95% have less than 50 head. In my sample, only 57% of the farms had less than 50 head, and I had a range from 0 to 850 (Figure 12). The mode for my sample was 40 head, but the mean was skewed to 80 head because of the several large farms in the sample. Therefore, data presented is not generalizable to the population of Michigan farmers. Further, my sample was mostly accessed by farmers that were part of MSU's Extension mailing lists, which likely results in an oversampling of adaptive farmers because they subscribed to content such as Soil Health School, Beef Quality Assurance Training, and Fencing 101. I combated this skew toward adaptive by also distributing my survey through the Michigan Beef Industry Commission, however response rates from this solicitation were very low. These are topics that are more likely to be interesting to farmers who are transitioning their farms to an adaptive system, are younger, and/or are more technologically savvy. Many of the farmers above 60 years old said they hardly use the internet and this likely impacted who accessed my survey and volunteered for interviews because all recruitment was done via emails and e-newsletters. To increase generalizability future research should also include mail recruitment to better represent the range of pasture-based beef farmers in Michigan.

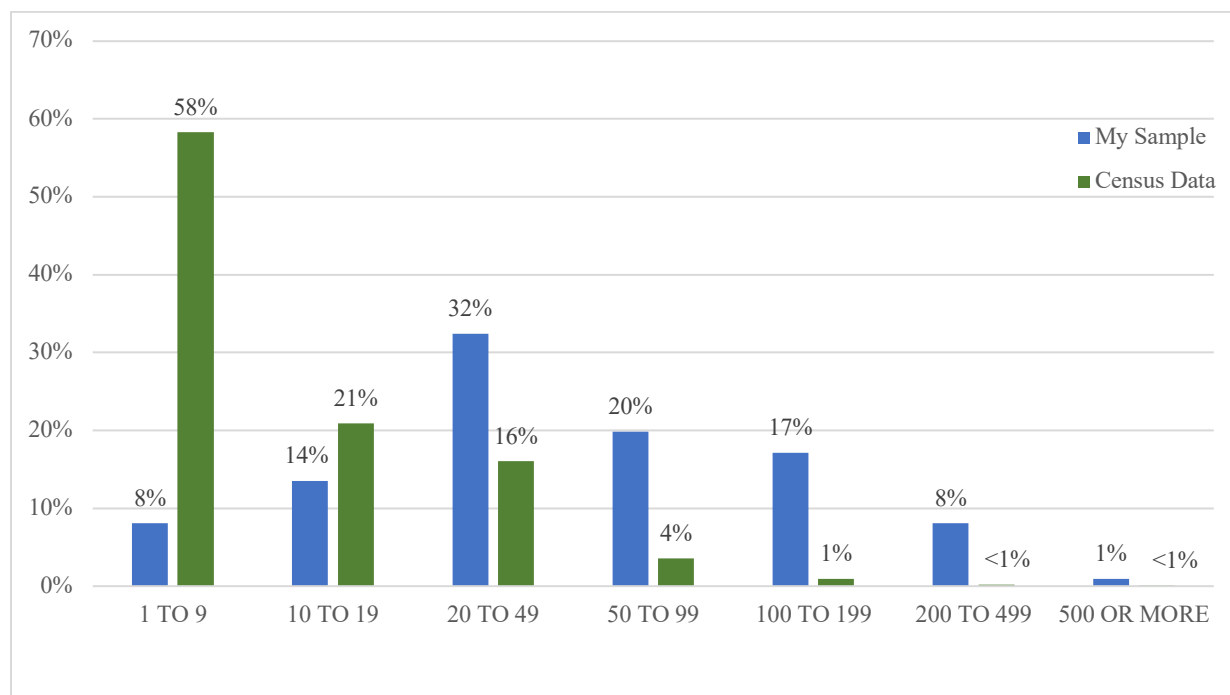


Figure 12. This figure compares my survey sample to the census data for the size of Michigan's pasture-based beef farms. In the census 95% of Michigan farms have less than 50 head of cattle, however in my sample only 54% of farms had less than 50 head. Further, 9% of my sample had more than 200 head of cattle, which is inconsistent with the census data where <1% of farms have more than 200 cattle.

## 2.4 Methodology - Interview

The interview protocol contained seven sections: (1) farm details, (2) grazing spaces, (3) management practices, (4) grazing plan and motivations, (5) wellbeing impacts, (6) social networks, and the (7) effects of the pandemic. In addition to feedback from the survey, the interview protocol evolved from work I conducted on two other research projects. Protocol questions were developed in concert with research questions 2-4: What leads to management decisions on Michigan beef farms; How do different management styles impact farmer wellbeing; and What is the impact of the COVID-19 pandemic on Michigan's beef farmers?

The semi-structured design of the responsive, in-depth interview (Patton, 2015) allowed me to use my judgement about following up on responses and probing further into responses that offer unanticipated sources of detail and description. This interviewing technique created a more detailed understanding and provided further context and understanding to the survey data. The interview contained seven sections to address the information gathered in the survey and included open-ended questions that allowed for additional probing questions to follow up on responses which facilitated a deeper understanding of the lived experiences of the interview subset.

Questions regarding the details of the farm were included to cross-check the survey results and gain further context about the farmers' operations (i.e., are they also grass finishing, participating in other enterprises, etc.). Demographic and operation information helped give a background about each farm's unique situation. I also asked questions about the farm's grazing setup and how this related to each farmer's management choices and grazing plan. I asked more factual, less personal, questions first to develop rapport with the farmer.

I then asked questions regarding what motivated the farmer to manage their farm the way they do. The focus was on the current situation; however, I also took the time to discuss what a typical day pre-pandemic was like to gauge the overall impacts. Additionally, this information helped me better understand some of the factors behind decision making, and I was able to compare these responses to the survey data about behavioral antecedents. Again, the focus here was about why the farmer manages the way they do.

Next, I asked the farmer about their wellbeing, both as individual factors (i.e., social,

psychological, and physical) as well as holistically. Questions included concepts such as happiness and coping with changes in wellbeing. Because the pandemic caused such a profound shift in the collective wellbeing, it was vital that conversations included questions about emotions (i.e., social wellbeing), goal achievements (i.e., psychological wellbeing), and physical health (i.e., physical wellbeing) benefits and challenges.

The farmers and I also discussed how the first year of the COVID-19 pandemic impacted them and their farm, how they managed their animals and wellbeing during the beginning of the pandemic, and what they anticipated life would look like as they moved forward. I used the information gathered in the first section to compare with the information gathered in the survey about COVID-19. I used these data as a lens for understanding the other interview sections regarding behavioral decisions and wellbeing. The structure of the interview allowed me to use my judgement about following up on responses that offered unanticipated sources of detail and description, which created a more holistic picture of what daily life is like.

#### 2.4.1 Interview Distribution and Sample

Interview participants were all survey participants who indicated that they were willing to participate in an interview. I used a random number generator to determine the order to contact possible interview participants (N=30) and then emailed them a request to sign up for an interview day and time. I sent out ten emails at a time each week and scheduled interviews with the respondents. The resulting sample included every farmer who responded to my solicitations and was available to participate via the phone or web-based platform between February 15 and May 15, 2020 (n=20).

I began interviews on February 24, 2021. I conducted five pilot interviews before proceeding with data collection, and there were three modifications which involved listing examples for three different questions. Because the questions themselves were not changed I chose to include the data from the five pilot participants in the overall dataset of 20 interviews. All the interviews were conducted either over the phone or via Zoom web-based video conferencing software and were recorded using both the Zoom recording function and the audio recorders.

In my sample, farmers were moving cattle anywhere from three times every day to every ten days. The deciding factors for categorization as an adaptive farm was that they were moving their cattle at least every three days and identify as an adaptive farmer who focuses on adjusting management decisions daily. Meanwhile the rotational group was comprised of farmers who were either grazing pastures for more than three days in a single period or were moving cattle quickly based on number of paddocks available and not adjusting these periods based on forage. Lastly, continuous grazing was defined as those who were not moving their cattle at all.

#### 2.4.2 Interview Implementation

The basic interview structure started with a discussion of the physical farm landscape including the number of cattle, acreage available, cattle enterprises and non-cattle enterprises, and the farmer's story about how they became a farmer (i.e., growing up on a farm, college education, personal interest in food, etc.). After understanding the physical farm landscape, I pivoted to discussing the farmer's grazing plan and questions about: (a) how many grazing-specific spaces they worked with, (b) when they moved their animals, and (c) what factors influenced these decisions. This information helped me understand some of their grazing decisions and the



motivations behind those choices such as herd size and grass (re)growth. These data were used to address my first research question ‘What is the distribution of grazing styles in Michigan?’ I discuss them below in section 3.1 Overview of the Distribution of Grazing Styles in Michigan.

To investigate the second research question, ‘Why do farmers choose to manage their beef herd the way they do?’ I asked questions about farmers’ motivations and their goals for the farm including: (a) when and why did you start managing your cattle the way you do; (b) can you tell me more about why you chose the two motivations you did on the survey; (c) if you wanted to make major changes to the grazing management plan who would you go to for support; and (d) have you heard about adaptive grazing and how do you feel about it. This logic behind why farmers manage the way they do isn’t something many farmers think about regularly, so by asking the farmers to elaborate on these choices I was able to collect and code for data about the perceptions of control, attitudes, norms, and values that guide the farmers’ management goals, decisions, and practices (Figure 10). These data were analyzed and discussed in section 3.2 Behavioral Factors for Management Decisions.

The next section of the interview was used to better understand wellbeing outcomes. To create a holistic understanding, I included questions about the impacts of being farmer on physical, psychological, and social wellbeing (Figure 8). The physical wellbeing questions included: (a) What physical health concerns do you have related to being a farmer? and (b) How does farming benefit your physical health? Psychological wellbeing questions included: (c) What are the things about grazing beef that stress you out the most? (d) How does farming help decrease your stress? (e) If you are having a tough day on the farm what might be happening? (f) How do you cope with

there is a rough day on the farm? and (g) What are the most rewarding aspects of grazing beef? Social wellbeing was discussed via the questions: (g) Are there people in your life you frequently talk to about grazing beef? (h) Are there people you don't talk to about raising cattle? (i) Do you feel like you have the support you need to manage your cattle the way you do? and (j) When you have exciting news about the farm who do you share it with? These data were used to address the third research question 'How do management choices impact the wellbeing of the farmer?' and are discussed in section 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers.

I then moved to a discussion about how the COVID-19 crisis impacted the farmer and how they managed during the first year of the crisis. Specific questions included: (a) How did the pandemic impact your operation? (b) Did the pandemic impact how you manage your animals? and (c) If you could go back in time to the beginning of the pandemic, are there things you would do differently in terms of your grazing plan or your beef herd knowing what you do now? The final question about the pandemic was: (d) How was responding to COVID different from responding to other shocks on the farm? The information gathered in this section was compared to the survey results about COVID-19, and these data addressed the final research question 'What were the impacts of the COVID-19 crisis on farmers and their wellbeing?' and are discussed in section 3.4 Michigan's Farmers and the First Year of the COVID-19 Pandemic.

#### 2.4.3 Interview Analysis

The recordings were transcribed via Temi.com and then I edited and cleaned the transcripts by comparing the narrative to the recording. The transcripts were deductively coded (Patton, 2015) using 18 pre-chosen codes developed in relation to the literature cited above for concepts related

to management style, behavioral antecedents, wellbeing, and impacts of the COVID-19 pandemic.

The interview codebook in Appendix B The 18 codes were:

- Adaptations
- Adaptive grazing opinions
- Outside support - farming team
- Motivations
- Cattle feed
- Enterprises
- Cattle details
- Farm details
- Acreage
- Grazing plan
- Social wellbeing benefits
- Social wellbeing challenges
- Psychological wellbeing benefits
- Psychological wellbeing challenges
- Physical wellbeing benefits
- Physical wellbeing challenges
- COVID-farmer
- COVID-farm

I coded three interviews independently before reviewing my coded data and coding process with Dr. Jennifer Hodbod, a colleague, to ensure the codes and their definitions were clear and my

coding method was replicable (DeCuir-Gunby et al., 2010; Hesse-Biber, 2017; Rubin & Rubin, 2012). After reviewing my code book and coding process, I further refined my code definitions and expanded the three codes for wellbeing, which were originally not divided by benefits and challenges. After coding the whole dataset of 20 interviews, I revisited the codebook again to determine if any additional codes were needed or if any details were being excluded from the participant responses (Rubin & Rubin, 2012). Upon determining that I was accurately and reliably capturing the interview data, I completed a second round of coding to ensure consistency and accuracy (DeCuir-Gunby et al., 2010).

Once coding was complete and each code's data were summarized in data tables (Hesse-Biber, 2017), the coded segments were analyzed further to understand the nuances and depth provided by the different farmers and for comparisons between the rotational and adaptive farmers. After summarizing the data for each code, I further divided the data to compare the coded segments of different subgroups (i.e., comparing the data for different age groups or different grazing management styles).

#### 2.4.4 Compensation

In the social sciences, compensating for research participation is a generally accepted practice (Dillman et al., 2009). It is important to neither over- nor under-compensate the research participants because it could be seen as coercive or belittling, respectively (Dillman et al., 2009; Estrada et al., 2014). Compensation in this project were particularly important because farmers are exceptionally busy people are often balancing being a full-time farmer as well as often having another job. Therefore, farmers who completed the survey were sent a \$10 VISA gift card either

electronically or physically. This amount was decided upon because it assumes a farmer could earn \$40 per hour for the work they do on the farm, and this survey was designed to take approximately 15 minutes to complete. Therefore, the \$10 incentive reflects the farmer's economic opportunity costs that were lost due to taking the time for completing the survey. Additionally, there were budget considerations to account for. Farmers who participated in the interview were compensated an additional \$25, also sent as a VISA gift card. This number reflects the original plan for the interview to last between 30 minutes and an hour, as well as the research budget available. There can be concern that offering compensation could bias the results to people who need that additional money, but there is also a possibility that the opposite could happen, those who do not need the money answer more frequently, because they have the time and resources to participate in a 15-minute survey and an interview.

Because I conducted the survey online and offered compensation, it was important to put practices in place to ensure the participants were not robots, did not take the survey multiple times, and gave quality responses to the questions. To ensure the survey was completed by humans I used the Captcha Verification as the first question on the survey. Further, I setup the survey to stop individuals from taking the survey more than once by using the Qualtrics (Qualtrics, 2019) function "prevent ballot box stuffing." Lastly, to ensure participants thoughtfully responded and did not simply rush through the survey to obtain the compensation, I checked the amount of time it took each respondent to take the entire survey, how long each user spends on a given page of questions, and how many times the user clicked on the page (Buchanan & Scofield, 2018). These five tools helped me ensure the answers given were authentically human and were serious responses, not rushed through for the sole purpose of obtaining the gift card.

### 3 RESULTS AND DISCUSSION

Taking a mixed methods approach was ideal for this project because it allowed me to gather a broad sample from my survey whose responses helped shape my interview protocol. The interview sample provided detailed information that is impossible to gather from a survey to illuminate some of the unclear trends such as qualifying grazing management style. The insights from the interview helped clarify the impacts of COVID-19 on the wellbeing of farmers, and it added context and detail to the differences in wellbeing and behavioral outcomes. Research questions were addressed in the order listed above and, in each section, I integrate results from both the survey and interview data and offer points for discussion based on my findings.

#### 3.1 Overview of the Distribution of Grazing Styles in Michigan

To answer the RQ1 “What is the distribution of grazing styles in Michigan?” I used the series of four questions described above concerning elements of grazing management:

1. Which grazing style is most similar to how you are grazing your cattle this year?
2. How often are cattle moved between pastures during the grazing season?
3. If you add up all the time from each visit to any given pasture this season, what is the average length of time the cattle spend in each pasture?
4. Do you use an adaptive approach?

##### 3.1.1 Survey Sample Characteristics

Originally, I planned to have three comparison groups, however after exploratory analyses I determined only two groups were definable in the survey sample. Throughout the analyses I consistently found one group of people (n=41; 36%) who answered all four questions in a way that

aligns with expert advice pertaining to grazing adaptively. Furthermore, Table 1 shows how individuals responded to Question 1, which was intended to separate out the adaptive farmers from the rotational, time-based farmers, and the continuous, non-moving farmers because daily forage checks and pasture observations are a foundation of adaptive management, however the continuous grazing group did not emerge. There were no significant differences in how many cattle the rotational and adaptive farms in my survey sample had (with a sample range from 0 to 850) or how many permanently fenced pastures were on the farms (with a sample range from 1 to 300) because the mean and mode for comparing the rotational and adaptive farmers was so similar.

Table 1. Questions used to identify rotational and adaptive ranchers, with numbers and percentages of each in parentheses.

Do you use an adaptive approach to grazing (i.e., holistic management, adaptive multi-paddock grazing, management intensive grazing, etc.)?	Which grazing style is most similar to how you graze your cattle?		
	The cattle have access to all available pasture(s) throughout the grazing season (n=12; 11%)	The cattle are moved between different pastures throughout the grazing season based on time (n=15; 13%)	The cattle are moved between different pastures throughout the grazing season based on forage health and recovery (n=87; 76%)
<b>No (n=38; 33.3%)</b>	Rotational (n=11; 10%)	Rotational (n=5; 4%)	Rotational (n=22; 19%)
<b>Yes (n=76; 66.7%)</b>	Rotational (n=1; 1%)	Rotational (n=10; 9%)	Rotational (n=25; 22%) Adaptive (n=40, 35%)

Harmel et al. (2021) suggested that continuous grazing systems were still the norm on ranches in the Western USA, so I thought the continuous grazing group would be a similar proportion, however of the 12 total farmers that reported their cattle have access to all pastures all season, only four would be defined as continuous, given answers from the other seven to the remaining management questions in the survey. I integrated the four continuous farmers into the rotational group because there was substantial variability in the rotational group and having a category of four individuals was not conducive to means comparisons. The remaining three questions were analyzed to determine if the rotational farmers who identify as grazing adaptively adhere to the other grazing management recommendations. Trainers and specialists who recommend moving cattle at least every 4 days, spending less than 30 days in any given pasture for the duration of the grazing season, and checking forage health daily. Daily forage checks and pasture observations are a foundation of adaptive management, and this question was intended to separate out the adaptive farmers from the rotational, time-based farmers, however this divide was not reflected in these data.

The comparison of rotational and adaptive farmers in Figure 13 illustrates that the majority of rotational and adaptive farmers move cattle based on forage health and recovery (Question 1), which shows non-adaptive farmers are also checking their forage health frequently. Additionally, rotational farmers report moving their animals at least every four days and over one third of the respondents in the rotational group indicated they did not spend more than one month in any given pasture for the duration of the grazing season, significantly different from the distribution of the adaptive farmers (Question 3). When it was clear they were not grazing adaptively because they did not identify as an adaptive grazing system, they were moving their cattle less frequently than



every four days, they left cattle in pastures for more than one month over the course of the season, and/or they were not moving based on forage health or regrowth, farmers were included in the rotational grazing group. Because I chose to adhere with adaptive grazing management guidelines suggested by trainers, the breakdown between rotational and adaptive grazing management was relatively clear and only eight individuals had to be sorted manually. These eight outlier cases were labeled as rotational or adaptive on a per case basis by also investigating the number of temporary grazing spaces, number of enterprises, and number of different animal species.

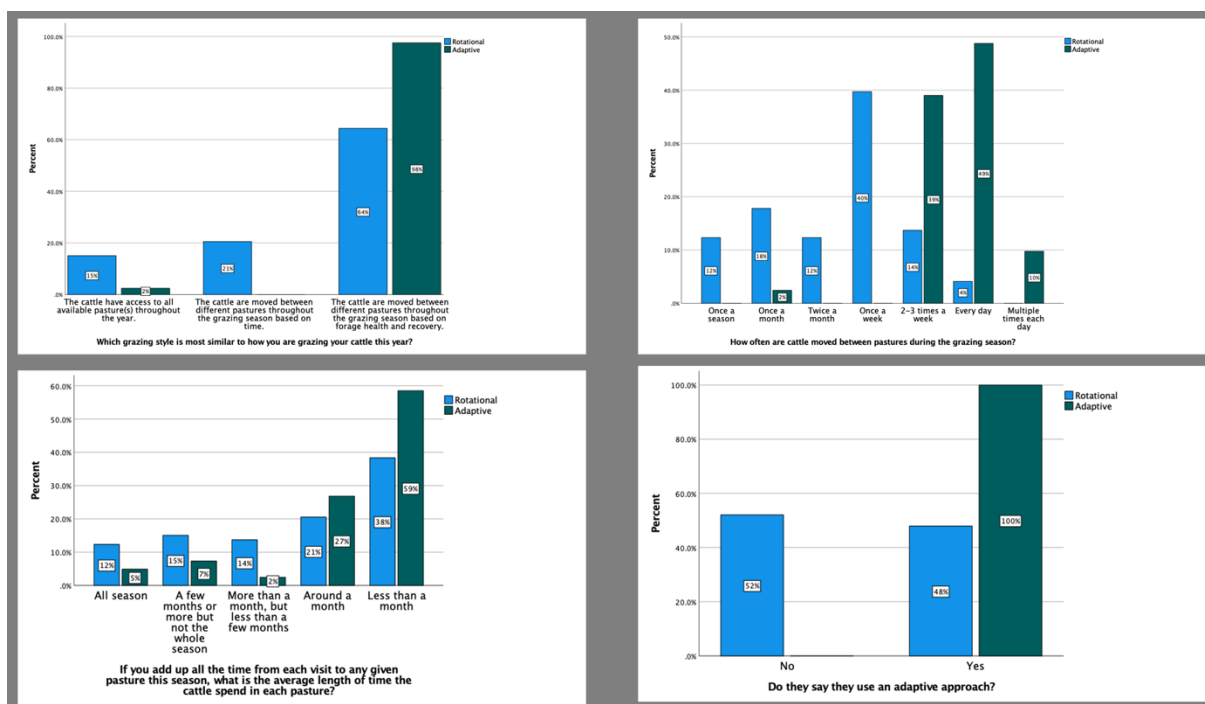


Figure 13. These four panels show the division between rotational and adaptive farmers' answers to the four questions regarding grazing management decisions. Consistently the adaptive farmers were delineated from the rotational farmers.

In Michigan, organizations such as the Cattleman's Association, the Beef Industry Commission,

and MSU-Extension promote rotational or adaptive grazing in their curriculums and meetings, so it is possible the high number of rotational farmers in my sample is representative of a new norm in Michigan's pasture-based beef farm management decisions and a cultural shift to more frequent animal movements when animals are out grazing.

A statewide needs assessment for the Michigan beef sector conducted by the MSU-E Beef Team (McKendree et al., 2020) found the percentage of farms reporting each management style similar to my rotational grazing group findings, with 55% of their respondents identifying as cow-calf, 10% raising stockers, and 25% grass finishing. In my overall sample the percentage of farmers in each category is substantially different from the needs assessment with 38% identifying as cow-calf, 5% raising stockers, and 7% grass finishing. However, the needs assessment focuses on single enterprise outcomes while my sample reported multiple enterprises. Therefore, I found 26% of farmers identify as both cow-calf and grass finishing. The differences between my sample and the Michigan needs assessment is likely influenced by differences in enterprise options to choose from on the surveys and the option to select multiple enterprise combinations.

Further details were gathered about management practices (i.e., social system) and physical farm features (i.e., ecological system) as depicted in my research framework (Figure 10). First, one question asked participants to 'select all that apply' from a list of possible livestock enterprises. According to the survey, 89% of rotational farmers and 73% of adaptive farmers reported being a cow-calf operation or having a cow-calf enterprise along with another enterprise. Another difference was that 66% of adaptive farmers and 29% of rotational farmers reported being a grass finishing operation. Figure 14 shows the enterprise combinations the farmers participated in.

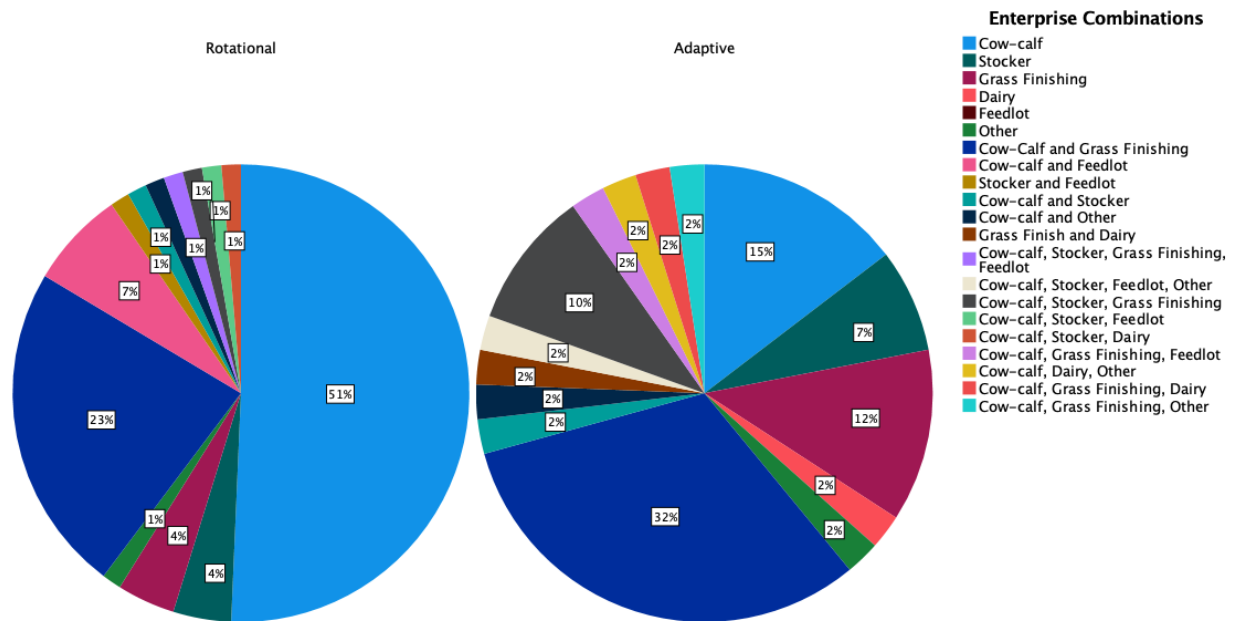


Figure 14. These pie charts depict the different types of cattle enterprises used by the sample of pasture-based beef farms. Most rotational farms are solely cow-calf, enterprises but the adaptive farm category is more varied with the largest percent doing both cow-calf and grass finishing simultaneously.

When investigating responses to the question regarding other farm enterprises, the most important factor to note is that 72 farmers (63%) across both management categories had off farm employment, and 30 (26%) were producing hay to sell. These numbers are lower than national averages reported by the USDA ERS which say 89% of US farms are small and typically rely on off-farm income (Whitt et al., 2021). Of the adaptive farmers in my survey sample, 41% reported having another livestock species such as sheep compared to the 14% of rotational farmers who have multiple livestock species, which was a significant difference, and suggests that adaptive farmers may be more diversified.

### 3.1.2 Interview Subsample Characteristics

The 20 interview participants were a subset of the survey respondents who volunteered to participate in an interview and were available by phone or internet. The farmer subsample ranged in age from 28 to 74 years old averaging 54 years with 15 self-identified as male and five as female (Table 2). According to the 2017 USDA Agricultural Census most Michigan's pasture-based beef farms have less than ten head of cattle, however the interview subsample contained only four farms of that size (National Agricultural Statistics Service, 2017). The census also depicts 95% of Michigan farms owning less than 50 head of cattle, and the interview subsample contained 65% (n=13) farms in that bracket (including the four that are less than ten head). Of the remaining seven farms, five have over 100 head of cattle which places them in the largest 1% of Michigan farms as there are only 86 farms in Michigan over 100 head noted on the 2017 agriculture census (Figure 12) (National Agricultural Statistics Service, 2017).

Table 2. The table shows the breakdown of demographic data for the full survey sample as well as the interview subsample. The outcomes for the two groups are very similar, suggesting that my interview subsample is accurately capturing the range of farmers present in the survey sample.

	<b>Survey Sample</b>	<b>Interview Subsample</b>	<b>Michigan 2017 Ag Census Data</b>
Age Range (years)	27-79	28-74	<25 to >75
Mean Age (years)	57	54	55
Male (%)	83%	75%	94%
Female (%)	17%	25%	6%
Adaptive Farmers (%)	36%	60%	N/A

In my interview subsample, farmers were moving cattle anywhere from three times per day to once every ten days. The interview subsample was divided into two groups, mimicking the survey analysis, to ensure comparability and triangulation. All the farmers in the interview subsample confirmed their management practices with me and I was able to compare that to their survey data to ensure the categorization was consistent between the survey and interview. The rotational group (n=8, 40%) allowed cattle to graze any one space for a period of one to ten days, and these movements were based on number of paddocks available rather than the quality and regrowth of the forage. Alternatively, the adaptive group (n=12, 60%) was moving their cattle based on forage health which resulted in moving a minimum of every three days, and sometimes as frequently as three times a day. The breakdown of the interview subsample was determined through deductive analysis of the interview data, however it aligned with the divisions in the survey sample suggesting movement speed and forage quality are two factors necessary for understanding the reason farmers make certain management decisions.

### 3.1.3 Summary

The analyses of data regarding the first research question, “What is the distribution of grazing styles in Michigan?” helped me understand not just the distribution but also changes in management trends. First, in my overall sample 36% were managing adaptively and 64% were managing rotationally which conflicts with the literature by Roche et al. (2015) found that about 5% of ranches in California and Wyoming used adaptive approaches, and research by Sherren et al. (2012) in Australia indicated the range to be approximately 5% to 10% of farms. Further, I found only four farmers who were not moving their animals at least once a month, known as grazing in a continuous manner, which is very different from literature suggesting having one large

space where the cattle are free to move as they like is still the most common management style in the Western United States (Roche et al., 2015). This suggests that Michigan's farmers may manage more rotationally than other parts of the U.S., which is a new norm that needs further tracking to determine if my sample was representative or not.

It is possible that the discrepancies between the percentage of my sample managing adaptively and the work in the Western U.S. are related to ecological differences between arid and temperate grazing lands, but more research is needed to explore this. It is more likely that the higher-than-average number is due to my sampling strategy and distribution networks that were skewed toward MSU-E mailing lists that were geared toward farmers who were interested in learning about grazing and forage management, which could be related to farmers who are considering or have adopted adaptive grazing management styles. To combat this limitation, I also distributed my survey via the Michigan Beef Industry Commission's e-newsletter, but response rates from this list were very low. A random sample would also address this limitation.

Within rotational grazing management, Michigan farmers displayed a wide range of on-the-ground practices. In my interview sample I found rotational management could be broken into a slow/fast dichotomy. This breakdown was impossible to determine in the survey sample due to the structuring of the questions, but future surveys would benefit from asking specific questions related to cattle movement frequency that can be used to compare slow and fast rotational systems. It is also important to determine if these slow rotations are the new normal in Michigan and determine if the continuous farmers started rotating or if the literature on the benefits of moving animals rotationally has permeated current pasture-based beef systems.

Additionally, my survey sample generally reflects data gathered at both the state and national level indicating that small-sized farms are the norm, although my sample had a higher average herd size than the average Michigan beef farm. In line with information from the 2017 agriculture census (National Agricultural Statistics Service, 2017) as well as the MSU-Extension needs assessment report (McKendree et al., 2020), the majority of my sample were small-sized farms with less than 50 head of cattle who were either cow-calf or grass-finishing operations. These data from the rotational farmers reflect this, but when comparing to my overall sample there are slight differences between my sample and the state-wide assessment. Comparing the rotational and adaptive farmers showed grass-finishing was more common among the adaptive farmers, and cow-calf operations are most common among rotational farmers. Further, on average the adaptive farms had more diverse operations than the rotational farms by including a variety of enterprises. The higher diversity was related to norms, values, attitudes, and perceptions of behavioral control, and further research should investigate what pre-decisional factors differ most between farmers who value enterprise diversity versus those who value specialization.

Lastly, one main goal of this research was to develop a set of survey questions that could be used to categorize farm management types. However, the four questions used to categorize farmers into different management styles need to be further honed because these four questions did not consistently or reliably reflect the management strategy used on-farm. For example, one adaptive farmer denoted the cattle have access to all pastures all season, but during our interview the farmer explained that the cattle are on pasture all year, but they are being moved a minimum of every three days all year. Further clarity in the questions on the survey and ensuring alignment between survey questions and on-the-ground practices will bolster the effectiveness of these survey

questions. One way to mitigate this is to ask about the number of temporary grazing spaces created by cross-fencing because the adaptive farmers in my sample consistently had more temporary pastures than their rotational counterparts. Additionally, to divide the rotational grazing group into groups of slow and fast the question regarding the length of time in any one pasture should be broken into smaller time brackets such as daily to every four days, three days to once a week, once a week to once a month, and not moved more than once per month. Further, a question that allows the farm to note the main factor used to determine cattle movements will help describe the grazing spectrum.

Only 63% of small farms I surveyed indicated a form of off-farm employment, which is lower than the national average of 91% (Brown & Weber, 2013). There are several possibilities for this outcome including having a sample with a significant proportion of retirees, capturing several large farms who earn all their income from farming, and having many of my farmers with a spouse that works off-farm to supplement the couple's income.

In summary, the goal of this section was to understand the range of management practices used on pasture-based beef farms in Michigan and the findings suggest a cultural shift from continuous grazing to slow or fast rotational grazing in my sample. Therefore, the four continuous farmers I captured in my sample were added to the rotational group and the remainder of this manuscript compares the adaptive and rotational management groups to answer research questions two through four.



### 3.2 Behavioral Factors for Management Decisions

Rather than one single pre-decisional factor being responsible for behavioral outcomes, the combination of the pre-decisional factors ultimately influence behavioral decisions and outcomes (Ajzen & Fishbein, 1972). As a reminder, perceived behavioral control refers to an individual's opinions about whether or not they will be able to conduct the behavior (i.e., do I have the resources to do this), attitudes are defined as an affective response to a specific behavior or object (i.e., how do I feel about this behavior), social norms are the internalized notions about what is right and wrong learned from society (i.e., what behaviors are socially acceptable or not), and values (Schwartz, 1992) are deeply held beliefs that motivate behavioral decisions (i.e., does this align with my principles) (Ajzen & Fishbein, 1972).

It is expected that different variables can be analyzed as pertaining to multiple pre-decisional factors (Ajzen, 1991, 2012, 2015), and in the survey I asked about different farming aspects such as finances, environmental stewardship, and motivations to gather information about all pre-decisional factors. The pre-decisional factors and aspects of farming were determined ahead of time based on the literature reviewed in Sok et al. (2020). There is not any one section that corresponds with a specific behavioral antecedent, rather I chose environmental stewardship, financial perceptions, and motivations to highlight connections to the pre-decisional factors. From the interview data I note where there is overlap in pre-decisional factors and explain how each factor could be interpreted multiple ways.

#### 3.2.1 On-farm Enterprises

Rather than collecting specific information regarding the financial situation of the farm, which can

be perceived as invasive, I asked questions about the farmers' perceptions of their finances. These questions targeted both diversity of money-making enterprises as well as questions about finances over time. Due to the personal nature of financial questions and the lack of time to build rapport and trust with my participants, accounting information was not explicitly collected in the survey or interviews.

Overall, there were differences in what on-farm enterprises the rotational and adaptive groups use as well as their opinions on their financial situations. This section in my survey asked farmers to indicate the variety of enterprises, or farm-specific income-generating ventures and was formatted as 'select all that apply' with six pre-conceived options as well as an 'other' box that allowed farmers to self-describe any enterprises they participate in. To help support their finances, farmers in my sample had a variety of production enterprises including multiple livestock species, corn and soybeans, vegetable production, but were also engaged in enterprises along the value chain, i.e., farm services, direct marketing. These various income streams are, in part, a reflection of the farmers' perception of behavioral control because determining the economic feasibility of management decisions is impacted by the total number of farm enterprises. Possible income generating enterprises were suggested based on the National Agricultural Statistics Service (2017) data for Michigan farm enterprises.

Rotational farmers in my survey sample typically managed on-farm enterprises resembling a conventional Midwest agricultural system of cattle, hay, and crop rotations, whereas adaptive farmers were producing hay while simultaneously raising other livestock, growing vegetables, and providing services to other farms (Figure 15). In fact, 41% of adaptive farmers raised another form

of livestock, higher than the percentage of rotational farmers participating in any on-farm enterprise. The next most common farm enterprises for adaptive farmers were producing hay (i.e., 27%) and selling supplements (i.e., 22%). The most common farm enterprises for rotational farmers were hay production (i.e., 26%) followed by growing crops (i.e., 15%) and raising other livestock species (i.e., 15%) (Figure 15).

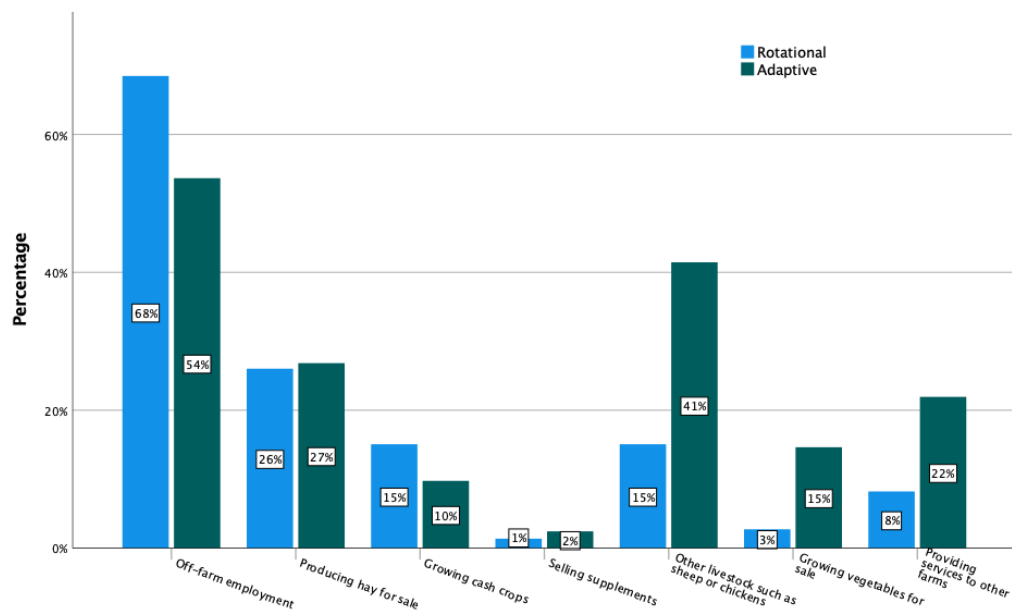


Figure 15. This graph illustrates the percentage of adaptive and rotational farmers who participate in different on-farm enterprises. There were no significant differences in the first three variables on the left, however at a 90% confidence interval there were differences in the final three variables on the right.

Approximately 93% of my sample had other sources of income including other on-farm enterprises and off-farm jobs. This was a social norm for these farmers because many of them were raised on farms that were more of a hobby than an income source. As explained by one rotational farmer:

I almost would say that I have animals because I want to see the land look nice. I don't have animals because I want to see the animals. I want to see what the animals do to beautify the fields and so forth.

(F12)

This quote demonstrates that for this rotational farmer, having animals was about the aesthetics and not income, which was based on their experiences while growing up on a hobby farm. This idea was something the rotational farmer learned from their parents many years ago and it still influenced their choice to raise another farmer's grass-finished stockers on the rotational farmer's land. Rather than focusing on whether the farm could be further diversified or used in a different matter (i.e., a perception of control), this farmer and others I spoke with ascribed to the social norm of having cattle if you live on a farm, but not necessarily other animal enterprises.

Additionally, differences in enterprises impact the farmers' perceptions of behavioral control. For example, perceptions of control can be a limiting factor for some farmers, as was explained during one rotational farmer interview:

When you've been doing something with the same type of livestock for so long changing enterprises would be difficult. (F9)

This farmer produces cattle and hay, and the perception that it would be difficult to change enterprises limits their willingness to engage in new enterprises. Contrastingly, adaptive farmers spoke about more unique enterprises such as cleaning skulls and cow hides to sell, selling forage seed, growing heirloom beans, and milling flour from small grains they raise on their property. The enterprises depicted in Figure 16 are sized in relation to the other enterprises farmers within the same grazing management style spoke about, thus comparing the size (i.e., frequency) of the

words is not indicative of intergroup differences but in-group comparisons. For example, “chickens” were mentioned more frequently than corn, hay, ducks, etc. within the rotational groups, but when compared to the adaptive grazing group the frequency was greater than the rotational group.

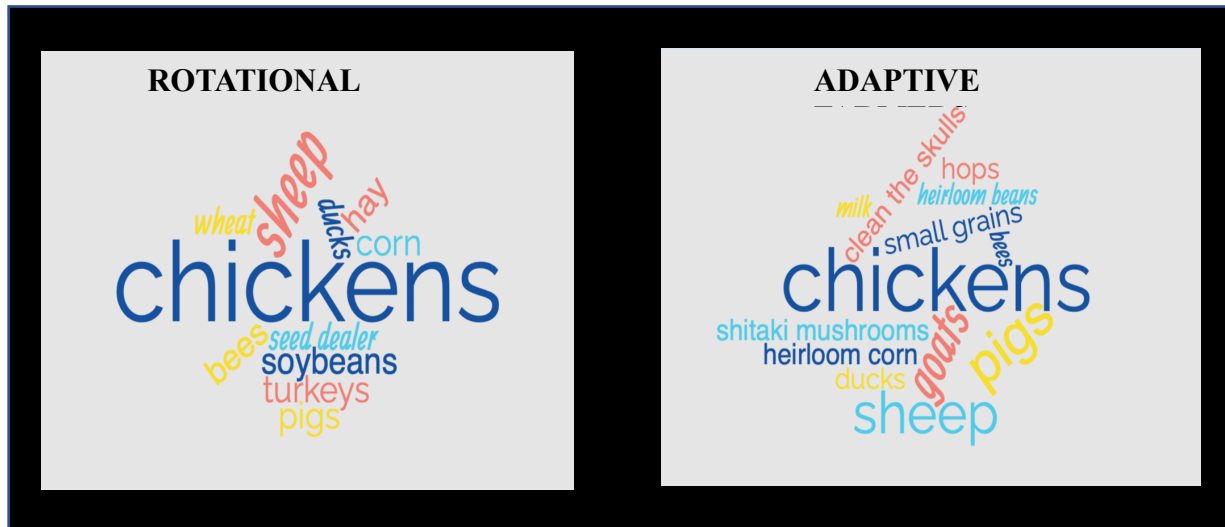


Figure 16. These two word clouds show the relative within-group frequency of the different non-cattle enterprises the rotational (left) and adaptive (right) farmers shared in the interviews, as well as the non-cattle enterprises the subsample of farmers interviewed were using on their farms.

As shared by one adaptive farmer:

Currently, there's about 94 acres in pasture. The other side we're gonna grow about five to seven acres of open pollinated corn this year and we have 23 acres of small grains and 12-15 acres of heirloom dry beans. So, we're a very diversified farm. (F3)

These choices demonstrate behavioral control perceptions and farmers' willingness or beliefs about whether they can diversify. However, as discussed in the literature review, enterprise

stacking was also an attitude and social norm related to diversification (Coon et al., 2020; Maseyk et al., 2021).

### 3.2.2 Environmental Stewardship

Another section of the survey that was used to capture pre-decisional factors was environmental stewardship. The three survey questions were on a scale from one (strongly disagree) to seven (strongly agree) and asked about the relationships between the farm and the environment (Royal Government of Bhutan, 2014). The environmental stewardship scale was created from these three questions and had an internal reliability score that showed consistency and allowed for scale creation (Cronbach's Alpha=0.794). Comparing adaptive farmers to rotational farmers shows the adaptive farmers had a higher average score (18.95 with a 90% confidence interval from 18.33 to 19.57) than their rotational counterparts (17.53 with a 90% confidence interval from 16.94 to 18.13) (Figure 17). The difference was because adaptive farmers were more likely to strongly agree with the two questions, "I consider the potential positive impacts of my farm on the environment" and "I am responsible for conserving the natural environment" (Figure 18). These responses are indicative of three of the four pre-decisional factors (attitudes, social norms, and perceptions of control) depending on the nuances interpreted by the farmer. For example, the question "I am responsible for conserving the natural environment" could cause the farmer to consider their ability to implement conservation practices (i.e., perception of control), elicit an emotional reaction (i.e., attitude), or identify with a stewardship identity encouraged by their peers (i.e., social norm), all depending on how the farmer interprets and relates to the question.

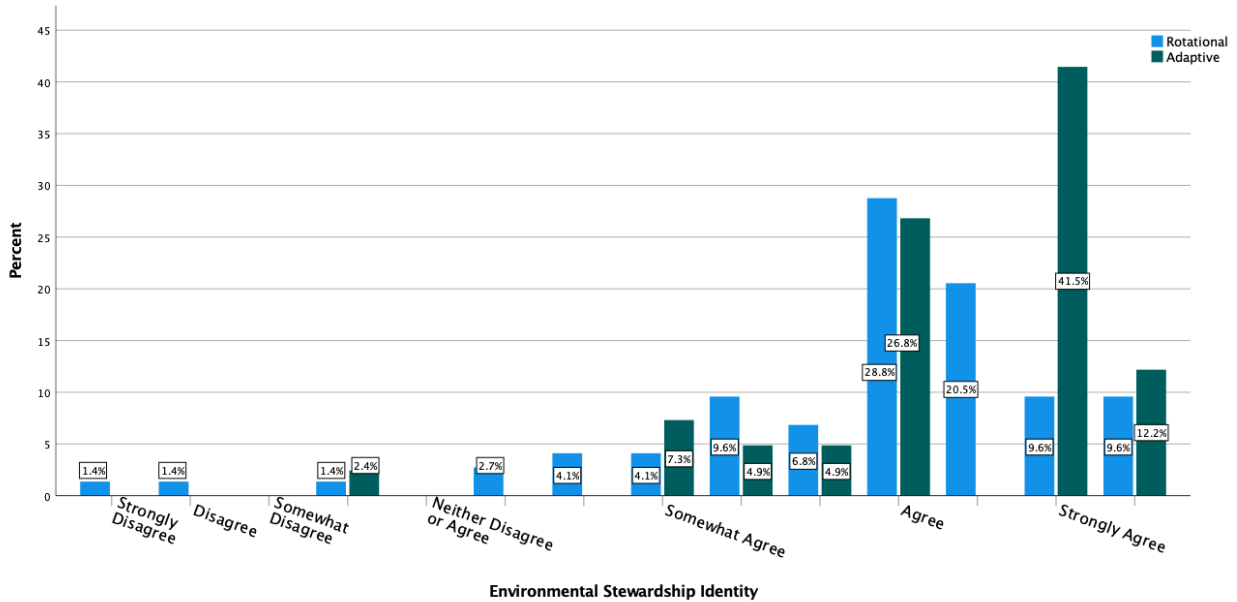


Figure 17. Graph illustrating the percent of each management group's response to the Environmental Stewardship scale. The scale was from 3 (strongly disagree) to 24 (strongly agree) because the scale was created from three independent questions.

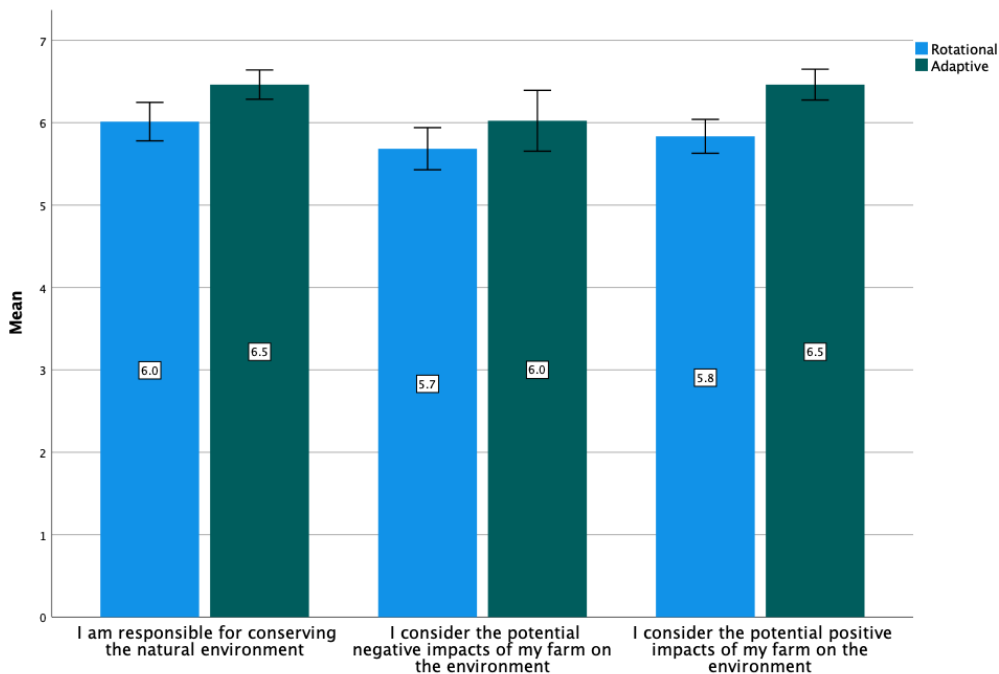


Figure 18. Graph illustrating the percent of each management group's response to the three environmental stewardship questions on a scale from 1 (strongly disagree) to 7 (strongly agree).

A common way the adaptive farmers explained they protect the environment was through improving soil health, and they acknowledged the complex ecological relationships they need to consider. These survey data demonstrated that 54% of adaptive farmers chose “improving soil quality” as one of their two main motivations for farming the way they do compared to 30% of rotational farmers. As one adaptive farmer shared:

To maintain sustainability, we've got to take care of our soil. If we take care of our soil, it'll take care of us, and our goal is to add as much live stuff below the surface as there is on top. (F2)

In the interviews I learned that the adaptive farmers were more likely to talk about diversification and the soil-animal-human health connections. For example, one adaptive farmer shared:

I don't care if you're doing pastures or doing horticulture. Diversification is key to everything. It's great for the animals, the plants, the insect, the whole environment. (F10)

Diversification was a demonstration of norms regarding the improvement of soil and environmental stewardship. A focus on improving soil health was a norm that had been engrained in the above farmer through their university education who was not from a generational farm. However, improving soil health was discussed by others who had learned about the role of diversification in supporting ecological health through trainings, workshops, and publications. This focus on diversification was less common among the rotational farmers because they ascribe to norms related to having animals on the land because that is like what their parents taught them.

### 3.2.3 Opinions about Regenerative and Adaptive Grazing

During the interview I wanted to better understand how pre-decisional factors impact farmers



opinions about, and willingness to try adaptive grazing management styles. I encouraged them to reflect on their opinions of “regenerative or adaptive grazing”; primarily, I was interested in the perceived barriers to adoption for those who are grazing rotationally, and what facets of adaptive grazing management resonated with those already grazing adaptively. Much of the theory regarding uptake of best management practices, in crops and livestock, has shown the focus historically is on profitability increases (Reimer et al., 2014; Reimer et al., 2012; Thompson et al., 2014), however more recent research is focusing on the social and emotional connections to conservation practices (Church et al., 2020; Floress et al., 2018; Prokopy, 2008; Reimer et al., 2014). The social and emotional concepts in best management practices research reflect the ‘social norms’ and ‘attitudes’ pre-decisional factors, and farmers’ opinions about their ability to implement and use such strategies reflect perceptions of control.

When asked about adaptive grazing management every farmer in my interview sample had heard of regenerative or adaptive grazing and attitudes toward it were generally positive. Those already using adaptive grazing highlighted the importance they believe it plays in sustainable agriculture and mitigating global climate change, a norm perpetuated by their social interactions with other like-minded farmers (i.e., a social norm). One adaptive farmer said:

I think it's the real thing. And I think that agriculture is going to have  
to move in that direction to sustain ourselves into the future. (F9)

Similarly, another adaptive farmer shared stories about their involvement with Holistic Management (Savory & Butterfield, 2016), a specific form of adaptive grazing, and said,

If you see land that is basically barren, and then you put animals on  
it and you manage them in the proper way. When you look 10 years  
down the road, the transformation is amazing. (F5)

Adaptive farmers shared that they attended classes, read about the benefits of adaptive grazing, and communicated with like-minded farmers about grazing adaptively, all of which are indicative of a social norm because these farmers surrounded themselves with other farmers who affirmed their beliefs about adaptive grazing management.

Holistic Management education perpetuated an even stronger social norm regarding adaptive farming due to more formalized networks developed through attending trainings with other like-minded farmers. This is a reinforcing relationship because most farmers seek out social networks of farmers using similar management styles and thereby, in this case, perpetuate the belief that forage should be managed for growth and diversity and not grazed down to bare ground. This reinforcing loop is also present in rotational grazing systems where farmers who are moving cattle based on a time-based schedule attend events and network with others managing in a similar manner and ascribe to the same norms and attitudes. These events tend to be events that have been happening for years including agricultural exploration days, stockmanship trainings, and increasing profitability workshops which were all mentioned in the interviews and traditionally have little to do with grazing management techniques.

Multiple adaptive farmers expressed that they feel grazing adaptively will sustain agriculture into the future. One adaptive farmer bluntly stated an attitude about adaptive grazing saying:

Well, here it's gonna last. I don't know what anyone else is gonna  
do. I think it should last but that ain't up to me. (F1)

This quote depicted several pre-decisional factors. One was the attitude this farmer had regarding adaptive management, building on other interview data regarding the benefits of grazing animals,

is animals contribute to forage and soil transformations, which is an affective evaluation of adaptive grazing. Another was that adaptive grazing is something they have implemented on their farm, and could continue to refine or improve, which also illustrates a perception of control.

However, several rotational farmers seemed skeptical about adaptive grazing and made comments such as:

I don't know [if adaptive management works] in the real world out here, where you're managing a bunch of cows and such. (F16)

This farmer was referencing a workshop they participated in about adaptive grazing and spoke at length about scalability of the practice. Rotational farmers also made comments such as:

My prediction would be that it's going to be a fad that settles in in certain areas. Maybe it's the climate, maybe it's the soil, maybe it's the system that works for some farmers, and in some areas, it doesn't. (F17)

This type of attitude about adaptive grazing often stops farmers from fully transitioning to an adaptive approach because they are uncertain if the benefits will outweigh the costs, both economically and in terms of cattle production. Rotational farmers in my interview subsample shared they had all heard of adaptive grazing management, but they were concerned about achieving the results depicted by proponents of managing grazing adaptively. This has also been shown in other research concerning the uptake of best management practices, reviewed by Baumgart-Getz et al. (2012), and currently more research is focusing on overcoming this barrier through changes in information dissemination such as focusing on communication and building social networks with farmers across different management styles (Benyishay & Mobarak, 2013;

Skaalsveen et al., 2020).

Additionally, doubts about the benefits of adaptive management were more frequent among generational farms in my sample, suggesting there are also social norms influencing these decisions. Rotational farmers commonly shared that they are not convinced of the benefits of a more intensive management style that requires more time spent building fence and moving animals between pastures. The non-generational farmers that I spoke with were all practicing adaptive grazing techniques, and one young adaptive farmer captured this sentiment by saying:

She's [the spouse] never been around farming and so the Holistic Management was easy for her. She didn't have to unlearn anything.

(F4)

Unlearning methods that have been engrained and used by generations before you (i.e., social norms) can be incredibly difficult and it may seem impossible for some farmers because they think they do not have the resources to make adaptive grazing work on their farm (i.e., perceptions of control). For some rotational farmers another attitude of adaptive grazing was that it was “wasting grass” because a substantial amount of forage is left in the pasture when animals are moved.

In summary, perceptions of control, attitudes, social norms, and values were present across the interview subsample during our conversations about perceptions of adaptive grazing and most statements could be coded for multiple behavioral antecedents. Further, looking at these three facets, (i.e., financial perceptions, environmental stewardship, and opinions about adaptive grazing) illustrated the complex relationships and interactions between the four behavioral antecedents, and showed they could not be deduced down to a one-to-one relationship where

behavioral outcomes were linked to a single behavioral antecedent. Therefore, changing behavioral outcomes is difficult because changes to one antecedent may have unanticipated impacts to the other antecedents resulting in unintended behavioral outcomes.

Environmental stewardship, financial perceptions, and opinions about adaptive grazing were both motivating and limiting depending on which pre-decisional factors were analyzed. For example, a generational farmer who ascribes to the social norm that grazable pastures should be utilized by cattle and a perception of control that the farm is too small to subdivide pastures may simultaneously have the attitude that adaptive grazing is environmentally beneficial, yet not participate in adaptive grazing. This was demonstrated in my interview with a rotational farmer F16 who explained that farming adaptively makes sense in theory, however they are skeptical about putting it into practice. Alternatively, this same farmer may decide to try adaptive grazing because they believe so strongly that adaptive grazing benefits the environment (i.e., an attitude). In short, behavioral antecedents are so pervasive that they are inherent in all parts of life and impact different behavioral outcomes depending on the individual and action under consideration, but identifying the pre-decisional factors that are most influential in farmers' decision making can result in more effective communication between educators and farmers (Benyishay & Mobarak, 2013) which improves uptake of sustainable practices (Skaalsveen et al., 2020).

### 3.2.4 Schwartz Short Value Survey

My survey contained the Schwartz Short Value Survey (SVSS) (Schwartz 1992) which asks participants to rate the importance of 10 values as “life-guiding principles”. Significant differences in mean SVSS values (with a 90% confidence interval) between the two groups were found for the

values tradition, conformity, and security (Figure 19). In this case study, the rotational farmers were more likely to rate these three values as more important than the values power, achievement, hedonism, stimulation, and universalism. They are also significantly more likely to rate these higher than the adaptive farmers (Figure 19). These three values are all part of the value category Conservation (Schwartz, 2012) (Figure 4).

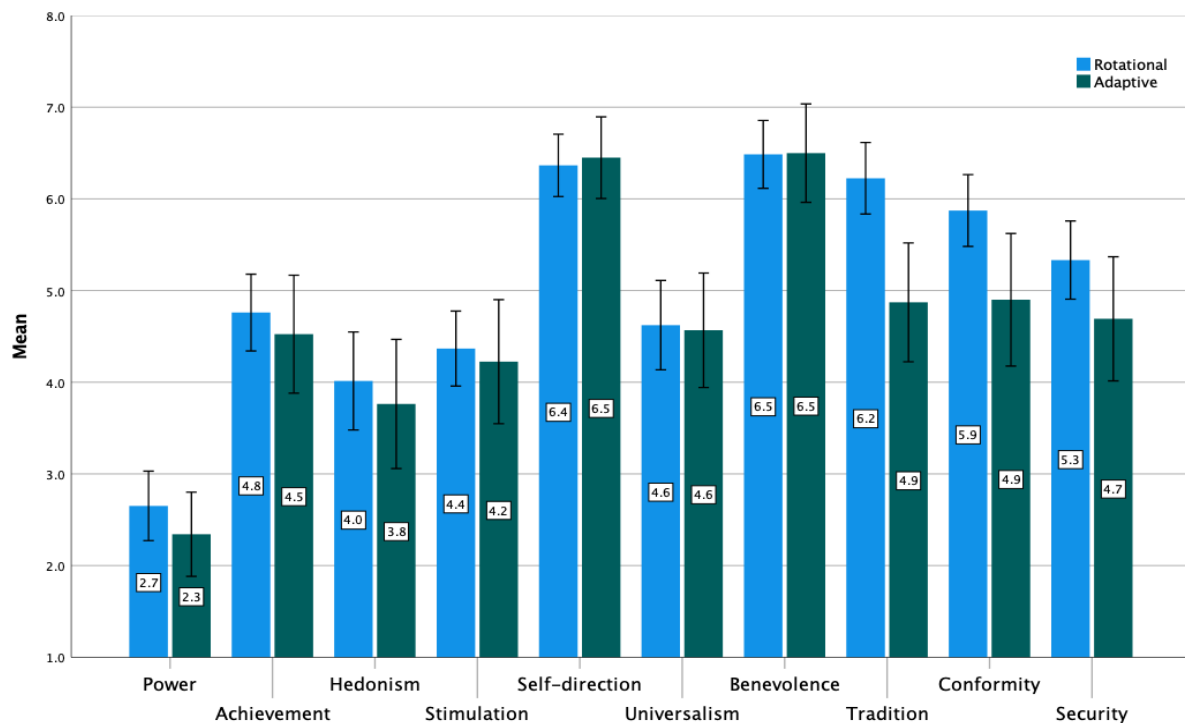


Figure 19. This graph depicts the differences in the SVSS mean scores for each value between rotational and adaptive farmers. The three final values, (i.e., tradition, conformity, and security) have significantly different scores at a 90% confidence interval with rotational farmers scoring higher than their adaptive counterparts. 1 means opposed to my values and 8 means of supreme importance to my values.

Rotational farmers scored higher in the Conservation category with an average score of 17.81 out of 24 (with a 90% confidence interval from 16.61 to 18.25) compared to the adaptive farmers who

scored 14.42 on average (with a 90% confidence interval from 13.13 to 15.98). These differences suggested that rotational farmers were more likely to manage their farm in a way that aligns with family traditions, directly corresponding to the tradition value from Schwartz (1992), which was also expressed as a social norm for generational farmers. It seemed possible that this would result in the adaptive farmers scoring higher on the value category Openness to Change, (i.e., experimenting and trying new things) because they are opposite to the Conservation value category however this was not reflected in these data (Figure 20).

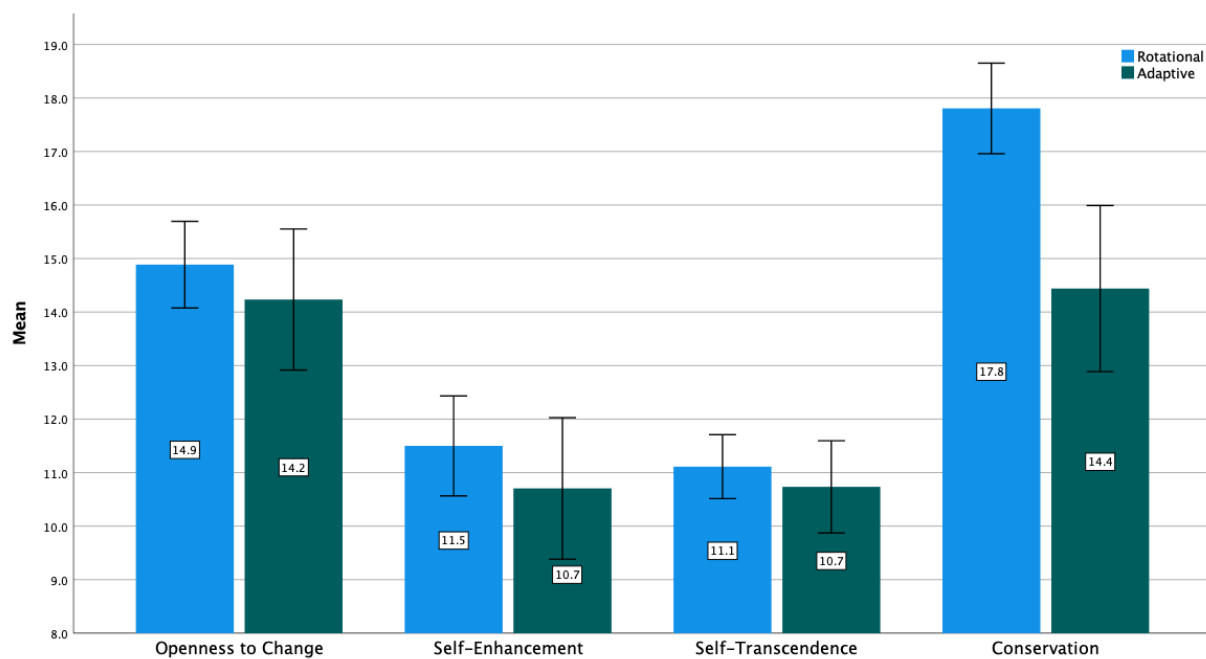


Figure 20. This graph depicts the differences in the average scores of rotational and adaptive farmers pertaining to the four SVSS value categories. There are significant differences in the Conservation value category but not the other three value categories with error bars showing a 90% confidence interval.

During the interviews a theme common to all farmers was independence and being their own boss,

which likely contributed to the high scores in the openness to change value category which is comprised of the values self-direction, stimulation, and hedonism (Schwartz, 1992). I also found relatively low scores for both management groups in the self-transcendence and self-enhancement value categories which suggested farmers are less influenced by self or group promotion than they are concerned with being open to change or conserving the status quo.

### 3.2.5 Relationship Between Wellbeing and Behavior

As outlined in the introduction, literature from social work and social psychology describes the relationship between wellbeing and behavior as bidirectional. In short, one's level of wellbeing can impact what behaviors they are willing to engage in, and the actions an individual takes will in turn influence their wellbeing (Figure 8). The relationship between management style and wellbeing is bidirectional. Therefore I explain how wellbeing can both impact and be impacted by behavioral decisions.

Adaptive farmers often shared in their interviews that a main goal of farming was being able to produce food they believed enhances human health, indicating that physical wellbeing is important to these farmers. Several adaptive farmers explained that they had investigated the differences in the nutritional outcomes of grass-finished and grain-finished beef. One adaptive farmer articulated the role human health played in his attitude toward adaptive grazing stating:

Having healthy soil that produces healthy plants, that sustains  
healthy animals, and it only makes sense that those healthy animals  
would be good food for people who want to be healthy. (F18)

Another adaptive farmer shared that the main motivation for starting a farm and producing their



own food was for the physical health of their family:

When I was approached about getting involved with farming, I was

like, yes, because we can raise our own healthy beef that way. (F14)

The fact that this farmer was approached by another producer who uses adaptive management could also be interpreted as a social norm because interactions between farmers reinforce behaviors as socially acceptable.

Beyond nutritional differences, farmers across the spectrum highlighted the importance for overall physical and mental health. One farmer spoke to me about their reasons for managing the farm in an adaptive way by stating:

Now [farming] has just become an overall health support. For our

health, animal health, our farm health, our health as a family. (F4)

Another adaptive farmer shared:

We're supposed to have a great health system here [USA], yet, as

we use more and more of these prepackaged foods, we're finding

out it's not doing us any good for our health. So that's what's driven

us into our sustainable, [adaptive] grazing. (F3)

This is indicative of the farmers' attitudes about grazing and how wellbeing implications impact farmers' behaviors. The farmer who explained that farming was an 'overall health support' is demonstrating an attitude about farming being 'good' for their holistic wellbeing, and the farmer who discussed the 'great health system' had a negative emotional evaluation (i.e., attitude) of these claims and an attitude that adaptive farming is beneficial or good. While impacts of grazing

management styles on wellbeing are being discussed further in section 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers, it is important to acknowledge farmers' perceptions of the impacts of certain management decision on their wellbeing influence their willingness and commitment to their chosen grazing management style.

### 3.2.6 Summary

My research is the first to examine relationship between pre-decisional, behavioral antecedents and management goals, and adaptations (Figure 10) in a Michigan context and in the pasture-based beef sector in the United States. My results demonstrate the value of this conceptual framing when looking at grazing management behaviors between rotational and adaptive pasture-based beef farmers.

Throughout the analyses I repeatedly found overlap between the behavioral antecedents and interactions across all four factors, which supports my integrated theoretical framework for including values in the Theory of Planned Behavior (Ajzen, 1991). My results demonstrated the value of this conceptual framing when looking at grazing management behaviors between rotational and adaptive pasture-based beef farmers. Differences in behavioral outcomes stem from the interactions between the pre-decisional factors (Ajzen & Fishbein, 1972) and there is a growing literature applying this framing with farmers. There was quantitative and qualitative literature on the use of the Theory of Planned Behavior to study farmers, however much of the work investigates the impact of individual pre-decisional factors on behavioral outcomes (see review by Sok et al. (2020) rather than the integration of how the pre-decisional factors interact and overlap to influence behavioral decisions. This research gap was addressed through my survey and interviews where I

asked about the reasons behind management choices as investigated through enterprise diversification, environmental stewardship, opinions on grazing styles, and values (Schwartz, 1992) to answer research question 2: Why do farmers choose to manage their beef herd the way they do?

First, the largest influence on the pre-decisional factors was related to whether the farm was generational or not. Family norms and attitudes were often at the heart of differences in which management style is adopted, which was demonstrated by all the non-generational farms in my sample grazing adaptively and only four of the generational farms (n=13) managing adaptively. This is consistent with the literature on best management practices adoption which indicates new farms are more likely to adopt sustainable farming practices than pre-established farms (Baumgart-Getz et al., 2012; Liu et al., 2018; Prokopy et al., 2008; Ranjan et al., 2019) and is likely related in part to learning new information and sources of expertise. The generational farms tended to have strong relationships with the older generation and therefore would turn to them as an expert about the property and animals, but the non-generational farms relied more on external networks, which will be discussed further in 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers as part of social wellbeing. My findings produced results similar to the work by Coon et al. (2020) and Maseyk et al. (2021) in which they found attitudes and social norms have the largest behavioral impact, both antecedents that are very influential to generational farmers in my sample.

These generational differences should be explored further to determine which comes first, holding values related to the Conservation value category (i.e., tradition, security, and conformity) or ascribing to norms and attitudes that foster a more traditional Midwest agricultural system of cows,

corn, soybeans, and hay (Church et al., 2020; Prokopy et al., 2019). The likely answer is that both are interacting and perpetuating each other in a positive feedback loop, which should be explored further in future research by intentionally surveying and/or interviewing generational and non-generational farms.

Lastly, exploring the enterprises pasture-based beef farmers engaged showed that differences in enterprises impact the farmers' perceptions of behavioral control. For example, in the survey sample rotational farmers typically manage enterprises resembling a conventional agricultural system of cattle, hay, and crop rotations, whereas adaptive farmers were producing hay while simultaneously raising other livestock, growing vegetables, and providing services to other farms (Figure 15). These differences suggested that rotational farmers were more likely to manage their farm in a way that aligns with family traditions, directly related to the value 'tradition' (Schwartz, 1992), because it is something they know they can be successful at, which is a perception of control. The differences in the number and frequency of unique on-farm enterprises the farmers participate in showed adaptive farmers have different behavioral control perceptions about whether they can diversify when compared to their rotational counterparts. Several interviews with adaptive farmers depicted positive attitudes toward ecological and social factor diversification, illustrated social norms promoting diversification, and values related to trying new things (i.e., openness to change value category).

In a search for management systems that can mitigate or reverse grassland degradation, some beef farmers are turning to adaptive management to mitigate the environmental risks of farming or ranching (Joyce & Marshall, 2017). In my research, every farmer in my interview sample had

heard of regenerative or adaptive grazing and attitudes toward it were generally positive. However, rotational farmers often shared that they are not convinced of the benefits of a more intensive management style that requires more time spent building fence and moving animals between pastures. This finding represents an attitude about the additional responsibilities for managing adaptively and a perception of control because these farmers think they do not have the resources to allocate additional time to farming. Negative attitudes about adaptive grazing often stop farmers from committing to fully transitioning to adaptive grazing because they have a negative attitude (i.e., negative emotional evaluation, not the colloquial term) regarding the benefits of adaptive grazing management. Often these negative evaluations stop the farmer from even trying a different management system if they have a positive attitude about their current system. If, however, the farmer has a negative attitude about their current system it may be possible to tailor communication with them to encourage the adoption of adaptive practices. Thus, if we understand the pre-decisional factors that limit adoption of beneficial practices, both ecologically and socially, conversations with farmers can be tailored to mirror their perceptions of control, attitudes, social norms, and values to support the adoption of these practices and in turn address rangeland degradation.

I concluded that it is necessary and appropriate to investigate differences in the four behavioral antecedents (i.e., perceptions of control, attitudes, social norms, and values) because they showed differences in management outcomes as well as similarities for pasture-based beef farmers. Because I determined the best way to investigate behavioral antecedents was through financial, environmental, and opinions on adaptive grazing, all of which are well established as highly important to farmers (Sok et al., 2020), it is possible the conflation of these pre-decisional factors

was due to my method of asking about perceptions of control, attitudes, norms, and values through these concepts. However, this is an important starting point for research regarding the management behavior outcomes of farmers. Understanding the differences will help encourage the adoption of practices that support farmers management goals and the adoption of more sustainable grazing management styles.

Next, I explore how these different management styles impact the wellbeing of Michigan's pasture-based beef farmers from a social, physical, and psychological wellbeing perspective. This helped me understand what management practices and decisions should be promoted as beneficial to the social factors of this social-ecological system. It also allowed me to determine the general level of wellbeing in this sample, which is an important step in addressing the farmer mental health crisis.

### 3.3 Wellbeing of Michigan's Pasture-based Beef Farmers

Here I address my third research question: How do management choices impact the wellbeing of the farmer? In addition to wellbeing outcomes, it will also be important to focus on the balance between wellbeing and behavior (Figure 8). Wellbeing theory shows balance is influenced by social, physical, and psychological wellbeing factors, so it was important to pay attention to the resources and challenges to wellbeing different farmers shared, particularly as they relate to influencing behavioral outcomes (Dodge et al., 2012). In the survey I asked questions about how satisfied the farmers are with their life in general, how happy they are, what makes them happy, if they are setting and meeting goals for their life and their farm, what they value most about their farm, and specific questions about how satisfied they are with aspects of life such as being part of

a community. These questions were asked using Likert and Likert-style scales in the survey but were repeated in an open-ended fashion during the interview to gather deeper understanding of these data.

The format of the results section mirrors my wellbeing framework by discussing social, physical, and psychological wellbeing independently. The survey contained four sections specifically about wellbeing:

- General Satisfaction with Life (i.e., social wellbeing)
- Happiness (i.e., social wellbeing)
- Physical health (i.e., physical wellbeing)
- Psychological Wellbeing (i.e., psychological wellbeing)

Each of these factors were used to compare the rotational (n=73; 64%) and adaptive (n=41; 36%) groups. When I analyzed the interview subsample, I found differences in the wellbeing of different age groups, so the survey data were further analyzed to compare these age groups. The spread of ages was from 27 to 79. I divided the data into three equal groups: (1) 27 - 52, (2) 53 - 64, and (3) 65 - 79. Because this was very similar to the break down in the interviews (i.e., less than 50, in their 50s, and older than 59) I chose to break the survey data down into the same groups as the interviews: <50, 50s, and >60. The analyses showed differences in wellbeing outcomes dependent on grazing and age group, which I will demonstrate with quotations from representative farmers from each group.

### 3.3.1 Social Wellbeing

Social wellbeing is subjective and focuses on the outcome of interactions between positive emotions, negative emotions, and long-term life satisfaction (Diener, 1994). Further, social wellbeing includes relationships with others and having a sense of community. The General Satisfaction with Life survey is a standardized, five question survey that measures broad, overall satisfaction with life (Diener et al., 1985). The five questions showed internal consistency (Cronbach's  $\alpha=0.7373$ ) and were merged into a scale for analysis. The original questions were a Likert scale from 1 labeled strongly disagree to 7 labeled strongly agree, so merging them into a scale allowed for a minimum of seven, and a maximum of 35. The range of responses was from 10-35 with a standard deviation of 5.943 and there were no differences between the two grazing management styles (Figure 21). The average responses to life satisfaction were "agree" across all five statements regardless of age or grazing management style (Mean=27.5) (Figure 21) and shows that according to the farmers in my sample they are satisfied with their lives overall, which is a social wellbeing benefit.



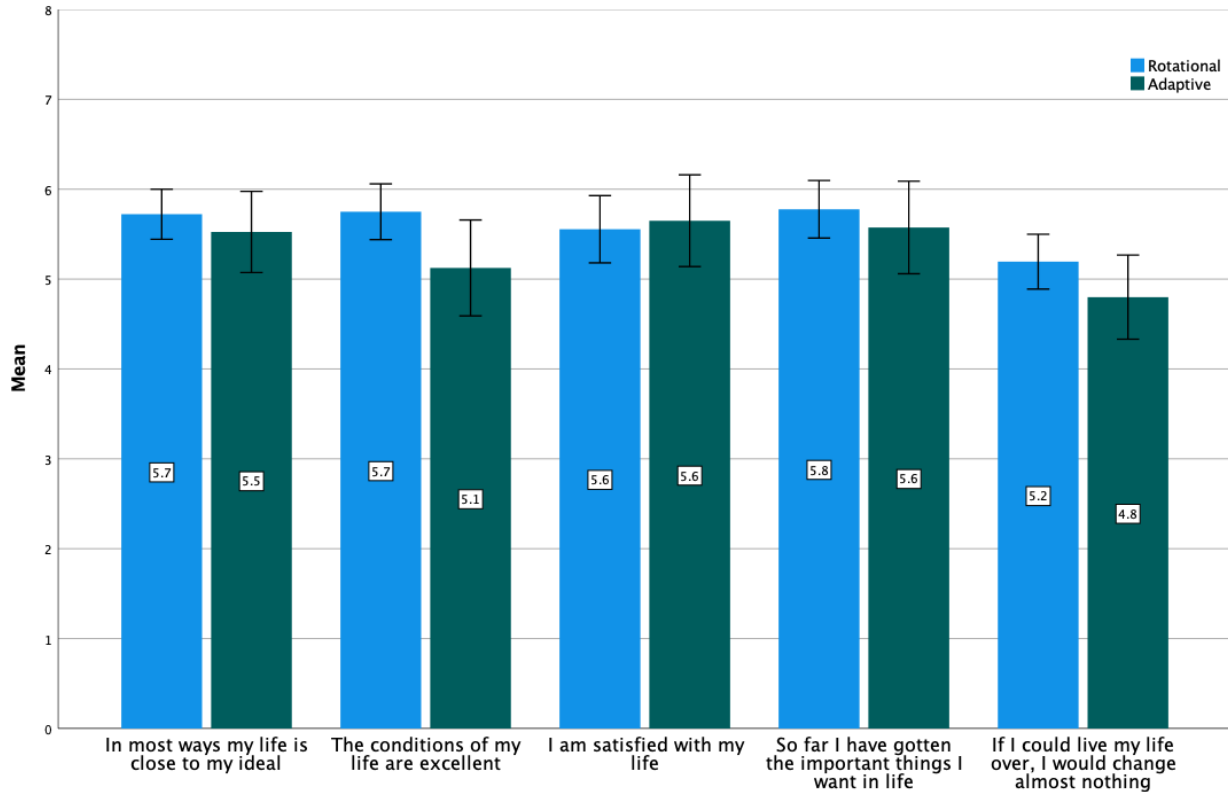


Figure 21. Comparing the averages between the rotational and adaptive farmers scores on the General Satisfaction with Life Scale showed no significant differences in the reported scores with error bars showing a 90% confidence interval.

#### 3.3.1.1 Benefits to Social Wellbeing

In the survey there were also three questions regarding levels of happiness. These questions were inspired by the Royal Government of Bhutan (2014) Gross National Happiness Survey and used three questions to determine an individual's hedonic or emotional wellbeing. The first asked about current happiness levels and was a 1-7 Likert scale with 1 labeled as 'extremely unhappy' and 7 labeled as 'extremely happy'. The other two questions regarding past and future happiness were on a four-point Likert-style scale ranging from 1-3 with 1 being 'less' and 3 being 'more'. In all three questions responses of zero were indicative of 'do not wish to answer' and were excluded

from analyses. When comparing the responses of the adaptive farmers with the rotational farmers a means comparison showed the adaptive farmers were more likely to say their happiness has improved in the last five years indicated by an average score of 2.66 (with a 90% confidence interval from 2.5 to 2.82) compared to rotational farmers who scored 2.27 (with a 90% confidence interval from 2.10 to 2.44). There were no differences between the two management styles in the response to the questions of present happiness because both management styles scored at or above average and they rated future happiness as staying the same or increasing (Figure 22).

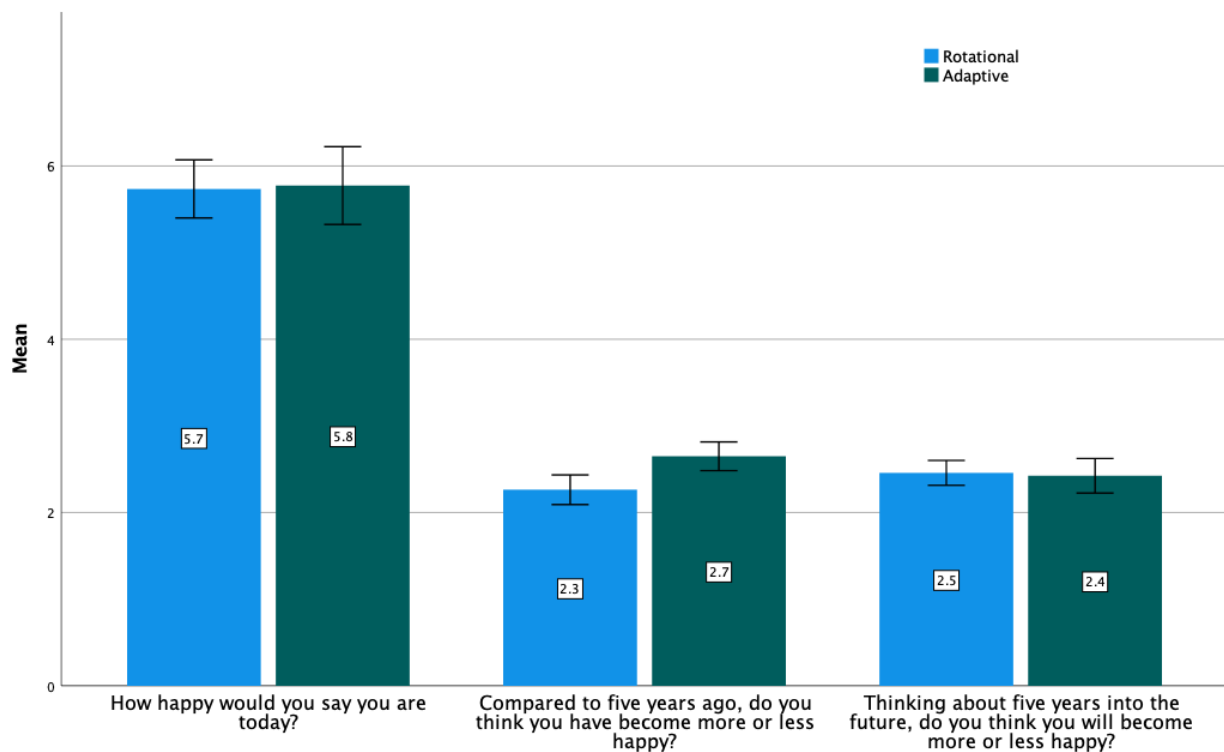


Figure 22. This graph shows the differences in average scores on the three happiness questions (i.e., social wellbeing) between rotational and adaptive farmers with error bars showing a 90% confidence interval. First question was on a 1-7 scale and the remaining two were on a 1-3 scale.

Analyzing happiness by age (Figure 23) showed significant differences with the >60 farmers more likely to rate expecting that ‘in five years they will be happier than they are now’ lower than the 50s and <50 groups (with a score of 2.38 and a 90% confidence interval from 2.23 to 2.53). Thankfully, none of the age categories expected their happiness to decline over time. Comparing the scores for past and current happiness shows all groups would rate their current happiness as “moderately happy” and that they have maintained or improved their happiness in the past five years. Due to the nature of the survey, it is impossible to know why these farmers have seen improvements in happiness or expect to be happier in the future, so I investigated that further during in-depth interviews by coding for benefits and challenges to social, psychological, and physical wellbeing (i.e., independently by wellbeing type) to identify the impacts to overall wellbeing and behaviors as per Dodge et al. (2012).

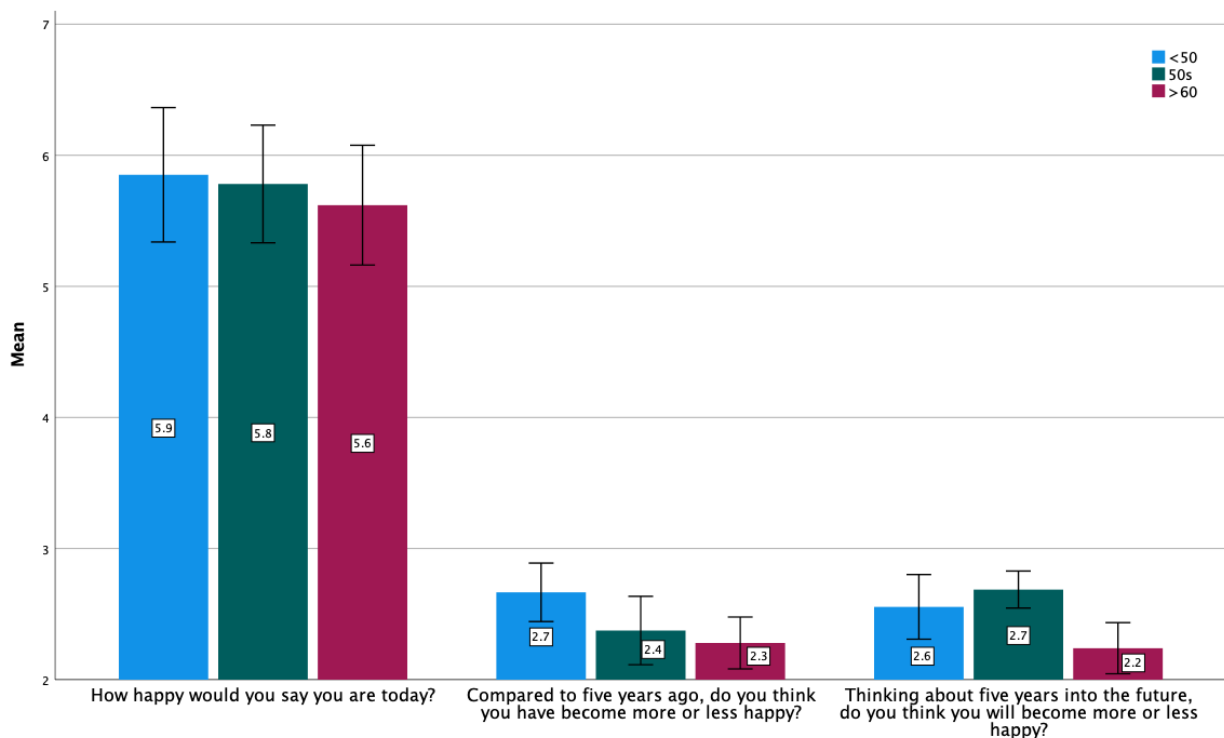


Figure 23. Investigating the three happiness questions when compared by age groups with error bars showing a 90% confidence interval.

For the <50 farmers, one place they find community and support (and thus a resource for social wellbeing) is with their consumers because of the appreciation their customers express. As stated by one adaptive farmer:

There's not really a ton of support beyond the customer base that we've built who [say], 'yeah, we love what you guys are doing. Thanks for doing what you do.' (F19)

Social media is another one of the main sources of social support for the <50 group. They use social media to learn, connect with like-minded farmers, and promote their farms. Many times, the farmers they connect with are not geographically close, so without this tool the <50 farmers would find themselves far more isolated than they already are. For example, one adaptive farmer said:

That's where I appreciate the social media aspect. I can't go talk to 15 farmers [in person] about 'how did you do this', or 'what are you doing', or 'what have you learned', but a lot of people are putting it out there ... things that they've learned, what they're doing, how they're doing it on social media, and I really appreciate that. (F8)

The 50s farmers used the internet as well as farm publications and consulted with experts on a semi-regular basis to gather the information they needed, other forms of social wellbeing resources. However, the 50s farmers were in a slightly different situation because all of them had family members that currently or previously farmed and they grew up immersed in agriculture, though not always resident on a farm. During the interview it became clear that many talked to their parents, and some talked to other family almost daily, thus family were a key social wellbeing resource, but beyond the family unit these farmers felt isolated. By first talking with family members that understand the farm, they gained knowledge specific to their property. This approach

to information attainment at times influenced their management choices. For example, one rotational farmer shared:

At one point in time my dad and my oldest brother, and I actually  
co-op farmed together. (F16)

Although they now own their own farm, this rotational farmer connected with their family members to learn new things and discuss the current state of farming. One adaptive farmer who had changed management styles from what he had seen other farmers doing when he was young (e.g., leaving cattle in one pasture all year) to better align with his own goals (e.g., moving cattle every two days) shared with me:

When I had the resources and finances to start doing things  
[independently], I started reading books, and gravitated towards  
likeminded peoples' thinking, and tried to learn as much as I could.  
(F5)

Despite having a strong background in conventional agriculture, this farmer believed they needed to gather new and different information about grazing cattle and its impacts on soil health that could help facilitate their goals of being ecologically sustainable. While there were behavioral antecedents represented in these quotations, the analysis presented here pertains to the social wellbeing resources and challenges farmers were facing.

Farmers >60 all had parents who farmed and they themselves lived on the farm, which was a social wellbeing resource because these farmers grew up in agriculture and learned by doing. One farmer did not grow up on the farm property but remembered going to the farm at least once a week to check on and move cattle when they were younger. This was also an age group where rural farming

communities in Michigan had far more farms in operation when they were young. Many rural families had livestock in some capacity (e.g., laying chickens, hogs, dairy, etc.), so the >60 farmers remembered that farm community-based lifestyle and valued it. They did not fight changing social relationships, particularly the move to online because of the pandemic, but many of them did not use social media to interact with other farmers. Instead, they opted for in-person meetings (i.e., attending Farm Expo Days as well as other in-person gatherings) and read agricultural publications (books and magazines).

Perhaps the most important social resource the >60 group had was their family. Differently to the 50s group, the >60 farmers shared stories of raising kids on the farm. Some shared the hope of passing on the farm to the next generation. However, passing on the farm was not always a goal for these farmers, with some of the >60 farmers recognize that their children had no desire to farm. Rather than focusing on the loss this represents, the >60 farmers instead highlighted the positive impact being raised on a farm had on their children and often grandchildren. Despite the obvious bias of a parent/grandparent, one farmer described the role the farm played in raising children sharing:

It's a wonderful lifestyle for the kids [children and grandchildren].

It's good for them financially, it teaches them how to work. My three kids are the best workers in the world because they were taught that at an early age. (F12)

### 3.3.1.2 Challenges for Social Wellbeing

One social wellbeing challenge all farmers discussed in the interview was finding farming or even

non-farming friends who understand agriculture and animal production. Farmers across the grazing and age spectrums commented about the lack of other farmers in their lives, however it was particularly prevalent with the <50 farmers. These are mostly new farmers rather than generational, and they shared that they did not have an existing farming community they related to (i.e., all their farming relationships are being built from scratch). This results in the youngest farmers feeling like they do not have local or regional farmers to talk to or work with on farming projects.

These social wellbeing challenges are mirrored in the interviews of the >60 group who acknowledged that they have a lack of friends that are in agriculture or friends who understand what it means to be a farmer, frequently because there are not new farmers beginning to farm in the area. As depicted by an older farmer who has been farming for decades:

Farmers in general are almost autonomous in a lot of things. So,  
when you find a farmer friend that that you can actually relate with  
it seems like it's a rarity more than not. (F9)

This lack of farmer friends is hard on all farmers because it causes them to feel isolated, feel like people do not understand them, and feel like others have no intention of getting to know them. The lack of community also results in a shortage of on-farm help or labor because there are few people who know or want to learn how to manage a farm.

Ultimately, social benefits and challenges farmers across management styles and age categories are relatively similar. Most farmers were challenged by not having social resources such as neighboring farms, in-person meetings, and a lack of friends in agriculture. However, the <50

farmers were benefiting from social media platforms where like-minded farmers were sharing information at a large scale. There were decreases in the number of farming communities in Michigan, and rural landscapes changed such that there were fewer farmers overall in the state.

### 3.3.2 Physical Wellbeing

Physical wellbeing is the combination of attaining material assets and economic wellbeing such as having a livelihood that is profitable and stable; meeting basic needs; and supporting physical health (Gillett-Swan & Sargeant, 2014 ). Therefore, this category encompassed both economic factors and physical health factors. To assess economic factors of wellbeing in the survey I asked four questions on a Likert scale from 1 (i.e., strongly disagree) to 7 (i.e., strongly agree) and created an economic wellbeing scale from them (Cronbach's  $\alpha = 0.714$ ) that had a possible range from 4 to 28. The adaptive farmers scored an average of 18.80 (with a 90% confidence interval from 18.14 to 19.46) thus perceiving their financial situation to be more desirable than their rotational counterparts who scored 17.95 on average (with a 90% confidence interval from 17.50 to 18.40), but not significantly different. The difference that was seen was due to differences in the responses to three of the four economic wellbeing questions: (1) "In 5 years I expect my financial situation to improve"; (2) "My financial situation is a constant source of worry"; and (3) "I have made choices that will help me be financially secure".

#### 3.3.2.1 Benefits to Physical Wellbeing

In the literature on farmer decision making much of the research focuses on agricultural economics (LaCanne & Lundgren, 2018; Peel et al., 2015; Rode et al., 2015; Sok et al., 2020; Torell et al., 2010). Historically best management practices for social system factors focused on increasing



profitability (Reimer et al., 2014; Reimer et al., 2012; Thompson et al., 2014), however, there is an increase in the frequency of articles now suggesting that maybe economics are not the main driver of adopting sustainable practices broadly (Bolis et al., 2017), and specifically in agriculture (Baumgart-Getz et al., 2012; Floress et al., 2018; Liu et al., 2018; Prokopy et al., 2019). Thus, it was important to investigate farmers' perceptions of their finances and how these perceptions influence the farmers' wellbeing. As a reminder, there is an abundance of literature on the adoption of best management practices (Church et al., 2020; Floress et al., 2018; Prokopy, 2008; Reimer et al., 2014), but much of this literature is related to crops rather than livestock. In this study I asked five questions about perceptions of finances lifted from research by Marshall and Smajgl (2013) in Australia studying the adaptations livestock farmers undergo when managing for droughts.

Of the four questions, two showed notable outcome differences, one showed slightly different outcomes, and one showed similar outcomes (Figure 24). When asked if they were financially better off now than 5 years ago, both the rotational and adaptive farmers indicated the same response; they 'slightly agree' with the statement and are slightly better off. The rotational farmers scored a 5.00 (with a 90% confidence interval from 4.70 to 5.30) and the adaptive farmers scored a 5.35 (with a 90% confidence interval from 4.95 to 5.79). This was the question with no major reported differences between the two management styles. The question that had slightly different outcomes was 'regardless of what happens I have made choices that will help me be financially secure', where the adaptive rotational farmers scored slightly lower at 5.10 (with a 90% confidence interval from 4.85 to 5.34) and the adaptive farmers scored 5.58 (with a 90% confidence interval from 5.26 to 5.89), again resulting in slight agreement with the statement.

The two major differences were in the final two questions on Figure 24. The adaptive farmers more frequently reported slight agreement with the belief that their financial situation will improve over the next five years with a score of 5.45 (with a 90% confidence interval from 5.13 to 5.77) compared to the rotational farmers who scored a 4.94 (with a 90% confidence interval from 4.71 to 5.18). This suggests adaptive farmers have a more positive financial outlook than their rotational counterparts, which is bolstered by the responses to the final question in the section, “My financial situation is a constant source of worry”. Here the rotational farmers chose ‘neither agree or disagree’ with an average score of 4.19 (with a 90% confidence interval from 3.86 to 4.52) while the adaptive farmers scored, on average, 3.45 (with a 90% confidence interval from 2.91 to 3.99) indicating they ‘slightly disagree’ with this statement and are not constantly worried about finances. This is, to my knowledge, the first published study to suggest that grazing management style can benefit physical wellbeing through mediating financial worries and stressors and is something that should be studied further to determine if it is consistent with the broader population of adaptive farmers or if it is confined to my survey sample.

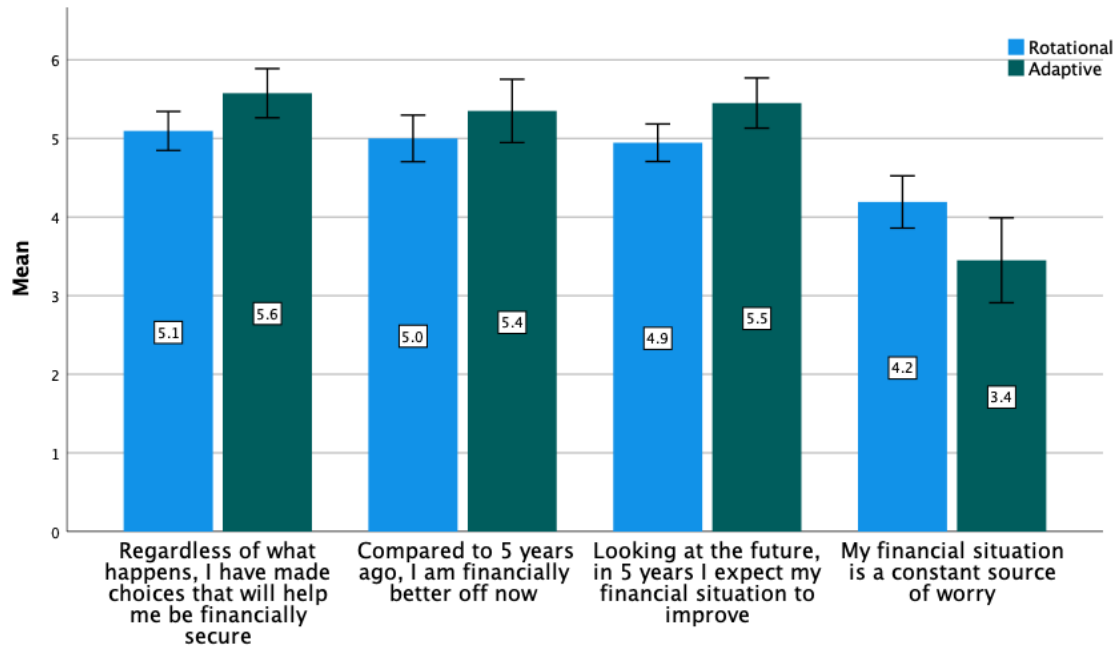


Figure 24. Comparing the rotational and adaptive farmers' responses to questions regarding financial perceptions. Error bars indicate a 90% confidence interval.

The financial perceptions scale was created by summing the scores of the four financial wellbeing questions after reverse scoring the question about worry so that all questions were positively phrases (Cronbach's Alpha = 0.714). The results show slight differences between the two management groups, but as is shown in Figure 25 the adaptive farmers (53%) were more likely to score between 'somewhat agree' and 'agree' while the rotational farmers (63%) were more likely to score between 'neither agree or disagree' and 'somewhat agree'. Because the same differences were accounted for from the individual scale constructs, future research may benefit from creating a similar financial wellbeing scale, which could help researchers understand some of the benefits and challenges to physical wellbeing.

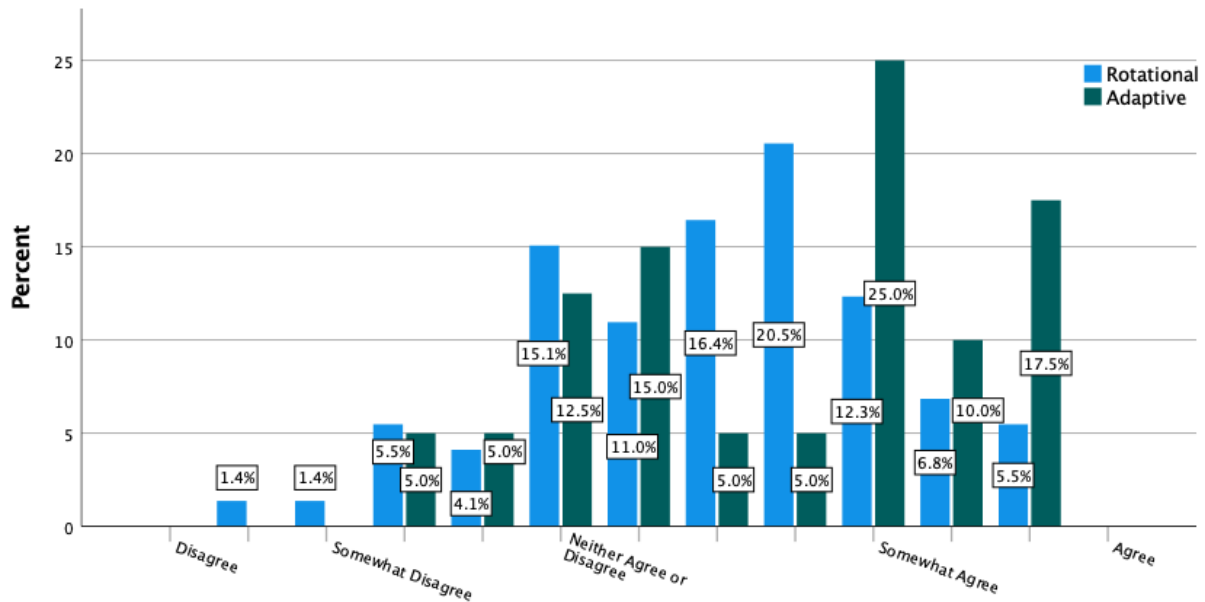


Figure 25. A graph of the perceived economic wellbeing as depicted through creating an economic wellbeing scale.

When comparing the economic wellbeing of the different age groups, they were very similar across three of the four financial perceptions but the question ‘My financial situation is a constant source of worry’ showed significant differences, specifically, younger farmers are far more likely to be worried about finances than their older counterparts (i.e., both the 50s and >60 groups). As will be discussed below, the differences in financial situation are in part a result of the <50 farmers being new farms, not a generational farm, and it is a reflection of general population data where younger people have higher debt than their older counterparts which leads to anxiety (Drentea, 2000), a psychological wellbeing challenge as well as a physical wellbeing challenge.

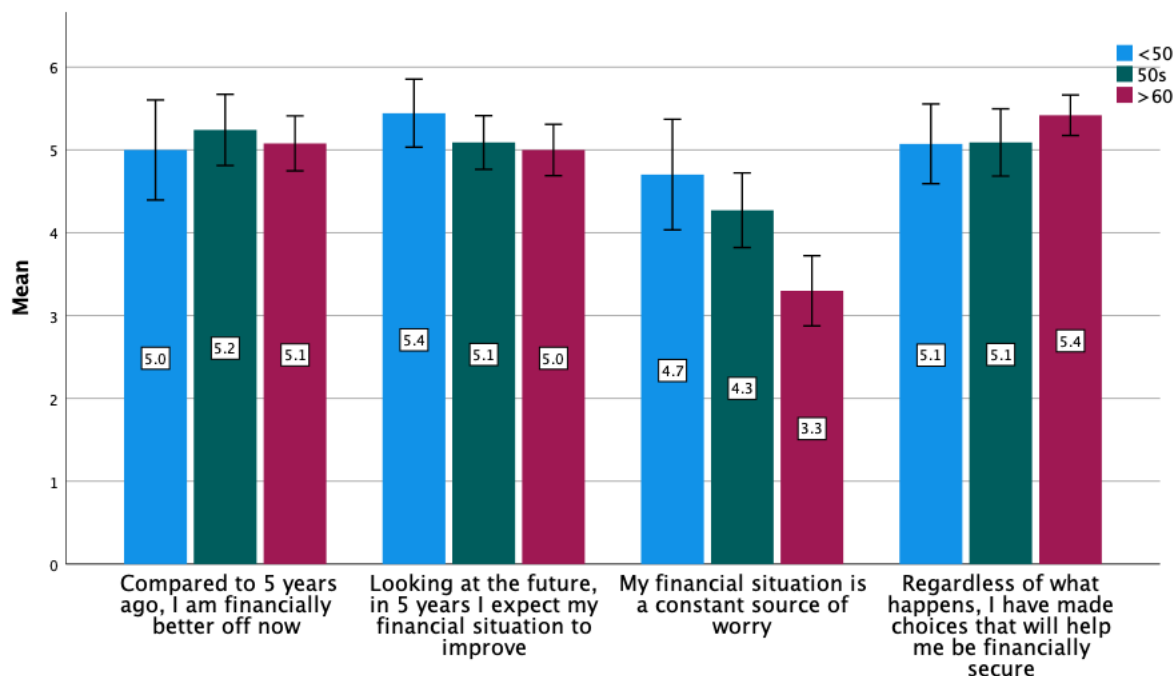


Figure 26. Comparing the financial perceptions of the three age groups. Error bars depict a 90% confidence interval.

With regard to why they farm the way they do, adaptive farmers in who participated in the survey were more likely to choose “using the farm to make a profit” as a main motivation with 34% of the adaptive farmer group choosing this as one of their two main motivations compared to the rotational farmers where only 19% of the group chose this as a main motivation (Figure 27). In the age data, <50 farmers were more likely to report using the farm to make a profit than their older counterparts when compared by the percentage of farmers in each age category (i.e., 41%, 12%, and 26% respectively, as age increased) (Figure 28).

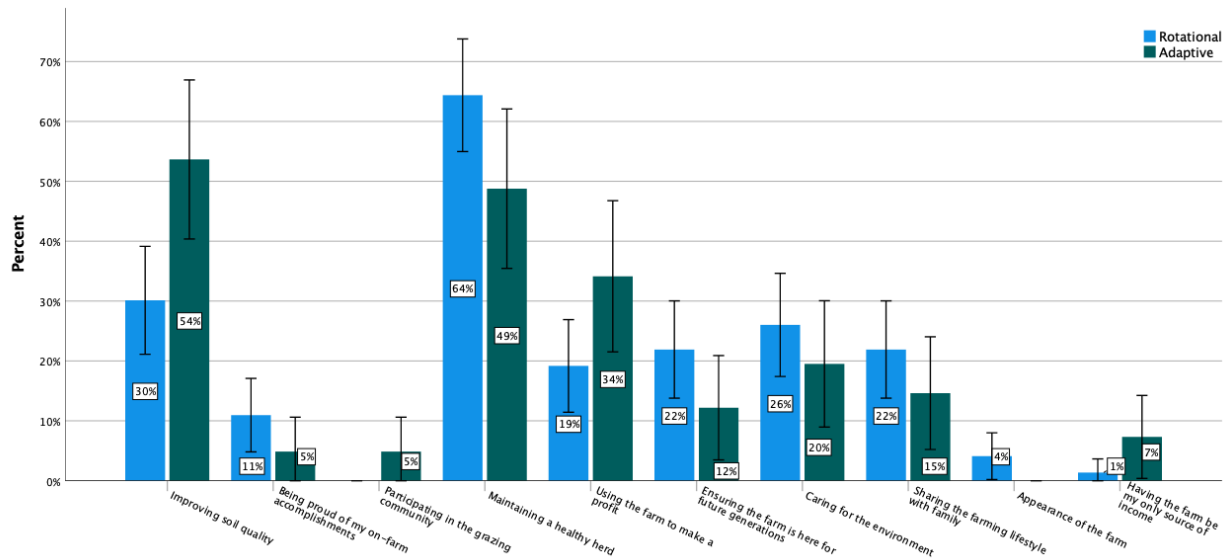


Figure 27. This chart shows the percentage of rotational and adaptive farmers who chose the above motivations as one of their top two. Error bars represent a 90% confidence interval. The percentages will not sum to 100% because each participant chose two motivations.

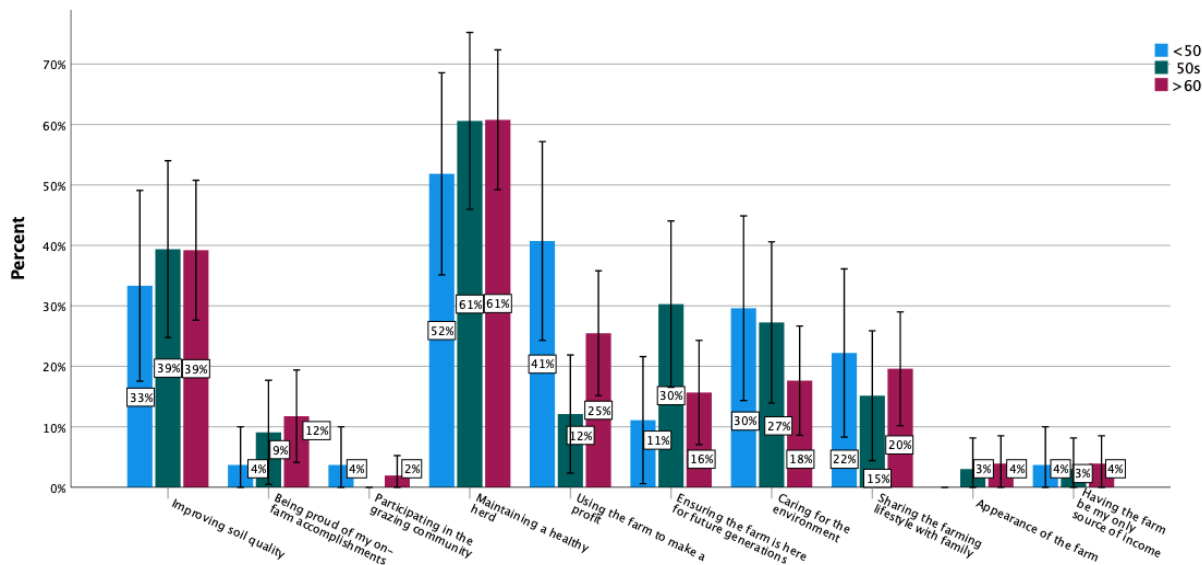


Figure 28. This chart shows the percentage of farmers in each age category who chose the above motivations as one of their top two. Error bars represent a 90% confidence interval. The percentages will not sum to 100% because each participant chose two motivations.

While the adaptive farmers in the interviews were often talking about the farm being a main source of income, the rotational farmers were more focused on ensuring the farm pays for itself rather than being a source of profit. One rotational farmer shared:

We both worked off the farm for many years, but the farm has been very important to us. And it is financially important to us also, in terms of 'it paid for itself.' (F13)

All the rotational farmers grew up either on a farm or with a family farm they spent substantial time at, but these were typically hobby farms that had been operating therefore for multiple generations.

Many of the farmers in their 50s commented that their debt was better managed now that they had time to get established or because their generational farm was updated, which required less current investment and there was less that needed investing in. These trends are also apparent in the >60 farmers who made very few comments about economics or profitability. The older the farmer was, the more likely they were to have farm debt paid down or off and were thinking about farm succession planning. However, this was not universal with one adaptive farming couple in their 50s who inherited a family farm that was already in debt. They shared with me:

I don't sleep much at night. It's our family farm. We're almost a half million dollars in debt. We were down to \$100,000 10 years ago. That's how we much [debt] we added to keep [the farm] going, and it's like, how the hell do you get out of it?? (F10)

Between the different grazing styles there were no statistically significant differences in their

physical health concerns across the groups. The question, "how satisfied are you with your physical health" had a range from 1 (i.e., strongly disagree) to 7 (i.e., strongly agree) and overall, the average score for both groups combined was 5.12 or "slightly above average" (with a 90% confidence interval from 4.85 to 5.38). Further, about 83% report eating healthy food, 35% do some form of planned exercise, and on average participants reported sleeping 7 hours each night. This suggests that overall, pasture-based beef farmers in Michigan are content with their health.

Between the different age categories and management styles there were few differences in the positive impacts of farming on the farmers' physical health. The <50 farmers spoke about the role of strength training for staying safe on the farm. The 50s farmers were the only group to bring up producing healthy food as a main goal of the farm, but this is likely due to two of the eight farmers being physicians during the earlier parts of their lives. The >60 farmers focused on the health benefits of walking and shared that despite the physical demands of farming, they feel their bodies are in better shape than their non-farmer counterparts specifically because they are so active.

#### 3.3.2.2 Challenges for Physical Wellbeing

The interviews revealed some differences in the financial wellbeing of the different age groups, most notably the impact of debt and a lack of access to physical capital (i.e., land and infrastructure). The latter was focused on by the <50 farmers because the majority were beginning and have invested significant amounts of money in the last five years. For example, one <50 farmer commented about the need to change how they managed cattle and what enterprises they were using because of the financial losses the original management system was taking, stating:

Profit per animal wasn't there. We worked our butts off, we did the



math, and it was gonna take us 10 years just to cover the initial expenses. (F4)

Making changes on farm or adding new enterprises is incredibly difficult for <50 farmers who have accrued high levels of debt, a common outcome of starting a new farm.

According to the interview data, as age increases farmers are more aware of physical health constraints. Some of the <50 farmers commented about physical health concerns in their interviews, all related to the impacts farming had on old physical injuries (i.e., on and off-farm). The 50s farmers commented on their increasing physical limitations and their concerns about their perceived future physical declines. The >60 farmers recognize that they are no longer able to do the things they used to, such as tossing hay bales over fences, quickly climbing in and out of tractors, and working cattle. Some of them even have family members that step in when needed. One older farmer commented:

And my son, he flat out says: “Don't get in there. I'm gonna do it [moving cattle]. You're not as quick as you used to be.”. ... And he's right, so he does a lot of the grunt work. (F7)

This quote indicates the interplay of physical wellbeing benefits and challenges because this >60 farmer has physical health concerns, but benefits from having a strong family network (i.e., social wellbeing).

### 3.3.3 Psychological Wellbeing

Psychological wellbeing is the relationship between real and imagined self (Ryff, 1989). It requires understanding whether or not an individual is living within their values and/or meeting their goals

(Lockwood, 1999). In this research the focus is on how individuals measure up to the person they want to be by living a life that is close to their ideal version and living up to their potential (Dodge et al., 2012; Ryff, 1989). All of the Psychological Wellbeing Scale (Ryff, 1989) questions were on a 1-7 scale with 1 labeled 'strongly disagree' and 7 representing 'strongly agree'. Despite previous validation by Ryff (1989) who determined several subscales could be created by clustering questions together, I did not encounter consistency in my sample and each question was analyzed individually rather than as the pre-determined subscales. Throughout these 18 questions the range typically included all seven options, but five questions had a range from 2-7, one was from 3-7 (i.e., people describe me as a giving person), and one from 4-7 (i.e., life has been a continuous process of growth and change). The three questions I want to highlight differences in are shown in Figure 29. This graph shows the average scores of rotational and adaptive farmers on three of the 18 questions on the Psychological Wellbeing Scale (Ryff, 1989). Error bars indicate a 90% confidence interval.

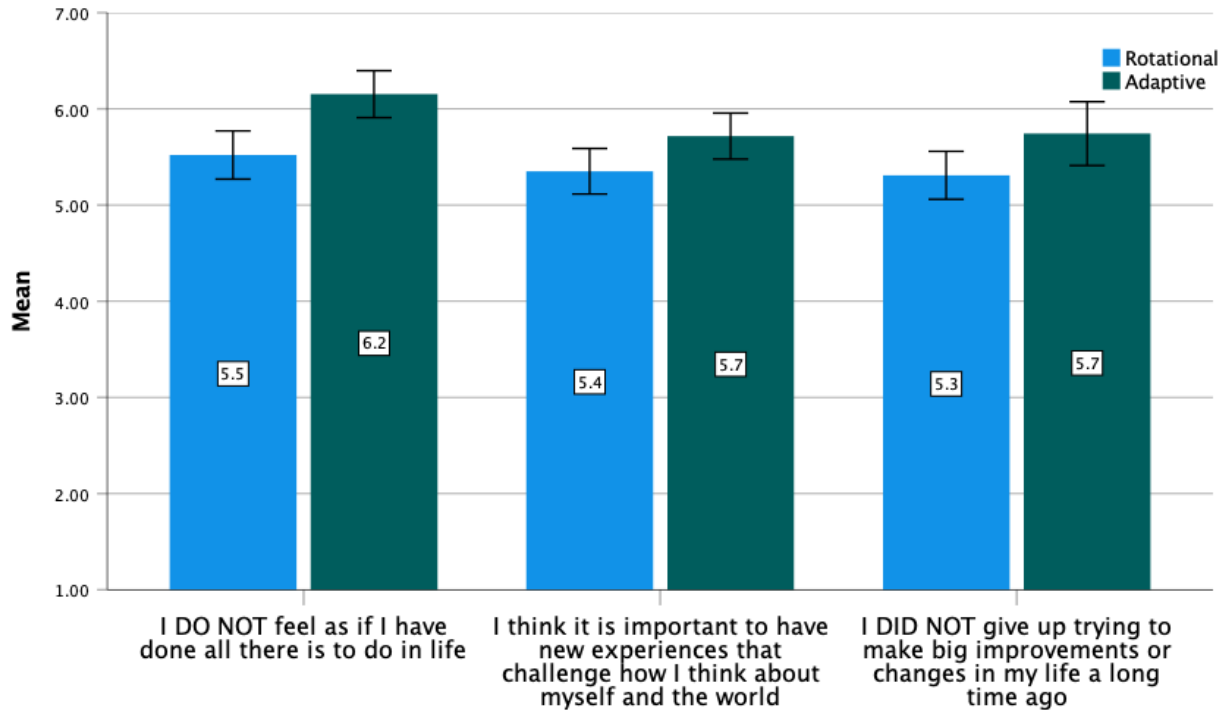


Figure 29. This graph shows the average scores of rotational and adaptive farmers on three of the 18 questions on the Psychological Wellbeing Scale (Ryff, 1989). Error bars indicate a 90% confidence interval.

### 3.3.3.1 Benefits to Psychological Wellbeing

One difference in psychological wellbeing was that the adaptive farmers were more likely to ‘agree’ with the statement, “I do not feel as if I have done all there is to do in life” with an average score of 6.15 (with a 90% confidence interval of 5.91 to 6.39) and the rotational farmers were ‘slightly agree’ and scored 5.51 (with a 90% confidence interval of 5.26 to 5.77). This suggests that adaptive farmers in my sample tend to have a positive outlook because they believe they have more to experience and do in life, and it relates to these data on values which suggest all farmers in the sample are open to change and growth. The question “I did not give up trying to make big improvements or changes in my life a long time ago” also had interesting responses. Here the

adaptive farmers were more likely to ‘agree’ with a score of 5.78 (with a 90% confidence interval from 5.45 to 6.10) and the rotational farmers ‘slightly agree’ with a score of 5.29 (with a 90% confidence interval from 5.04 to 5.53). Lastly, differences between the adaptive and rotational farmers were also reported in their responses to the statement “I think it is important to have new experiences that challenge how I think about myself and the world”. In this case the adaptive farmers ‘agree’ with a score of 5.73 (with a 90% confidence interval from 5.49 to 5.96) and the rotational farmers ‘slightly agree’ with a score of 5.34 (with a 90% confidence interval from 5.10 to 5.58).

This suggests that adaptive farmers in my sample tend to have a positive outlook on life because they believe they have more to experience and do. This mindset relates to these data on values (Schwartz, 1992) which suggest all farmers in the sample are open to change and growth. Further, farmers in the adaptive grazing management group tended to be more open to learning and ultimately adapting as they go through life. This is a mindset that is supported by the social networks developed in connection to learning about adaptive grazing practices, particularly in trainings related to Holistic Management (Savory & Butterfield, 2016). However, the rotational farmers also build social networks, primarily with family members and neighbors that help support their growth and attainment of new information and ideas.

Like the interview outcomes for responses about physical wellbeing, when comparing rotational and adaptive farmers very few farmers mentioned the impact of farming negatively impacting their mental health, rather, as was shown in the age group comparisons, most farmers in both management groups believe farming is a major source of stress reduction and happiness in their

lives. Some farmers shared stories about the role farming played in improving their mental health, but across the grazing spectrum psychological wellbeing was very similar.

The <50 age group were most likely to talk about the benefits farming has on their mental health. This generation of people has seen the normalization of mental health conversations in the public sphere, and therefore are more likely to speak about enjoying an activity because it helps them manage a mental illness or generally decrease their risk of developing a mental illness. One adaptive farmer even shared how farming saved his life:

When I first came home from the service, I was in a dark place. I wasn't happy with anything. The farm, the animals, the benefits that has had for me. ... Farming for me is giving me a quality of life that I wouldn't have had otherwise. (F4)

Multiple <50 and 50s farmers shared that one of their main reasons for grazing beef is that it decreases their stress level. They also note that being outdoors in nature and spending time with animals is highly beneficial to their happiness and psychological wellbeing. One adaptive farmer shared:

My peaceful area is at sunrise, on an early June morning, walking out in my pasture with the sun coming up. You see the dew on the grass, you see all the spider webs, and you see a newborn calf with the mom cleaning it up. I mean, that's my heaven right there. (F5)

Beyond talking about the importance farming plays in keeping stress levels manageable, the 50s

age group all talked about how grazing beef gives them a lifestyle they desire. For one adaptive farmer, lifestyle was all about family:

It's extremely important to have that strong family unit and to have that for this grandchild and if there are any more. And this lifestyle provides that opportunity. (F15)

For another adaptive farmer it was instead an escape from a stressful job working in emergency medicine. They shared:

There was nothing better for me then after I'd been working 16 hours at the hospital to come home and go feed the cows. That never seemed like it was work. (F5)

The group with the most differences was the over 60 age group. This group of farmers has put years of time and resources into their farms and while discussing the impact of time and age on stress, one beautiful statement an adaptive farmer shared:

Just being patient with things. Through experience you realize that when something happens, bad or good, it's gonna change. Tomorrow's gonna be a new day. That's what you've got to look at. Our family is still there [on the farm], and the end hasn't come and those are calming things. (F9)

This response was more descriptive, but all the farmers in the over 60 age group commented on the need to let things “run off your shoulders” and “not let it get to you”. This group made it clear that they have not always been this way and that they have calmed with time and age. These changes in reactivity have allowed these farmers to maintain a general sense of psychological

wellness.

### 3.3.3.2 Challenges for Psychological Wellbeing

Farming can be very stressful, which was illustrated by the wealth of responses to the interview question farmers were asked, “What is it about farming that stresses you out the most?”. The differences across the age groups reflected concerns non-farmers also have, such that <50 farmers were more likely to have stresses related to young children, off-farm jobs, and a lower disposable income for younger farmers. There was often sadness in the voices of the youngest farmers as one <50 farmer shared:

I think that [being out feeding cattle in the morning] might be about  
it [the only not stressful thing about farming] to be honest. It's  
definitely not a job for the light of heart. (F20)

The 50s age group found animals escaping the fence to be the most stressful thing and they work very hard to avoid this scenario. One farmer commented:

I don't even want the calves out. If there's a spot they're getting out,  
it needs to get fixed because I don't want them out roaming and  
possibly getting hit [with a vehicle] by somebody. (F16)

This concern was also present in the other age groups, but not to the same extent as it was focused on by the 50s group.

The oldest age bracket faced a unique stressor: death. Animal deaths were particularly upsetting to this group partially because not only are the animals dying, but so are older friends and family members. Once they pass 60 years old farmers were more likely to comment about the stress of

animal deaths have on them, as one adaptive farmer said:

Death is all around us, all the time. You just never know when it's  
going to come. (F9)

The death he refers to is both the animals' deaths on the farm, and the deaths of friends and older family members. The focus on death and loss was unique to this age group. Instead of getting easier to be around death due to exposure, these farmers are more focused on animal death than their younger counterparts despite losing similar numbers of cattle each year.

#### 3.3.4 Summary

The literature presents a vision that regardless of which commodity they are involved in, farmers are facing a mental health crisis demonstrated by high rates of depression and anxiety (Ringgenberg et al., 2018) in part due to increased land degradation, threatened livelihoods, lack control over commodity and input prices, and perceptions of little social value (Baines, 2013; Intergovernmental Panel on Climate Change, 2014; Ringgenberg et al., 2018). Overall, the pasture-based beef farmers in this study reported average and above average levels of physical, psychological, and social wellbeing, which contradicts the literature that says all farmers are struggling to maintain their mental health (Ringgenberg et al., 2018).

Savory and Butterfield (2016) and Holistic Management organizations (e.g., Holistic Management International, Savory Network) often report adaptive farmers have higher wellbeing than non-adaptive farmers due to an increase in happiness (i.e., social wellbeing), more stable incomes (i.e., physical wellbeing), a heightened sense of fulfillment (i.e., psychological wellbeing). These differences were not always major, however evidence presented suggests that adaptive farmers do



have more physical, psychological, and social wellbeing factors that are beneficial than the rotational farmers. Specifically, adaptive farmers were more likely to say their happiness has improved in the last five years (i.e., social wellbeing), perceive their finances improved in the last five years and they are less worried about their financial security (i.e., physical wellbeing). Further, the adaptive farmers tend toward a more positive outlook on life because they are excited about the experiences they have yet to encounter (i.e., psychological wellbeing).

Family was a major social wellbeing resource for most farmers in my sample, and whether they are still actively farming farmers in my sample consult with other family members about the farm weekly if not daily. Another major benefit to social wellbeing shared by the interview subsample was social media. The 50s and <50 farmers used social media to learn about farming methods and tricks, connect with like-minded farmers, and promote their farms, and without this tool they would find themselves far more isolated than they already are. One downside of having social media-based networks the <50 farmers shared with me was they could not find nearby farmers to help them on the farm when needed because these online networks are spatially diverse.

Overall, farmers across management styles and age categories all felt isolated and that they lacked farmer friends. The consolidation of agriculture from ‘many small’ to ‘fewer large’ across all commodities is perhaps less pronounced in the pasture-based beef sector, but as Hendrickson et al. (2020) showed in 1997 there were close to 900,000 pasture-based beef farms in the United States, and in 2017 it was closer to 700,000 (Hendrickson et al., 2020). The decrease in the overall number of farms was reflected in my data because most of the sample commented on their lack of farmer friends and other farms in operation nearby. Further, in my sample I had a higher proportion

of large farms compared to the National Agricultural Statistics Service (2017) which could be evidence of this consolidation, but further investigation is needed to know if this was unique to my sample or generalizable to all pasture-based beef farmers.

There were also differences in the financial perceptions, or physical wellbeing, of the different age categories likely related to the younger farmers being new startups that have taken on debt to purchase and prepare the farm for livestock through preparing fences and setting up watering systems for the animals. This finding was also determined in a study by Batterham et al. (2022) who found younger farmers and those with high debt have more mental health struggles than other farmers. However, these differences were mitigated by the role of generational farms. Young farmers that inherit a family property already had the infrastructure in place and had fewer starting costs than their non-generational counterparts. Generational farmers, however, were more likely to manage the farm in a similar manner to the prior generation because of their relationships. This is also related to the pre-decisional factors discussed in 1.2. Understanding Behavior in Grazing Social-Ecological Systems, because the generational aspect indicates farmers ascribe to this social norm. Also, individuals will hold different attitudes about different grazing management styles that are partially impacted by the attitudes of the people around them. Therefore, generational farms managed rotationally were more likely to perpetuate the rotational system than switch to adaptive grazing management, but once the switch to adaptive management happened the social norms and attitudes regarding the benefits of rotational management no longer hold weight for these farmers and they rebuild their social networks to include others who are managing adaptively and spend more time connecting with these new people than they spend connecting with family members who support rotational grazing.

During the interviews farmers in both management groups expressed that farming was a major source of stress reduction and joy in their lives, a psychological wellbeing benefit. Multiple <50 and 50s farmers shared that grazing beef decreases their stress level and being outdoors, in nature, spending time with animals benefits their mental health and psychological wellbeing. This aligns with literature regarding the role of green space in improving wellbeing (Bell et al., 2014; Chang et al., 2016; Colleony et al., 2020). While much of the literature on green space is related to urban environments, the fact remains that spending time in nature is good for our soul (Gosnell, 2021). The differences in responses to the Psychological Wellbeing Survey (Ryff, 1989) show the adaptive farmers were more likely to ‘agree’ with the statements:

- I do not feel as if I have done all there is to do in life”
- “I think it is important to have new experiences that challenge how I think about myself and the world” than their rotational counterparts.
- “I did not give up trying to make big improvements or changes in my life a long time ago”

These questions suggest adaptive farmers have an optimistic outlook and are excited to try new things through learning, discovery, and adapting based on their new knowledge. However, this focus on being open to change was not as clear in the Schwartz Short Value survey (Schwartz, 1992) outcomes where there were very little difference in the rotational and adaptive farmers scores on the values self-direction, stimulation, and hedonism (i.e., the Openness to Change value category). The differences in the two surveys’ outcomes may have been related to farmers generally scoring high on self-direction values due to identifying as highly independent and valuing being their own boss (Manfredo et al., 2017; Parminter & Perkins, 1997). Therefore, future research should work to determine if the Schwartz Short Value survey (Schwartz, 1992) is

sensitive enough to capture differences in the held values of different management types of if a longer version of the values survey would better capture the differences depicted in the Psychological Wellbeing survey (Ryff, 1989).

In summary, the goal for this section was to investigate the use of the wellbeing framework from Dodge et al. (2012) to investigate the wellbeing of pasture-based beef farmers who were expected to be suffering from the deplorable mental health conditions noted by Ringgenberg et al. (2018). The fact that overall wellbeing was high across management and age groups does not mean further investigation is not needed, rather it will be important to continue tracking pasture-based farmer wellbeing to determine if the younger farmers who experience significant stress concerning finances continue to face this challenge as time goes on, or if they have fewer challenges to their physical wellbeing as they age (i.e., as they move up in age categories do their stress levels reflect the stress levels of the current 50s and >60 age groups in my sample). Similarly, it will be important to track holistic wellbeing over time to determine whether pasture-based beef farmers continue to have higher wellbeing than other farm commodities.

Moving forward, research also needs to examine the role different management styles play in improving wellbeing over time, particularly tracking changes to wellbeing in farmers switching from rotational to adaptive systems. Further, age variables need to be controlled for in projects due to unavoidable differences in life circumstances between a 30-year-old farmer and an 80-year-old farmer, and data should be collected regarding how the property was obtained (i.e., generational transfer or startup). This project demonstrates the importance in studying multiple forms of wellbeing (i.e., physical, psychological, and social) related to finances wellness, utilizing multiple

enterprises, and a mindset that they are still learning and adapting which will cause continued improvements to their overall wellbeing.

### 3.4 Michigan's Farmers and the First Year of the COVID-19 Pandemic

Conducting research on wellbeing in the middle of a crisis contained a unique set of challenges, and it convoluted the understanding of whether the reported levels of wellbeing were temporary or long-term. However, the emergence of the COVID-19 pandemic offered an opportunity to investigate the short-term adaptations and that farmer used to help manage the shocks and disturbances of the pandemic. There was no prior research investigating the impacts of COVID-19 on Michigan's farmers related to the impacts of learning, behavioral outcomes, wellbeing outcomes, and the relationships between these elements. Therefore, to understand how the COVID-19 pandemic impacted Michigan's pasture-based beef producers, I integrated quantitative and qualitative data about the producers' perceptions of impact on the individual farm scale.

#### 3.4.1 Impacts of the Pandemic

The survey contained five questions of which three questions were Likert scales from 1 (i.e., most negative option) to 5 (i.e., most positive option), and two were 'select all that apply' questions. The three scale questions were used to gather information about the overall impact of the pandemic on wellbeing, and I found that the two management groups were very similar in their responses. First, the score regarding how optimistic the farmer was that the farm would remain operable despite the pandemic indicated, on average, farmers 'agree' that they are optimistic about their ability to continue farming (4.45 with a 90% confidence interval from 4.33 to 4.57). When asked how much the pandemic is negatively impacting their wellbeing overall, the average score was 2.20 (with a

90% confidence interval from 2.07 to 2.33) indicating their wellbeing has been impacted ‘a little’. Further, when asked if their day-to-day life independent of the farm has been impacted by the pandemic, the average response was ‘probably yes’ with a score of 4.00 (with a 90% confidence interval from 3.79 to 4.21). Analyzing these questions by comparing age categories also showed similarities between the groups suggesting that the pandemic is impacting most pasture-based beef farmers rather than impacting subgroups differently.

Differences in the two multiple response questions illuminated some differences in pandemic’s effects. When asked in the survey about the specific impacts the pandemic had on the farm, 49% of the adaptive farmers and 37% of rotational farmers experienced problems with processors closing. This was a problem for 25% of rotational farmers and 17% of adaptive farmers because they were forced to take a lower-than-expected price for their animals, which ultimately impacts the financials of the farm. Additionally, some farmers saw decreases in non-cattle farm-based incomes, but the impact was limited to 12% of adaptive farmers and only 4% of rotational farmers. These two problems both decrease the disposable incomes the farmers had, and this was coupled with increases in the price of supplies noted by 25% of all farmers. The threats to income were partially counteracted by the increased demand for beef products for 46% of farmers. This increase in end-product demand was commented on extensively in the interviews and will be discussed below. The similarities between the two groups suggest that the pandemic impacted all the farms in a similar manner regardless of management style (Figure 30) or age (Figure 31). These findings were explored further in the interviews to determine why differences existed.

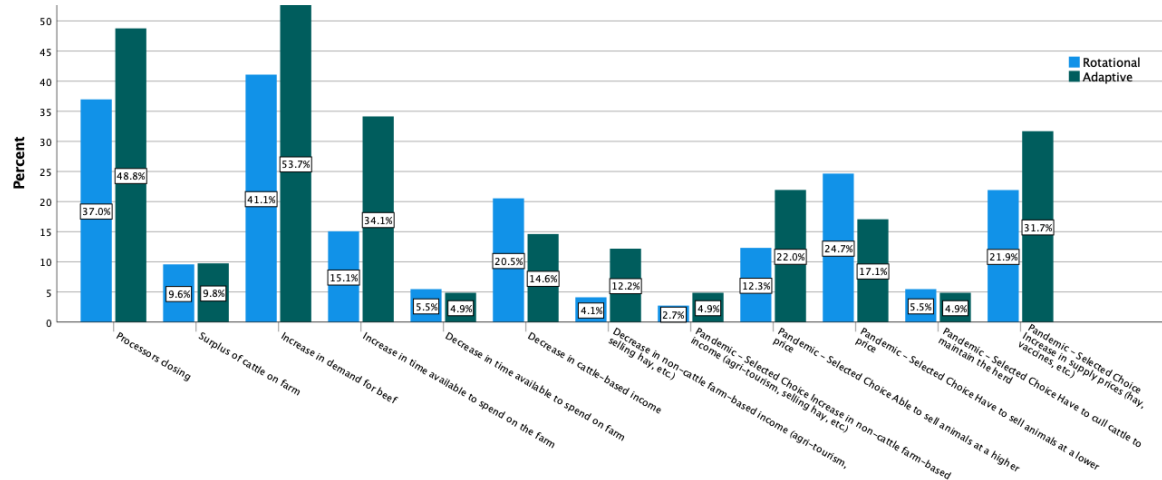


Figure 30. This graph shows the differences between the two management groups when looking at different impacts of the pandemic on the farm.

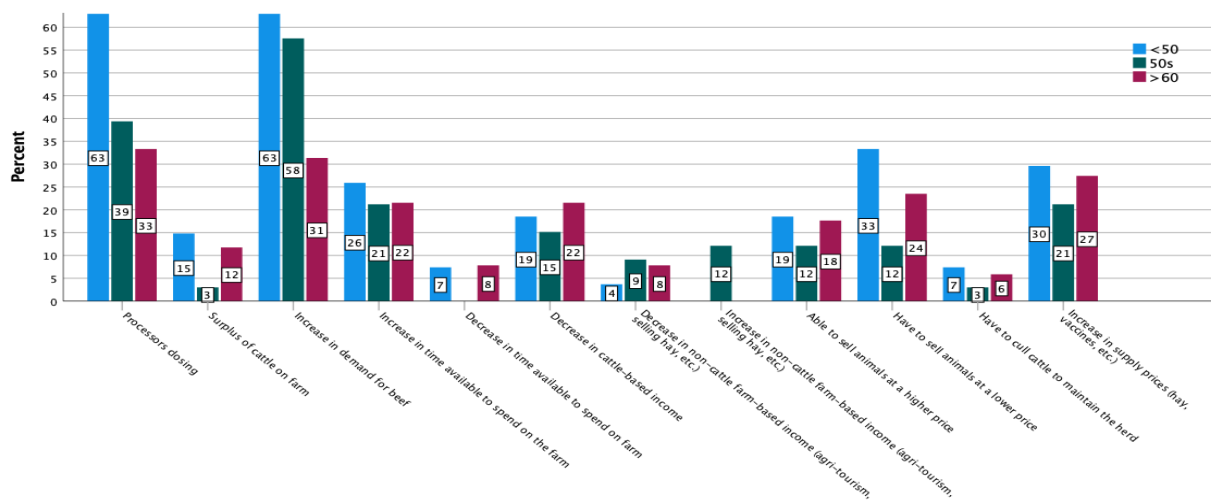


Figure 31. This graph shows the differences between the three age groups when looking at different impacts of the pandemic on the farm.

The results from the question regarding the effects the pandemic has had on the farmer personally showed similarities between the two grazing management styles. Being unable to spend time with family and friends was reported by 59% of all farmers suggesting that this was the most impactful

outcomes of the pandemic. There were also individuals that reported losing a job (6%), having adult children move home (9%), and being close to someone diagnosed with COVID-19 (9%), but the second most reported impact of the pandemic was for the 21% that had young children at home for more hours. There were not differences in the two grazing groups, however there were anticipated differences in how age groups were impacted namely that 59% of the under-50 years old farmers reported having young children at home while only 9% of 50–59-year-old and 10% of over-60-year-old farmers experienced this impact.

To help explain these survey differences I asked farmers who participated in interviews to explain how the pandemic had impacted them specifically, which allowed me to determine, 1. If I was asking about the correct pandemic impacts; and 2. If there were differences between grazing styles, or age groups, regarding how they coped with the pandemic. According to Lopez-Ridaura et al. (2021) the largest farms and the smallest farms fared best in the pandemic because large farms with enterprise diversity and integration at multiple points along the supply chain had more control over processing and retail, and small farmers had a higher capacity to adapt because they had fewer animals needing care (Lopez-Ridaura et al., 2021). This was seen in my sample where the more diverse farms were better able to cope with the major impacts to the beef supply chain by diverting resources to other income generating enterprises. Also, many of the farmers shared they were able to adjust their butcher dates because they only had a small number of cattle to process at a time.

#### 3.4.1.1 Processors

Like other producers across the United States, the closing of processing and packaging plants had a significant negative impact on Michigan's beef farmers. For example, one adaptive farmer stated:



The processor that we use had some issues with COVID and they had to shut down for a while. So, it really threw a wrench into things for a while. (F5)

Most processors in Michigan are small operations (Schweihofer et al., 2014) that were at capacity with the supply from large farms if they stopped using larger processors during COVID-19 related shutdowns. Many of the adaptive farmers were surprised when their usual processor told them they would have to wait almost a year before they would have processing spaces available because pre-pandemic, they rarely had problems getting animals butchered.

To get the animals off the farm, pasture-based farmers needed to be flexible; one adaptive farmer shared:

I had a heck of a time getting my cattle in to get them processed. I ended up having to split and go to three separate processors. (F20)

Deciding to split the finished animals and take to separate processors was one way they coped to closures, but farmers also used other coping strategies such as retaining the animals on farm longer and traveling further distances to use any processor that could fit in their animals for butchering.

#### 3.4.1.2 Direct Marketing to Mitigate Negative Impacts

When grocery shelves were empty, the public turned to farmers to supply their food. This was highly beneficial to farmer initially, and due to data collection ending in May of 2021 it was too soon to determine if these trends continued or if people returned to their old habits of shopping at the grocery store. One farmer shared:

My hope is that most people once they start buying directly from

farmers, and they can taste the difference in their food, they stick around. And that has been our experience for the most part. But it can go away. (F19)

Unfortunately, some of the interview sample had already noticed sales declining in 2021 when people were able to find meat in the grocery stores again and made comments such as:

All the people that bought from us last year [2020] because they wanted to buy local. ... where are those people now [2021]? (F10)

The adaptive farmers spoke at length about the positive impacts of the pandemic and stated:

I wish another COVID would hit. I had 5,000 pounds of meat in the freezer, and one buyer bought it all and we were cleaned out. (F10)

This was not the only adaptive farmer who was able to completely sell out of their stored beef, and several commented that they wished they had been able to process more animals before the pandemic hit so they could have sold more product. A rotational farmer who raises and sells bulls said:

Last year was one of the best years I ever had selling bulls. Maybe part of that had to do with the guys selling freezer beef were getting a premium. They were looking to expand a bit. (F6)

Like the adaptive farmer above, this rotational farmer shared that they could have sold more of their products if they had any available.

Another strategy farmers used to sell their products was to increase their online presence. For some this meant creating farm-specific social media accounts but for others it was about creating a farm website or online farm store. This online presence helped farmers sell their products during social

lockdowns and contributed to the growth in their customer base because people who would not have known about farms near them selling meat were now finding them online and buying directly from them.

#### 3.4.1.3 Social Lockdowns and Farming

Another common interview discussion topic was about using the farm as natural social distancing. For farmers across the management spectrum the farm was a haven where they could go to experience life as it was pre-pandemic and manage the stress of pandemic life. As one adaptive farmer said:

Honestly though, the farm was great when we were in quarantine because we had so much to do still. So, we didn't feel the stir craziness that most people did. (F11)

Similarly, another adaptive farmer stated:

For a long time when you couldn't go anywhere or do anything we were just happy to be able to go out and do farming stuff. (F14)

The fact that daily life as a farmer wasn't impacted by the pandemic was a relief for nearly every farmer because even when the outside world was uncertain, they could trust that the animals and the land needed to be cared for regardless. One adaptive farmer shared with me:

Maybe we will just keep social distancing for the rest of our lives. Because it's a whole lot nicer not having to be involved in all the things that pull you away from the farm. (F15)

Several farmers commented on how they learned to appreciate the physical land more because

they were spending more time outside in the fields with the animals and noticed things, they were too busy to see before such as dew-covered spider webs and wildflowers blooming.

#### 3.4.1.4 Government Payments

One other impact of the COVID-19 pandemic for my sample of farmers was receiving Coronavirus Food Assistance Program (CFAP) payments. These were monetary payments from the Department of Agriculture (USDA) Farm Service Agency (FSA) given to farmers who faced disruptions due to the impacts the pandemic had on the agricultural sector. There were two rounds of CFAP funding with stricter requirements for the first round than the second, with changes made by the FSA due to feedback from producers across commodities. The first was distributed starting June 4, 2020, and the CFAP 1 payments required farmers apply for the funding, which required them to show they had experienced a 5% or greater price decline due to the pandemic and farmers received a specific price per animal that was sold between January 15 and April 15, 2020. The prices ranged from \$99 for mature cattle to \$277 for finished animals. All farmers who applied and received funding for CFAP 1 were automatically sent payments for CFAP 2, but previously unfunded farms could also apply for the second round (CFAP 2) of payments. The CFAP 2 payments were a set price of \$55 per head of inventory for beef farmers and were distributed starting April 5, 2021.

One adaptive farmer was already working on selling off the remaining animals on the farm and shared:

I sold my herd on May 1, 2020. So, I got \$15,000 from the feds for selling my herd early. I thought that was a nice parting gift. (F1)

One rotational farmer used some of the CFAP 1 payments they received to move into a sheep and vegetable production system and away from cattle. After spending increased time on the farm due to government mandated lockdowns one rotational farmer shared:

I would say if anything, [the pandemic] has lessened my motivation for putting a lot of time into the farming endeavor. (F17)

This was the only instance where the pandemic was the final push for leaving farming because the only other farmer to sell off their herd had already planned to do so and managed to benefit from CFAP 1 as a bonus. The remaining 18 farmers all received the CFAP 2 payments, however they did receive CFAP 1 from selling animals. Most frequently the money was used to maintain the current farm management system and physical farm and to offset income lost due to decreases in sale prices and retaining cattle on the farm longer than normal due to processor closures.

### 3.4.2 Summary

My fourth research question: What were the impacts of the first year of the COVID-19 crisis on farmers and their wellbeing? was answered through the survey responses and interviews with farmers who revealed that the first year of the COVID-19 pandemic was generally beneficial due to increased sales and growing their customer base. Ijaz et al. (2021) explained that meat producers faced farm-specific challenges with simultaneously managing the social challenges that non-producers faced, primarily auction and processor closures, rapid changes in meat supply and demand including loss of restaurant contracts, and lack of access to veterinary services. While these were factors commented on by my sample, overall, the farmers used a range of coping strategies to mitigate these challenges such as finding alternate suppliers and processors, selling off animals to decrease herd size, and increasing sales directly to consumers. In contrast to the

literature suggesting processor closures were the largest pandemic-specific problem for livestock farmers, my farmer sample were able to find processors and butcher dates through being flexible and coping with different processing schedules than they typically had.

Additionally, as described by Meuwissen et al. (2021) farms with greater diversity of enterprises, including animals, vegetables, fruits, and more tended to have more stability during the pandemic, and this research showed that the adaptive farmers tended to have a greater diversity of enterprises. Because of the number of income sources available to these diversified farms, they felt more economically stable throughout the pandemic. For example, one adaptive farmer was able to additionally market honey, hops, and small grains when unable to get meat processed, which helped support the farm economically, which is an example of an adaptation to their farm that helped them to cope with the pandemic shock.

One of the largest concerns for pasture-based beef farmers whose customer base grew exponentially was customer retention and what will happen as grocery stores return to having cheap meat in stock. This uncertainty should be tracked moving forward through the pandemic and research should focus on how to best support farmers who suffer from a loss in customers as the pandemic lingers. A long-term interest should be in understanding what allowed these farmers to cope with the pandemic so well, how they have managed the pandemic as time passes and, as one farmer said:

All the people that bought from us last year [2020] because they  
wanted to buy local. ... where are those people now [2021]? (F10)

By coping with and adapting to the shock that the pandemic caused in agricultural production and

learning how to manage and succeed in this novel social environment, Michigan's pasture-based beef farmers demonstrated resilience. When their usual processors closed these farmers found new companies to work with or found ways to retain their cattle on the farm, which all involves learning and adapting. When public schools closed and farmers had young and adult children home more often, they found ways to include the family in chores and improve everybody's psychological wellbeing. Time and again the farmers turned to the farm to buffer against the stress of the outside world, and the farm provided for them and helped them stay well despite living in a global pandemic.

## 4 BROADER DISCUSSION AND CONCLUSION

The goal of this research was to explore four questions:

1. What is the distribution of grazing styles in Michigan?
2. Why do farmers choose to manage their beef herd the way they do?
3. How do management choices impact the wellbeing of the farmer?
4. What were the impacts of the first year of the COVID-19 crisis on farmers and their wellbeing?

To answer these questions, I created new theoretical framework (Figure 10) that integrated values as a pre-decisional factor for behavioral outcomes. I maintained the three behavioral antecedents from the Theory of Planned Behavior (Ajzen, 1991), a common theory for exploring behaviors in agricultural systems (Biesheuvel et al., 2021; Coon et al., 2020; Maleksaeidi & Keshavarz, 2019; Maseyk et al., 2021; Price & Leviston, 2014; Sok et al., 2020; Tama et al., 2021). Investigating these questions through a mixed methods approach that utilized an online survey coupled with interviews from a subsample of the survey participants helped me answer these questions and ponder new research questions that would benefit the understanding of Michigan's pasture-based beef farms' management decisions and wellbeing as part of a social-ecological system.

The framework I created based on changes to the ecological factors including land use distribution, livestock species composition, livestock number, and livestock grazing patterns depicts the cyclical, reiterative nature of individual farm systems and that the ecological factors will impact the social system factors such as management goals, management practices, management decisions, and adaptations (Figure 8). This framework was applied to the research design, analysis, and interpretation of the findings with success, and I found it beneficial for bounding the system



to maintain focus on individual farm system factors. These interdependencies within the social-ecological system have also been studied by Roche et al. (2015); Church et al. (2020); Knight et al. (2019); Mann et al. (2019); Williams et al. (2017); and Lalani et al. (2021) who determined that a systems perspective is necessary for studying agricultural production and conservation or sustainability.

As an interdisciplinary social scientist my goal was to understand the social system factors of pasture-based beef farms such as management goals, management practices, management decisions, and adaptations and how these factors impact behavioral decisions and farmer wellbeing. Thus, I developed a framework that integrated these social factors with the ecological factors of land use distribution, livestock species composition, livestock number, and livestock grazing patterns and added the connection between behaviors and wellbeing that social psychology and social work have determined shown in Figure 10. This framework allowed me to investigate the interdependencies between behavioral antecedents, behavioral outcomes (i.e., management practices), and wellbeing of Michigan's pasture-based beef farmers.

#### 4.1 Principles of Social-Ecological Resilience

Once the analysis was completed it became clear that farmers were applying the principles of social-ecological resilience (Biggs et al., 2015), whether intentionally or not, to managing their farm. The seven principles pertain to individual farms as well as the broader food system. Resilience contributes to the farmers' physical, psychological, and social wellbeing as well as influencing the behavioral antecedents that lead to management decisions, all factors in my theoretical framework shown in Figure 8. Here, I outline the principles and how they relate to my

results purely as an overview because of the post-hoc nature of the analysis. I am certain more cases could be highlighted if the data were re-analyzed deductively for the principles, but that is beyond the scope of this project. Further, this analysis was not part of my original theoretical framework because I did not plan to conduct a resilience assessment or analyze specifically for resilience principles.

#### 4.1.1 Principle 1: Diversity and Redundancy

According to Biggs et al. (2012) diversity in a SES includes biodiversity, spatial heterogeneity, livelihood strategies, and institutional diversity, and incorporating a variety of these factors as well as having multiple elements address one thing (i.e., redundancy) such that if any of the elements fail others can continue to provide the service and help the system cope with change. For farmers, this mean ensuring they have elements that address these issues from ecological and social perspectives. Meuwissen et al. (2021) explained farms with greater diversity of enterprises, including animals, vegetables, fruits, and more tended to have more stability during the pandemic, and my research showed that the adaptive farmers tended to have a greater diversity of enterprises. The number of income sources available on diversified farms helped support the adaptive farmers' physical wellbeing via economic stability throughout the pandemic. The diversity of on-farm enterprises helped farmers maintain a steady income regardless of what was happening in the cattle industry at the time.

#### 4.1.2 Principle 2: Connectivity

In resilience thinking connectivity is defined as the structure and strength with which resources, species or actors interact across landscapes, system scales, or social factors in a social-ecological

system. This is different from principle 6, participation, which focuses on multiple actors participating in the management of a system. In my sample, connectivity was demonstrated by the relationships farmers have with their customers, processors, other farmers, trainers, and specialists. Adaptive farmers more frequently took their cattle directly to processors and had established relationships and butcher slots with these businesses and did not have as many problems securing butcher dates. Further, if their current butcher was unable to fit them in, the butcher would suggest other businesses to contact who may have availability. The connections these farmers have with others in the industry helped them to navigate the pandemic and ensure the farmers could meet their needs despite the destabilization of the food system. According to Meuwissen et al. (2021) farmers who had established social networks with other producers and with current customers buffered against shocks such as market closures, supply chain disruptions, and isolating social lockdowns. These were all factors commented on by my interview subsample and the farmers were aware of the role these relationships, a benefit to social wellbeing, played in helping them navigate the first year of the pandemic.

Another example of connectivity I want to highlight is social media. Farmers used social media during the pandemic to market their products on farm-specific profiles that could reach an audience far greater than the individual could reach without social media. Additionally, for the startup farms as well as the <50 farmers, social media is a major source of social support. Farmers are connected to social media groups and pages that target other young and startup farms which gives otherwise isolated farmers a sense of community. A sense of community also improves farmer social and psychological wellbeing.

#### 4.1.3 Principle 3: Slow variables and feedbacks

Feedbacks are the bi-directional relationships between variables that can either reinforce (i.e., a positive feedback) or dampen (i.e., a negative feedback) change. The cyclical relationships in social-ecological systems are part of what makes studying them complex, thus bounding the system is important, hence my focus on the individual farm scale rather than a whole system analysis. Due to the design of my theoretical framework, many examples of feedbacks are present in this research ranging from the ecological feedbacks between soil health and cattle movements, to the social feedbacks between behaviors and wellbeing. One slow variable in this study was values as longstanding, life-guiding principles which can enhance or degrade resilience. When the values a farmer ascribes to are accounted for in decision making, desirable resilience can be maintained or improved as needed.

#### 4.1.4 Principle 4: Understanding complex adaptive systems

Researchers across a wide range of disciplines now debate, embrace and advocate complex adaptive systems thinking as imperative for understanding and dealing with pressing current social-ecological challenges (Church et al., 2020; Gosnell et al., 2020; Knight et al., 2019; Mann et al., 2019). In my sample, farmers practicing adaptive management techniques were more likely to talk about their farm in terms of these complex relationships, for example, adaptive farmers frequently commented on the ability of the cattle to revitalize a previously degraded pasture by improving water infiltration and incorporating natural fertilization. By viewing the farm as a complex adaptive system farmers enhance their ability to work with the system for benefits to social, physical, and psychological wellbeing. However, in this sample the rotational farmers could benefit from more systems thinking, which is hard to foster because it involves changes in the pre-

decisional factors in my theoretical framework. Because the adaptive farmers are using more systems thinking than their rotational counterparts this suggests their farm will be more resilient to shocks and disturbances as demonstrated in the interviews during discussions about how the farmers successfully managed droughts and erratic weather patterns.

#### 4.1.5 Principle 5: Learning and Experimenting

Two of the most important aspects of managing adaptively, in any field not just grazing, are learning and making adaptations. Adaptive management, adaptive co-management and adaptive governance all focus on learning as an integral part of decision making and base their strategies on the fact that knowledge is incomplete. Further, uncertainty, change, and shocks to a system are inevitable and therefore play an important part in managing social-ecological systems. In this study, most farmers across both management styles to the shock of a global pandemic and turned it into a learning opportunity. They found new ways to connect with consumers including on-farm markets, creating websites, and selling items online to deliver directly to consumers. These adaptations helped many of the farmers improve their physical and social wellbeing in terms of income and social networks, and these adaptations helped farmers maintain psychological wellbeing because they found ways to express their values such as increased marketing explaining their management processes. Further, outside of the pandemic farmers are learning more about the benefits of moving cattle while they are grazing, and many are trying to adapt some if not all the best management practices suggested by trainers and specialists.

#### 4.1.6 Principles 6 & 7: Participation & Polycentric Governance

The final two principles were least obvious in my study. According to Biggs et al. (2012, p. 119),

“Participation refers to the active engagement of relevant stakeholders in the management and governance process.” Because I only investigated the individual farm scale there were only one or two farmers managing any single farm and while both participate in management, this is different from the core of the principle which refers to gathering a range of stakeholders. Polycentric governance captures the divestment from a central, large governing or rule enforcing group to a more dispersed system where there are multiple groups managing the rules and expectations. Like Principle 6, such governance typically takes place at a scale larger than an individual farm, thus this principle was not common in my data. However, one example was the use of extension programming to diversify the programming available to farmers across the state instead of the MSU-Extension program only occupying space and offering programming on the East Lansing campus. To better account for these final two principles will require research that takes place at a scale broader than the individual farm.

## 5 CONCLUSION

To improve the sustainability of the social and ecological factors within an individual farm system it is important to think about diversity and redundancy, connectivity, slow variables and feedbacks, understanding complex systems, and learning and experimenting. At broader food system scales, participation and polycentric governance are also important. The application of the resilience principles is useful as a framework, however it is equally important farmers manage in a way that results in desirable changes on the farm over time. Throughout this study farmers across the management spectrum demonstrated their ability to foster resilience on their farm. Whether intentionally or not, resilience was supported by promoting diversity in forage species, management strategies, and on-farm enterprises, connecting with other farmers nearby and via social media, monitoring slow variables and feedbacks in the ecological and social domains, and using learning to support adaptations that benefit the farm during periods of disturbance and help buffer against future shocks. Farmers frequently think about cross-scale interactions such as the impact animals have on the grass and what that means for farm income, but the adaptive farmers bolster their resilience by also contemplating the role of the human within the system more explicitly. Accounting for the principles will ensure farmers are able to cope with the inevitable shocks an individual farm will face and can work to support high levels of wellbeing for the farm and the farmer. Therefore, I created Figure 32 to illustrate that the social-ecological resilience is underlying all scales of the social-ecological system and future research must consider how the principles can be used to improve the wellbeing of farms and farmers on scales from individual to global.

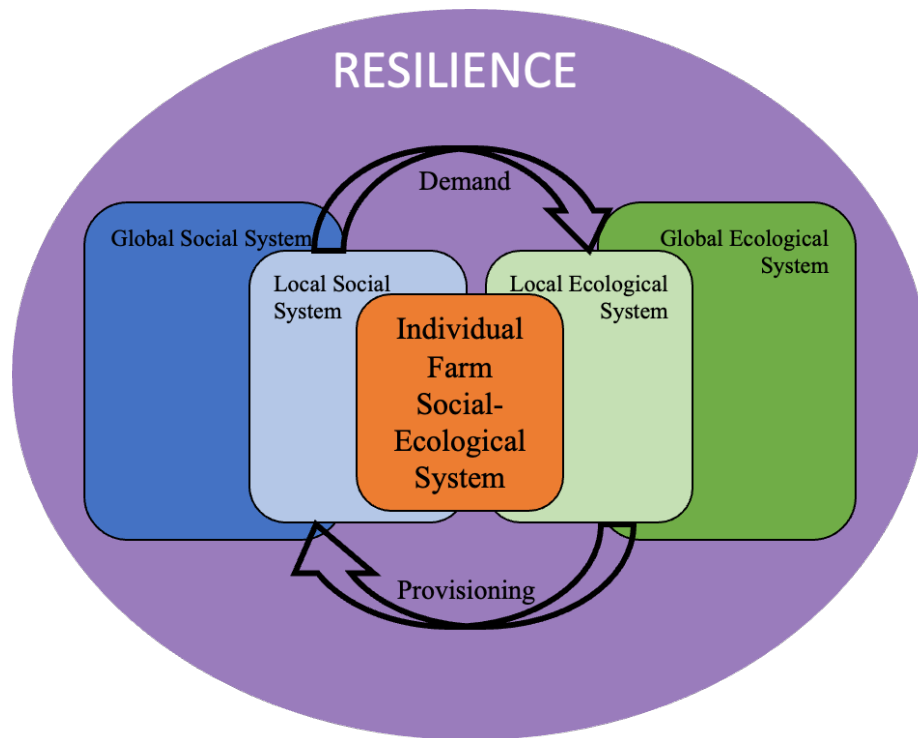


Figure 32. This figure indicates that underlying my novel theoretical framework are the principles of social-ecological resilience thinking.

The results discussed above provided evidence and insight into the wellbeing of Michigan's pasture-based beef farmers. The analysis of pre-decisional factors and farmers' motivations for managing in a particular way (i.e., rotationally, or adaptively) indicated differences between the two groups and offered insight into the why of behavioral outcomes related to management style. The wellbeing of Michigan's pasture-based beef farmers is higher than expected as per the literature on farmer mental health, and this is related to the high levels of social and psychological wellbeing benefits including social networks, spending time in nature, and high levels of satisfaction with their lives. Further, the first year of the COVID-19 pandemic positively impacted physical wellbeing of farmers because they were able to grow their customer base and had more time to spend outside with the animals during social lockdowns. The post-hoc application of the



principles of resilience is encouraging as a demonstration of the importance to keep the theory of social-ecological resilience in mind when studying any scale or social-ecological system, particularly when humans are acting as managers. Therefore, I conclude that these four research questions were addressed and serve as a new foundation for research into the types of grazing management that are being used in Michigan; the physical, psychological, and social wellbeing of pasture-based farmers; and the challenges and benefits of the first year of the COVID-19 pandemic.

## APPENDICES

## Appendix A: Online Survey Instrument

Thank you for your willingness to participate in a research study of Michigan's pasture-based beef farmers. The purpose of the study is to understand the spectrum of grazing management practices used on Michigan's pasture-based beef farms.

The survey should take you approximately 15 minutes to complete, and you will be asked to answer questions related to your management choices, farming motivations, and wellbeing. Your participation is completely voluntary. Any personal information gathered will be maintained separately from the survey answers to ensure anonymity. You can skip any question you do not wish to answer and you can withdraw at any point before submitting the survey. You must be 18 or older to participate. If you have concerns or questions about this study, such as scientific issues or how to do any part of it, please contact me, Morgan MathisonSlee, via 715 419 1422 or mathiso9@msu.edu, or my PhD advisor Dr. Jenny Hodbod, via 480 278 1790 or jhodbod@msu.edu. By clicking on the button below, you indicate your voluntary agreement to participate in this online survey.

☐ I agree. Please take me to the survey.

What cattle enterprises do you currently operate? (select all that apply)

- ☐ Cow-calf
- ☐ Stocker
- ☐ Grass finishing
- ☐ Dairy
- ☐ Feedlot
- ☐ Other (Please Specify)

Approximately how many cattle do you have on your farm today? Please include cows, calves, steers, and bulls.

---

Which grazing style is most similar to how you are grazing your cattle this year?

- ☐ The cattle have access to all available pasture(s) throughout the year.
- ☐ The cattle are moved between different pastures throughout the grazing season based on time.
- ☐ The cattle are moved between different pastures throughout the grazing season based on forage health and recovery.

How many permanently fenced pastures do you currently have?

---

Approximately how many temporary pastures do you make by cross-fencing or another similar approach?

---

During the grazing season, how often are the cattle moved from one pasture to the next?

- ☐ Once a season
- ☐ Once a month
- ☐ Twice a month
- ☐ Once a week
- ☐ Two or three times a week
- ☐ Every day
- ☐ Multiple times each day
- ☐ Other (Please Specify) \_\_\_\_\_

If you add up all the time from each visit to any given pasture this season, what is the average length of time the cattle spend in each pasture?

- ☐ All season
- ☐ A few months or more but not the whole season
- ☐ More than a month, but less than a few months
- ☐ Around a month
- ☐ Less than a month
- ☐ Other (Please Specify) \_\_\_\_\_

How many years have you been grazing cattle using this approach?

\_\_\_\_\_

How many years in total have you been grazing cattle regardless of approach?

\_\_\_\_\_

Do you use an approach such as holistic management, adaptive multi-paddock grazing, or management intensive grazing?

- ☐ No
- ☐ Yes
- ☐ Prefer not to answer

Which grazing style is most similar to how you are grazing your cattle this year?

- ☐ The cattle have access to all available pasture(s) throughout the year.
- ☐ The cattle are moved between different pastures throughout the grazing season based on time.
- ☐ The cattle are moved between different pastures throughout the grazing season based on forage health and recovery.

How many permanently fenced pastures do you currently have?

---

Approximately how many temporary pastures do you make by cross-fencing or another similar approach?

---

During the grazing season, how often are the cattle moved from one pasture to the next?

- ☐ Once a season
- ☐ Once a month
- ☐ Twice a month
- ☐ Once a week
- ☐ Two or three times a week
- ☐ Every day
- ☐ Multiple times each day
- ☐ Other (Please Specify) \_\_\_\_\_

If you add up all the time from each visit to any given pasture this season, what is the average length of time the cattle spend in each pasture?

- ☐ All season
- ☐ A few months or more but not the whole season
- ☐ More than a month, but less than a few months
- ☐ Around a month
- ☐ Less than a month
- ☐ Other (Please Specify) \_\_\_\_\_

Do you use an approach such as holistic management, adaptive multi-paddock grazing, or management intensive grazing?

- ☐ No
- ☐ Yes
- ☐ Prefer not to answer

This question asks about the motivations for your management decisions. What do you consider to be the 2 main measures of success on your farm?

- ☐ Improving soil quality
- ☐ Being proud of my on-farm accomplishments
- ☐ Participating in the grazing community
- ☐ Maintaining a healthy herd
- ☐ Using the farm to make a profit
- ☐ Ensuring the farm is here for future generations
- ☐ Caring for the environment
- ☐ Sharing the farming lifestyle with family
- ☐ Appearance of the farm
- ☐ Having the farm be my only source of income



In this question you are asked about your farm's relationship with the environment. How much do you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am responsible for conserving the natural environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider the potential negative impacts of my farm on the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider the potential positive impacts of my farm on the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

In this question you are asked about your farm's financial situation. How much do you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Compared to 5 years ago, I am financially better off now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Looking at the future, in 5 years I expect my financial situation to improve	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My financial situation is a constant source of worry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regardless of what happens, I have made choices that will help me be financially secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Besides grazing cattle, do you have any other sources of income on or off the farm this year?

- ☐ No
- ☐ Yes
- ☐ Prefer not to answer

What other sources of income or enterprises do you have? (Select all that apply)

- ☐ Off-farm employment
  - ☐ Producing hay for sale
  - ☐ Growing cash crops
  - ☐ Selling supplements
  - ☐ Other livestock such as sheep or chickens
  - ☐ Growing vegetables for sale
  - ☐ Providing services to other farms
  - ☐ Other (Please Specify)
-






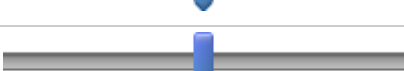




Which is your main source of income?

- ☐ Cattle on the farm
- ☐ Off-farm employment
- ☐ Producing hay for sale
- ☐ Growing cash crops
- ☐ Selling supplements
- ☐ Other livestock such as sheep or chickens
- ☐ Growing vegetables for sale
- ☐ Providing services to other farms
- ☐ Other (Please Specify)

Approximately what percentage of your income is from on-farm enterprises this year?

---

In this question you are asked about your values. Please rate the importance of the following values as a life-guiding principle for you. Use the 8-point scale in which 0 indicates that the value is opposed to your principles, 1 indicates that the value is not important for you, 4 indicates that the value is important, and 8 indicates that the value is of the utmost importance for you.

	0	1	2	3	4	5	6	7	8
Opposed Not to myimportant principles									
Important									
Of the utmost importance									
	0	1	2	3	4	5	6	7	8
Social power, authority, wealth [Power]									
Success, capability, ambition, influence on people and events [Achievement]									
Enjoyment in life, self-indulgence, gratification of desires [Hedonism]									
Daring, a varied and challenging life, an exciting life [Stimulation]									
Creativity, freedom, curiosity, independence, choosing one's own goals [Self-direction]									
Broad-mindedness, beauty of nature and arts, social justice, a world at peace, equality, wisdom, unity with nature, environmental protection [Universalism]									
Helpfulness, honesty, forgiveness, loyalty, responsibility [Benevolence]									
Respect for tradition, humbleness, accepting one's portion in life, devotion, modesty [Tradition]									
Obedience, honoring parents and elders, self-discipline, politeness [Conformity]									
National security, family security, social order, cleanliness, reciprocation of favors [Security]									

In the following questions you will be asked about your happiness and life satisfaction.

How happy would you say you are today?

- ☐ Extremely unhappy
- ☐ Moderately unhappy
- ☐ Slightly unhappy
- ☐ Neither happy nor unhappy
- ☐ Slightly happy
- ☐ Moderately happy
- ☐ Extremely happy
- ☐ Prefer not to answer

Compared to five years ago, do you think you have become more or less happy?

- ☐ Less happy
- ☐ No change
- ☐ Happier
- ☐ Prefer not to answer

Thinking about five years into the future, do you think you will become more or less happy?

- ☐ Less happy
- ☐ No change
- ☐ Happier
- ☐ Prefer not to answer

How much do you agree with the following statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In most ways my life is close to my ideal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The conditions of my life are excellent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with my life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
So far I have gotten the important things I want in life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I could live my life over, I would change almost nothing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I like most parts of my personality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I look at the story of my life, I am pleased with how things have turned out so far	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Some people wander aimlessly through life, but I am not one of them	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The demands of everyday life often get me down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In many ways I feel disappointed about my achievements in life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintaining close relationships has been difficult and frustrating for me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



I live life one day at a time and do not really think about the future

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

In general, I feel I am in charge of the situation in which I live

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I am good at managing the responsibilities of daily life

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I sometimes feel as if I have done all there is to do in life

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

For me, life has been a continuous process of learning, changing, and growth

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I think it is important to have new experiences that challenge how I think about myself and the world

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

People would describe me as a giving person, willing to share my time with others

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I gave up  
trying to make  
big  
improvements  
or changes in  
my life a long  
time ago



I tend to be  
influenced by  
people with  
strong  
opinions



I have not  
experienced  
many warm  
and trusting  
relationships  
with others



I have  
confidence in  
my own  
opinions,  
even if they  
are different  
from the way  
most other  
people think



I judge myself  
by what I  
think is  
important, not  
by the values  
of what others  
think is  
important



In the following questions you will be asked about your physical health.

Are you satisfied with your physical health?

- ☐ Extremely dissatisfied
- ☐ Moderately dissatisfied
- ☐ Slightly dissatisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Slightly satisfied
- ☐ Moderately satisfied
- ☐ Extremely satisfied
- ☐ Prefer not to answer

Often farmers are on the move much of the day, but do you complete any other planned exercise?

- ☐ No
- ☐ Yes
- ☐ Prefer not to answer

Do you eat healthy food most of the time?

- ☐ No
- ☐ Yes
- ☐ Prefer not to answer

In general, how would you say your physical health is?

- ☐ Far below average
- ☐ Moderately below average
- ☐ Slightly below average
- ☐ Average
- ☐ Slightly above average
- ☐ Moderately above average
- ☐ Far above average
- ☐ Prefer not to answer

How often does being sick prevent you from working?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ About half the time
- ☐ Most of the time
- ☐ Almost Always
- ☐ Always
- ☐ Prefer not to answer

How much sleep do you get in a typical night?

▼ Less than 3 hours ... More than 12 hours

In the following questions you will be asked about the impacts of the COVID-19 pandemic on your farm and life this year.

Has your farm been impacted by the pandemic? This could be positively or negatively.

- ☐ Definitely not
- ☐ Probably not
- ☐ Unsure
- ☐ Probably yes
- ☐ Definitely yes
- ☐ Prefer not to answer

Which of the following pandemic-related situations have impacted your farm. Please select all that apply.

- ☐ Processors closing
  - ☐ Surplus of cattle on farm
  - ☐ Increase in demand for beef
  - ☐ Increase in time available to spend on the farm
  - ☐ Decrease in time available to spend on farm
  - ☐ Decrease in cattle-based income
  - ☐ Decrease in non-cattle farm-based income (agri-tourism, selling hay, etc.)
  - ☐ Increase in non-cattle farm-based income (agri-tourism, selling hay, etc.)
  - ☐ Able to sell animals at a higher price
  - ☐ Have to sell animals at a lower price
  - ☐ Have to cull cattle to maintain the herd
  - ☐ Increase in supply prices (hay, vaccines, etc.)
  - ☐ Other (Please Specify)
-

How optimistic are you that your farm be able to remain operable despite the impacts of the pandemic?

- ☐ Definitely not
- ☐ Probably not
- ☐ Unsure
- ☐ Probably yes
- ☐ Definitely yes
- ☐ Prefer not to answer

Has your day-to-day life independent of the farm been impacted by the pandemic? This could be positively or negatively.

- ☐ Definitely not
- ☐ Probably not
- ☐ Unsure
- ☐ Probably yes
- ☐ Definitely yes
- ☐ Prefer not to answer

Which of the following pandemic-related situations have impacted your day-to-day life. Please select all that apply.

- ☐ Loss of off-farm job
  - ☐ Loss of overall income
  - ☐ Having young children be at home more hours (screen-to-screen learning, increased childcare responsibilities, etc.)
  - ☐ Having adult children move back home (online colleges, insufficient income, etc.)
  - ☐ Personally diagnosed with COVID-19
  - ☐ Close family member or friend diagnosed with COVID-19
  - ☐ Unable to spend time with family and friends
  - ☐ Other (Please Specify)
- 

How much has the pandemic negatively impacted your overall wellbeing?

- ☐ Not at all
- ☐ A little
- ☐ A moderate amount
- ☐ A lot
- ☐ Completely
- ☐ Prefer not to answer



In this final section you will be asked for information about yourself.

What year were you born? Please use four-digit year (ex. 2020).

---

What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to answer

What is your marital status?

- ☐ Married
- ☐ Widowed
- ☐ Divorced
- ☐ Separated
- ☐ Never married
- ☐ Prefer not to answer

What is the highest degree of education you have completed?

- ☐ Less than a high school diploma
- ☐ High school diploma
- ☐ Technical or associates degree
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Doctoral or professional degree
- ☐ Prefer not to answer

Would you be willing to participate in an interview in January of 2021 to follow up on the information I gather from the survey responses?

- ☐ No
- ☐ Yes

## Appendix B: Interview Protocol

Hello! I am so glad you are willing to participate in an interview and am excited to meet you! The goal of this interview is for me to gain a more detailed understanding of how you manage your beef, your quality of life, and what motivates to farm the way you do. I want to start out by mentioning that there are no right or wrong answers here, and if there is anything you don't want to answer you do not have to. By conducting interviews with farmers I am hoping to be able to understand how grazing and human wellbeing are intertwined.

The plan is to keep this interview to under an hour and you will be compensated for your time. Anything you share with me will remain confidential to anyone besides me and my academic advisor. As I said, if there are any questions that you wish to skip just let me know.. Also, with your permission I would like to record the interview so that I can type it up and make sure I am correctly capturing what you share with me. If you realize later on that you shared something with me you wish you hadn't, please reach out and let me know. I will remove it from the record and treat it as if you had not shared it with me. Do I have your permission to record the interview?

And before we begin, I want you to know you can ask questions at any time. Throughout my work talking with farmers I have learned that there are many words to describe the same thing in agriculture, so I may use a phrase you are not used to at some point. If you need clarification or have another term that you use, please let me know.

To begin, I would really appreciate it if you could tell me a little bit about your farm.

- Did you grow up on a farm?
- Where is your farm located?
  - Did generations before you farm there, or are you a self-start-up?
- What cattle breed or breeds do you have on your farm?
- What is your primary cattle enterprise?
  - Ex: Cow/calf, stocker, grass finishing
- Do you sell the animals as calves or steers, or do you finish them on your farm?
- Approximately how much do they weigh when you sell them?
  - Has this always been the case or has it changed?
    - When did it change?
- How many cattle do you typically have on your farm?
  - Is this cow/calf pairs or individual animals?
  - Does this match your goal or not?
    - Are you satisfied with this number, or would you do something different?
- Do you have other agricultural activities on your farm such as other animals, crops, vegetables, or pick-your-own berries or apples?
  - Have you in the past?
- (If they have changed enterprises) Were these changes because you wanted to try something new, or because you needed to change?

The next set of questions is about your grazing pastures, paddocks, or fields.

- Approximately how many acres do you have available for grazing?
  - Are there parts of this land that are not grazed?

- For example, woodlands, lakes, etc.?
  - So approximately how many acres do you use for grazing?
- Approximately how many grazing fields or pastures do you have?
  - Are these permanent or temporary pastures?
- Do you graze all of your cattle in one group or do you have multiple herds?
  - Have you always raised these animals or have you had other enterprises?
- How many months out of the year do you graze your cattle out in the field?
- While they are out there, are you also feeding any hay or grain? Or are they only on pasture?
  - If they are feeding hay, how much hay do you purchase in a typical year?
  - Have your hay needs changed over time? Why?
    - Check with the farmer if this is related to management practices/changes over time.

Next, I would like to talk in more detail about how you manage your grazing animals.

- Would you please describe your grazing plan to me?
  - How do you decide when to you move your cattle?
    - Do you graze all of the grass, or leave some behind?
      - Why?
    - How often do you move your animals? (Daily, weekly, monthly, seasonally)
      - Is this between temporary pastures or permanent pastures?
    - How does this rotation schedule change throughout the year?
      - How often are you moving in spring versus the fall/winter?
  - Do you have an estimate about how long pastures are rested/sit empty between grazing periods?
    - How did you decide on this number?
    - Are the fields used in any other way when the cattle are not on them such as haying or growing crops?
  - Do you use temporary fences/polywire to build paddocks, or how do you move your cattle?
    - How do you design them?
    - What size range are they?
    - How many paddocks do you estimate you use in a given year?
  - Do you calculate stocking rate and/or stocking density?
    - What are your current numbers?
    - Does this match your goal or not?
      - $\text{Stocking Rate} = \text{Number of head divided by total area of all pastures}$ 
        - $\text{Total herd by total acreage}$
      - $\text{Stocking Density} = \text{Number of head per grazing zone for a given time}$
      - $\text{Herd on a sub-pasture grazing during one rotation}$

Now that I know the details of your grazing plan, I would like to talk about why you manage your cattle this way building on your survey answers. Again, there are no right or wrong answers, rather I am interested in what motivates you and how you make your decisions.

- First, when did you start managing your cattle this way?

- Why did you manage this way?
- In the survey I asked you about your motivations for the way you manage your herd, and you said your two main motivations were [INSERT]. Why did you choose these options?
- Are you the only decision maker on your farm, or do you have someone else you work with?
  - About how many of the decisions do you discuss with your partner?
    - (Is it a team or mostly one-sided)
- IF GENERATIONAL: I know there can be a lot of pressure when the farm has been in the family for multiple generations. Would you be comfortable making major changes to your grazing management plan?
  - Are there things or people that would make you more comfortable making management changes?
  - Similarly, are there things or people that would make it more difficult?
- IF NOT GENERATIONAL: If you wanted to make major changes to your grazing management plan, who do you go to for support?
  - Are there people who you would trust to help guide you in the right direction?
  - Are there people you would not want to talk about these management changes with?
- Additionally, if you wanted to change enterprises or stop farming all together, would you be able to?
  - Same as before, are there things or people you have that would make this transition easier?
  - Are there things or people that would make this transition more difficult?
- When I ask this next question I want you to know I am asking because I would like to hear your honest opinion, even if you think it is an unpopular answer. When it comes to grazing cattle there is a common debate about the impacts of different grazing management styles on the landscape. To be clear, there is no “right” way to farm, and there is no “right” answer to this question, I am just hoping to better understand what people know and think about these different styles.
  - So, have you heard about adaptive and/or regenerative grazing?
    - How do you feel about it?
    - Do you think it is something that will last?
    - Will a new concept replace it?
      - For example, “sustainable agriculture”

I would now like to transition to talking about how being a farmer impacts your quality of life or wellbeing .

- I know that farming can be a physically demanding occupation, so what are the physical health concerns you have related to farming?
  - (If necessary) examples could be muscle pain, joint pain, sunburns.
- On the flip side, what are some of the benefits farming has on your physical health?
  - (If necessary) examples could include getting fresh air, meeting your goals for how many steps you take each day
- Farming can often be a stressful occupation, so what are the things about grazing beef that stress you out the most?

- (If necessary) examples could be finances, time, animal health, changing weather patterns, farm succession.
- How does farming help decrease your level of stress?
  - (If necessary) examples could include spending time outdoors, time with family, enjoying the animals, flexibility, independence, family history.
- If you are having a rough day on the farm, what types of things might be happening?
  - (If necessary) examples could include the cattle get out, machinery breaks, you lose a calf.
- When there is a rough day on the farm, how do you cope?
  - (If necessary) examples could include spending extra time with family, remembering the reasons you farm, just ‘moving on’ and accepting the challenges.
- And lastly, what are the most rewarding aspects of grazing beef?
  - (If necessary) examples could include seeing baby animals born, providing food for others, continuing family legacy.

Next, I have a couple of questions about who you discuss the farm with.

- Obviously, we all have different people we talk to about different aspects of our lives. Are there people in your life you frequently talk to about grazing beef?
  - What aspects of grazing are you most likely to talk about?
- Are there people you don’t talk to about your beef herd?
  - Why is that?
- Do you feel like you have the support you need, both physically and socially, to manage your cattle the way you do?
  - What, or who, are these supports?
  - IF NOT: What support could you use? I am happy to help connect you in any way I can.
- Do you have other farmers that you interact with?
  - Are they nearby or not?
  - How often do you connect with them?
  - Do they manage their grazing animals similarly to you, or do they do something different?
- Have you used resources such as MSU-Extension, the Cattleman’s Association, farm expo days, magazines, or field days?
  - Do you prefer to attend events in person or online?
- And, lastly, when you have exciting news about the farm or the beef herd, who do you share it with?
  - Why do you share it with them?

In this final section I want to talk about how the pandemic has impacted you. I am asking these questions because many people have seen a decrease in their wellbeing because of it. I can say, personally, that I have experienced changes to my wellbeing and disruptions to my “normal” life, so I want to spend a little time discussing how COVID-19 has impacted you. I know that Michigan has seen a lot of tension about the way the governor handles the pandemic, and it is not my goal to get into a discussion about this, rather I want to focus on how the pandemic impacted your grazing management and your farm. If there are any questions you would rather not answer, just

let me know.

- In order to be sensitive to the situation you have faced during the past year, I want to ask, have you or someone close to you been impacted by COVID-19 more than the average person? This could mean getting sick, experiencing increases in hours at work, increased risk of exposure to the virus, or other ways. You do not need to feel obligated to answer or give details, but if you would like to you can.
  - (If they want to talk) How did you cope with (or manage) that?
- How did the pandemic impact your beef operation? This could be either positively or negatively.
  - (If needed) examples include changes in revenue, difficulty with getting materials needed, more time trying new things, lack of labor, increases in demand for meat, new markets, processors, etc.
- Did the pandemic impact how you manage your animals?
  - Did you try a new management technique?
  - Did you read about grazing or attend any talks?
- If you could go back in time to the beginning of the pandemic, are there things you would do differently in terms of your grazing plan or your beef herd knowing what you do now?
  - For example, would you sell animals, switch to finishing, or add/change enterprises?
    - USE CAUTION because of the emotions linked to this, particularly in Michigan.
      - Stick to how the pandemic impacted the farm, not the individual
- How was responding to COVID different to responding to other shocks on the farm such as drought, polar vortexes, or drops in prices?
  - Were there aspects that were more difficult?
  - How about things that were easier?
- Lastly, are there any topics you felt were missing from this discussion about grazing management or wellbeing?
- And that is it! Thank you so much for your time and thoughtful responses! Do you have any thoughts or questions for me?
- Would you rather me email you the gift card, or would you prefer I mail it to you?
- Please don't hesitate to reach out at any time if there is anything you need or any questions you have. I will do my best to connect you with whatever you need.

## Appendix C: Interview Codebook

Code	Memo
Adapting and Learning	For all farm stressors as well as COVID
Adaptive/Regen Grazing Opinions	Based on "opinions" question
Wellbeing-social	Use this when coding for social wellbeing resources AND/OR challenges.
Social Resources	Factors that benefit social wellbeing
Social Challenges	Factors that challenge social wellbeing
Farming Team	Those who are there daily and people who offer REGULAR support.
Motivations	Why they make the choices they make. Who, What, Why?
Cattle Feed	Are cattle grass only? Grass-grain? Majority grain?
Enterprises	What farm-related enterprises are being used? Multi-species, crops, hay, value-added?
Cattle/Animal Details	Which breeds and sizes as well as the why
Farm Details	Discussions of farm history
Pastures, Paddocks, Fields	How many? What size? What uses (cows, hay, crops, other animals)
Acreage	All about farm size and grazable acreage.
Grazing Plan	For discussions related to management choices
Wellbeing-psychological	Use this when coding for psychological resources AND/OR challenges
Psychological Challenges	Negative impacts on WB-Psych
Psychological Resources	Positive impacts to WB-Psych
Wellbeing-Physical	Use this when coding for physical wellbeing resources AND/OR challenges
Physical Challenges	Negative impacts of farming on WB-Physical
Physical Resources	Positive impacts of farming on WB-Physical
COVID-Farmer	Use this for coding info on how COVID impacted the farmer



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