

AN ASSESSMENT OF INFLUENCES ON ORGANIC AGRICULTURAL
PRODUCERS' ATTITUDES, BEHAVIORS, AND DECISIONS RELATED TO
SUSTAINABLE BEST MANAGEMENT PRACTICES

by

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DEDICATION

This work is dedicated to the wholistic thinkers who value intellect and contribution in conjunction with cultural background and experience. Reductionist thinking only gets you so far.

“Nothing in life is to be feared,
it is only to be understood.
Now is the time to understand more,
so that we may fear less.”

Marie Curie

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ABSTRACT

A definition for sustainable agriculture that spans competing agriculturalists' philosophies is ambiguous. Organic agriculture is a transformative approach that balances the goals of sustainable agriculture. Understanding how producers identify themselves may give insight as to what drives their decision to explore innovative practices.

The purpose of this study was to assess influences on organic agricultural producers' attitudes, behaviors, and decisions related to sustainable best management practices. The objectives of this research were to: 1.) Describe organic agricultural producers' attitudes surrounding sustainable best management practices, 2.) Describe organic agricultural producers' behaviors surrounding sustainable best management practices, and 3.) Describe other influential factors on organic agricultural producers' decisions to adopt sustainable best management practices.

Rogers' Diffusions of Innovations and the Theory of Planned Behavior (TPB) were used to analyze organic producers' attitudes, behaviors, and decisions related to sustainable best management practices (BMP). This descriptive study utilized a survey research design of producer members of the Montana Organic Association. Data analysis was conducted utilizing Confirmatory Factor Analysis to assess the relationships between questions and constructs of the TPB.

The strongest pairwise relationships indicated that respondents with a positive attitude to implement sustainable practices likely intend to implement them, and that respondents with a high intention to implement BMP likely will participate in the behavior. Respondents considered themselves risk takers, leaders, and deliberators who use an integrated whole farm approach. Influences of peers and social groups had a significant effect on producers' decisions to implement sustainable BMPs.

Results suggest these theories are valuable to study agricultural producers' decisions. Future research should include a much larger population of organic and conventional agricultural producers to allow for the model to draw conclusions about broader populations. Sustainability can be a divisive topic. Future work utilizing the theories should include researching agriculturalists from all backgrounds on their feelings about non-production specific agricultural concepts and terminology. There is unlimited potential for uniting divided groups to solve common problems related to environmental resources, policy, and markets. Future research should include a larger sample of organic and conventional producers to draw conclusions about broader populations.

CHAPTER ONE

INTRODUCTION

Background

Ecologically sound agricultural practices started gaining attention in the late 1970's and early 1980's after a period of major advancement in agricultural practices, which focused solely on increasing productivity. Questions arose about the “long-term viability of industry-scale” farming (Herndl, Honeycutt, Wilson, Graham & Niedergeses, 2011, p. 473) as a result of the ecological degradation due to productivity-centric agricultural practices (Lacy, 1993). Support for sustainable agriculture grew slowly in the time between 1970-80's and 1991 when “federal funds to conduct research and extension programs in low-input sustainable agriculture” were “less than one percent of the total public expenditure on agriculture research” (Korsching & Malia, 1991, p. 17).

Sustainable agriculture is a “complex concept that refers to an interconnected framework of technologies, practices, and systems being developed in response to problems currently facing agriculture and our food system” (Lacy, 1993, p. 41). According to the United States Department of Agriculture (USDA), “Sustainable agriculture frequently encompasses a wide range of production practices, including conventional and organic” (USDA NIFA, n.d., para. 2). While “there is no social consensus on the precise meaning of sustainability” (Sydorovych & Wossink, 2008, p. 10), ultimately, producers and professionals seem to agree that sustainable agriculture should improve the “quality of life for whole communities, modeling environmentally

sustainable practices, fostering local relationships...creating viable commercial ventures...sustaining local economies” (Moskwa, Higgins-Desbiolles & Gifford, 2015, p. 127). Since 1992 land in organic agriculture production had more than doubled by 2005 (Constance & Choi, 2010). Both large and small-scale producers are attracted to organics thanks to the growth in demand for organic products by consumers (Constance & Choi, 2010), and for the benefits to their operation, dependent on their individual environmental and economic expectations (Peuch, Baudry, Joannon & Poggi, 2014).

Updated curriculum, educational programs and policy changes were suggested as solutions for meeting the increased desire for information on sustainable practices (Korsching & Malia, 1991). Research expanded after a need for more education and training was identified in the 1980’s. More recently, Nelles (2011) investigated the research and educational outcomes of the Consultative Group on International Agriculture Research (CIGAR), a global research partnership on food security issues pertaining to environmental education and sustainable agriculture. It was concluded that conflicting scientific and educational views within the organization has resulted in an incoherent “notion of ecological literacy” (p. 412). Diversifying perceptions of agriculture in the last decade has made addressing agricultural issues difficult due to polarized views (Martin, 2016). Current and future producers require updated research, educational resources and technical assistance in order to be informed of and take advantage of developments in agricultural technologies, production practices, alternative markets, and consumer demand for the sustainable agricultural movement. Today, there are approximately 39 academic programs at Land Grant Universities and approximately

51 academic programs at state, community and private colleges that have been specifically designed to address the issues of and related to sustainable agriculture (Parr, 2016). The National Agricultural Library maintains a Sustainable Agriculture Education and Training Directory, which list certificate programs, on farm training programs and research experiences in addition to academic programs available. In Montana, organizations such as the Organic Advisory Education Council, a research and education specific non-profit, and Montana Organic Association (MOA), a professional organization emphasizing production assistance, have contributed to the growth of organic agriculture in the state through research, education, and networking assistance. MOA has provided resources for producers on organic transition, production practices, funding and cost share programs, and political representation (MOA, “About MOA”; OAEC, “Our Mission”).

According to Martin (2016), farmers, ranchers, and consumers fall into two distinct groups, conventional and nonconventional, for a number of different reasons dependent on each person’s values. Generally, conventional agriculturalists emphasize productivity and value emerging technologies, while nonconventional agriculturalists are a diverse group that emphasizes ecologically sound practices as well as social justice. This nonconventional group includes agriculturalists that identify as sustainable, low-input, alternative, and organic (Velten, Leventon, Jager & Newig, 2015).

The agricultural industry plays a significant role in Montana’s public and economic welfare. The economic impacts of can be seen in its services, enterprises, revenue, business taxes, and employment connected to the diverse industry sectors.

According to the Montana Department of Agriculture (MDA, 2015), agriculture continues to be the leading industry in Montana with 27,500 farms and ranches totaling 59,700,000 acres, \$4.6 billion in agricultural services and products (2015), and is a leading producer of certified organic wheat, dry peas, lentils, and flax, seed potatoes, honey, and hay. Montana ranks 29th nationally in the total value of agricultural products sold, with the value of crops ranked at 27th in the nation (MDA, 2012). The agricultural industries offer significant contributions to Montana, the nation and the world with 75% of its wheat being exported to Asian markets (MDA, 2015). Sixty four percent of land in Montana is in farms and ranches and in 2016 Montana was ranked number three in the nation for certified organic acres (USDA NASS, 2016) and number one for organic wheat production in 2015 (MDA, 2015). A total of 266,000 acres are certified organic, 0.45% of the 59.7 million acres. Organic certification allows access to local, national and international value-added markets for organic food products. The Organic program inspects and certifies 169 farms and ranches and 55 food handlers annually as compliant with USDA organic standards (MDA, 2017).

While certified organic agriculture has grown, it has not kept up with demand and as a result, organic products are being imported to meet consumer demand in the U.S. (Constance, 2010). The National Organic Program (NOP) has implemented regulations (2002) to enable greater organic production; however, it is evident that more resources are needed to make organics more accessible. This research will assess the influencing factors on organic agricultural producers' attitudes, behaviors, and resulting decisions related to sustainable best management practices. It is our hope that results of this

research will yield information that can benefit educators, Cooperative Extension, policy makers and agriculturalists.

Research Question

This research addressed the following question: What are the influential factors on organic agricultural producers' attitudes, behaviors, and decisions related to sustainable best management practices?

Purpose

The purpose of this study was to assess influences on organic agricultural producers' attitudes, behaviors, and decisions related to sustainable best management practices.

Objectives

The objectives of this research were to:

1. Describe organic agricultural producers' attitudes surrounding sustainable best management practices.
2. Describe organic agricultural producers' behaviors surrounding sustainable best management practices.
3. Describe other influential factors on organic agricultural producers' decisions to adopt sustainable best management practices.

Sustainable Best Management Practices

For the purposes of this research, the following terms were used (SARE, 2010, p.2-3)

- Conservation tillage (contour, reduced, no-till): a broad range of soil tillage systems that leave residue cover on the soil surface, substantially reducing the effects of soil erosion from wind and water. (NAL, 2007, “Sustainable Agriculture”)
- Local Marketing: Local marketing for small-scale producers is diverse and includes farmers markets, community supported agriculture, direct marketing, and cooperatives and food hubs. (NAL, 2007, “Alternative Farming Systems Information Center: Marketing”)
- Whole-farm (holistic) approach: a proven, whole farm/whole system approach to resource management that incorporates financial planning, land planning, grazing planning and biological monitoring. (NAL, 2007, “Sustainable Agriculture”)
- Vegetative wind and water buffers: a strategy of increasing landscape diversity that aids in nutrient, soil, and water management. (SARE, 2010, p.3)

Conservation Buffer Strips are areas or strips of land maintained in permanent vegetation, designed to intercept pollutants and erosion. Placed around fields, they can enhance wildlife habitat, improve water quality, and enrich aesthetics on farmlands. Various types of buffers include contour buffer strips, filter strips, riparian forest buffers, field borders windbreaks/shelterbelts, hedgerows, grassed waterways, and alley cropping. (NAL, 2007, “Sustainable Agriculture”)

- Cover crops: Growing plants such as rye, clover, or vetch after harvesting a grain or vegetable crop or intercropping them can provide several benefits, including weed suppression, erosion control, and improved soil nutrients and soil quality. (NIFA, n.d., para. 8)
- Grazing management: livestock and grass management practices that focus on increased levels of manager involvement, increased forage quality, increased meat protection per unit area, and more uniform forage utilization (NAL, 2007, “Sustainable Agriculture”)
- Crop, livestock and landscape biodiversity: "At its simplest level, biodiversity is the sum total of all the plants, animals, fungi and microorganisms in the world, or in a particular area; all of their individual variation; and all the interactions between them." (Raven, 1994)
- Crop and livestock nutrient management: Nutrient management has taken on new connotations in recent times. Soil fertility traditionally dealt with supplying and managing nutrients to meet crop production requirements, focusing on optimization of agronomic production and economic returns to crop production. Contemporary nutrient management deals with these same production concerns, but recognizes that ways of farming must now balance the limits of soil and crop nutrient use with the demands of intensive animal production. Current decision-making processes include crop and animal production factors, economic factors, and the integrity of local surface water and groundwater, as well as the fate of far-away environmental systems. (NAL, 2007, “Sustainable Agriculture”)

- Water conservation management: water conservation and protection have become important parts of agricultural stewardship. Practices such as planting riparian buffer strips can improve the quality of drinking and surface water, as well as protect wetlands. (NIFA, n.d. para. 7)
- Ecological insect and weed management: an ecologically based approach to pest (animal and weed) control that utilizes a multi-disciplinary knowledge of crop/pest relationships, establishment of acceptable economic thresholds for pest populations and constant field monitoring for potential problems. (NAL, 2007, “Sustainable Agriculture”)
- On-farm energy conservation and production: the use of energy-saving devices, windmills and solar power, while also learning how to grow and process fuel. These practices make farm operations more profitable, clean and efficient, and help reduce dependence on foreign oil and reduce greenhouse gas emissions. (USDA SARE, 2010, p. 3)
- Sustainable Agriculture – An integrated system of plant and animal production practices having a site-specific application that will over the long-term:
 - Satisfy human food and fiber needs.
 - Enhance environmental quality and the natural resource base upon which the agriculture economy depends.
 - Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls.

- Sustain the economic viability of farm operations.
- Enhance the quality of life for farmers and society as a whole. (USDA NIFA, n.d. para. 2)

Limitations of the Study

This study does not include all Certified Organic producers in Montana. It was limited to those producers who were listed in the Directory of the Montana Organic Association website who chose to respond to the survey. This study was designed to reach producers who likely utilize sustainable agricultural practices and sustainable agriculture information resources. The study is limited in its generalizability across the agricultural industry as a result of its sample and geographic location.

Basic Assumptions of the study

This research assumed that:

- All survey respondents are members of Montana Organic Association
- All survey respondents completed the survey to the best of their abilities.
- All survey respondents responded honestly to the survey questions.

Significance of the Study

This study sought to describe the influential factors on attitudes of organic agricultural producers and their resulting behaviors and decisions related to sustainable best management practices as defined by the SARE program (2010). Producers choose to utilize specific production practices based on internal and external factors (Martin 2015). Inquiry into what informs and influences these perceptions in regards to how producers identify with specific production practices should give insight to development of future

educational and information resources. Attitudes of consumers are changing; they are showing concern for the methods and nature of modern agricultural production and therefore are making choices that are more ethically sound and personally pleasurable (Moskwa et al., 2015). Updated curriculum, educational programs and policy changes have been suggested as solutions for meeting this increased desire for information on sustainable practices (Korsching & Malia, 1991). Universities and private organizations have stepped up to provide education and training resources that are widely available. However, the percent of acres in organic agriculture is not representative of the education and training available. Of the 915 million acres in agriculture in the U.S. (Census of Agriculture, 2012), only 4.4 million is organic (Ag Facts, 2015). This research sought to identify the influencing factors that lead to the adoption of sustainable practices.

This research specifically addressed Research Priority Seven of the 2016-2020 National Research Agenda from the American Association of Agricultural Education, which asks how can teaching, research, and extension programs in agricultural leadership, education, and communication address complex interdisciplinary issues (eg. climate change, food security, sustainability, water conservation, etc.). Additionally, this research is directly related to the number one question in Research Priority Seven: Addressing Complex Problems, which asks what methods, models, and programs, are effective in preparing people to solve complex, interdisciplinary problems (eg. climate change, food security, sustainability, water conservation, etc.).

CHAPTER TWO

THEORETICAL FRAMEWORKS AND REVIEW OF THE LITERATURE

Introduction

Chapter I established the need to understand influencing factors on the attitudes of producers and the effects on behaviors and decision-making processes.

Chapter II described the application of the diffusion of innovations theory and the theory of planned behavior to understand the decision-making process in agriculture. Chapter II also explored the concepts of sustainable and organic agriculture, education in agriculture, and specifics behind extrinsic and intrinsic motivation related to sustainable agriculture terms.

Theoretical Framework

This study sought to examine the influences on attitudes and resulting behaviors and decisions of producers to utilize sustainable best management practices. Therefore, a theoretical framework based on behavior theory and decision-making was appropriate for the study.

The Theory of Diffusion of Innovations

Roger's theory of the diffusion of innovations says that the rate at which an innovation is adopted depends on to what degree the idea is perceived as better than that which it supersedes, and the complexity of the idea, or how difficult the idea is to understand and use. Diffusion is how an innovation is communicated among a social

system over time (Rogers, 2003). In order for an innovation to spread there must first be knowledge of the innovation, then persuasion based on the perceived characteristics of the innovation, then decision to either adopt or reject the innovation, then implementation and confirmation of the innovation. The theory states that innovation adoption follows a bell shaped curve (Figure 1). Five groups make up the curve: the innovators are risk takers and make up about 2.5% of the population, early adopters (10-15% of population) are leaders, early majority (~34% of population) require intense thought and deliberation but generally adopt an innovation before the average population, the late majority (~34% of population) tend to adopt an innovation due to social pressure or economic necessity, and finally the laggards (~15% of population) are the last to adopt an innovation and tend to make decisions based on what has been done in the past (Rogers, 2003). It has become a dominant framework in agricultural extension research and is a suitable framework for assessing how sustainable agriculture practices are “communicated and adopted over time” (Inwood, Sharp, Moore & Stinner, 2016, p. 178). Interest in sustainable agricultural practices has been growing since the 1980’s (Lacy, 1993). These practices are not new ideas but “in today’s global and industrial food systems such intentional consumption has become novel” (Inwood et al., 2016, p. 178).

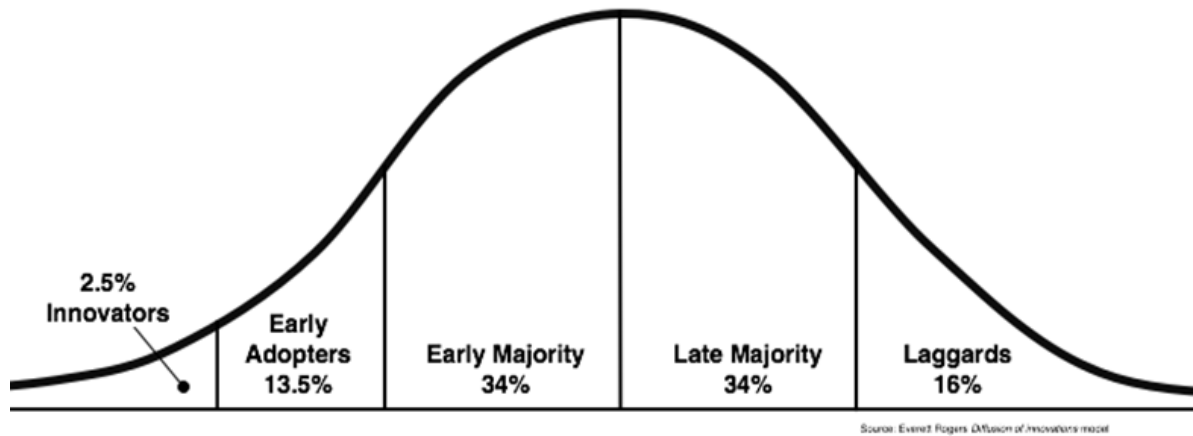


Figure 1. Rogers' theory of Diffusion of Innovations model (Rodgers, 2003, p. 281)

The Theory of Planned Behavior

The nature of the relationship between attitude and behavior is an on-going debate among social psychologists. There is a broad range of literature addressing theories of decision-making processes (Genius, 2017; Lois, 2015; O'Connor, 2017; Pearson, 2014).

The Theory of Reasoned Action (TRA) introduced by Fishbein and Ajzen in 1975 states that an understanding of attitudes would increase the predictability of behaviors (Ajzen and Fishbein, 1974). Due to broad generalities that influence attitudes and the "limitations in dealing with behaviors over which people have incomplete volitional control" (Ajzen 1991, p. 191), the Theory of Planned Behavior (TPB) supplanted the TRA in 1991. As seen in Figure 1, at the center of the TPB is the intention of an individual to perform a behavior. Intention captures an individual's motivation and how much effort they will put into performing a behavior. Intention is influenced by three

belief factors. The TPB framework does not assume that people are rational, but that their actions logically follow their beliefs (Ajzen, 2010). Beliefs can be formed through observations, outside information, and through inferences about observations or outside information. Some other factors that shape beliefs include demographics, gender, cultural background, and personal dispositions. The first belief factor, *attitude toward the behavior*, is the degree to which an individual views a behavior as favorable or not. The second factor is *subjective norm*, which is the social influence or pressure perceived by an individual to perform or not to perform a behavior. Social norms are broken down into injunctive norms; what behaviors a person thinks she should perform, and descriptive norms; the perception that others in a person's social group are or not performing a behavior. The third factor is the *perceived behavioral control*. This refers to a person's perceived ability to have control over or successfully achieve a behavior (Ajzen, 1991; 2010).

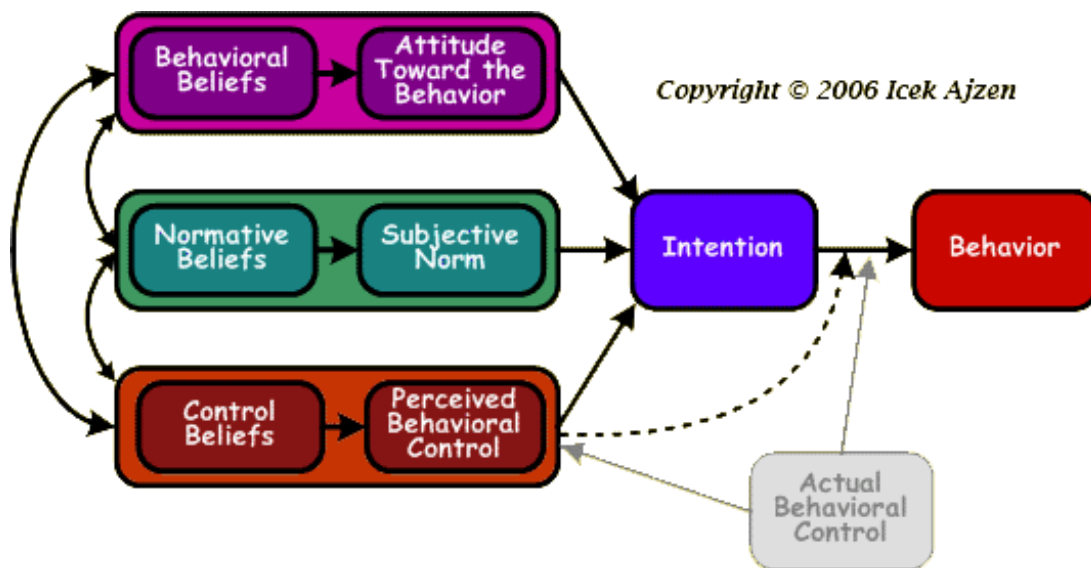


Figure 2. Ajzen's Theory of Planned Behavior (Ajzen, 1991)

Behavior Theory in Agriculture

Because of the concern about the effects of agriculture on the environment, the Diffusions of Innovations theory and the Theory of Planned Behavior are both widely referenced in sustainable agricultural literature in attempts to understand why producers reject or adopt sustainable practices (Ajzen, 1991; Rogers, 2003; Saltiel, 1994). It is stated by Rogers (2003) that the first step in adopting an innovation is knowledge of the innovation. It can be assumed then that a producer's decision to adopt sustainable agricultural practices starts with the ability to obtain necessary information (Genius, Pantzios & Tzouvelekas, 2006). Information can come from public institutions such as government and universities, professional publications, and social groups including family and peers. How that information is obtained and perceived depends on the source. The sources shape producers' social groups and thus normative beliefs (Meijer, Catacutan, Ajayi, Sileshi & Nieuwenhuis, 2015). Technologies, production practices, and research are constantly updating as a result of the broad and diverse goals of sustainable agriculture leading to new innovations seemingly all the time. This requires flexibility and the ability to shift thinking. Lalani, Dorward, Holloway & Wauters (2016) used the TPB to determine farmers' motivations for using conservation agriculture and the roles of yield, labor, and soil fertility in their decision-making. The TPB questionnaire is an appropriate tool in an agricultural context because producers use diverse management practices and are often widely dispersed geographically. The questionnaire can address multiple behaviors over different time scales, as well as assess producers' attitudes about

what they are currently doing and intentions for what they would like to do in the future (Lynne, Franklin, Hodges & Rahmani, 1995).

Review of Literature

This research reviewed literature related to the state of sustainable agriculture, the nature of organic agriculture in the U.S. and Montana, education for agriculture, information acquisition by producers, and influences on decisions to explore or adopt innovative agricultural production practices. This analysis consisted of a review of the informational sources available to producers seeking knowledge and information about innovative agriculture. Research regarding the attitude, perceptions, behaviors, and decision-making was reviewed. Finally, a review of the literature regarding popular terms in agriculture and the industry definition of specific terminology was conducted. This information provided insight into how producers understand and operate within their industry, and how information might be best presented to this audience.

Sustainable Agriculture

Ecologically conscience agricultural practices started gaining attention in the late 1970's and early 1980's after a period of major advancement in conventional agricultural practices, which focused solely on increasing productivity. Support for sustainable agriculture grew slowly and little progress was made in the years between the increasing rise in curiosity in the 1990's (Korsching & Malia, 1991). Understanding between theoretical and operational concepts around sustainable agriculture were a result of a lack of information about results on yield and profitability of using sustainable practices rather

than input heavy practices based on maximum yield (Keeney, Hildebrand, Everhart & Myers, 1990). A definition for sustainable agriculture that spans competing agricultural philosophies is hard to come by. Using sustainable agriculture practices is less complicated than defining what sustainable agriculture is (SARE, 2006). Producers and professionals seem to agree that sustainable agriculture should improve the “quality of life for whole communities, modeling environmentally sustainable practices, fostering local relationships...creating viable commercial ventures...sustaining local economies” (Moskwa et al., 2015, p. 127). The USDA legally defines sustainable agriculture as: “An integrated system of plant and animal production practices having a site-specific application that will over the long-term:

- Satisfy human food and fiber needs,
- Enhance environmental quality and the natural resource base upon which the agriculture economy depends,
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls,
- Sustain the economic viability of farm operations, and
- Enhance the quality of life for farmers and society as a whole” (USDA NIFA, n.d., para. 2).

Understanding sustainable agriculture today is still dependent on individual and site specific characteristics. The same concepts hold true; social, financial, and ecological goals determine decisions and management. However, academic and professional literature about sustainable agriculture is much more abundant than it was twenty years ago and the themes the literature covers are equally abundant. Velten et al. (2015) did a systematic review to determine the most prolific themes for goals, strategies, and actions taken. It was found that certain themes have persisted in the literature since 1989, such as ecosystem function and production specific concepts, while others have changed in

relevance, such as collaboration and communication has become less relevant while ecological principles have become more relevant. Overall social and non-production specific goals are more relevant to professionals while production-specific and environmental goals are most relevant to scientists.

The USDA Sustainable Agriculture Research and Education (SARE) program provides up to date information about practices based on relevant research and provides funding for research and professional development. According to SARE (2012), while sustainable agriculture “strategies vary greatly, they all embrace three broad goals, or what SARE calls the Three Pillars of Sustainability: profit over the long term, stewardship of our nation’s land, air and water, and quality of life for farmers, ranchers and their communities” (para. 2). In 2010, SARE published a sampler of best management practices used in sustainable agriculture including community vitality, ecological insect and weed management, grazing, conservation tillage, cover crops, crop, livestock and landscape diversity, nutrient management, on-farm energy conservation and production, and whole-farm approach (p. 1). These terms were utilized in this research study as the foundational sustainable management practices for producers.

Organic Agriculture

Organic agriculture is a transformative approach to agriculture that balances the goals of sustainable agriculture (USDA, 2012), but has a specific and regulated definition of what it means to be a certified organic producer, including different standards depending on the product. According to the USDA National Organic Standards Board (1995), “organic agriculture is an ecological production management system that

promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony.” Similar to the broad definition of sustainable agriculture, a simple comparison of organic practices does not consider the complexity of that exists between farming systems. While the USDA outlines standards for production to be able to utilize the “organic” seal, the standards cannot address the qualitative factors with which producers identify. For example, some conventional farmers may use practices that resemble organic practices even though they are not certified, while some organic farmers may use organic inputs or tillage which is allowed in the standards but potentially harmful to soil life (Puech et al., 2014), while other organic farmers may focus on profit as a driving factor, more typical of conventional management (Herndl, 2011; Constance, 2010)

Organic agriculture in Montana is supported by the USDA National Organic Program, a federal regulatory program founded in 2002 with a mission to protect the integrity of organic products (USDA, 2018). Products with the USDA Organic seal have met the federal and state requirements for approved Organic production practices that “integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity” (USDA, AMS p. 2). The state of Montana passed legislation for state organic certification in the Department of Agriculture in 1999. The mission of the program is to provide professional certification services and on-going evaluation “to facilitate growth and success of Organic agriculture” (MT Organic Policy Manual, p. 1). Of the 4.4 million certified organic acres

in the US, Montana ranked third (2015) in the nation with 250,531 acres in certified organic production by 138 operations. As of April 2018, that number is up to 296 operations (Integrity Database, 2018). Organic sales totaled \$48.9 million with organic crops and cropland making up 72% and totaling 190,255 acres. In 2015, 81% of MT sales from certified organic crops came from spring wheat, chicken eggs, winter wheat, durum wheat, and cattle. Most certified organic producers have been in operation for less than 10 years, the next group, (22%) have been in operation for 10-19 years (Ag Facts, Organic Production, 2015).

Educating for Agriculture

Educational resources that address diverse agricultural practices have increased since the 1980's when the need was identified (Korsching & Malia, 1991). These resources have been, and continue to be (USDA, 2012), produced by private, academic, and government entities. The American Farm Bureau Foundation for Agriculture (AFBFA) founded in 1967 is one private organization that has developed agricultural curricula. The AFBFA's early focus was on research for advancing agricultural mechanization and technology (AFBFA, 2018). Current efforts focus on teaching people where their food comes from. AFBFA does this through a number of online and classroom resources based on their framework, the Pillars of Agricultural Literacy. The Pillars are a tool for educators, planners, and managers of agricultural literacy programs that are based on "foundational knowledge" to demonstrate the "intersection between agriculture and society" (AFBFA, 2012, p. 1). The foundational knowledge; the definition of agriculture, agricultural history, taxonomy and identification, and production

awareness, are broken down into learning expectations designed for agricultural awareness, discovery, knowledge building, and analysis for early childhood, middle school, high school, and early adulthood respectively. Cumulatively, this should result in more informed consumers and voters. The AFBFA disseminates this information out to the community via educators, agricultural literacy coordinators, and industry partners.

Another private organization, the Rodale Institute, founded in 1947, is a farm-based research and education organization. Their mission is to improve the health and well being of people and the planet through organic leadership (Rodale Institute, Mission and History, 2018). This is accomplished through on-farm research focused on soil quality and crop quality and yield; online resources such as webinars; online classes for farmers including the Organic Transition Course; classroom resources for educators, such as how to start a school garden; and the Young Scientists Program. The Institute distributes these resources to the community via educators, farm tours, public events, veterans programs, and farmers markets.

Institutional support is important for adoption of sustainable agriculture practices (Korsching & Malia, 1991). The USDA National Agricultural Library is a robust online resource that covers all agricultural topics and includes listings for academic degree programs, certificate programs, apprenticeships, and on-farm training programs specific to sustainable agriculture. The USDA SARE program, founded in 1988, is a grant and education program that provides funding and education opportunities to producers and professionals to advance the science of sustainable agriculture (SARE, 2018). It operates as a learning center that provides current information and news based on projects

conducted by producers and professionals in its four regions; north central, northeast, south and west which are uniquely eligible for funding. Each state has a coordinator associated with Cooperative Extension. The mission of Extension work is “enable people to improve their lives and their communities” through “learning by doing” (SeEVERS & Graham, 2012, p. 13). Program areas in agriculture and natural resources are valuable adult education opportunities to make information available about innovative technologies. Occupational and practical trainings are necessary to keep knowledge current on research and practices (Birkenholz, 1999). The diverse nature of sustainable agriculture requires broad educational and outreach strategies for producers to be able to sift through information to decide on production practices that work for them and their operations.

Decision Making

Decision-making in agriculture is often misunderstood by those outside a farming operation because agriculturalists regularly make decisions based on personal goals, ambition, values, and beliefs that often surpass economic drivers (Long, 2013). People make decisions based on many extrinsic and intrinsic factors (Meijer et al., 2014). Understanding how agriculturalists identify themselves may give insight as to what drives their decision to explore innovative agricultural practices. Often “farmers are assumed to either adopt or not adopt” an innovative technology but more realistically, they are adapting it to their unique operation (Meijer et al., 2015, p.45). Producers considered conventional may use sustainable practices when they apply while producers considered sustainable may use more conventional practices when they apply (Peuch et

al., 2014). Motivations to adopt more sustainable practices are often economic, as the price of chemical inputs is high, or social, often farmers are viewed as polluters (Batie & Taylor, 1989).

Knowledge of agricultural issues and innovations influence producers' ability to make decisions about production practices (Meijer, 2015; Prokopy, 2008; Rogers, 2003; Saltiel, 1994). Technical issues, such as access to information, marketing concerns, such as general knowledge of markets, viability of the market as it pertains to the operation and access to the market influence adoption of sustainable practices (Constance, 2010; Lelani, 2016). Local, regional, and government support can also affect adoption of sustainable practices by being either absent of support or controlling to the point of limiting (Constance, 2010; Lynne 1994)

Depending on how strictly a farmer holds to the paradigm of conventional or sustainable agriculture they will differ on their views of their relationship with natural systems, whether they will dominate or exploit versus practice restraint and work with the system, and the degree of diversification or specialization on their operation (Herndl, 2011). Early on, diversified crop-livestock operations are often associated with more sustainable practices because the practices are seen as more profitable for the operation (Saltiel, Bauder, Bauder & Palakovich, 1994). Velten et al. (2015) found that profitability plays a key role in goals, strategies, and actions pertaining to sustainable agriculture in academic and professional literature on sustainability. This concept has persisted and is current today and encompasses productivity, labor, maintenance, climate variability, and infrastructure concerns (Constance, 2010; Lelani, 2016). Other topics relevant to

producer decision making natural resource conservation, and stability and resilience (Velten et al., 2017). Together, these concepts cover the economic, environmental, and social goals that make up the concept of sustainability.

Perceptions and Attitudes

Modern, technological agriculture has approached the art of growing food in a disciplined, compartmentalized way applying universal principles across all growing situations. Agriculture should be approached with a diversity of site-specific applications (Francis, Lieblein, Helenius, Salomonsson, Olsen & Porter, 2001). Attitudes of consumers are changing; they are showing concern for the methods and nature of modern production and thus are making choices that are more ethically sound and personally pleasurable (Moskwa et al., 2015).

Understanding the role of knowledge, attitudes, and perceptions in decision-making has implications for understanding how to reach audiences with information. Because terminology is how people come to understand a subject or idea, it can be used to examine influences on a person's perceptions about that subject or idea. In a study of the effects of terminologies on attitudes toward brands and advertising, Chuang, Tsai, Cheng & Sun (2009) found that individuals with low product knowledge formed favorable attitudes towards brands that used industry terminology, while individuals with high product knowledge were not influenced by industry terminologies used. Additionally, in their study of the influence of medical language on perceptions of illness, Young, Norman and Humphreys (2008) found that the use of medical terminology affected individuals' perceptions of the seriousness of illness more than common names

for the disorders, illustrating that words with the same meaning illicit different responses based on the assumptions of the reader.

Sustainability in agriculture is associated with local food. People who believe that they can play a role in sustainability value sustainably produced food (Sackett, Shupp & Tonsor, 2013). Support of the local economy is a major altruistic motivator for purchasing local foods. “Some consumers are attracted to local foods by a perception of poor flavor and quality of conventionally grown foods; others may be motivated by concerns about...energy costs of transporting foods great distances” (Inwood, Sharp, Moore & Stinner, 2009, p. 178). Food origin is another major motivating factor for consumer decision-making. Food safety concerns are commonly associated with the distance food travels as well as scale of production (Wageli & Hamm, 2016). Consumers fall on the spectrum of “food as fuel” or “food as heritage and culture” for different reasons, which are dictated by diverse values (Miele & Murdoch, 2003, p. #). A challenge for today’s educational professionals is to figure out how to work with diverse groups of people that have strong diverging agricultural values, while respecting their differences (Martin, 2016).

CHAPTER THREE

METHODOLOGY

The purpose of this study was to assess influences on organic agricultural producers' attitudes, behaviors, and decisions related to sustainable best management practices. The study sought to 1) describe agricultural producers' attitudes surrounding sustainable best management practices, 2) describe agricultural producers' behaviors surrounding sustainable best management practices, and 3) describe other influential factors on producers' decisions to adopt sustainable best management practices. This chapter explains the research study design and instrumentation process. The reliability and validity of the instrument, respondents in the study, and data collection and analysis are also discussed.

Research Design

This descriptive study utilized a survey research design as it provides “a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population... to generalize or draw inferences to the population (Creswell, 2014, p. 155). Descriptive, quantitative research involves examining a situation as it is, to determine the occurrence and distribution of behaviors or characteristics (Leedy & Ormrod, 2016). The survey method has been an efficient tool for learning about human behavior for over 75 years (Dillman, 2009). The researcher collected data with an online questionnaire instrument that was developed using previous literature on sustainable agriculture (Bosari, 2001; Francis, 2001; Korsching, 1991;

Nelles, 2011; Lacy, 1993; Lelani, 2016; Madden, 1989; Miele, 2003; Moskwa, 2015; Ripoll-Bosch, 2012; SARE, 2010; Sydorovych, 2008; Saltiel, 1994; Wagner, 1998), decision making process (Young, 2008; Meijer, 2014; Hanson, 1995; Chuang, 2013; Burton, 2004; Azjen, 1974, 1991, 2002), and the Theory of Planned Behavior (TPB) (Ajzen, 1991) as a framework. The questionnaire was constructed utilizing the Theory of Planned Behavior with consultation from Dr. Icek Ajzen. Dr Ajzen, a professor emeritus of Psychology at the University of Massachusetts-Amherst, is credited with development of the TPB, the theoretical framework of this study. Ajzen provided consultation in constructing a modified TPB questionnaire, feedback on the draft instrument, a discussion of data analyses to perform, and guidance in the interpretation of findings.

A questionnaire was the most appropriate method for this study because of the inherent anonymity of the instrument. Respondents can feel secure in their answers and will likely be more truthful than in a face-to-face interview, especially concerning sensitive topics such as sustainable agriculture (Leedy & Ormrod, 2016). Careful effort was made to construct the instrument in such a way to reduce misinterpretation of the questions with the use of a pilot test. The instrument was approved the Institutional Review Board on October 9th, 2017.

Procedures

Sample Selection

The population for this study was organic agricultural producers in the state of Montana. Producers that are members of Montana Organic Association (MOA) were chosen as the sample. MOA was chosen because 1) members include a diverse group of sustainable producers 2) they partner with and utilize stakeholders, including United States Department of Agriculture agencies, to host events and provide information, and 3) they provide programming specific to sustainable agriculture. The mission of The MOA is to “advocate and promote organic agriculture for the highest good of the people, the environment and the state's economy” (MOA, 2018, “About MOA”, para. 2). MOA is a non-profit 501(c)(6) organization, run by a volunteer board and has members from all over the state of Montana. MOA “provides education, information, support, assistance, promotion, and representation for organic producers, processors, handlers, retailers, consumers, researchers, agricultural service providers, and other interested parties.” (MOA, 2018, “About MOA”, para. 1)

Subjects selected to participate in the survey were producers listed in the online directory that had an email address available. The questionnaire was sent to 41 producers who live and operate farms in Montana. Respondents represent 43% of the total certified organic acreage in Montana (USDA NASS, 2016). A qualifying question at the beginning of the questionnaire determined if the respondents considered themselves a farmer, rancher, or producer in order to eliminate any recipients that did not qualify for the study.

The Questionnaire

The data collection instrument was constructed using “Constructing a TPB Questionnaire” (n.d.) written by Dr. Icek Ajzen as a framework. Preparation for construction of a questionnaire is described in the following four steps:

- 1) Define the behavior
- 2) Specify the research question
- 3) Formulate items for direct measure
 - a. Attitude
 - b. Perceived norm
 - c. Perceived behavioral control
 - d. Intention
 - e. Past behavior
- 4) Administer a pilot questionnaire

Ajzen provided consultation in constructing the TPB questionnaire and feedback on the draft instrument. A TPB questionnaire is uniquely constructed based on the objectives of the research and the constructs of the theory. Based on Azjen (2002), a standard questionnaire must address the following in which questions are formulated to assess the strength of the belief, likelihood that a factor is present, and power to impede or facilitate a behavior.

- 1) Behavioral beliefs and outcome evaluations
- 2) Injunctive normative beliefs and motivation to comply
- 3) Descriptive normative belief

- 4) Control beliefs and power of control factors
- 5) Direct measures: developed based on the pilot to assess past behavior, attitudes, perceived norm/behavioral control, and intentions
- 6) Other measures: demographic and personality variables included in final questionnaire
- 7) Behavior: follow up on behaviors addressed in questionnaire

The questionnaire was comprised of questions that addressed organic producers' perceptions of sustainable agriculture practices, social affiliations, behaviors surrounding information seeking practices, financial and production practices, and decision. A qualifying question at the beginning of the questionnaire eliminated any respondents that were not a beginning farmer, rancher, or producer. This provided a preliminary assessment of the sample and qualified the respondents for the study. The nature of the questionnaire did not reveal the identity of respondents. All respondents were assigned a number to code their answers and preserve anonymity. This stipulation was made to help increase the level of participation. After initial review by the research committee, the instrument was sent to Dr. Icek Ajzen for consultation on content validity to ensure the instrument was asking questions that directly examined the research objectives and components of the theory accurately (Dillman et al., 2009). After evaluation, questions were added or removed to more equally address each construct of the theory and reduce length of the questionnaire in the interest of time to complete it.

Data Collection

Primary data collection utilized a modified TPB questionnaire that was piloted with a group of potential future sustainable agricultural producers in the Montana State University class AGSC 356 Plant Nutrition and Soil Fertility Management). Pilot studies are conducted to “evaluate interconnections among questions, the questionnaire, and the implementation procedures” (Dillman, 2009). The pilot was conducted to test the instrument and ensure validity of the study, understand reliability of the instrument, and identify the items to be used in the final questionnaire (Azjen, 2002). After evaluation of the pilot data, some of the direct measures were reworded to more accurately address the constructs.

Respondents’ participation in the study was voluntary, thus ensuring protection of human rights. An opening statement notifying respondents of their consent to participate was presented to all respondents and required an answer in order to proceed with the survey research. Anonymity was guaranteed and respondents’ information was coded to minimize risks associated with subject security (Dillman, 2009). Permission to administer the modified TPB questionnaire was granted by the MOA Board of Directors. An endorsement of the questionnaire by the MOA Board of Directors was included in the initial contact, survey consent form, and all reminder emails. The final sample of beginning sustainable agriculture producers in Montana consisted of 41 respondents, which represent 45% of the Certified Organic acres in the state, based on the 250,531 certified organic acres in 2015 (MDA, Ag Facts, Organic Production).

The questionnaire was administered electronically through Qualtrics to an email list curated from the directory on the MOA website. The directory lists all businesses, processors and producers that are certified organic. The list was first reduced to include only producers that listed their farms and ranches. Then, it was reduced to producers that listed and email address in their contact information. The total number was 41 farms and ranches. The survey was open for four weeks starting February 5th, 2018. Prior approval was obtained from the MOA Board of Directors via individual phone calls and emails. An announcement about the coming survey was made five days prior to distribution on (February 1st) to sending out the initial survey on February 5th. The survey included the endorsement of the Board and also explained the importance of the research, including the benefits to the respondents, possibly resulting in more targeted educational resources and technical assistance available to them from MOA and related stakeholders. Two reminder emails were sent to unfinished respondents. The third and final announcement about the questionnaire was sent on March 2nd, requesting completion by March 5th. Paper questionnaires were sent to those that had not completed an online survey on February 16th. Follow up phone calls were made on February 28th through March 1st to those from whom a paper questionnaire had not been received. A final response of 72% was obtained.

Data Analysis

Descriptive statistics and inferential statistics were employed during analysis to summarize the nature of a set of data and allow inferences to a larger population to be drawn (Leedy & Ormrod, 2016). Responses were analyzed utilizing Confirmatory Factor

Analysis (CFA) to assess the relationships between questions and constructs of the questionnaire. Confirmatory Factor Analysis (CFA) (Brown, 2006) is a type of structural equation modeling (SEM) used to quantify the relationships between observed data (the survey items) and underlying latent factors (latent constructs of interest) that are specified a priori. Unlike SEM, CFA cannot be used to simultaneously examine latent constructs and assess relationships between constructs (via regression models). In the current dataset, we do not have a large enough sample size to estimate the SEM model specified by the Theory of Planned Behavior (Ajzen, 1991). Instead, individual CFA models were fit for each construct separately. Path diagrams and test statistics for model loadings are presented to assess strength of the relationships between latent constructs and the survey items. Path diagrams provide a graphical display of the relationship between the latent construct and the individual survey items onto which it manifests. The z-statistics quantify the strength of evidence of these relationships. The percent of variation in the items explained by the latent construct will also be included. Factor scores (the underlying value of the construct for individual respondents) will be estimated from each model, and the relationships specified in the Theory of Planned Behavior will be examined via scatterplots and Pearson correlation coefficients. The α and p-values were the two indicators of significance utilized to identify the strength of each relationship. Excel was utilized for descriptive statistics of demographic questions. Inferential statistics were useful for understanding the extent to which the surveyed sample described the attitudes, perceived norms and behaviors MOA members.

Validity and Reliability

Validity in research refers to the extent that the measurement tool accurately measures and makes inferences about the characteristic being assessed, and reliability is the extent that a measurement tool produces consistent information about the characteristics being assessed (Leedy & Ormrod, 2016). In this study, validity of the instrument was addressed by administering a pilot questionnaire to a class of potential future sustainable farmers in the Sustainable Foods and Bioenergy Systems program at Montana State University with permission of the professor. Additional validity and reliability concerns were addressed in consultation with Dr. Ajzen to ensure the questionnaire was accurately examining the research objectives and theory components (Dillman et al., 2009).

Statistical analysis of pilot data was performed using R statistical software version 3.3.2 (R Core Team, 2016). R is a free, open-source programming language designed for statistical analysis and graphical displays of data and has become a popular tool among statisticians and data scientists in recent years. Within each of the factor constructs, Pearson correlations between all pairs of questions were examined using the corrplot R package (Wei & Simko 2016). Cronbach's α (Cronbach, 1951) and the ω_t coefficient (McDonald, 1999) were calculated to estimate the internal consistency reliability of the factor constructs (Table 1). Both were estimated using the omega function in the psych R package. While Cronbach's α coefficient is the most widely used for reliability estimates, it makes assumptions often violated in practice (such as uncorrelated errors between pairs of questions and equal factor loadings for questions within the same construct), while ω_t

makes less stringent assumptions (see, e.g., Trizano-Hermosilla & Alvarado 2016). However, similar estimates were obtained for both procedures in each of the factor constructs. For attitude and perceived behavioral control, Cronbach's α yielded slightly less significant results than ωt (Table 1). Overall, ωt yielded high significance for each of the constructs for the pilot data.

Table 1. Preliminary Reliability Statistics

Constructs	Number of unique questions	Cronbach's α	ωt
Attitude	9	0.79	0.827
Behaviors	11	0.832	0.841
Intention	4	0.862	0.865
Subjective Norm	4	0.805	0.817
Perceived Behavioral Control	5	0.596	0.647

Non-response error is when individuals in the sample fail to respond to the study (Lindner, Murphy & Briers, 2001). To help decrease non-response and increase the return rate, multiple announcements of the coming survey were sent out via email, including a description of how the results could benefit the respondents through the development of more targeted educational materials and technical assistance. After two weeks, individuals who had not responded to the survey were given reminder phone calls and all received a paper survey in the mail with a self-addressed, postage paid envelope. Of the 31 surveys, 11 of them, or 35%, were late responses that were received via the mail. These late responses were compared to early responses on the Diffusion of Innovation curve. The late responses are equally distributed in the Diffusion of Innovations curve

among the early responders, as well as in gender and acres represented. Therefore, early and late responses are no different and can be generalized (Johnson, 2017).

CHAPTER FOUR

RESULTS

The analysis for this research was derived from data collected from 31 organic producers in the state of Montana through an online and paper questionnaire in the spring of 2018. The purpose of this analysis was to 1) describe organic agricultural producers' attitudes surrounding sustainable best management practices, 2) describe organic agricultural producers' behaviors surrounding sustainable best management practices, and 3) describe other influential factors on organic agricultural producers' decisions to adopt sustainable best management practices.

This chapter contains the procedures followed to address the research objectives, including discussion of the population sample. The chapter presents actual survey responses and analyses of each of the TPB constructs. For the total sample, the corplot and significance pathways are provided for each construct. Additionally, summary statistics for construct relationships demonstrate significant findings from the theory.

Questionnaire Respondent Demographics

The target population for this research was organic producers of Montana. The sample was producer members of Montana Organic Association. Of the total possible responses ($n = 41$), 34 were received, yielding a response rate of 82%. Of the 34 received, 31 were complete and usable, yielding a usable return rate of 75%.

Respondents completed five demographic questions. The average length of time respondents' farm or ranch has been in operation is 32 years, with the oldest being 107

years and the youngest being three years, with a median of 20 years. Of the respondents that volunteered their gender, 27.6% (n = 8) were female and 72.4% (n = 21) were male. Approximately 62.1% of respondents own their land while 24.1% lease land and the other 13.8% have a combination of leased and owned land (Table 2).

Table 2. Respondent Demographics

Demographic	Frequency
<u>Gender</u>	
Female	8
Male	21
<u>Respondent Age</u>	
Average Age	55
20-29 years	1
30-39 years	2
40-49 years	5
50-59 years	10
60-69 years	7
70+ years	3
<u>Land situation</u>	
Own	18
Lease	7
Other	4
<u>Farm Size</u>	
- Small family farm (less than \$10,000 gross farm income)	0
- Small family farm (\$10,000 to \$99,999 gross farm income)	5
- Small family farm (\$100,000 to \$249,000 gross farm income)	7
- Midsize family farm (\$350,000 to \$999,999 gross farm income)	16
- Large family farm (\$1,000,000 to \$4,999,999 gross farm income)	0

Demographic question five sought to determine the approximate size of respondents' farm or ranch based on gross sales. The majority of respondents, 57% (n =

28), operate farms or ranches that are considered midsize family farms, as defined by the USDA, with \$350,000 to \$999,999 in gross farm income. The size of farms varied from one acre to over 20,000 acres. Respondents represent approximately 114,899 acres of land in Montana under organic production. The smallest farm reported was one acre while the largest farm reported was 25,000 acres. The most common farm size of respondents is between 100 and 4,999 acres with 34% ($n = 29$) of respondents' operations in that range. The next most common farm sizes among respondents were 10 to 49 acres and 5,000 to 9,999 acres, both making up approximately 13.8% of respondents operations (Table 3).

Table 3. Size of respondent farm or ranch

Average acres	3962
Total acres represented	114899
<u>Acres</u>	<u>Frequency</u>
1 to 9	2
10 to 49	4
50 to 99	1
100 to 499	3
500 to 999	1
1000 to 4999	10
5000 to 9999	4
10000 to 19999	3
20000 +	1

Respondents represented diverse growing regions in Montana, as can be seen in Figure 2. Table 4 displays the specific number of respondents from each county in Montana. Hill, Gallatin, and Phillips counties make up 32% ($n = 28$) of respondents.

Table 4. Montana counties represented by respondents

County	Frequency
Lake	1
Hill	5
Flathead	1
Sweet Grass	2
Valley	1
Teton	2
Gallatin	4
Phillips	3
Madison	1
Judith Basin	2
Missoula	1
Richland	1
Sanders	1
Dawson	1
Lincoln	1
Chouteau	1

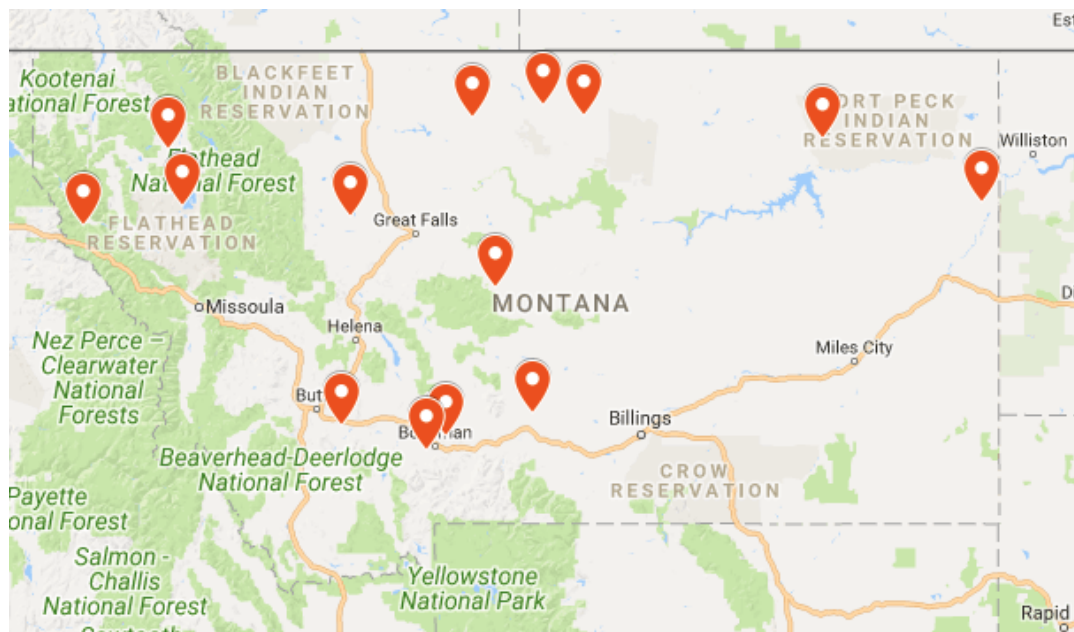


Figure 3. Map of online respondents general location in Montana obtained from Qualtrics. Mail-in responses are not included.

Summary of Best Management Practices,
Information Acquisition, and Communication Channels

Respondents' use of best management practices was summarized in Table 5. Because respondents were not required to select an answer, but could also select more than one BMP, total responses do not always add up to 100%, and may add up to greater than 100%. The table summarizes the use of each best management practice by respondents. Water conservation management practices are always used by 64.3% of respondents, followed by ecological insect and weed management was practiced by 57.1% of respondents. The best management practices of whole-farm approach, crop livestock and landscape biodiversity, and crop and livestock nutrient management are always used by 42.9% of respondents. Conservation tillage (29.0%), vegetative wind and water buffers (31.0%), and cover crops (34.5%) are sometimes used by producers. Grazing management did not apply to 32.1% of respondents, which reflects the commodities most producers reported on their operation (Table 6).

Table 5. Frequency of use of Best Management Practices

Please indicate how frequently you use the following Best Management Practices (as defined by USDA Sustainable Agriculture Research and Education program) on your operation?					
<u>BMP</u>	<u>Always</u>	<u>Mostly</u>	<u>Sometimes</u>	<u>Never</u>	<u>Does not apply</u>
- Conservation tillage	34.5%	24.1%	29.0%	0.0%	6.9%
- Local Marketing	32.1%	21.4%	25.0%	14.3%	7.1%
- Whole-farm (holistic) approach	42.9%	28.6%	17.9%	3.6%	7.1%
- Vegetative wind and water buffers	24.1%	24.1%	31.0%	10.3%	10.3%
- Cover Crops	34.5%	27.6%	34.5%	0.0%	3.4%
- Grazing Management	35.7%	21.4%	7.1%	3.6%	32.1%
- Crop, livestock and landscape biodiversity	42.9%	28.6%	7.1%	3.6%	17.9%
- Crop and livestock nutrient management	42.9%	17.9%	17.9%	7.1%	14.3%
- Water conservation management	64.3%	14.3%	21.4%	0.0%	0.0%
- Ecological insect and weed management	57.1%	25.0%	17.9%	0.0%	0.0%
- On-farm energy conservation and production	25.0%	10.7%	35.7%	14.3%	14.3%

Table 6 shows that eight respondents (n = 31) produce only grains on their operation, three produce only vegetables, two produce only livestock, and one produces only fruits. Fifty-five percent (n=17) of respondents' produced a mixture of commodities and livestock on their operations. Text entries for "Other" include value-added products, pulses, oilseed, broadleaf crops, beef, wool, lentils, specialty crops, grapes for wine, and gardening products.

Table 6. Frequency of respondents percent of operation production by commodity

Percent of production	Frequency of respondents				
	<u>Fruits</u>	<u>Vegetables</u>	<u>Grains</u>	<u>Livestock</u>	<u>Dairy</u>
100	1	3	8	2	0
75 to 99	0	1	2	0	0
50 to 74	1	2	5	3	0
25 to 49	1	1	0	3	0
1 to 24	1	1	0	2	1
None	27	22	14	20	29

Methods for obtaining information about BMP from common sources were summarized by frequency of use (Table 7). Because respondents were not required to select an answer, but could also select more than one BMP, total responses do not always add up to 100%, and may add up to greater than 100%. Results mostly varied except that 72.4% of respondents said they rarely use their local cooperative extension office as a resource for information. Internet searches are the most consistent information source with 31.0% of respondents using it daily and 37.9% using it weekly. The majority of respondents rarely or never use the National Agriculture Library, 48.3% of respondents. The “Other” option was heavily used with daily (21.4%), weekly (35.7%), and monthly responses (28.6%) reported. Common “other” options included Instagram feeds of farmers around the country/world, reading farm publications, direct contact with innovators, books and trade journals, traders dispatch, NRCS, books, and out-of-state researchers.

Table 7. Information acquisition

Please rate how frequently you use each of these sources to obtain information about Best Management Practices.

<u>Method</u>	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>	<u>Rarely</u>	<u>Never</u>
- Internet search (such as Google)	31.0%	37.9%	13.8%	17.2%	0.0%
- Local Cooperative Extension Office	0.0%	0.0%	17.2%	72.4%	10.3%
- USDA National Agriculture Library (online)	0.0%	0.0%	3.4%	48.3%	48.3%
- Sustainable Agriculture Research Education (SARE)	0.0%	3.4%	27.6%	48.3%	20.7%
- Farm Service Agency (FSA)	0.0%	3.4%	10.3%	48.3%	37.9%
- Family	3.4%	17.2%	20.7%	34.5%	24.1%
- Neighbors	0.0%	20.7%	24.1%	37.9%	17.2%
- Other	21.4%	35.7%	28.6%	7.1%	7.1%

Table 8 outlines communication channels used by respondents. Data confirmed more support for the Internet as a primary information channel. Seminars and workshops are rarely used by 62.1% and 65.5% of respondents respectively. No one listed face-to-face conversations as part of their daily routine, but 39.7% use them weekly and 44.8% use them monthly. Findings revealed additional support for Instagram in the text entry option.

Table 8. Communication Channels

Please rate how frequently you use each of these communication channels to obtain information about Best Management Practices.

<u>Method</u>	<u>Daily</u>	<u>Weekly</u>	<u>Monthly</u>	<u>Rarely</u>	<u>Never</u>
- Visit a website	27.6%	41.4%	13.8%	17.2%	0.0%
- Watch TV	13.8%	0.0%	6.9%	31.0%	48.3%
- Printed publications (brochures, fact sheets)	14.3%	21.4%	42.9%	21.4%	0.0%
- Read a newspaper article	7.1%	25.0%	39.3%	25.0%	3.6%
- Watch a video	0.0%	17.2%	24.1%	58.6%	0.0%
- Participate in a seminar or conference	0.0%	0.0%	37.9%	62.1%	0.0%
- Attend a short course or workshop	0.0%	3.4%	24.1%	65.5%	6.9%
- Face to face conversation	0.0%	37.9%	44.8%	17.2%	0.0%
- Online social networking	3.6%	10.7%	14.3%	50.0%	21.4%
- Email	10.3%	34.5%	24.1%	27.6%	3.4%
- Other	25.0%	0.0%	50.0%	0.0%	25.0%

Financial Information and Decisions

Respondents' financial information seeking behaviors were summarized (Table 9). Because respondents were not required to select an answer, but could also select more than one answer, total responses do not always add up to 100%, and may add up to greater than 100%. Many respondents have applied for a loan in the past and are aware of services, loans and programs available to them from the Farm Service Agency. As a whole, respondents showed the most interest in future loans that address equipment, land, farm storage facilities and crop disaster assistance needs. There was the least amount of interest in loans that address youth agricultural projects, labor needs, and beginning farmer and rancher assistance. Out of 25 responses for this question, 13 showed some interest in loans that would address diversification of their operation. When asked about

organic certification loans and service awareness from Farm Service Agency, nine reported yes, 11 reported no, and four reported maybe.

Table 9. Financial information seeking behaviors

Questions	Total Responses	Yes	No	Other
12. Have you ever applied for a loan to finance your agricultural operation? If no, why not?	28	21	4	3
	Total Responses	Yes	No	Maybe
14. Are you aware of the Farm Service Agency services, loans and programs?	29	24	4	1
15. If you were to apply for loans, which of the following areas would you seek funding for? Please choose all that apply	Total Responses	Frequency		
Youth agricultural project	23	1	20	2
Farm storage facilities	26	14	3	9
Land	24	15	4	5
Equipment	27	18	4	5
Labor	23	5	13	5
Crop disaster assistance	25	10	6	9
Business management	24	4	11	9
Diversification of operation	25	9	3	13
Marketing	24	4	13	7
Organic certification	24	9	11	4
Beginning farmer and rancher assistance	23	4	16	3

Data Analysis of Theory of Innovations

Table 10 shows where producers feel they fall on the curve of the theory of innovations. Of the 29 respondents that answered this question, 62% (n = 18) consider themselves leaders when it comes to adopting sustainable best management practices. Approximately 17% (n=5) consider themselves risk takers, while approximately 20% (n=6) consider themselves deliberators.

Table 10. Diffusion of Innovations

When it comes to adopting Best Management Practices, I am (a):	Frequency
Risk taker, the first to adopt	5
Leader, will adopt before most people	18
Deliberator, will adopt after much consideration	6
Reluctant, will adopt only when necessary	0
No interest in adopting	0

Data Analysis of TPB Constructs

The data from each of the TPB constructs were analyzed for strength of relationship and significance using Cronbach's α and Omega ω reliability statistics and Confirmatory Factor Analysis (Table 11) slightly higher estimates were obtained with ω in every construct of the Theory of Planned Behavior. Within each of the factor constructs, Pearson correlations between all pairs of questions were examined using the corrrplot R package (Wei & Simko, 2016). The lower-triangular portion of these plots display circles, where the size and hue reflects the magnitude of the correlation between the pair of questions. The upper-triangular portion of these plots displays the calculated

correlations. In the path diagrams, arrows represent how changes in the underlying latent construct manifests as changes in the observed items, with green arrows representing a positive relationship (higher values of the construct manifest as higher values in the question) and red arrows representing a negative relationship (higher values in the construct manifest as lower values in the questions). Stronger hues represent stronger associations. The summary tables provide numerical information corresponding to the path diagram, including factor loading estimates, standard errors, z-statistics, and p-values, along with percentage of variation explained in the item by the latent construct. A higher percent explained means that more of the variation that was seen in the individual questions is explained by differences in how respondents view the construct. Answers to questions with a high percent explained are also better indicators of where the individual respondents are on that construct in terms of the range of their beliefs. In general, the size of percent explained will match with the p-values; the smaller p-values, the higher percent explained.

Table 11. Reliability Statistics

Theory Construct	Number of unique questions	Cronbach's α	ω^2
Behavior	11	0.804	0.82
Intention	4	0.708	0.781
Injunctive Subjective Norm	6	0.72	0.752
Descriptive Subjective Norm	4	0.814	0.819
Perceived Behavioral Control	6	0.694	0.718
Attitude	10	0.941	0.943

Research Objective 1: Describe organic agricultural producers'
attitudes surrounding sustainable best management practices

The correlation plot (Figure 4) for the attitude construct shows very strong relationships between factors in questions seven and 11 in the survey (Appendix A). The strong correlation (.93) between factors 7.2 and 7.3 shows that respondents who feel adopting one or more BMP to be extremely desirable also feel they are extremely good. The strength of the correlation (.93) between question 7.2 and 7.3 show that respondents also feel that adopting one or more BMP is environmentally beneficial. Question 7.3 and 7.4 are strongly correlated (.88) saying that respondents that feel adopting one or more BMP is extremely good also feel it is extremely valuable. There are moderate correlations between factor 5 (socially beneficial) and other factors. Between question seven and 11 there is a moderate correlation (.72) that says respondents who feel that best management practices are helpful (question 11.2) are also extremely valuable (question 7.4). Another moderate correlation (.71) exists between question 11.3 and 7.6 that says that respondents who feel adopting one or more BMP is economically beneficial also feel it is easy.

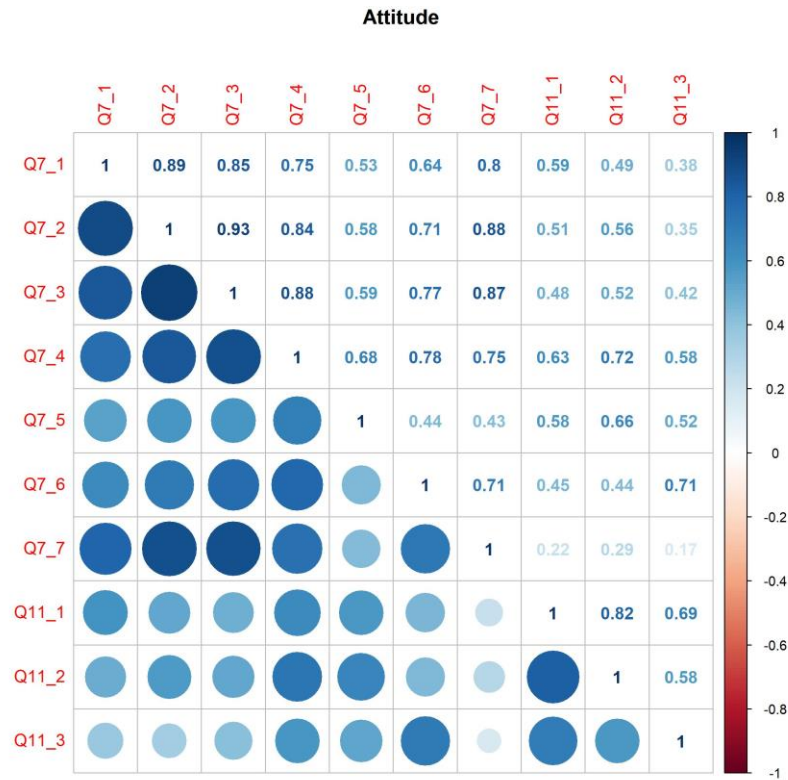


Figure 4. Correlation plot for “attitude” construct. Questions seven and 11 in the TPB questionnaire.

Of the highly significant factors ($p < 0.001$) from the CFA for the attitude construct (Figure 5), the path diagram shows very strong loading for question 7.2, 7.3, and 7.4, meaning that respondents who have a positive attitude about BMP feel that adopting one or more BMP is extremely desirable, extremely good, and extremely valuable. The moderate loadings for questions 7.1, 7.7, and 11.1, and 11.2 says that respondents who have a positive attitude about BMP feel that adopting one or more BMP is extremely interesting and environmentally beneficial, and respondents who have a positive attitude about BMP feel that they are pleasant and helpful.

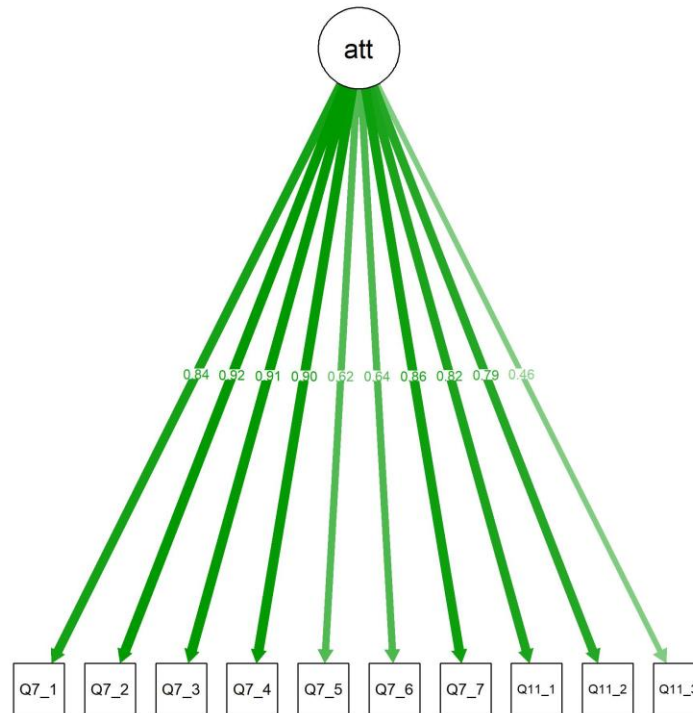


Figure 5. Path diagram of standardized loadings for the CFA examining the attitude construct.

Table 12. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Attitude” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q7_1	1.1373	0.2208	5.1512	<0.001	70.2926
Q7_2	1.0785	0.1808	5.9665	<0.001	83.9444
Q7_3	0.9496	0.1597	5.9465	<0.001	83.6235
Q7_4	0.9025	0.1551	5.8208	<0.001	81.5881
Q7_5	0.6564	0.1932	3.3982	<0.001	38.473
Q7_6	0.6821	0.1937	3.5222	<0.001	40.7293
Q7_7	0.8213	0.1518	5.4105	<0.001	74.7551
Q11_1	0.8779	0.1763	4.9791	<0.001	67.2759
Q11_2	0.8127	0.1736	4.682	<0.001	61.9765
Q11_3	0.6335	0.2673	2.3696	0.0178	20.8331

Research Objective 2: Describe organic agricultural producers' behaviors surrounding sustainable best management practices.

The correlation plot for behavior shows moderate relationships between many behaviors in question five of the questionnaire (Appendix A). The correlation between behavior three and one (.66), six and seven (.65), seven and eight (.72) are the strongest. This states that producers who use conservation tillage are more likely to also use a whole farm approach, producers who use crop, livestock, and landscape biodiversity are more likely to also use grazing management, and producers who use crop and livestock nutrient management are more likely to also use water conservation management. Weak to moderate correlations exist between behavior 3 and behaviors four (.53), five (.54), seven (.59), eight (.56), nine (.57), and 10 (.53). This says that producers who use a whole farm approach are more likely to also use vegetative wind and water buffers, cover crops, crop, livestock, and landscape biodiversity, crop and livestock nutrient management, water conservation management, and ecological insect and weed management. There was little correlation with behavior 11, on-farm energy conservation and production, but a weak to moderate correlation exists between behavior 11 and seven that says that producers who use on-farm energy conservation and production are more likely to also use crop, livestock, and landscape biodiversity.

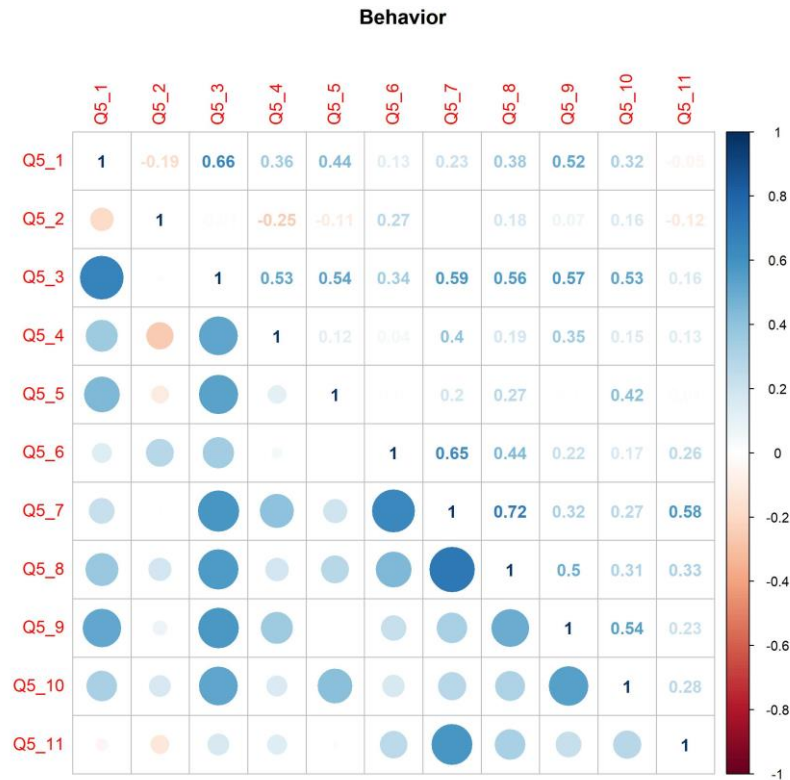


Figure 6. Correlation plot for the “behavior” construct.

Of the highly significant factors ($p < 0.001$) from the CFA for the behavior construct (Figure 7) the path diagram shows strong loading for question 5.7, 5.8 and 5.9 says that respondents with strong behavioral beliefs are very likely to participate in crop, livestock and landscape biodiversity, crop and livestock nutrient management, and water conservation. The less significant factors (Table 13) ($p = 0.002-0.005$) show more moderate loading for question 5.10, ecological insect and weed management, and 5.4 and 5.5, vegetative wind and water buffers, cover crops. This says that respondents with strong behavioral beliefs are likely to participate in these behaviors. Question 5.3 ($p < 0.001$) has extremely high loading showing high likely hood of respondents with strong

behavioral beliefs participating in a whole farm (holistic) approach with 87% of variation accurately explained by differences in respondent behavior beliefs

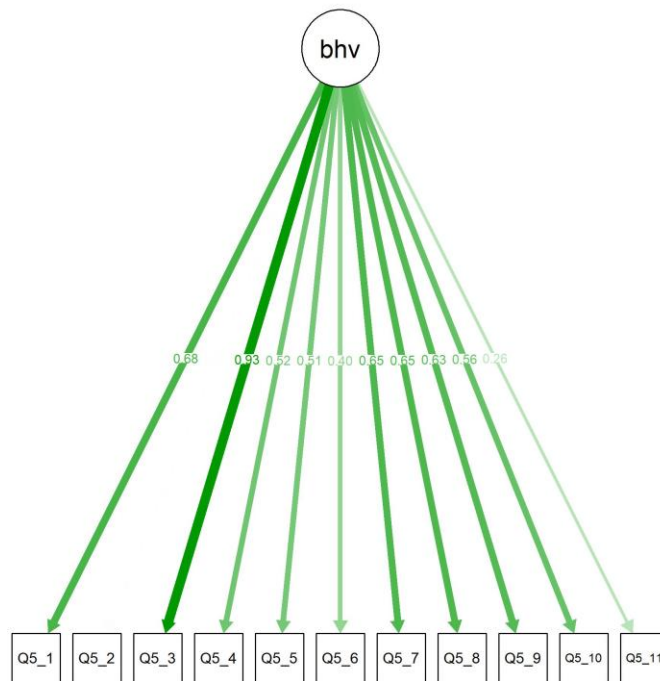


Figure 7. Path diagram of standardized loadings for the CFA examining the behavior construct.

Table 13. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Behavior” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q5_1	0.7807	0.2030	3.8461	< 0.001	45.6138
Q5_2	-0.0141	0.2527	-0.0559	0.9555	0.0126
Q5_3	1.1219	0.1819	6.1667	< 0.001	87.2192
Q5_4	0.6511	0.2321	2.8055	0.0050	27.2556
Q5_5	0.5144	0.1899	2.7087	0.0068	25.6537
Q5_6	0.6878	0.3325	2.0683	0.0386	15.8353
Q5_7	0.9841	0.2669	3.6875	< 0.001	42.7321
Q5_8	0.9464	0.2596	3.6448	< 0.001	41.9590
Q5_9	0.5200	0.1484	3.5040	< 0.001	39.4210
Q5_10	0.4393	0.1437	3.0581	0.0022	31.5505
Q5_11	0.3486	0.2688	1.2967	0.1947	6.5512

Research Objective 3: Describe other influential factors on organic agricultural producers’ decisions to adopt sustainable best management practices.

Subjective Norms. The correlation plot for subjective norm (Figure 8) shows many significant relationships between factors in question six and 16 in the survey (Appendix A). The correlation between factors 6.7 and 6.10, (.72), and 6.7 and 6.2 (.61) says that respondents who feel that the people they look up to would approve of them using BMP also feel that most people whose opinions they value think they should use BMP and that the people important to them support them using BMP. Factors 6.13 and 6.10 (.63) and 6.13 and 6.15 (.63) says that respondents who believe they have complete control over using BMP also feel that most people whose opinions they value think they should use BMP and that many agricultural producers across the country use BMP. The correlation between factors 16.2 and 16.3 (.57) says that respondents who believe that most people they respect and admire are seeking information about available loans are

somewhat likely to believe that the people whose opinions they value would support their decision to apply for a loan.

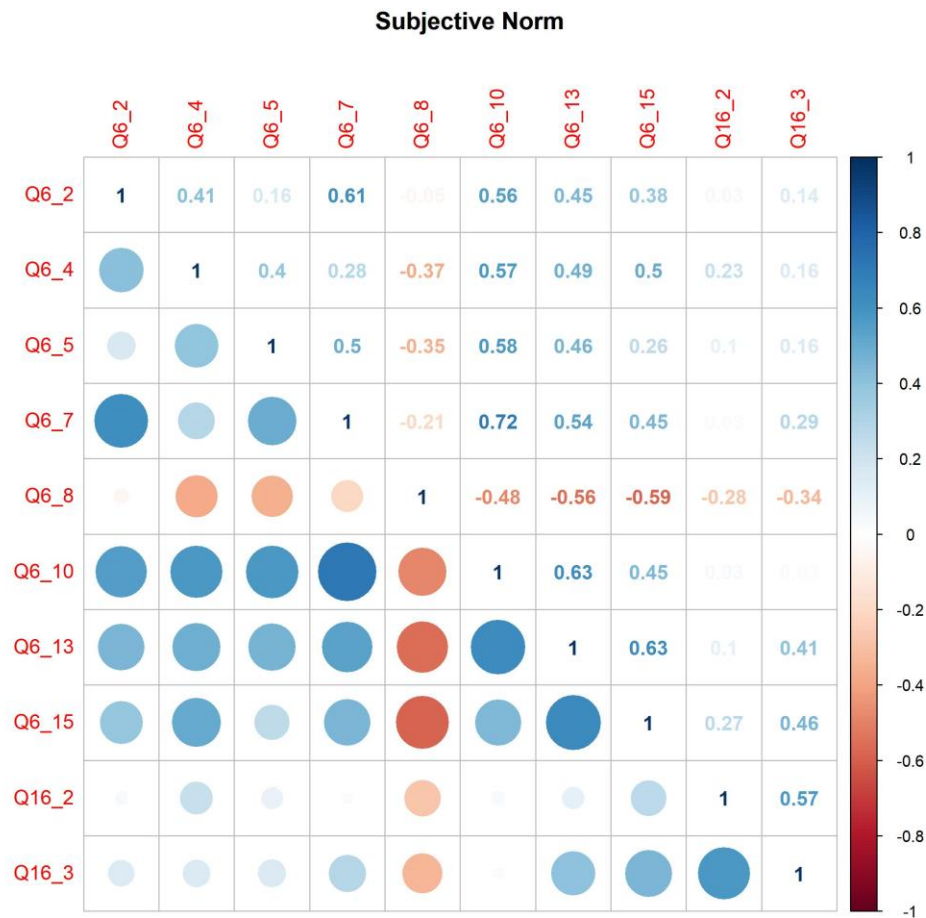


Figure 8. Correlation plot for the “subjective norm” construct.

Of the highly significant factors ($p < 0.001$) from the CFA for the subjective norm construct (Figure 9), the path diagram shows strong loading for factors 6.7, 6.10 and 6.13, with 77.6% of variation in factor 6.10 accurately explained by differences in respondents’ social norm beliefs. This says that respondents with strong subjective norm beliefs feel

that the people they look up to would approve of them using BMP, many people whose opinions they value think they should use BMP, and that they have complete control over using BMP. The less significant factors ($p= 0.0019-0.0025$) of 6.4 and 6.5 respondents with strong subjective norm beliefs feel that over the past few years, agricultural producers in their community have started using BMP and that it is expected of them by their peers that they use BMP. The negative estimate of factor 6.8 has a moderate significance ($p=0.007$) which states that respondents with strong subjective norm beliefs feel that many agricultural producers they know are *not* reluctant to use BMP.

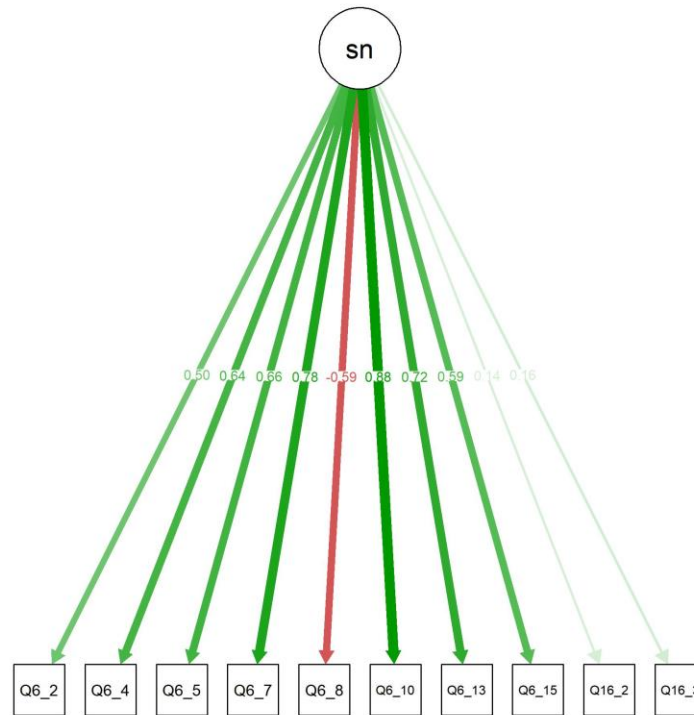


Figure 9. Path diagram of standardized loadings for the CFA examining the subjective norm construct.

Table 14. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Subjective Norm (combined)” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q6_2	0.5566	0.2515	2.2130	0.0269	24.8561
Q6_4	0.6720	0.2225	3.0196	0.0025	41.5897
Q6_5	0.6132	0.1981	3.0958	0.0020	43.2339
Q6_7	0.5795	0.1476	3.9260	< 0.001	61.2202
Q6_8	-0.6752	0.2516	-2.6839	0.0073	34.4344
Q6_10	0.6324	0.1345	4.7008	< 0.001	77.6172
Q6_13	0.6598	0.1876	3.5173	< 0.001	52.3790
Q6_15	0.5824	0.2172	2.6820	0.0073	34.3948
Q16_2	0.0921	0.1611	0.5716	0.5676	1.8908
Q16_3	0.1604	0.2471	0.6492	0.5162	2.4314

Of the highly significant factors (Table 15) ($p = <0.001$) from the CFA for the injunctive subjective norm construct (Figure 10), factors 6.5, 6.7 and 6.10 reflect the beliefs observed in the combined subjective norm path diagram. However, it can be observed that by separating the injunctive norm out, 99.3% variation in factor 6.7 is accurately explained by differences in respondent's *injunctive* subjective norms. This means that these factors are affected more by what respondents think they should do versus what they think their peers are doing.

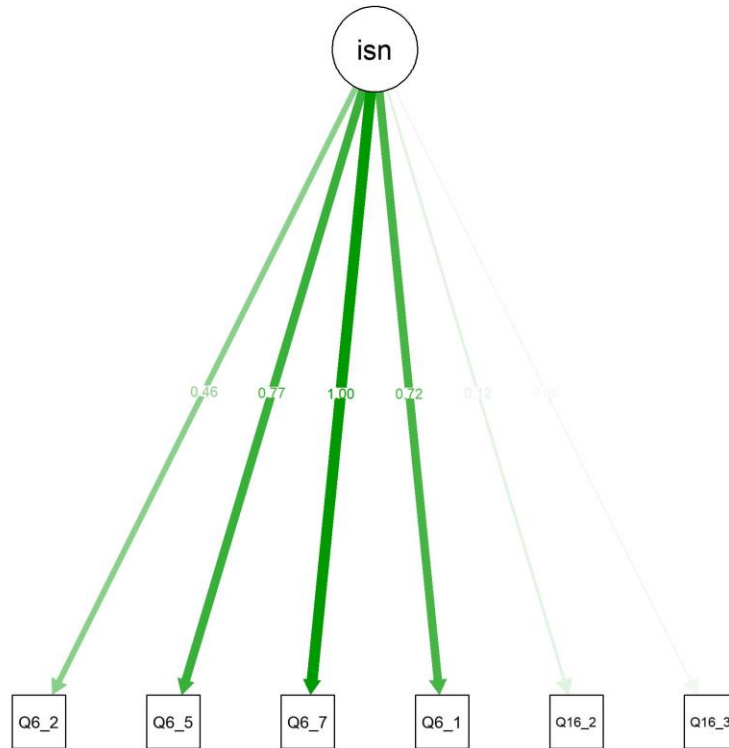


Figure 10. Path diagram of standardized loadings for the CFA examining the injunctive subjective norm construct.

Table 15. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Injunctive Subjective Norm” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q6_2	0.5099	0.2460	2.0728	0.0382	20.8591
Q6_5	0.7200	0.1875	3.8409	<0.001	59.6014
Q6_7	0.7380	0.1329	5.5516	<0.001	99.3078
Q6_10	0.5188	0.1470	3.5294	<0.001	52.2291
Q16_2	0.0782	0.1538	0.5086	0.6110	1.3635
Q16_3	0.0569	0.2367	0.2406	0.8098	0.3065

Of the highly significant factors (Table 16) ($p < 0.001$) from the CFA for the descriptive subjective norm construct (Figure 11), factors 6.8, 6.13, and 6.15 reflect the beliefs observed in the combined subjective norm path diagram. However, it can be observed that by separating the descriptive norm out, variation is more accurately explained by differences in respondent *descriptive* norms with large increases in each factor, 49.3%, 60.6% and 67.6%, formerly 34.4%, 52.3% and 34.3%, respectively. This means that these factors are affected more by what respondents think their peers are doing versus what they think they should do.

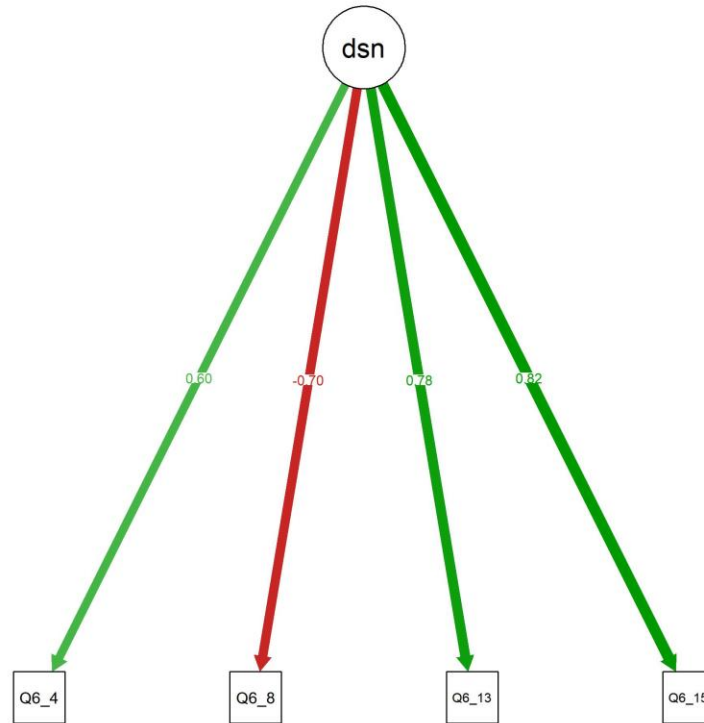


Figure 11. Path diagram of standardized loadings for the CFA examining the descriptive subjective norm construct.

Table 16. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Descriptive Subjective Norm” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q6_4	0.5683	0.1772	3.2077	0.0013	35.8082
Q6_8	-0.8170	0.2084	-3.9202	< 0.001	49.3733
Q6_13	0.7353	0.1648	4.4607	< 0.001	60.6414
Q6_15	0.8634	0.1806	4.7811	< 0.001	67.6362

Perceived behavioral control. The correlation plot for perceived behavioral control (Figure 12) shows a moderate relationship between question 6.11 and 6.14 in the survey (Appendix A). The correlation (.66) in Figure 8 says that respondents who feel they are capable of using BMP also feel that many agricultural producers around the country use BMP. A moderate correlation (.55) also exists between questions 6.14 and 6.3 stating that producers who feel many agricultural producers around the country are using BMP also feel that if they want to they can easily use BMP. The weakest correlations exist between questions 6.9 and 16.4 (-.22) “whether or not I use BMP is completely up to me” and “I have complete control over using loan programs”. There are no strong correlations between perceived control over use of BMP and perceived control over use of loan programs

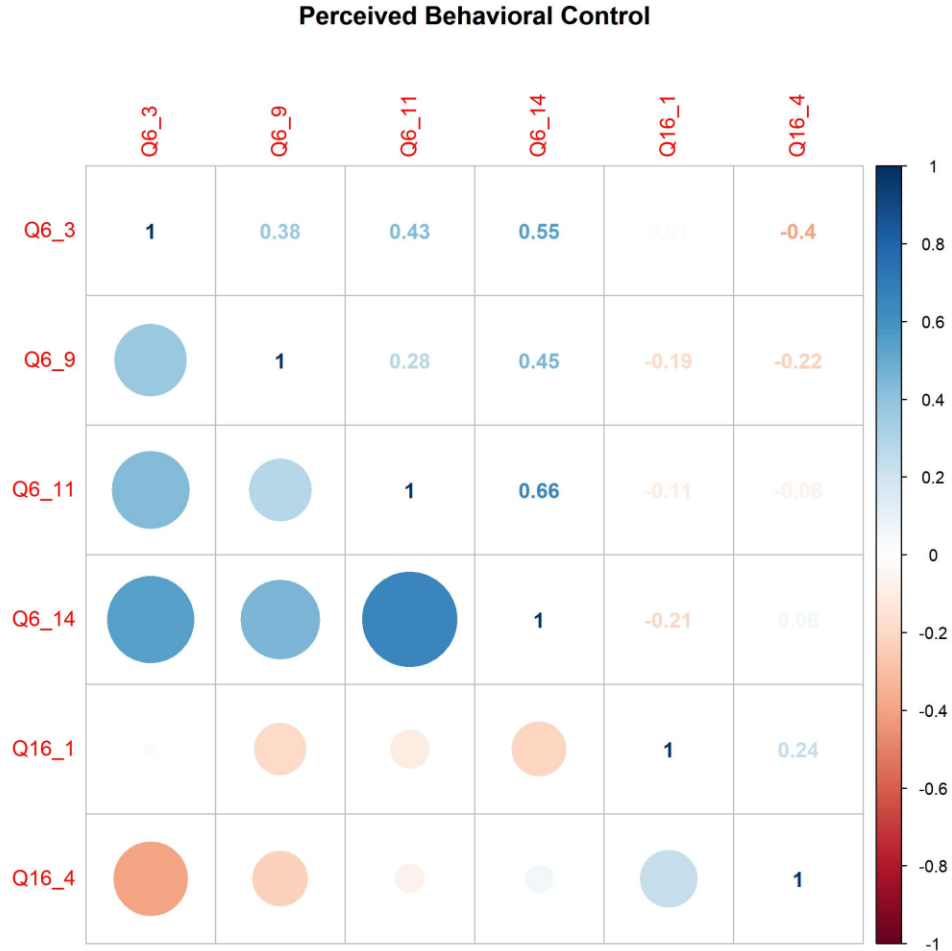


Figure 12. Correlation plot of questions within the “perceived behavioral control” construct.

Of the highly significant factors ($p = <0.001$) from the CFA (Table 17) for the perceived behavioral control construct (Figure 13), the path diagram shows strong loading for factors 6.11 and 6.14 with 87% of variation in factor 6.14 accurately explained by differences in respondents’ perceived behavioral control beliefs. This supports the correlation plot above that states respondents with perceived behavioral control beliefs feel that they are capable of using BMP and that many agricultural producers around the

country use BMP. The less significant ($p = 0.0012$) factor 6.3 says that respondents with strong control beliefs feel that if they want to they can easily use BMP.

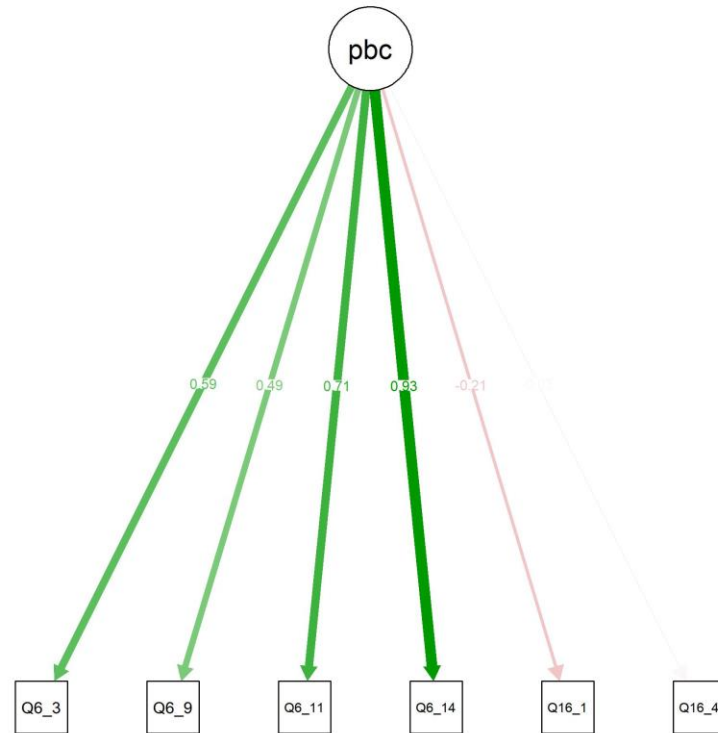


Figure 13. Path diagram of standardized loadings for the CFA examining the perceived behavioral control construct.

Table 17. Coefficient estimates, standard errors, z-statistics, p-values, and percent explained variation for the item loadings in the “Perceived Behavioral Control” construct.

Question	Estimate	SE	Z-value	P-value	% Explained
Q6_3	0.4587	0.1427	3.2140	0.0013	35.3247
Q6_9	0.5528	0.2143	2.5792	0.0099	23.8621
Q6_11	0.4806	0.1230	3.9078	< 0.001	49.8785
Q6_14	0.9644	0.1779	5.4210	< 0.001	87.2134
Q16_1	-0.2465	0.2323	-1.0613	0.2885	4.3994
Q16_4	-0.0327	0.2557	-0.1280	0.8982	0.0652

Intention. The correlation plot for intention (Figure 14) shows very strong relationships between question 6.6 and 6.12 (.91). The correlation says that respondents who are planning to use BMP feel that the use of BMP is common among agricultural producers like them. There is moderate correlation (.56) between 6.6 and 6.1 that says that producers who intend to use BMP are planning to use BMP. There is little to no correlation between respondents’ intention to seek more information about available loans and their intention to use BMP. A CFA model could not be fit for the “intention” latent construct due to the small variability in the answered items for this construct by the respondents. Factor scores for this item were evaluated by the average of the items within the construct.

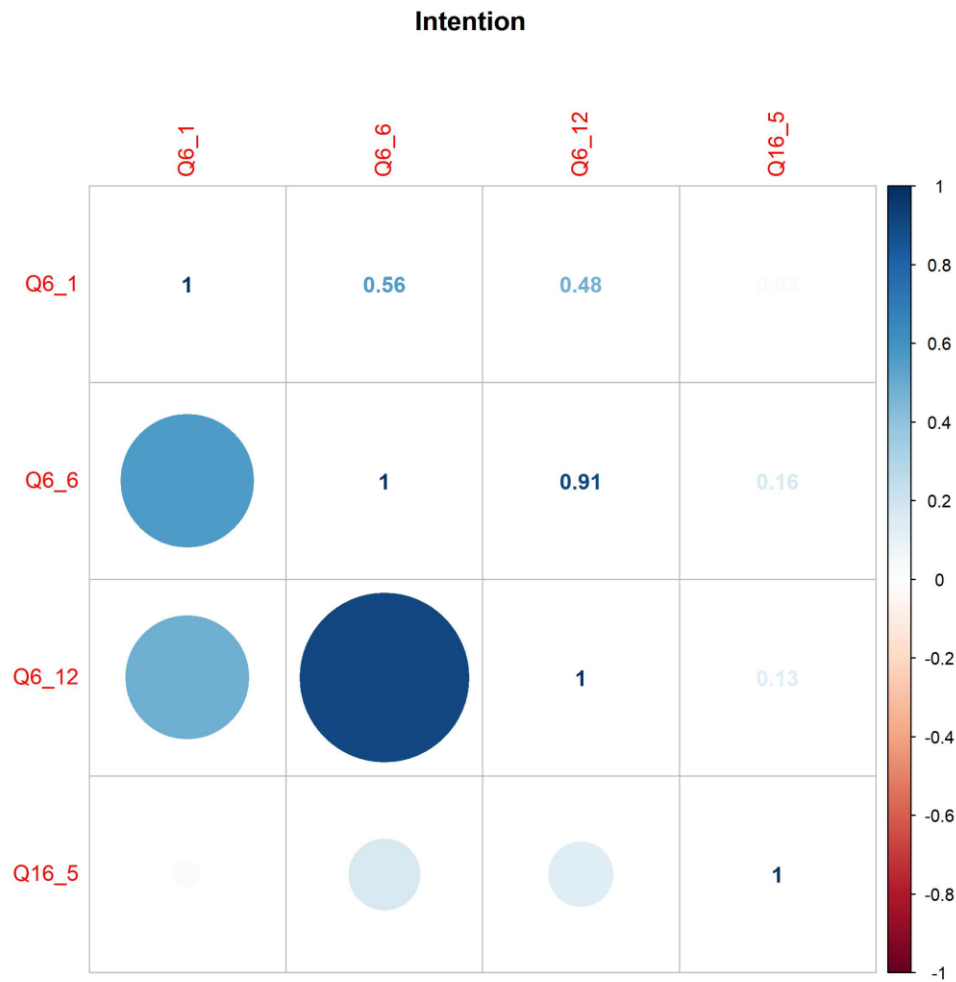


Figure 14. Correlation plot for the “intention” construct.

Summary of Construct Relationships

Scatterplots of factor scores representing pairwise comparisons of interest are displayed in Figure 15. Pearson correlation coefficients and p-values are displayed in each panel. We would expect that all relationships displayed should have positive associations, which we observe with at least moderate strength of evidence in each relationship. The strongest pairwise relationship was “attitude” having a strong

association with “intention”, indicating that respondents with a positive attitude to implement sustainable practices likely intend to implement them. This is followed by “intention” having a strong association with “behavior”, indicating that respondents with a high intention to implement BMP likely will participate in the behavior. Less significant contributing factors are “perceived behavioral control” and “subjective norm (combined)”, indicating that respondents who feel they have high control over using BMP and that their social groups would approve of them.

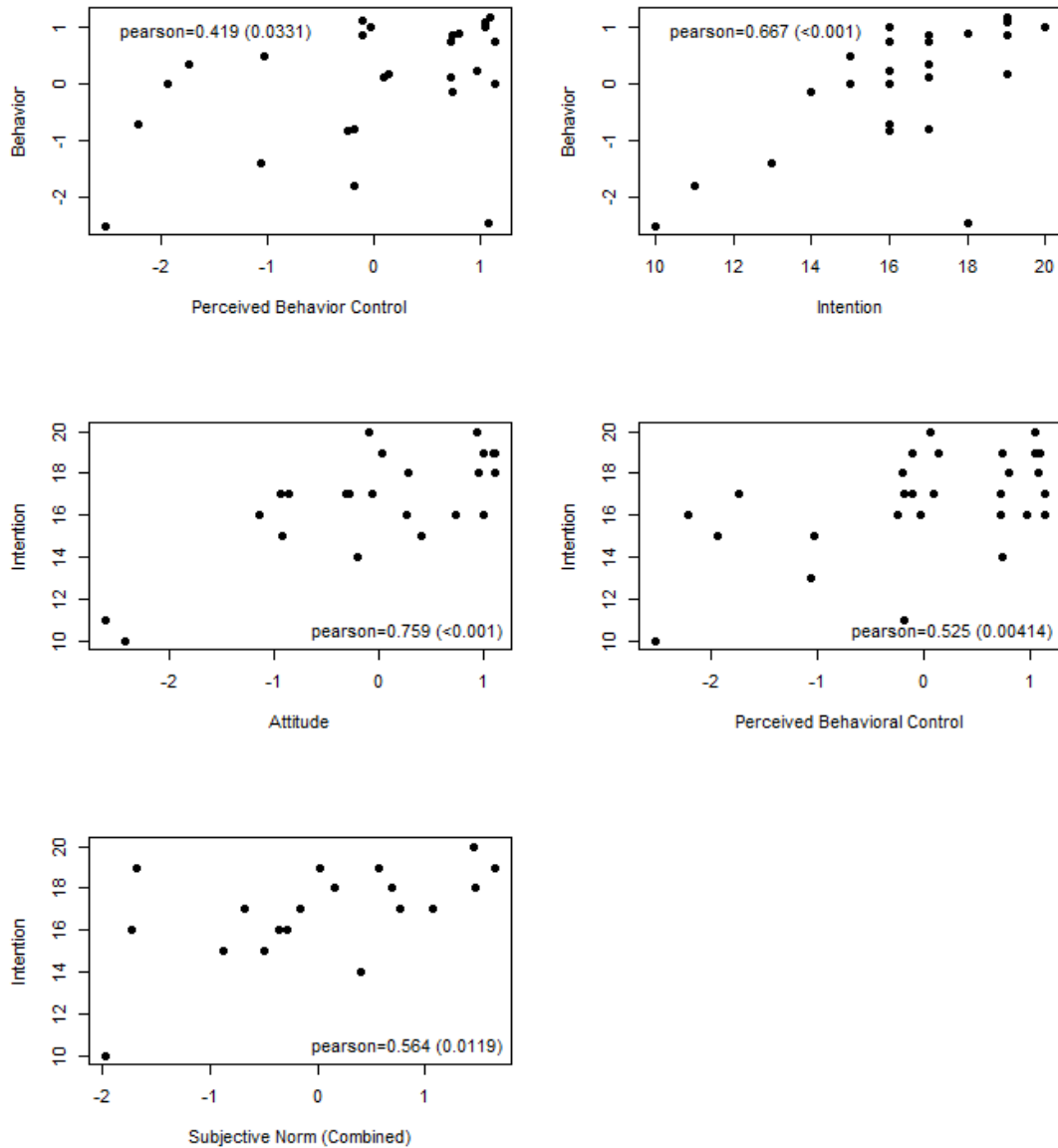


Figure 15. Scatterplots of relationships between different pairs of latent constructs. The estimated Pearson correlation and p-values for each pair are displayed in the individual panels.

Statistical Limitations

While not enough survey data was collected to allow for an SEM to be fit, this model would simultaneously allow for estimation of all latent constructs and relationships among them, accounting for more information and leading to stronger conclusions. A CFA model could not be fit for the “intention” latent construct due to the small variability in the answered items for this construct by the respondents. Factor scores for this item were evaluated by the average of the items within the construct.

Sample Bias

People are more likely to respond to a survey if the content is relevant to them. (Dillman, 2009). Therefore, producers who are more likely to utilize BMP's are also more likely to respond to the survey (Prokopy et al., 2008). This research sought to understand the attitudes, behaviors, and decisions around sustainable BMP's of organic producers; what makes farmers adopt sustainable BMP's and why with the hope that understanding will help to increase necessary resources for adoption.

The TPB gathers information about a person's behavioral, normative, and control beliefs but cannot specify how those beliefs were formed. It does try to identify various background factors that can influence those beliefs (Ajzen, 2011, p. 1123). We asked demographic questions and inquired about information acquisition and financial needs to try to gain a better understanding of how the beliefs of MOA producers were formed to understand their decision making process. We acknowledge the inherent bias that exists

with sustainable producers answering questions about sustainable agriculture (Hanson et al., 1995).

CHAPTER FIVE

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The purpose of this study was to assess influences on organic agricultural producers' attitudes, behaviors, and decisions related to sustainable best management practices. This chapter will conclude with key findings for each of the research objectives, as well as provide implications and recommendations for further research, practice, and education.

Representative Nature of the Sample

To verify that the sample in the research was representative of the population of organic producers in Montana, the demographics of the sample were compared to agricultural statistics for the state of Montana and other states with high rankings for acres in certified organic agriculture. Respondents represented 43% of the total certified organic acreage in Montana (MDA, 2015). A total of 266,000 acres are certified organic in Montana, 0.45% of the 59.7 million acres in agriculture. The average size of respondents' farms was 3,962 acres, compared to 2,134 acres, the average size of farms in Montana in 2012 (MDA, 2012).

The average age of respondents was 55 years, while the average age of farmers in Montana is 59. Approximately 27.5% of respondents were female, while in 2012, 15.0% of principle farm operators in Montana were female (USDA NASS 2017). In New York, close behind MT in certified organic acres (264,000), the average age of producers was 57 and 18.0% of principle farm operators are female in 2012.

Conclusions

The following section summarizes the findings analyzed in chapter four.

Objective one was to describe organic agricultural producers' attitudes surrounding sustainable best management practices. Objective two was to describe organic agricultural producers' behaviors surrounding sustainable best management practices. Objective three was to describe other influential factors on organic agricultural producers' decisions to adopt sustainable best management practices. Analyses and interpretations are made on the results from the Diffusion of Innovations, the CFA results on the TPB constructs, information seeking behaviors, and demographics.

Diffusion of Innovations

Roger's theory of the diffusion of innovations says that the rate at which an innovation is adopted depends on the degree the idea is perceived as better than that which it supersedes, and the complexity of the idea, or how difficult the idea is to understand and use (Rogers, 2003). We see that respondents primarily consider themselves risk takers, leaders, and deliberators in the curve of diffusion of innovations that Roger's theory illustrates (Figure 16).

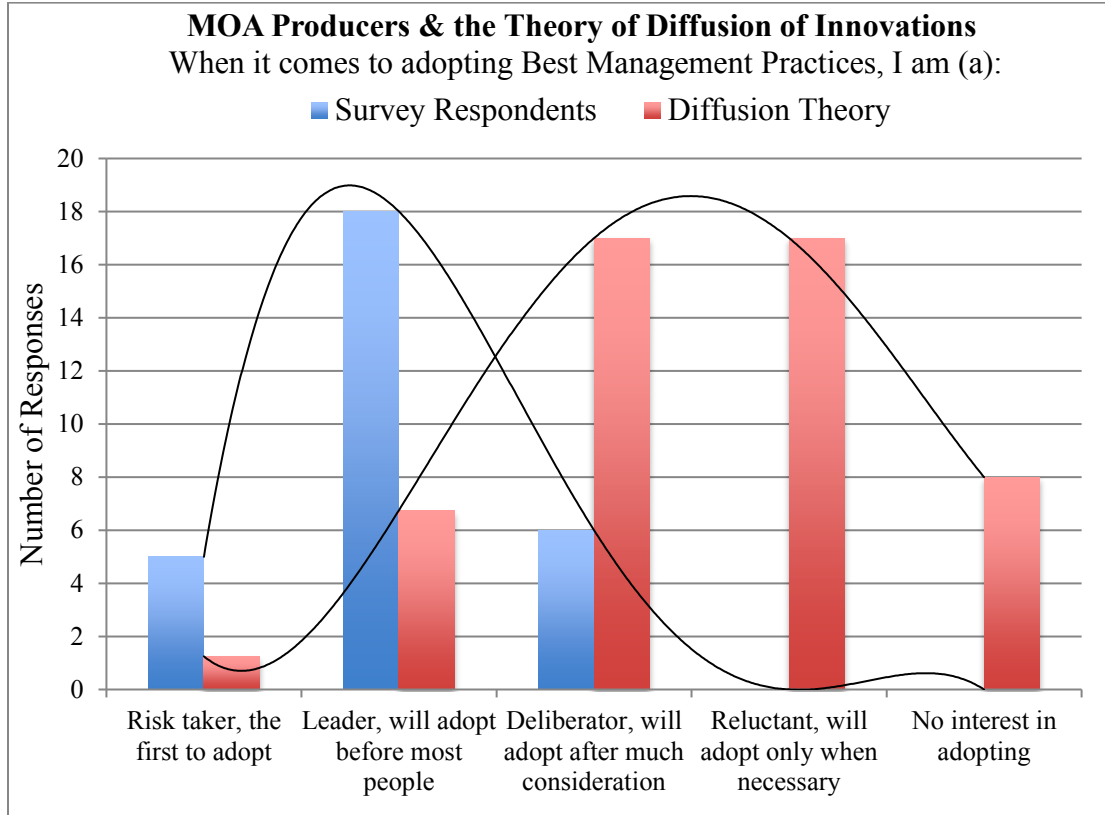


Figure 16. MOA producers fall into a bell shaped curve like that of Rogers' theory of diffusion of innovations.

It is generally understood that sustainable agriculturalists have a pioneering mentality. Similar to previous findings, knowledge of agricultural issues and innovations influence producers' ability to make decisions about production practices (Meijer, 2015; Prokopy, 2008; Rogers, 2003; Saltiel, 1994). The willingness of MOA producers to adopt ideas more quickly than others suggests that sustainable agricultural producers are those that seek or obtain knowledge about sustainable BMPs and experiment with implementation before the majority of agriculturalists. Knowing that sustainable agricultural producers identify themselves as innovators is valuable information for

educators, industry professionals and policy makers. This information can be used to target more specific populations with resources about sustainable agricultural practices. Educators, industry professionals and policy makers could be more effective in their programming knowing that producers who have already adopted sustainable BMPs do not need to be targeted, but could be helpful in suggesting what topics should be covered in online information sources, educational materials and workshops, and what policies would be most effective in increasing the rate of adoptions of BMPs.

Attitude, Intention, and Behavior

The debate over the relationship between attitude and behavior sees comparison of both intrinsic and extrinsic factors (Meijer et al., 2014), and that education has a strong association with adoption (Prokopy et al., 2008). In this study, respondents who had a positive attitude about BMP felt that adopting one or more BMP is extremely desirable, good, valuable, interesting and environmentally beneficial. Sustainable agricultural producers self identify as innovators so we know that they are intrinsically motivated by these values. When seeking to increase the adoption of sustainable BMPs by a broader producer audience, the experience or presence of opinion leaders in sustainable agriculture can be a tool to influence the values of producers that are on the fence. If producers who are interested in sustainable BMPs can learn from industry leaders' experiences, adoption of new practices may not seem like such a hurdle for new and potential future sustainable producers.

Attitude is seen as having the strongest influence on other factors of producer decision-making, such as intention (Lelani, 2016; Prokpy, 2008; Saltiel, 1994; Lynne,

1995; Meijer, 2015). Respondents with strong intention beliefs are planning to use BMP and feel that the use of BMP is common among agricultural producers like them. We see among producers who use a whole farm approach there is strong interconnectedness with other BMPs. Respondents with strong behavioral beliefs are very likely to participate in crop, livestock and landscape biodiversity, crop and livestock nutrient management, water conservation, ecological insect and weed management, vegetative wind and water buffers, and cover crops. Education and training materials produced by public and private groups such as Cooperative Extension, universities, agricultural businesses and organizations such as Farm Service Agency, and non-profits like Rodale Institute, should address diversity on an operation as demonstrated by the mix of behaviors that sustainable producers utilize. These educational materials should also be available in both paper and online formats.

Results of information seeking behaviors mostly varied except Internet searches which were the most consistent primary information source. Seminars and workshops were rarely used as a primary information source by the majority of respondents, suggesting that the Internet is both a readily available source of information, and provides information not available by other means. This finding is particularly important for educational organizations, such as Cooperative Extension, that use workshops as a primary communication method; this format may not be the most effective when working with this specific audience. Respondents most commonly listed face-to-face conversations as part of their weekly and monthly information seeking routine, which supports the need to talk with producers at their farms and venues, including farmers'

markets. Further support was shown for Instagram in many responses showing that innovators will seek information from state and national sources rather than local sources and will often travel to obtain information. This demonstrates great potential for Cooperative Extension to address needs of innovators in creative ways to expand reach, especially because 72.4% of respondents said they rarely used their local cooperative extension office as a resource for information. Expanding Extension's social media presence may be an effective method to reach this growing audience. Using Instagram to showcase sustainable agricultural practices and creating a schedule to provide weekly and monthly communications with producers would be useful ideas to implement.

While we understand that knowledge of a behavior is important, we see that understanding how to carry out that behavior is more important in order to see change in adoption rates (Prokopy et al., 2008). This suggests that extension agents and educators should offer more tailored technical information for producers to be able to adopt sustainable BMPs on their own farms and ranches. The data shows that respondents who feel adopting one or more BMP to be extremely desirable also feel that BMPs are extremely good, environmentally beneficial, and extremely valuable. We see that these producers are already supportive of the social and environmental aspects of sustainable agricultural BMPs. Respondents who felt adopting one or more BMP is economically beneficial also felt it was easy, demonstrating that they are understanding of the economic benefits. In a systematic literature review of sustainable agricultural publications, Velten (2015) also found an emphasis on publications that addressed economic efficiency, and adaptations of production practices and technologies, with less

information about food systems and supply chains. The data showed that whether BMP are easy or difficult is not as much of a concern as if they are helpful or pleasant. This group of producers feel they have sufficient information about the environmental benefits of utilizing sustainable BMPs and are supportive of them. This suggests that literature that addresses the social and non-production specific environmental issues of sustainable agriculture, including supply chains and markets, could be well received (Velten et al., 2015). Sustainable agricultural producers need information about how to market and transport their products as opposed to more production specific information.

Subjective Norms

In the TPB, the social influences or pressures perceived by an individual to perform or not perform a behavior are known as the subjective norms. Social norms are broken down into injunctive norms; what behaviors a person thinks he/she should perform, and descriptive norms; the perception that others in a person's social group are or are not performing a behavior.

Respondents with strong subjective norm beliefs are more highly influenced by the people they identify with. They feel that people whose opinions they value think they should use BMP, the people they look up to would approve of their use, and that many agricultural producers across the country use BMP. This shows that the influences of peers and social groups has a significant effect on whether producers feel they can or should use sustainable BMPs. Therefore, educational efforts should not only target potential adopters, but also the organizations they associate with. Respondents did not feel strongly that agricultural producers in their community have started using BMP but

that it is expected that they do use them by their peers; thus, they feel that many agricultural producers they know are *not* reluctant to use BMP. These norms should inform the approach taken to educate agriculturists on the sustainability of BMP. This suggests that while all agriculturalists may have similar environmental, social, and economic goals, it is their social norms that dictate their decisions about BMP (Peuch, 2014).

We have observed that respondents identify themselves as innovators (Figure 16.) and therefore, they are ahead of the curve as compared to their social groups. Information seeking behaviors favored by respondents included Instagram feeds of farmers around the country/world, reading farm publications, and “direct contact with INNOVATORS” (TPB Survey, Anonymous, 2018), further demonstrating that their social groups are made up of innovators and are widely dispersed in Montana (Figure 3), rather than existing in their home communities. Understanding the values of the social groups that sustainable agricultural producers identify with should be an important goal in understanding how to target new audiences with information about sustainable agricultural practices. Changes in beliefs may be the most effective way to reach a broader audience and higher adoption of sustainable BMP among producers (Lynne et al., 1995). Further understanding of the beliefs of MOA producers and their social groups can help facilitate the decision making process surrounding this topic.

Perceived Behavioral Control

Perceived control is important in the decision of whether or not to adopt a practice (Lynne, 1995). Respondents who felt they were capable of using BMP also believe that

many agricultural producers around the country use them and if they want to, they can easily use them as well. Respondents' self identification as innovators and leaders of sustainable agriculture suggests they feel they have already overcome knowledge and technical barriers that still exist for other producers, resulting in a feeling of control over their decisions.

Respondents who believe that the people they respect and admire are seeking information about loans are also somewhat likely to believe that the people whose opinions they value would support their decision to apply for a loan. This suggests that social groups are not having a negative effect on loan interest for this population; but rather, it is the types of loans that are of particular use. In the literature, working conditions and infrastructure have been identified as important (Velten et al., 2015). Respondents had low control beliefs about loan programs. Many respondents have applied for a loan in the past and are aware of services, loans and programs available to them from the Farm Service Agency. As a whole, respondents showed the most interest in future loans that address equipment, land, farm storage facilities and crop disaster assistance needs. Out of 25 responses, 13 respondents showed some interest in loans that would address diversification of their operation. Diversity is an inherent concept in sustainable BMPs. They were least interested in loans that address youth agricultural projects, labor needs, and beginning farmer and rancher assistance. Average age of respondents was 55 years old (Table 2) with the majority falling in the range of 50-59 years. This suggests that they are more established and therefore, may explain the lower interest in the loan programs that target producers in the early stages of their operation.

Lenders would benefit from marketing loans that offer assistance to farmers that allow them to address needs to add long-term diversification to operations with payoffs versus short-term projects and labor needs.

Implication and Recommendations for Future Work

There are many valuable outcomes of this research for understanding the complexity of sustainable agriculture and future possibilities. Producers are more likely to adopt a practice if they perceive that the decision is within their control and if there are positive social norms in their community regarding BMP adoption (Herndl, 2011; Peuch, 2014). Not only is education necessary for producers to know what practices may apply to or improve their operation, but training is also necessary for producers to know how to adopt and utilize practices. Education on social benefits may be the most promising tools to encourage changes in beliefs that will encourage community support, without which adoption may fail (Herndl, 2011; Lynne, 1995; Prokopy, 2008). Technical trainings on and non production specific components to agriculture, such as bringing products to markets, would benefit producers looking to transition to more sustainable BMP's. Sustainable agriculture campaigns focused on the social, economic, and environmental benefits to the entire community, rather than the individual, may have profound effects on adoption rates.

Agriculture and natural resources programs are valuable adult education opportunities to make information available about innovative technologies. Occupational and practical trainings are necessary to keep knowledge current on research and practices (Birkenholz, 1999). The diverse nature of sustainable agriculture requires broad

educational and outreach strategies for producers to be able to sift through information to decide on production practices that work for their operations. Producers in this study are using the Internet as their primary resource for information about sustainable BMP's. Human behavior is complex and combined with a hard to define concept like sustainability requires continuous promotion and adaptation of research-based information, knowledge, attitudes, and practices (Larson & Frisk, 2011). Online education and training opportunities will likely be the most effective way to reach this audience. Paper materials are likely not the most productive use of resources and should only be used as supplementary materials during workshops and conferences that producers do attend.

As mentioned previously, the SEM model specified by the Theory of Planned Behavior was unable to be fit due to the small amount of data. Results suggest that the Theory of Planned Behavior applies to these agricultural producers and that follow-up studies should be done. Future research should include a much larger population of organic and conventional agricultural producers to allow for the SEM model to draw conclusions about these broader populations. The questionnaire should also include more questions that address the intention and perceived behavioral control constructs as these constructs were sufficiently covered to address research objective three. However, knowing more about producers' thoughts in these construct areas could lead to stronger recommendations for outreach education and training. Terms selected for the attitude construct were sufficient based on previous literature, but adding new terms from emerging research can increase the breadth and diversity of this topics. Questions that ask

producers more specifics about their certification experience and their intention to maintain organic certification would also have been valuable.

Re-organization of the questionnaire to be more efficient would be recommended. Questions about information seeking behaviors may have been redundant and unclear. “Local Marketing” as a BMP was unrelated to the other BMPs as it was the only non-production specific behavior and should be re-categorized. The Diffusion of Innovations theory question was very valuable to drawing conclusions about producers’ attitudes, behaviors, and intentions to their social norms and self-identity. Finally, additional information about loan seeking behaviors in a format consistent with the rest of the survey would have been valuable.

While Montana ranks third in the nation for certified organic acres with .45% of acres in agriculture certified organic, the state did not rank in the top ten for sales of organic agricultural products (USDA NASS, 2016; 2017). This is promising for the future growth of organic agriculture in Montana; a state with an agricultural heritage, a lot of land to protect, and an aging producer population. Finding success to increase the proportion of organic agriculture in Montana may require emphasis on education that changes community attitudes and beliefs (Herndl et al., 2011).

Allowing flexibility in the concept and definition of sustainability and sustainable agriculture (Velten, 2015; Peuch, 2014) is likely the most productive way to work within the paradigm. Sustainable agriculture is not a one size fits all approach; by definition it is a broad concept that allows producers to pick and choose what works for their operation to meet economic, ecological, and social goals. Depending on the producers’ background,

sustainability can be a divisive topic for agriculturalists. Future work utilizing the TPB should include researching agriculturalists from all backgrounds on their feelings about non-production specific agricultural concepts and terminology, including common “buzzwords”. There is unlimited potential for uniting divided groups, such as conventional and nonconventional agriculturalists, to solve common problems related to environmental resources, policy, and markets. Conflicts that arise around the concept of sustainability (Constance & Choi, 2010) can be managed through a united approach to education and communication and help to translate different historical, cultural, and political “paradigms into a single common language” (Herndl et al., 2011, p. 439).

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APPENDICES

APPENDIX A

SURVEY INSTRUMENT

Producers' Decisions and Behaviors about Sustainable Agriculture Practices

Q1 Informed consent statement

SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN RESEARCH AT MONTANA STATE UNIVERSITY

Project Title: An Assessment of Influences on Producers' Decision Making and Behaviors about Sustainable Agriculture Practices

You are being asked to participate in a research study exploring influential factors affecting producers' decisions to adopt certain agricultural practices. This may help us obtain a better understanding of the kinds of educational resources producers need to run their operation. You were chosen as a potential participant because of your involvement with agriculture in the State of Montana.

Your participation is voluntary. If you agree to participate, you will be asked to complete an online questionnaire. You can choose to answer or not answer any questions and/or you can stop at any time. Choosing to participate in this research study will only require approximately 15 minutes of your time. If you agree to participate, your responses will be anonymous and confidential.

There are no foreseen risks associated with your participation in this study. Inconveniences are minimal and include the time required to complete the questionnaire. Results of this study will help educators and professionals develop more targeted educational materials and technical assistance resources for producers. There are no costs to participate. You may stop or decline to participate at any time. All data will be kept confidential and available to the researcher only.

Should you have questions about the research, feel free to contact Rebecca Kurnick at (406) 994-5778 or email: rebecca.kurnick@msu.montana.edu. If you have questions or concerns about your rights as a human subject involved in this research, you may contact Dr. Mark Quinn, Institutional Review Board Chairperson, at (406) 994-4707, or email: mquinn@montana.edu.

By continuing with this questionnaire, you give your voluntary informed consent to participate in this research

Q2 Do you consider yourself a farmer, rancher or agricultural producer, OR a full time employee that makes decisions about agricultural operations (having annual sales of at least \$1,000)?

- ☐ Yes
- ☐ No
- ☐ Employee

Skip To: End of Survey If Do you consider yourself a farmer, rancher or agricultural producer, OR a full time employee that... = No

Q3 How many years has your farm or ranch been in operation?

Q4 Please rank the commodities produced on your operation in order of percentage of sales with 1 being the highest percentage and 4 being the lowest percentage.

- _____ Fruits
- _____ Vegetables
- _____ Grains
- _____ Livestock
- _____ Dairy
- _____ Other:

Q5 Please indicate how frequently you use the following Best Management Practices (as defined by USDA Sustainable Agriculture Research and Education program) on your operation?

	Does not apply	Never	Sometimes	Mostly	Always
Conservation tillage (contour, reduced, no-till)	☐	☐	☐	☐	☐
Local Marketing	☐	☐	☐	☐	☐
Whole-farm (holistic) approach	☐	☐	☐	☐	☐
Vegetative wind and water buffers	☐	☐	☐	☐	☐
Cover Crops	☐	☐	☐	☐	☐
Grazing Management	☐	☐	☐	☐	☐
Crop, livestock and landscape biodiversity	☐	☐	☐	☐	☐
Crop and livestock nutrient management	☐	☐	☐	☐	☐
Water conservation management	☐	☐	☐	☐	☐
Ecological insect and weed management	☐	☐	☐	☐	☐
On-farm energy conservation and production	☐	☐	☐	☐	☐

Q6 Choose the remark that best describes your agreement or disagreement with the following statements about the best management practices previously listed.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I intend to use best management practices.	☐	☐	☐	☐	☐
People who are important to me support my using best management practices.	☐	☐	☐	☐	☐
If I want to, I can easily use best management practices.	☐	☐	☐	☐	☐
Over the past few years, agricultural producers in my community have started using best management practices.	☐	☐	☐	☐	☐
It is expected of me by my peers that I use best management practices.	☐	☐	☐	☐	☐
I am planning to use best management practices.	☐	☐	☐	☐	☐
The people I look up to would approve of me using best management practices.	☐	☐	☐	☐	☐
Many agricultural producers I know are reluctant to use best management practices.	☐	☐	☐	☐	☐

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Whether or not I use best management practices is completely up to me.	☐	☐	☐	☐	☐
Most people whose opinions I value think that I should use best management practices.	☐	☐	☐	☐	☐
I am capable of using best management practices.	☐	☐	☐	☐	☐
I will make an effort to use best management practices.	☐	☐	☐	☐	☐
The use of best management practices is common among agricultural producers like me.	☐	☐	☐	☐	☐
I have complete control over using best management practices.	☐	☐	☐	☐	☐
Many agricultural producers across the country use best management practices.	☐	☐	☐	☐	☐

Q7 Please rate each remark on a scale of 1-7 to best describe how you feel about the following statements.

For me, adopting one or more previously listed Best Management Practices would be:

	1	2	3	4	5	6	7	
extremely interesting	☐	☐	☐	☐	☐	☐	☐	extremely boring
extremely desirable	☐	☐	☐	☐	☐	☐	☐	extremely undesirable
extremely good	☐	☐	☐	☐	☐	☐	☐	extremely bad
extremely valuable	☐	☐	☐	☐	☐	☐	☐	extremely worthless
socially beneficial	☐	☐	☐	☐	☐	☐	☐	socially harmful
economically beneficial	☐	☐	☐	☐	☐	☐	☐	economically harmful
environmentally beneficial	☐	☐	☐	☐	☐	☐	☐	environmentally harmful

Q8 Choose one remark that best describes your position on the following statements.

When it comes to adopting Best Management Practices, I am (a):

- ☐ Risk taker, the first to adopt
 - ☐ Leader, will adopt before most people
 - ☐ Deliberator, will adopt after much consideration
 - ☐ Reluctant, will adopt only when necessary
 - ☐ No interest in adopting
-

Q9 Please rate how frequently you use each of these sources to obtain information about Best Management Practices.

	Daily	Weekly	Monthly	Rarely	Never
Internet search (such as Google)	☐	☐	☐	☐	☐
Local Cooperative Extension Office	☐	☐	☐	☐	☐
USDA National Agriculture Library (online)	☐	☐	☐	☐	☐
Sustainable Agriculture Research Education (SARE)	☐	☐	☐	☐	☐
Farm Service Agency (FSA)	☐	☐	☐	☐	☐
Family	☐	☐	☐	☐	☐
Neighbors	☐	☐	☐	☐	☐
Other:	☐	☐	☐	☐	☐

Q10 Please rate how frequently you use each of these communication channels to obtain information about Best Management Practices.

	Daily	Weekly	Monthly	Rarely	Never
Visit a website	☐	☐	☐	☐	☐
Watch TV	☐	☐	☐	☐	☐
Printed publications (brochures, fact sheets)	☐	☐	☐	☐	☐
Read a newspaper article	☐	☐	☐	☐	☐
Watch a video	☐	☐	☐	☐	☐
Participate in a seminar or conference	☐	☐	☐	☐	☐
Attend a short course or workshop	☐	☐	☐	☐	☐
Face to face conversation	☐	☐	☐	☐	☐
Online social networking	☐	☐	☐	☐	☐
Email	☐	☐	☐	☐	☐
Other:	☐	☐	☐	☐	☐

Q11 Please rate each remark on a scale of 1-7 to best describe how you feel about the following statements.

For me Best Management Practices are:

	1	2	3	4	5	6	7	
Pleasant	☐	☐	☐	☐	☐	☐	☐	Unpleasant
Helpful	☐	☐	☐	☐	☐	☐	☐	Not Helpful
Easy	☐	☐	☐	☐	☐	☐	☐	Difficult

Q12 Have you ever applied for a loan to finance your agricultural operation?

☐ No

☐ Yes

☐ If no, why not? _____

Q13 How would you rate the accessibility of obtaining agricultural loan information?

☐ Extremely difficult

☐ Somewhat difficult

☐ Neither easy nor difficult

☐ Somewhat easy

☐ Extremely easy

Q14 Are you aware of the Farm Service Agency services, loans and programs?

- ☐ No
 - ☐ Maybe
 - ☐ Yes
-

Q15 If you were to apply for loans, which of the following areas would you seek funding for? Please choose all that apply.

	Yes	Maybe	No
Youth agricultural project	☐	☐	☐
Farm storage facilities	☐	☐	☐
Land	☐	☐	☐
Equipment	☐	☐	☐
Labor	☐	☐	☐
Crop disaster assistance	☐	☐	☐
Business management	☐	☐	☐
Diversification of operation	☐	☐	☐
Marketing	☐	☐	☐
Organic certification	☐	☐	☐
Beginning farmer and rancher assistance	☐	☐	☐

Q16 Choose the remark that best describes your agreement or disagreement with the following statements.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I would utilize loan programs if there was technical or financial assistance available.	☐	☐	☐	☐	☐
Most people whom I respect and admire are seeking information about available loans.	☐	☐	☐	☐	☐
The people whose opinions I value would support my decision to apply for a loan.	☐	☐	☐	☐	☐
I have complete control over using loan programs.	☐	☐	☐	☐	☐
I plan on seeking more information about available loans.	☐	☐	☐	☐	☐

Q17 What information would you like to learn more about related to potential loan programs? Please select all that apply.

- ☐ Eligibility requirements
- ☐ Paperwork involved
- ☐ Service fees and premiums
- ☐ Application procedure
- ☐ Loan guidelines
- ☐ Funding assistance
- ☐ Coverage levels and periods
- ☐ Loan term requirements
- ☐ Borrower responsibilities
- ☐ Qualifying crops
- ☐ Other, please explain. _____

Q18 What is your age?

Q19 With which gender do you most identify?

- ☐ Male
- ☐ Female
- ☐ Other

Q20 What Montana county is your farm or ranch located in?

Q21 Select the situation that best describes the majority of the land in your operation.

- ☐ Own
- ☐ Lease
- ☐ Other, please explain _____

Q22 Please choose which best describes your situation.

- ☐ Farming is the primary occupation (greater than 50%) of my time.
- ☐ The farm operator has a primary occupation (greater than 50% of the time) other than farming.
- ☐ The farm operator is retired but continues to farm.
- ☐ Other _____

Q23 Approximately how many acres do you use for agricultural production?

Q24 Please choose which best describes the scale of your operation.

- ☐ Small family farm (less than \$10,000 gross farm income)
- ☐ Small family farm (\$10,000 to \$99,999 gross farm income)
- ☐ Small family farm (\$100,000 to \$249,000 gross farm income)
- ☐ Midsize family farm (\$350,000 to \$999,999 gross farm income)
- ☐ Large family farm (\$1,000,000 to \$4,999,999 gross farm income)

APPENDIX B

MOA REQUEST LETTER

Hello Montana Organic Association Growers,

I hope this email finds you well. My name is Rebecca Kurnick and I am a graduate student at Montana State University in Agricultural Education. I am working with Dr. Shannon Arnold, Dr. Alison Harmon, Dr. Dustin Perry, and Dr. Mac Burgess on my research exploring agricultural producers' decisions regarding sustainable practices and your knowledge of services, loans, and programs available to you.

We are contacting you to request your participation in a 10 minute survey. In the spirit of collaboration, this project is endorsed by the Executive Committee of the Board of the Montana Organic Association, and has also been supported the Montana Department of Agriculture and AERO. The information gained will help agricultural organizations, such as MOA, to understand the influencing factors on producers' decisions and can enhance outreach and educational materials, with possible benefits to membership.

On Monday, February 5th you will receive and email from the survey platform, Qualtrics, that is administered by MSU. In that email, there will be a link to click that will take you to the online survey to be filled out. This platform will record all answers anonymously.

If you choose to participate, we ask that you complete the survey by Monday, February 19th.

Please consider completing the survey. Your participation is voluntary, but your input will help us understand the needs of producers in our state and is much appreciated.

Many thanks,

APPENDIX C

IRB APPROVAL



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
 c/o Microbiology & Immunology
 Montana State University
 Bozeman, MT 59718
 Telephone: 406-994-6783
 FAX: 406-994-4303
 E-mail: cherylj@montana.edu

Chair: Mark Quinn
 406-994-4707
 mquinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-4706
 cherylj@montana.edu

MEMORANDUM

TO: Rebecca Kurnick and Shannon Arnold

FROM: Mark Quinn *Mark Quinn es*
 Chair, Institutional Review Board for the Protection of Human Subjects

DATE: October 9, 2017

RE: "An Assessment of Influences on Sustainable Agriculture Producers' Decisions to Adopt Innovative Technologies" [RK100917-EX]

The above research, described in your submission of October 9, 2017, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- ☐ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- ☒ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- ☐ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- ☐ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- ☐ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- ☐ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX D

IRB TRAINING CERTIFICATE

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

• **Name:** Rebecca Kurnick (ID: 5827290)
 • **Institution Affiliation:** Montana State University (ID: 1096)
 • **Institution Email:** rebecca.kurnick@msu.montana.edu
 • **Institution Unit:** Agriculture Education
 • **Phone:** 406-994-5778

• **Curriculum Group:** Social and Behavioral Research Investigators/ Faculty
 • **Course Learner Group:** Social & Behavioral Research - Basic/Refresher
 • **Stage:** Stage 1 - Basic Course
 • **Description:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

• **Record ID:** 20883302
 • **Completion Date:** 13-Jun-2017
 • **Expiration Date:** 12-Jun-2020
 • **Minimum Passing:** 80
 • **Reported Score*:** 85

REQUIRED AND ELECTIVE MODULES ONLY

	DATE COMPLETED	SCORE
Cultural Competence in Research (ID: 15166)	05-Jun-2017	5/5 (100%)
Belmont Report and CITI Course Introduction (ID: 1127)	05-Jun-2017	3/3 (100%)
Students in Research (ID: 1321)	06-Jun-2017	4/5 (80%)
History and Ethical Principles - SBE (ID: 490)	06-Jun-2017	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	13-Jun-2017	5/5 (100%)
The Federal Regulations - SBE (ID: 502)	13-Jun-2017	4/5 (80%)
Assessing Risk - SBE (ID: 503)	13-Jun-2017	4/5 (80%)
Informed Consent - SBE (ID: 504)	13-Jun-2017	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	13-Jun-2017	4/5 (80%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	13-Jun-2017	2/5 (40%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k38e8801c-65ae-4391-b439-4bc032b58c5f-20883302

Collaborative Institutional Training Initiative (CITI Program)

Email: support@citiprogram.org

Phone: 888-529-5929

Web: <https://www.citiprogram.org>