UNDERSTANDING DETERMINANTS OF BEST MANAGEMENT PRACTICE ADOPTION WITH GEORGIA COTTON AND PEANUT PRODUCERS

by

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(Under the Direction of Abigail Borron)

ABSTRACT

The agricultural industry has garnered significant attention in recent years over concerns about the potential impacts of current production practices on the environment. While current discourse on the future of agriculture calls for sustainable intensification, measurable environmental improvements can be made through the adoption of best management practices. To better understand Georgia cotton and peanut farmers' motivations and barriers to the adoption of best management practices, this research applies the theory of planned behavior (Ajzen, 1991) to examine which factors influence cotton and peanut producers' adoption decisions regarding best management practices. This thesis uses a mixed methods approach of surveying and interviewing farmers to paint a full picture of the relevant decision-making factors for best management practice adoption. The findings of this study offer valuable insights for agricultural and conservation stakeholders to supplement BMP outreach and education efforts by targeting the specific needs, capacities, and preferences of farmers.

INDEX WORDS: Best management practices, Non-point source pollution, Adoption, Theory of planned behavior, Agriculture, Q methodology

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DEDICATION

This thesis is dedicated to all the men and women in the agricultural industry who work tirelessly to conserve our natural resources while also producing enough food and fiber to support our growing population.

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CHAPTER 1

INTRODUCTION

Structure of Thesis

This thesis contains five chapters that include an introduction, a review of the literature two research articles, and a conclusion chapter. Each of these chapters delve into farmers' perceptions of and influences on conservation/best management practice (BMP) adoption for further evaluation. The first article (Chapter 3) of this research uses a quantitative survey questionnaire to identify influences on BMP adoption among cotton and peanut farmers in Georgia. Article two (Chapter 4) applies a mixed methods approach that employs Q methodology to identify and examine the factors that influence farmers' decision making toward BMPs in southwest Georgia. The methods of this article include a statement sorting exercise followed by semi-structured interviews to elicit a better understanding of the subjectivities and decision-making processes of farmers when they are considering implementing conservation practices. Through a collaborative effort with University of Georgia Cooperative Extension, this research attempts to capture the perceptions of farmers toward BMPs and identify potential influences on BMP adoption among cotton and peanut farmers in Georgia.

Introduction

The global population has been rapidly increasing over the past century. This trend is expected to continue, resulting in a demand for a 50% increase in food production by 2050 (FAO, 2017). Despite these obstacles to feeding the world, agricultural production has consistently outpaced population growth. To meet the increased demand for food production, agriculture has intensified land cultivation through advancements in technology, biology, and chemistry, which consequently increased its environmental impacts (Sadowski & Baer-Nawrocka, 2018). The negative impacts on the climate and water quality from unsustainable agricultural practices have been widely acknowledged by environmental research over the past few decades (Ribaudo & Shortle, 2019; Vermeulen et al., 2012). Explicit examples of the environmental degradation from agriculture that is commonly acknowledged in the literature include animal waste pollution, an increasing loss of topsoil, nutrient runoff into waterways, and pesticide residues. This has led to many Americans believing that farmers do not conserve natural resources, and that they put profits ahead of environmental stewardship (Harris, 2002). However, American farmers tend to consider themselves as good stewards of the land (Ahnstrom et al., 2009). This dichotomy of perceptions dates back to the 1980s and has sparked tension in the agricultural industry surrounding the legitimacy of the need to integrate more sustainable practices into conventional agricultural production (Cassman & Grassini, 2020; Gomiero et al., 2011; Pretty & Bharucha, 2014; Rodenburg et al., 2020). As calls to sustainably increase production continue, farmers can potentially eliminate these concerns by implementing recommended conservation/best management practices (Chiang et al., 2014; Dobbs & Pretty, 2004; Elliot & Mumford, 2002; MEA, 2005; Pretty, 2008).

Conservation/best management practices (BMPs) are methods meant to practically and effectively prevent or reduce pollution from non-point sources to increase water quality. These practices have been found to be effective for increasing economic and environmental benefits while also reducing impairments to water quality (Chiang et al., 2014). A few of the common BMPs in agriculture include the use of cover crops, reduced tillage, nutrient management plans, crop rotation, and riparian buffers (Liu et al., 2017). These practices focus on reducing nutrient runoff and leaching, water usage, and soil erosion. The benefits of BMPs have a compound effect that not only reduces water pollution, but also alleviates compaction of the soil, protects air quality, increases long-term soil health, reduces fertilizer costs, and increases the water retention capabilities of the soil (Liu et al., 2017).

The role of BMPs is not only integral for preserving natural resources, but the use of these practices has also been found to bring many on-farm benefits to farmers such as weed control, increased soil health, and improved yields (Bergtold et al., 2012; Busari et al., 2015; Midingoyi et al., 2019). As changing environmental patterns such as climatological changes and urban sprawl threaten the longevity of traditional farming practices (Campbell et al., 2016; Lobell et al., 2011; Torbick & Corbiere, 2015), sustainable approaches that allow farmers to successfully adapt to these environmental changes are crucial for enabling farmers to have the best chances of long-term success. This has led entities like the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), and Cooperative Extension to emphasize the importance of adopting BMPs to farmers (Hadrich & Van Winkle, 2013; Savage & Ribaudo, 2013).

History of BMPs

The agricultural industry has been characterized as a significant contributor to environmental degradation since the environmental movement began in the 1960s, following the publication of Rachel Carson's *Silent Spring* (Logan, 1993). Just as environmental researchers began identifying the effects of nutrient and pesticide runoff from agriculture, American farms were faced with the soil erosion crisis of the 1970s (Garcia-Ruiz et al., 2016; Logan, 1993; Trimble & Crosson, 2000). Negative public sentiment toward agriculture was reignited in the 1980s with the events that transpired in Love Canal in New York and Times Beach in Missouri, when chemicals leached into ground water (Logan, 1993). Although significant attention and research efforts related to agricultural water pollution became more common at this time, concerns about the impacts from agricultural runoff on water quality date back to the Dust Bowl of the 1930s (Ice, 2004). This era marked a period of intense wind erosion, which created dust storms that were caused by loose soil from unsustainable agricultural practices and severe drought in the Great Plains of North America (Lee & Gill, 2015). An outcome from this agricultural disaster was the creation of the Soil Conservation Act of 1935 (Ice, 2004). This act developed a list of feasible land management practices for the protection of natural watershed functions and began an effort to increase soil conservation through U.S. agriculture. However, these practices were outrivaled by the adoption of rapid advancements in chemistry and technology in the following decades that ultimately gave rise to unprecedented water pollution concerns from leaching and runoff of synthetic chemical applications on farms (Logan, 1993). These newfound problems led policymakers to begin developing plans that attempted to control and prevent water pollution from agriculture.

To be able to establish policies and programs that remediated water pollution, the federal government needed to determine a method of distinguishing the specific sources of water pollution. In response to the evidence of nutrient runoff and soil erosion from unsustainable farming practices associated with agricultural intensification in the 1960s, the U.S. government significantly amended the 1948 Federal Water Pollution Control Act to create the Clean Water Act in 1972 (EPA, n.d.-b). These sweeping changes also included wording that differentiated pollution into two classes. Water pollution could now be referred to in two ways: point-source pollution, which can be distinguished based on the source of the pollution coming from a single identifiable discharge point such as a sewage pipe; and non-point source (NPS) pollution, which is more difficult to treat due to the pollution stemming from diffuse sources that typically come from many different sources like contaminated water runoff from urban areas, construction sites, and farms (Campbell et al., 2011).

Despite NPS pollution from agriculture typically being unintentional, its occurrence creates a gradual release of pollutants into water sources over time (GASWCC, 2013). The EPA (2005) describes NPS pollution as water runoff from rain, irrigation, and snowmelt that accumulates natural and synthetic pollutants such as animal manure and synthetic fertilizer, as it travels across land and into surface water and ground water. A few agricultural practices that are likely culprits of NPS pollution include overgrazing cattle, intensive tillage, and overapplication of fertilizers and pesticides (EPA, 2005). While agriculture is far from being the sole contributor to NPS pollution, farmers' decision to utilize BMPs serves a crucial role in reducing nutrient runoff and leaching (Chiang et al., 2014).

Although the Clean Water Act contained measures to decrease NPS pollution, it did not create mandatory stipulations for those who pollute. Instead, the act gave states the responsibility to manage agricultural NPS pollution and gave the USDA orders to give farmers technical assistance and financial incentives for reducing NPS pollution by adopting BMPs (Ribaudo & Shortle, 2019; Shortle et al., 2012; Shortle & Uetake, 2015; Thompson, 2011). Despite this attempt to combat the problem, no significant improvements in water quality were seen, thus leading to an amending of the 1972 Clean Water Act with Section 319 being added in 1987 to provide federal leadership and funding for states to implement methods of reducing NPS pollution (Campbell et al., 2011; Logan, 1993; Salzman & Thompson, 2003). One of these methods to reduce NPS pollution included concentrated efforts to increase adoption of BMPs that reduce water pollution and soil erosion.

Need for Study

Nearly half of all rivers and streams in the U.S. have excess nutrients, and agriculture is attributed with being a primary source of this nutrient pollution (EPA, n.d.-a). Although NPS pollution from agricultural areas is a persistent problem across the U.S., it can be controlled through the implementation of BMPs (Chiang et al., 2014). As these practices are meant to effectively reduce NPS pollution from agriculture, specific farming practices are selected and recommended to farmers from agricultural agencies based on the local farming contexts to account for the differences in environmental variables for specific crops and regions (Sharpley et al., 2006). Yet the adoption of these practices varies depending on the region and type of crops produced (Wade et al., 2015).

As states have taken different measures to control NPS pollution from agriculture, a large amount of research has investigated farmer adoption of these practices across the U.S. (Prokopy et al., 2019; Thompson et al., 2021; Wang et al., 2019). While these studies have examined various conservation practices and investigated many different areas of food and fiber production (Adusumilli & Wang, 2018; Rahelizatovo & Gillespie, 2004; Reimer et al., 2012), most of these studies in the U.S. have focused on the Midwest and Mid-Atlantic regions (Akkari & Bryant, 2017; Arbuckle & Roesch-McNally, 2015; Prokopy et al., 2008; Reimer et al., 2012; Schall et al., 2018). Although many solutions have been proposed and even implemented to control NPS pollution, it continues to be a serious issue that requires more localized studies to determine the best methods for identifying and abating the barriers to adoption of farm management practices that protect water quality (Dowd et al., 2008). This finding contributes to the growing body of literature stating that the current approaches to increase BMP adoption have not created legitimate improvements, thus suggesting that conservation adoption behaviors need to be better understood before future approaches are implemented (Liu et al., 2018). And while there is minimal conservation practice adoption literature examining major row crops in the Southeastern U.S. like cotton and peanuts, this research seeks to address this gap in the literature by focusing this research on the state of Georgia, which is one of the leading producers of cotton and peanuts in the U.S (Kane, 2021).

With a combined farm gate value of over $1.6 billion, the production of cotton and peanuts play a vital role in sustaining Georgia's economy (Kane, 2021). This major contribution to the state economy and rural communities in Georgia provides evidence for the critical need to sustain the production of these two crops for the future by using BMPs (Mishra et al., 2018). As climate change and projected population increases require agriculture to adapt and become more efficient, cotton and peanut farmers face a growing challenge to increase productivity while simultaneously balancing environmental stewardship. One potential avenue to propel the use of sustainable agricultural practices in Georgia cotton and peanut production is to provide policymakers, researchers, and practitioners, such as NRCS and Cooperative Extension with a stronger comprehension of the perceptions farmers have toward conservation practices. Behavioral insights of farmers not only benefit practitioners that seek to increase conservation practice adoption, but these insights can also provide important contributions to policymakers by informing future agricultural policy decisions that can potentially boost environmental stewardship (Dessart et al., 2019). This is especially true when considering efforts from agricultural practitioners to persuade farmers to voluntarily adopt conservation practices.

In Georgia, the agricultural entities who promote and help implement BMPs are mostly government agencies, such as NRCS, University of Georgia (UGA) Cooperative Extension, Georgia Department of Natural Resources (GADNR), Georgia Soil and Water Conservation

Commission (GASWCC), and the USDA Farm Service Agency (USDA FSA) (Hawkins & Wallace, 2013). These agencies have different responsibilities in relation to promoting BMPs, which include managing conservation incentive programs, educating farmers about conservation practices, and providing technical assistance to farmers. While each of these entities seek to increase farmers' adoption of BMPs, this research emphasizes the role of Cooperative Extension, as this entity serves as the primary liaison working to educate farmers and make recommendations about production decisions based on university research.

UGA Cooperative Extension agents work with farmers to suggest and implement the best practices that fit the specific needs of the individual's farm. The communication of innovations and knowledge in the field of agriculture has primarily been a top-down model in which scientists and researchers create solutions to agricultural problems that are then communicated to farmers by Cooperative Extension agents and educators. Farmers use this resource to seek help with production issues and to get expert advice about management decisions (Bruening & Martin, 1992; Martin & Cooke, 2002). The UGA Cooperative Extension system has been communicating the most up to date research-based information to farmers for over a century (UGA Extension, n.d.), and to compliment these services provided to farmers, this research aims to assist the enhancement of Cooperative Extension's educational and outreach efforts regarding BMPs for cotton and peanut production.

While there is no single solution to increase adoption, decades of BMP adoption research have found interpersonal contact and relationship building between farmers and conservation practitioners such as Cooperative Extension, oftentimes increases the prospect of adoption (Baumgart-Getz et al., 2012; Knowler & Bradshaw, 2007; Liu et al., 2018; Prokopy et al., 2019; Prokopy et al., 2008; Ranjan et al., 2019). With Cooperative Extension agents and educators being present in nearly every county in Georgia, this can be leveraged to promote conservation practice adoption while simultaneously building relationships and establishing trust with farmers. As Cooperative Extension seeks to educate farmers and help them solve agricultural problems, it can be a valuable resource for farmers. The recommendations made by Cooperative Extension and other practitioners who work with farmers to increase adoption of conservation practices, must ensure the conservation practices they are recommending are not only scientifically sound, but also economically feasible (GAEPD, 2019).

In response to the Water Quality Act of 1987, Georgia began developing management programs for NPS pollution (GAEPD, 2019). This led to the GASWCC being put in charge of managing agricultural NPS pollution within the state. Through decades of research and evaluation of conservation practices with the collaboration of the USDA and the UGA College of Agricultural and Environmental Sciences, the GASWCC developed a manual of voluntary conservation practices that serve to reduce NPS pollution (GAEPD, 2019). The most recent list of conservation practices specifically created for Georgia agriculture were released in the GASWCC 2013 manual on BMPs (GASWCC, 2013). This list of BMPs includes practices that are relevant to row crop production in Georgia. When used properly, BMPs are very effective in reducing NPS pollution (GAEPD, 2019). Many of the environmental and production benefits that are attributed with BMPs are primarily achieved through the implementation of specific practices such as conservation tillage, cover crops, nutrient management plans, and proper irrigation management (Cassman & Grassini, 2020).

For the purposes of this research, practices that were determined to be the most relevant for cotton and peanut production were selected from the GASWCC list of BMPs for further investigation (GASWCC, 2013). The selected practices along with respective descriptions of each practice can be seen in Table 1.1.

Table 1.1
Best Management Practices for Cotton and Peanut Production in Georgia

Best Management Practices (BMPs)	Description
Cover Crops	A practice that includes using close-growing grasses, legumes, and forages as a temporary cover to reduce soil erosion, capture and use excess nutrients, and improve soil quality
Crop Rotation	A planting system in which different crops are planted in a recurring sequence on the same fields
Nutrient Management Plans	A planning and record keeping process to assist farmers with improving the management of nutrient use for higher efficiency and a reduction of nutrient runoff
Conservation Tillage	The use of any tillage system that maintains at least 30% residue cover on the soil surface after planting; this includes mulch tillage, strip tillage, no-tillage, reduced tillage, and ridge tillage
Field Borders	Permanently vegetated borders established around fields and pastures to reduce soil erosion, protect water quality, provide wildlife habitats, and stabilize streambanks and channels. This also includes hedgerows, riparian forest buffers and critical area planting
Water and Sediment Control Basins	An impoundment constructed to temporarily capture runoff, trap sediment, reduce soil erosion and improve water quality. This also includes irrigation land leveling, underground outlets, irrigation recovery systems, subsurface drains, and alternative water systems
Irrigation Water Management	A management plan designed to efficiently use irrigation water by determining and controlling the rate, amount, and timing of irrigation water. This also includes the use of microirrigation, sprinklers, and other precision irrigation technologies.
Integrated Pest Management	A management plan that uses environmentally sensitive practices to control weeds, insects and disease on fields and pastures to reduce negative effects on humans, soil, and water quality

Statement of Problem

The current production model for American agriculture demands high yields and efficiency while attempting to balance environmental concerns (Thompson et al., 2015). A third of the total land area in the U.S. is managed by farmers who face arduous economic and financial pressure while also being confronted by constant environmental concerns. Therefore, the motivations and decision-making of farmers ultimately make positive or negative impacts on the environment. Nowak (2009) suggests that these impacts can be seen through an emphasis on the sustainability and resiliency of farm operations, or through unsustainable agricultural intensification as the result of focusing on short-term returns at the expense of land degradation. However, sustainable farming is not limited to BMP adoption, and a farmer's decision to adopt conservation practices is a long-term commitment that requires significant time, effort, and financial resources (Dessart et al., 2019).

While a strong incentive to the adoption of BMPs can be attributed with the opportunity to increase profits and reduce yield variability, other direct and indirect benefits to farmers such as increased yields and cash crop savings are also major considerations farmers contemplate when considering adoption (Bergtold et al., 2019; Pannell, 1999). Despite the well-documented benefits of BMPs, challenges to adoption could range from many direct or indirect factors with perceived risk being a notable driver of behavior (Bergtold et al., 2012; Wang et al., 2021). Given the uncertainty surrounding future costs and yield benefits from investing in conservation practices, the risk associated with adopting conservation practices is likely to cause concern among farmers. When farmers in an area adopt conservation practices, it can influence other farmers who are risk-averse, to see the actualized net impact of these practices on farms and increase their likelihood of adoption (Ramsey et al., 2019).

As voluntary adoption of BMPs has not reached the desired levels, an ongoing debate has ensued over whether conservation practices should be regulated or voluntary. The support policy makers, farmers, and conservation practitioners hold toward voluntary adoption of conservation practices encourages the idea that strict environmental regulations are costly and ineffective

(Thompson et al., 2015; Zaring, 1996). In the U.S., agricultural conservation policies put forth by the Farm Bill have primarily focused on incentive-based programs with the goal of increasing environmental quality through farmers receiving payments by voluntarily adopting certain management practices designed to improve environmental outcomes (Wu et al., 2004). As several studies have investigated farmer participation in these programs (Arbuckle, 2013; Chapman et al., 2019; Reimer & Prokopy, 2014), various factors such as farm characteristics, intrinsic motivations, social influences, and farmer demographic variables have all been found to influence participation (Bremer et al., 2014; Chapman et al., 2019; Christensen et al., 2011; Zanella et al., 2014).

The most notable conservation programs put forth by the Farm Bill include the Conservation Reserve Program (CRP), the Conservation Stewardship Program (CSP), and the Environmental Quality Incentives Program (EQIP) (USDA, 2019). As the Conservation Reserve Program (CRP) is the oldest among conservation programs in the U.S., it seeks to retire production land in environmentally sensitive areas through providing multi-year contractual payments to farmers so long as certain requirements are met by the farmer (Reimer & Prokopy, 2014; USDA FSA, 2019). While the size of the CRP in terms of retired acres is the largest of Farm Bill programs, there has been a policy shift in recent years to move toward programs like EQIP which target active production land through providing farmers cost-share payments and technical assistance in their adoption of conservation practices (USDA, 2019; USDA NRCS, 2022). The other popular agri-environmental program known as CSP takes a similar approach to CRP by paying farmers for meeting certain environmental outcomes on their production land (USDA, 2019).

While participation in these programs is voluntary, studies have found that some farmers adopt conservation practices without receiving financial compensation through cost-share programs (Meijboom & Stafleu, 2016; Osmond et al., 2015). This finding shows how nonfinancial motivations can play a large role in farmer decision-making (Vaske et al., 2020). Billions of dollars have been spent on incentives for farmers to adopt conservation practices over the past few decades (Duriancik et al., 2008; Napier, 2009; Reimer et al., 2012; Robinson & Napier, 2002). Yet agriculture continues to contribute to water quality impairment from NPS pollution (EPA, n.d.-a; Poudel, 2016; Zaring, 1996). Although there has been steady research in recent years promoting the effectiveness of BMPs, adoption rates remain low, thus continuing the trend of NPS pollution from agriculture (Liu et al., 2018).

Heterogeneity and complexity of farm operations have made it difficult to determine which factors consistently influence conservation practice adoption. The resulting lack of conservation practice adoption among farmers has frustrated policymakers, researchers, and Cooperative Extension agents that promote these conservation practices (Llewellyn, 2007; Pannell et al., 2006). The difficulty of implementing conservation practices is that it takes voluntary cooperation from diverse stakeholders including practitioners who work with farmers, policymakers, and the farmers themselves (Welch & Marc-Aurele, 2001). While BMP adoption rates are still too low to make the needed improvements in most watersheds, it should be noted that conservation tillage is one BMP that has started to gain traction among farmers in the Southeast and is becoming more commonly used in conventional agriculture (Bergtold et al., 2020; McLellan et al., 2018).

This trend can be seen in Georgia as farmers have slowly moved toward greater rates of BMP adoption in recent years. For example, the amount of harvested cropland in Georgia that utilizes conservation tillage grew from 44% in 2012, to 49% in 2017 (NASS, 2019). However, the adoption of cover crops is much lower with nearly 15% of harvested cropland in Georgia using this BMP (NASS, 2019). The calls for increased adoption of BMPs have continued as slow rates of adoption not only result in a loss of potential benefits for farmers, but it also hinders efforts to reduce soil erosion and nutrient runoff (Llewellyn, 2007). Agricultural policies are becoming more sustainability and conservation oriented, and for environmental stewardship to become the norm in agriculture, farmers are called to lead by example to promote BMPs and thus create widespread change in conservation behaviors (Bergtold et al., 2020).

Purpose and Research Objectives

The purpose of this research is to explore influences on BMP adoption among cotton and peanut farmers in Georgia. The intent of this project is to describe which factors influence farmers' adoption behavior and provide a better understanding of the decision-making process of farmers when they consider implementing conservation practices. This research aims to address the following research objectives:

1. Describe the sociodemographic characteristics of Georgia cotton and peanut farmers.
2. Describe Georgia cotton and peanut farmers' attitudes toward, subjective norms about, perceived behavioral control towards, and intent to adopt best management practices.
3. Describe Georgia cotton and peanut farmers' knowledge and moral norms related to best management practices.
4. Examine relationships between Georgia cotton and peanut farmers' attitudes, subjective norms, perceived behavioral control, knowledge, and moral norms, to their intent to adopt best management practices.
5. Explore farmers' perceptions of best management practices.

6. Determine which aspects of farm management farmers identify as having the greatest influence on their decision to utilize best management practices.

Context of Study

This research uses a mixed methods design to collect data in a sequential manner. This approach separates the research into two articles. Chapter 3 (Article one) addresses research objectives one, two, three, and four by examining common influences on cotton and peanut farmers intentions to adopt BMPs in Georgia by applying an expanded model of the theory of planned behavior to analyze data from a quantitative survey questionnaire. Chapter 4 (Article two) addresses research objectives five and six to provide a deeper look into how the subjectivities held by cotton and peanut farmers in southwest Georgia can influence their thoughts and opinions toward the use of BMPs. The data for this article was collected using a research method known as Q methodology. These methods allowed participants to reveal their thoughts, opinions, and understandings of conservation practices. The value of these studies is that the findings can shed light on the influences, motivations, and barriers for adoption of BMPs among Georgia cotton and peanut farmers.

Significance of Study

A frequent proposal of the literature cites a need for the adoption of conservation practices to increase across agriculture so that environmental degradation will subside (Doering et al., 2007; Ribaudo & Shortle, 2019; Sheeder & Lynne, 2011; Vermeulen et al., 2012). Much of the literature looking into farmer motivations for conservation behavior applies an oversimplified view of classifying motivations of farmers based on them taking a profit-driven economical approach or having a stewardship mindset (Chouinard et al., 2008; Prokopy et al., 2019). By condensing all the nuances of decision-making behaviors into two groups to predict future adoption of BMPs, individual-level and other structural factors are ignored (Prokopy et al., 2019). The literature widely recognizes that the adoption of conservation practices can be heavily influenced by many factors including personal, cultural, economic, and social variables (Pannell et al., 2006). By more precisely identifying the motivations and experiences of farmers, practitioners can educate farmers about the most appropriate conservation practices for their farms.

A stronger understanding of farmer motivations regarding BMP adoption will also give insights into the context of how farmers prioritize management decisions. By providing a deeper understanding of how farmer motivations and other management factors influence adoption of conservation practices, sustainable intensification through higher adoption rates may be actualized without increasing incentive programs (Claassen et al., 2018). With cost share programs not creating the desired levels of adoption, evidence shows that attitudinal variables may play a more significant role than previously thought (Lynne et al., 1988; Schneider & Francis, 2006). This has led to researchers employing socio-psychological approaches to explore the role of intrinsic and extrinsic motivations for influencing management decisions (Best, 2010; Lynne et al., 1988; Morris & Potter, 1995; Nassauer & Westmacott, 1987; Prokopy et al., 2019; Reimer et al., 2012; Sheeder & Lynne, 2011).

The expectations farmers hold about conservation practices is that the adoption of conservation practices must result in helping them achieve the specific goals for their farm (Pannell et al., 2006). Since individual farm goals can range from economic, environmental, or social outcomes, the decision to adopt conservation practices is dependent upon the subjective views and expectations of farmers. Although BMPs have been implemented at national and regional scales, farmers must be able to understand how these practices can fit within their local contexts and account for variables such as soil types, rainfall, and many other environmental factors, for it to be feasible to engage in adoption behavior (Giri & Nejadhashemi, 2014; Giri et al., 2014; Jackson-Smith et al., 2010).

Definition of Terms

The key terms below are presented throughout the research:

- *Attitudes*— the degree to which an individual positively or negatively views a specified behavior (Ajzen, 1991)
- *Best management practice (BMP)*— a practice or combination of practices determined by a state or designated planning agency to be the most effective and feasible means of preventing or reducing the pollutant generated by non-point sources to a level that meets water quality goals (GASWCC, 2013)
- *Concourse*— a conglomeration of all potential thoughts and opinions about a certain topic (Brown, 1993)
- *Intention*— an individual's motivation or likelihood to perform a specified behavior (Ajzen, 1991)
- *Knowledge*— information about a specified behavior that an individual has familiarity or awareness of (Bagheri et al., 2019)
- *Moral norms*— internal values or ethics that an individual feels are important to follow when considering performing specific behaviors (Bamberg & Moser, 2007)
- *Non-point source (NPS) pollution*— pollution from diffuse sources that originates as water runoff from hydrologic cycles accumulates natural and man-made pollutants as it travels across land and enters surface and ground waters, which makes it difficult to separate contributors to the original source of pollution (EPA, 2005)

- *Perceived behavioral control*— an individual's perceptions of potential barriers or needs to be able to engage in a specified behavior (Ajzen, 1991)
- *P set (P sample)*— intentionally chosen participants of the study (Watts & Stenner, 2012)
- *Q methodology*— a method of research created by William Stephenson in 1935 to evaluate subjectivity in participants of a research study through factor analysis (Brown, 1980)
- *Q set (Q sample)*— a grouping of selected statements derived from the concourse that are representative of the array of opinions about the topic being discussed (Brown, 1980).
- *Q sort*— a technique used in a Q-study where participants use rank ordering of the Q set (McKeown & Thomas, 2013)
- *Subjective Norms*— the social influences that can impact an individual's decision to engage in a specified behavior (Ajzen, 1991)
- *Theory of Planned Behavior*— a behavioral model based on the premise that three variables can predict an individual's intent to engage in a behavior: attitude, perceived behavioral control, and subjective norms (Ajzen, 1991)

Limitations

This research holds certain limitations that are important for consideration. First, as the number of participants in the convenience sample for this research is below the minimum threshold to meet generalizability standards, the findings of this research are not meant to be generalized to the wider population of cotton and peanut farmers. Next, while all the participants in this research utilize Cooperative Extension services for their farms, it is unknown how the results could change with a set of participants that does not utilize this service as an information source. Additionally, since the data collection methods for this research focused on participants' views toward a list of eight distinct BMPs for Georgia cotton and peanut production, it is possible that participants responses could vary if more or fewer BMPs were included in this list. Lastly, it was beyond the scope of this research to determine which of these eight specific BMPs Georgia cotton and peanut farmers favored more than others.

Assumptions

The following assumptions were present in this research:

1. Participants understood and honestly responded to all questions and prompts during data collection.
2. Every feasible measure was taken to ensure the clarity of questions and prompts for study participants (i.e., a list of BMPs along with respective descriptions were provided to all participants in this research).
3. Participants received adequate time to complete the surveys and interviews.

CHAPTER 2

LITERATURE REVIEW

Overview of Chapter

This chapter is organized into four sections to address the scope of the literature and provide a basis for the discussion of the ideas represented. The first two sections of this chapter reveal the breadth of literature looking into conservation practice adoption. This is done by examining conservation practice adoption studies through the years and the key variables that have been found to influence adoption. The next section lays out the conceptual framework for this research to demonstrate the role that the theory of planned behavior will have in framing this these studies, and provide an introduction into Q methodology, which is employed in (Article two) of this work. The last section of this chapter provides a discussion and summary on the topic of BMP adoption, as well as identifies the calls from scholars to incorporate certain methods and ideas into future studies looking into motivations and barriers to BMP adoption.

Conservation Practice Studies Through the Years

Research into the adoption of agricultural conservation practices dates back to the 1950s (Ervin & Ervin, 1982). However, despite some of the earliest work on this topic examining soil conservation practices in the Midwest (Blase & Timmons, 1961), it was not until the 1980s when researchers began to investigate farmers' motivations and barriers to adoption of conservation practices. During the 1980s and 1990s, research started examining farmers' intrinsic and extrinsic motivations, socio-economic characteristics, and many other factors that could potentially influence farmers' decision to voluntarily adopt conservation practices (Ervin &

Ervin, 1982; Feather & Amacher, 1994; Gould et al., 1989; Ice, 2004; Logan, 1993; Welch & Marc-Aurele Jr., 2001). The depth of research into this topic has grown exponentially since then, adding many nuances to the literature, including different geographic regions and types of production.

Current voluntary policies to control agricultural runoff have been mostly unsuccessful (Chouinard et al., 2016; Savage & Ribaudo, 2016). This has pushed many scholars to delve deeper into the variables previously thought to influence adoption of conservation practices. Researchers have compiled comprehensive reviews of quantitative and qualitative studies on this topic dating back nearly four decades and analyzed a vast array of potential determinants of adoption behavior related to economic, social, and environmental influences (Baumgart-Getz et al., 2012; Delaroche, 2020; Liu et al., 2018; Prokopy et al., 2019; Ranjan et al., 2019; Yoder et al., 2019). Many of these studies were in response to the synthesis study conducted by Prokopy et al. (2008), which synthesized social science literature on determinants of conservation practice adoption and concluded that there were none found to consistently predict farmers' adoption behavior. As a means of updating the previous study, Prokopy et al. (2019) conducted a similar synthesis review of studies looking into determinants of farmers' conservation practice adoption and found nothing contradictory to the 2008 study.

Despite the onslaught of research examining perceptions, motivations, and barriers to conservation practice adoption, variables that influence adoption behavior are difficult to consistently predict (Baumgart-Getz et al., 2012; Burton, 2014; Knowler & Bradshaw, 2007; Prokopy et al., 2008). Accordingly, there are constant calls for more research to examine determinants of conservation practice adoption, and to evaluate educational efforts from agricultural entities working to increase adoption of conservation practices among farmers.

Examination of relevant literature revealed an abundance of research on farmer perceptions and behavior; however, there is a very limited amount of timely research regarding farmer perceptions of agricultural BMPs in cotton and peanut production in the Southeast.

Determinants of Conservation Practice Adoption

Multiple synthesis studies have compiled literature from the past 40 years to address certain factors that influence BMP adoption (Liu et al., 2018; Prokopy et al., 2019; Yoder et al., 2019). In addition to synthesis studies, numerous factors impacting BMP adoption have been examined among farmers from an array of agricultural production areas (Gillespie et al., 2007; Johnson et al., 2010; Nyaupane & Gillespie, 2010; Paudel et al., 2008). While these studies found a wide range of variables to positively or negatively affect farmers' adoption behavior, they found that attitudes farmers had toward certain conservation practices was the strongest determinant of adoption behavior. Prokopy et al. (2019) found determinants of adoption behavior include, but are not limited to, formal education level, farm size, environmental attitudes, and self-identity. Other important variables that are less commonly analyzed in the literature are the awareness of farmers' current environmental impacts, the influence of collective decision making, the role of trust in willingness to adopt a recommended practice, and the proximity of a farm to degraded bodies of water (Liu et al., 2018; Napier & Tucker, 2001; Prokopy et al., 2019; Stallman & James, 2017; Wilson et al., 2014). These studies concede that the availability of technology and knowledge on how to control NPS pollution is available to farmers, but unless voluntary adoption of BMPs drastically increases, NPS pollution will persist.

Past social science studies have found the way farmers interpret BMP information plays a large role in influencing adoption (Prokopy et al., 2019; Schall et al., 2018). The importance of analyzing how messages regarding BMPs are interpreted can be seen in the work of Jones et al.

(2013). This work compared the views of farmers and experts on how effective BMPs are for mitigating environmental degradation from agriculture to address the importance of using multi-actor approaches when creating BMPs, so there can be an emphasis on practicality. BMPs can have different interpretations and roles depending on the viewpoints and position of the individual viewing them. Thus, if there is not a strong level of trust between those who are creating the BMPs and the farmers who are expected to implement them, then there will probably not be voluntary adoption.

Empirical evidence points to farmers' attitudes, environmental awareness, and various farmer demographics and socio-economic characteristics as the most applicable determinants of conservation practice adoption (Bagheri et al., 2019; Doran et al., 2020; Menapace et al., 2015; Prokopy et al., 2019; Senger et al., 2017). Wauters et al. (2010) examined farmers' adoption of soil erosion control practices such as cover crops, buffer strips, and reduced tillage in Belgium and found that farmers' attitudes were significantly correlated with their intention to adopt these practices. Farmers' environmental awareness or knowledge of environmental issues has also been found to be a significant determinant of adoption as it typically is associated with farmers' previous experiences with the consequences of environmental degradation (Broomell et al., 2015; Wheeler et al., 2013). Another widespread finding among the literature on farmers' determinants of conservation practice adoption is that contextual variables and farm characteristics are typically found to be associated with adoption decisions (Doran et al., 2020; Knowler & Bradshaw, 2007).

Much of the social science literature into conservation practice adoption explores how farmers' attitudes factor into their adoption behavior (Prokopy et al., 2019). The relevance of attitudes as a potential determinant of behavior are based on whether the attitudes toward that behavior are either positive or negative. An example of how farmers' attitudes can influence their adoption decisions can be seen in the work of Arbuckle and Roesch-McNally (2015) and Mase et al. (2017), where farmers' perceived benefits of adopting certain practices were found to be a determinant of adoption behavior. Farmers' identity and values, such as identifying as a steward of the land, being altruistic, or having a positive attitude toward certain conservation practices, have also been found to be related to adoption behavior (Floress et al., 2017; Reimer & Prokopy, 2012; Thompson et al., 2015). Whereas attitudes like risk aversion and a self-interest identity typically have been shown to have a negative relation to adoption (Prokopy et al., 2019).

The knowledge or awareness farmers have about environmental issues, conservation practices, and conservation programs can be highly influential in relation to farmers' adoption behavior (Baumgart-Getz et al., 2012; Knowler & Bradshaw, 2007; Prokopy et al., 2008). Although Baumgart-Getz et al. (2012) and Prokopy et al. (2019) found that awareness of detrimental impacts on the environment from current practices is not a strong determinant of adoption, when compounded with other factors such as environmental knowledge or stewardship attitudes, awareness of environmental consequences is a critical step in a farmer deciding to adopt a practice (Blackstock et al., 2010; Ervin & Ervin, 1982; Prokopy et al., 2008). In addition to this, Prokopy et al. (2019) found that environmental awareness is connected to farmer engagement and access with information, and this can influence adoption behavior. It is also important to note that awareness of programs can be associated with past adoption behaviors, which have been found to influence future adoption behavior (Lambert et al., 2014; Medwid, 2016).

Throughout the literature, the characteristics of farms and farmers are another widely recognized determinant of conservation practice adoption (Prokopy et al., 2019). Characteristics such as land tenure, farm size, type of operation, and proximity to a body of water are commonly associated with adoption behavior. Demographic or farm operator characteristics such as age, education, and farming experience are commonly included in adoption studies, with age and experience typically found to be negative determinants of adoption, whereas education level can be a positive determinant (Prokopy et al., 2019). While these studies give strong insights into determinants of BMP adoption, much of the credit can be given to the application of socio-psychological theories that provide a means for examining socio-demographic factors and motivational factors to better understand determinants of farmers' intention to adopt conservation practices (Doran et al., 2020).

Conceptual Framework

Theory of Planned Behavior

This research was framed by the Theory of Planned Behavior (TPB) (Ajzen, 1991). Literature has called for an incorporating of socio-psychological factors to predict individual behavior patterns, and an inclusion of proper structural factors (Prokopy et al., 2019; Shove, 2010). Thus, using an integrative approach, the TPB can determine how factors, such as socio-psychological, socio-economic, and demographic variables can impact current adoption behavior and intentions to adopt. There is strong backing from the literature on implementing the TPB into conservation practice adoption studies (Beedell & Rehman, 2000; Borges et al., 2014; Deng et al., 2016; Wauters & Mathijs, 2013). Previous literature that is grounded in TPB gives stronger insights into the adoption behavior of farmers compared to the studies with no utilization of theories (Borges et al., 2014; Greaves et al., 2013). In this context, the TPB model is typically applied to studies that examine BMP adoption through a socio-psychological lens by predicting behavior dependent on individual reasoning (Sok et al., 2020). However, for the purposes of this research, this theory is incorporated into our investigation of potential determinants of farmers' intent to adopt BMPs.

The efficacy of applying the TPB to understanding farmer behavior and intentions is widely accepted as many studies have utilized this framework (Deng et al., 2016; Hall et al., 2019; Hansson et al., 2012; Sok et al., 2020; Tama et al., 2021; Wauters et al., 2010; Wauters & Mathijs, 2013). The TPB has become increasingly applied to many contexts in agricultural research to investigate farmers' adoption decisions related to topics such as conservation practices (Avemegah, 2020), mixed cropping (Bonke & Musshoff, 2020), grassland management (Borges et al., 2014), nutrient management plans (Daxini et al., 2019), integrated pest management (Despotovic et al., 2019), diversification in agricultural production (Senger et al., 2017), cover crops, and buffer strips (Wang et al., 2021). The TPB, which is an addition to the Theory of Reasoned Action with the inclusion of the perceived behavioral control construct (Ajzen, 1991; Fishbein & Ajzen, 1975), interprets why individuals perform certain behaviors by analyzing their intentions (Daxini et al., 2018).

The TPB posits that intentions are a precursor to behavior, and those intentions are influenced by three constructs: *attitudes* (feelings toward), *subjective norms* (peer pressure), and *perceived behavioral control* (view of ease/difficulty) (Ajzen, 1991). If attitudes and subjective norms are more favorable toward a certain behavior, then perceived behavioral control will be higher, and the overall intention of the individual to perform the specified behavior will be stronger (Ajzen, 1991). These precursors of behavior are influenced by salient beliefs for each element and an assessment of the beliefs on behalf of the individual (Heath & Gifford, 2002). This TPB model of can be seen in Figure 2.1.

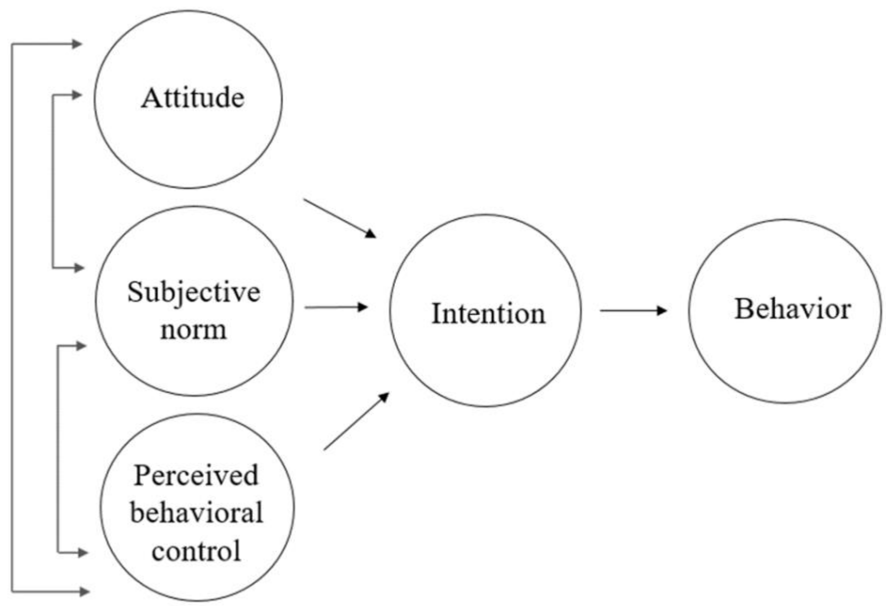

Figure 2.1
Theory of Planned Behavior Model (Ajzen, 1991)

Attitudes in this context can be defined as the degree of favorability an individual feels about the behavior in consideration (Ajzen, 1991). The relevance of considering farmers' attitudes in adoption has been shown in research studying on-farm food safety management in Iran (Rezaei et al., 2018), and in a study examining farmers' opinions on desirable characteristics of BMPs in Indiana (Reimer et al., 2012). Just as attitudes are an important variable for consideration, subjective norms can also influence perceptions and the likelihood of an individual performing a behavior (Bamberg et al., 2007; Bamberg & Moser, 2007). Subjective norms refer to the influence that perceived social pressure has on an individual's decision to perform the specific behavior (Ajzen, 1991). Research has found that the internal and external social pressures felt by individuals can have an influence on the perceptions of their own confidence or control in performing a behavior (Bamberg et al., 2007). Perceived behavioral control, which is the last determinant of intention, can be described as the role previous experiences and perceived challenges will have on how an individual perceives the ease or difficulty of performing the specified behavior (Ajzen, 1991).

Extended Model of the Theory of Planned Behavior

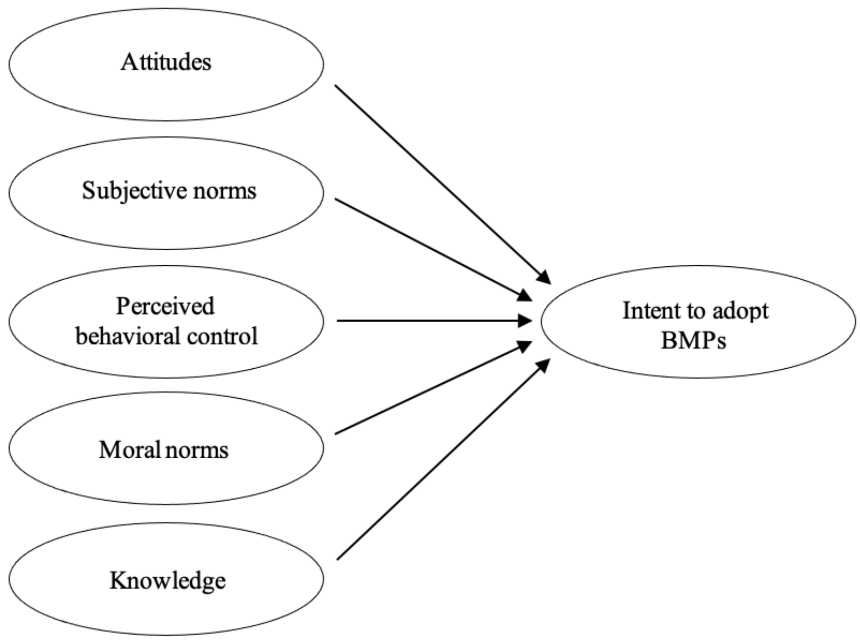

Figure 2.2
Extended Model of the Theory of Planned Behavior. This model was adapted from Rezaei et al. (2018) with Moral Norms and Knowledge as Additional Constructs.

Although the TPB has been used extensively among studies looking into farmer intentions, a limitation of these studies is an overemphasis on analyzing correlational factors rather than explicit causes (Daxini et al., 2019). Previous studies in this context do not delve deep enough into causal pathways or the influence of institutional variables such as Cooperative Extension education and communication, which can have an impact on behavior (Barnes et al., 2013; Bijttebier et al., 2018; Daxini et al., 2019). Because this research seeks to build from and extend the findings from previous TPB studies looking into BMP adoption in other states and types of production, two additional constructs have been added to the original TPB model. Ajzen (1991) suggested that the TPB is open to the inclusion of additional constructs to increase the predictive power of the model and better explain the variance in the findings. As this research attempts to determine what factors directly influence intention to adopt BMPs, based on supporting evidence from the literature, this research will incorporate two additional constructs—*moral norms* and *knowledge*—to the TPB model. The theoretical framework for the TPB with the additional constructs is presented in Figure 2.2 (Rezaei et al., 2018).

While the TPB has been shown to be a powerful model for predicting intention and behavior across a variety of studies analyzing farmer conservation behaviors (Borges et al., 2014; Lalani et al., 2016; van Dijk et al., 2016), it is not a holistic model that is able to account for all influential factors for a certain behavior (Bagheri et al., 2019). However, many studies have successfully attempted to increase the predictive power of this model through the addition of extra constructs (Chen, 2017; Gao et al., 2017; Savari & Gharechaee, 2020). For example, an extended TPB model has been applied to pro-environmental behavior studies looking into topics such as farmers' pesticide use (Bagheri et al., 2019), adoption of low carbon agriculture (Hou & Hou, 2019), wetland conservation and management (Valizadeh et al., 2021), and water conservation (Yazdanpanah et al., 2014).

The inclusion of these additional constructs to increase the validity of the TPB model has growing empirical evidence (Bagheri et al., 2019), and the consideration of additional factors such as the influence of personal or moral norms was stated by Ajzen (1991) to potentially increase the predictive power of the model. While various TPB studies have included the additional constructs of either personal or moral norms (Ataei et al., 2021; Chen & Tung, 2014), these two constructs can be used interchangeably (Ajzen, 1991). Bamberg and Moser (2007) found the inclusion of the moral norms construct explained much of the variance when looking into pro-environmental behaviors. This finding was tested in an extended TPB model study looking into recycling intentions, which also found moral norms to be an independent determinant of recycling behavior (Botetzagias et al., 2015).

As Bamberg and Moser (2007) described moral norms as a moral commitment felt by people toward performing a certain behavior, this research will apply this definition to include the additional construct of moral norms to investigate farmers' BMP adoption. Several TPB studies exploring pro-environmental farmer behaviors have investigated the construct of moral norms and have found this additional construct to be a positive determinant of intention (Bagheri & Teymouri, 2022; Govindharaj et al., 2021; Rezaei et al., 2018). Since moral norms have been found to effectively predict intentions in moral situations (Mullan et al., 2015), such as a farmer conserving the land and safely producing food for society, this construct is appropriate to be included in this TPB model to improve the predictive power of intentions to engage in BMPs.

Another construct that has been included in expanded TPB studies investigating farmer intentions and behavior is knowledge (Bagheri et al., 2019; Rezaei et al., 2018). Govindharaj et al. (2021) conducted a study on rice farmers' intention to use pesticides in which the knowledge construct was found to have the largest influence among the other constructs on intention. In another study examining farmers' intentions to conserve on-farm biodiversity, Maleksaeidi and Keshavarz (2019) also found the inclusion of a knowledge construct increased the predictive power of the TPB model. With these findings in mind, the additional construct of knowledge will be included in this extended TPB model to better predict intention to engage in BMPs. The knowledge construct in this research includes farmer knowledge of recommended BMPs and their knowledge regarding strategies to conserve natural resources, the potential benefits of these practices, and knowledge of the potential impacts of agriculture on natural resources. The inclusion of these two additional constructs of moral norms and knowledge is meant to increase the potential of this research to improve the predictive power of the TPB model and detect whether these two factors have an influence on farmers' intentions to adopt BMPs (Chen, 2017). As this is a two-part study that takes a mixed methods approach, this extended TPB model will be applied to both chapter three (Article one) and chapter four (Article two) to enhance the findings of this research.

For chapter three (Article one) of this research, the extended TPB model is applied as a theoretical framework that guides our analysis of factors affecting farmers' intention to adopt BMPs. As chapter three uses a quantitative survey method to measure farmers' intentions to adopt BMPs, this framework guided the development of the survey instrument as well as the analysis of the data. In using this framework, we analyze and describe participants' responses to each of the included constructs, explore relationships between these constructs, and determine if any of these constructs predict farmers' intentions to adopt BMPs.

Q Methodology

Q methodology dates back to 1935, when William Stephenson, a British psychologist and physicist, sought to develop a way of systematically measuring the subjectivity of individuals toward a certain topic (Brown, 1980; Watts & Stenner, 2012). This approach combines the strengths of quantitative and qualitative research to analyze subjective viewpoints of individuals in a comprehensive manner by grouping the perspectives, opinions, and beliefs participants have on a specific topic into typologies using factor analysis (Robbins & Krueger, 2000). Unlike traditional R methodology research, the opinions rather than the individuals are the subject of analysis in this method. Therefore, small sample sizes that are purposively selected are used in this method to ensure that the diversity of opinions and viewpoints on the topic are covered (Gongora et al., 2019). Q methodology seeks to identify the various perspectives on a topic present in a population to then be quantified through rigorous statistical analysis and compared for similarity (Watts & Stenner, 2012). This method was chosen for use in this study based on its potential for uncovering farmers' perspectives toward BMPs.

Given that the Q methodology approach ties in the statistical significance found in quantitative methods while not overlooking the distinct perspectives of individuals, the insights provided through this method reveal a holistic view of the topic being studied. This method is carried out by presenting participants, known as the P-set, with a sample of opinion statements about the specific topic, called the Q-set, to then be rank-ordered according to their individual point of view on a quasi-normal shaped grid in a process known as Q sorting. After the Q sorting process is complete, the results are factor analyzed and placed into distinct groups dependent on the relative placement of each statement on the Q sort (Barker, 2008). There are six steps used as a principal rule for successfully conducting a Q methodology study: (1) determine the research question; (2) create the Q-set of opinion statements; (3) select the participants (P-set); (4) perform the Q-sort; (5) conduct the factor analysis; (6) interpret the qualitative factors and place them into distinct groups (Stenner et al., 2017).

Q methodology has been increasingly applied to various social science research topics pertaining to farmers. Such topics include farmers' agricultural production decisions (Alexander et al., 2018), farmers' views on soil management (Braito et al., 2020), farmers' environmental perspectives (Davies & Hodge, 2007), stakeholder views on pesticide use (Lehrer & Sneegas, 2018), the values and goals of cattle ranchers (Pereira et al., 2016), and farmers' viewpoints on environmental behavior (Walder & Kantelhardt, 2018). However, it is still underutilized compared to traditional quantitative and qualitative methods in research exploring farmer attitudes. Although decades of research have attempted to identify determinants of conservation practice adoption, the absence of consistent determinants of conservation practice adoption continues to present a challenge to efforts focused on increasing adoption (Liu et al., 2018; Ulrich-Schad et al., 2017). Q methodology presents a novel approach to engaging farmers in a strategic manner that allows them to manage their own points of view on a subject matter, such as BMPs. In applying Q methodology to this study, this research can serve to establish a better understanding and provide a holistic view into the perceptions of Georgia cotton and peanut farmers regarding BMPs.

The role of the extended TPB model in chapter four (Article two) of this study serves as a conceptual framework that is used to develop and organize the wide range of opinion statements included in the Q-set to ensure all relevant decision-making factors regarding farmers' adoption of BMPs are included. In this Q methodology study, this conceptual framework assists our efforts to uncover a diversity of farmer viewpoints on BMPs and reveal influential factors on farmers' decision to adopt BMPs. The use of this conceptual framework provides a nuanced addition to the literature that can potentially increase our understanding of determinants of BMP adoption among cotton and peanut farmers.

The incorporation of the Q methodology approach for chapter four (Article two) with the quantitative method of chapter three (Article one) is meant to identify the diversity in decision-making factors by first analyzing perspectives from a broad view and then in a more individualized setting. As quantitative and qualitative methods have unique strengths and weaknesses, the marrying of these two approaches in this study allows for a closer examination of influential factors on cotton and peanut farmers' views and decisions regarding BMPs in Georgia. It is hoped that the findings from these research articles may be used to supplement educational efforts seeking to increase BMP adoption by allowing for more tailored approaches that conform to the various needs and preferences of this population of farmers.

Conclusion

To get a better grasp of the conservation attitudes and behaviors among farmers, a substantial amount of research has been conducted in the U.S. looking into potential influences on farmers' adoption of agricultural conservation practices (Ranjan et al., 2019). These studies are a conglomeration of quantitative and qualitative literature that analyze adoption decisions and determinants of adoption for conservation practices. A recurring focus of the quantitative studies on this topic show a tendency to analyze the motivations behind adopting conservation practices (Prokopy et al., 2019; Ranjan et al., 2019). However, certain issues have been acknowledged in some studies that use quantitative methods to study adoption decisions (Floress et al., 2018; Prokopy et al., 2019; Ranjan et al., 2019). In particular, there is a tendency for quantitative studies to ignore structural factors that could influence decision making, and this has likely impacted findings on the true motives behind adoption behavior (Prokopy et al., 2019). Another downfall for much of the research in this area is that there has been a gap in the application of theories (Baumgart-Getz et al., 2012; Prokopy et al., 2019).

A trend in this field of inquiry is that qualitative research on this topic is rising, with most of these studies being published within the last decade (Ranjan et al., 2019). The qualitative studies take barriers to adoption and motivations for adoption into account to create a better understanding of the determinants of conservation behavior (Pape & Prokopy, 2017; Ranjan et al., 2019; Woods et al., 2014). A benefit of taking a qualitative approach to study this topic is that it can broaden the scope of how adoption behavior is analyzed. A recommendation from the literature for how research on this topic can be strengthened is to analyze both intrinsic and extrinsic motivational factors that potentially influence adoption by applying the use of theory and socio-psychological approaches in future studies (Delaroche, 2020; Prokopy et al., 2019).

A recent meta-analysis of socio-psychological approaches in conservation practice adoption studies found a need for future studies to explicitly state a purpose of either analyzing current adoption rates of conservation practices or the perceived willingness to adopt conservation practices (Delaroche, 2020). Additionally, Reimer et al. (2014) acknowledged a need for more diverse methodologies to be incorporated into conservation behavior research to bring different perspectives to this realm. Therefore, with most of research on this topic applying a strictly quantitative or qualitative approach, the use of a mixed methods design in this research creates a valuable contribution to the literature that serves to examine farmers' willingness and intentions to adopt conservation practices. Furthermore, this research explores unique perspectives of farmers to potentially uncover subjective intricacies related to BMP adoption not previously identified in the literature.

CHAPTER 3

EXAMINING INFLUENCES ON COTTON AND PEANUT FARMERS' INTENTIONS TO ADOPT AGRICULTURAL BEST MANAGEMENT PRACTICES[1]

[1] Taylor Jr., W. R., Borron, A., Holt, J., & Monfort, W. S. To be submitted to *Journal of Extension.*

Abstract

The use of agricultural best management practices can play an integral role in reducing agriculture's impacts on water quality impairments. Thus, the voluntary decision for farmers to adopt best management practices has garnered much attention from policy makers and agricultural practitioners. While a gap exists in literature examining farmers' adoption of best management practices in cotton and peanut production, this study aims to provide insights about the influences on farmers' intentions to adopt best management practices. This study applied an extended model of the theory of planned behavior to examine the influences of certain intrinsic motivations and capacities on cotton and peanut farmers' intentions to adopt best management practices. Data were collected using a quantitative survey instrument on a sample of farmers in Georgia. Respondents held generally positive attitudes toward best management practices and felt that it is their responsibility as a farmer to protect natural resources. Farmers in this study also indicated that it is important for them to listen to agricultural experts about using best management practices. While the findings of this study may not be generalizable to the greater population, they can be leveraged by agricultural practitioners to supplement current farmer educational efforts regarding best management practices by tailoring discussions within trainings and seminars to account for the various motivations and farmer capacities outlined in this study. This study also provides specific recommendations about how future research can establish a broader understanding of influential factors on farmers' adoption of best management practices.

Introduction

Conventional agriculture is often blamed for many of the environmental issues that are seen today (Harris, 2002; Tal, 2018). Despite few Americans truly understanding the intricacies of agriculture, and what goes into producing food, negative portrayal of the agricultural industry in mass media has been a trend for decades (Lundy et al., 2007; McCluskey et al., 2016; McKendree et al., 2014; Specht & Beam, 2015). As negative perceptions of conventional agriculture are compounded by growing environmental challenges and the food demands of an increasing population (FAO, 2017; Sadowski & Baer-Nawrocka, 2018), American farmers face an uphill battle in accommodating the proliferating pressure to adopt socially desirable management practices while also sustainably intensifying production (Baur, 2020).

Calls for an immediate shift to a more sustainable agricultural production system tend to oversimplify the logistical constraints of radically changing conventional agriculture (Baur, 2020; Cassman & Grassini, 2020). Certain intensive farming practices used in conventional agriculture that lead to soil erosion, water degradation, and biodiversity loss, will need to be abandoned to preserve natural resources and ensure a sustainable future for agriculture (Ribaudo & Shortle, 2019; Zhang et al., 2007). However, these practices can be feasibly replaced with sustainable alternatives through farmers' adoption of research-based best management practices (BMPs) (Cassman & Grassini, 2020; Chiang et al., 2014; Liu et al., 2017).

Agricultural BMPs are farming practices specifically designed for the various sectors of crop and livestock production that farmers can voluntarily adopt to reduce non-point source (NPS) pollution and increase water quality goals in a practical manner (Reimer et al., 2012). As NPS pollution from agriculture includes nutrient pollution from runoff and leaching, these practices are designed to effectively reduce this pollution as well as increase soil and air quality

(Liu et al., 2017). To disseminate information about these practices to farmers, it is necessary for researchers, policymakers, and agricultural entities to work together to provide resources to farmers that encourage adoption (GASWCC, 2013; Hawkins & Wallace, 2013). Despite the well-documented benefits attributed to the adoption of these practices ranging from increased economic gains for farmers (Chiang et al., 2014), to positive impacts on soil health and water quality (Liu et al., 2017), the rate of adoption is low and has only increased at a gradual pace in recent decades that is not sufficient to achieve widespread sustainability in agriculture (Liu et al., 2018; Wauters & Mathijs, 2013).

One of the serious concerns to the sustainability efforts in modern agriculture is water quality impairment from agricultural NPS pollution (Brown et al., 2019; Capel et al., 2018; Poudel, 2016; Zaring, 1996). While agriculture could potentially mitigate NPS pollution if widespread adoption of BMPs occurred (Cassman & Grassini, 2020; Chiang et al., 2014), consistently low adoption rates have likely resulted in this problem persisting (Liu et al., 2018). The current projected population growth over the next few decades will require agriculture to increase productivity while simultaneously reducing its environmental impacts (FAO, 2017; Guerin, 2001). And as the agricultural industry faces the challenge of producing more food on less land, scientists, researchers, and policymakers have called for an increase in the adoption of BMPs across agriculture (Delaroche, 2020; FAO, 2017; Llewellyn, 2007; Pannell et al., 2006).

Current understanding on the motivations and barriers of agricultural BMP adoption stems primarily from research focusing on livestock and row crops in the Midwestern and Mid-Atlantic regions of the U.S. (Akkari & Bryant, 2017; Arbuckle & Roesch-McNally, 2015; Prokopy et al., 2008; Reimer et al., 2012; Schall et al., 2018). However, as different geographic regions in the U.S. produce certain crops depending on their climate, soil type, and other environmental factors, there is a need for BMP adoption research to investigate all of these areas to identify a holistic representation of the potential determinants of adoption and non-adoption of BMPs (Dowd et al., 2008). Therefore, as the literature investigating influences on BMP adoption in the Southeastern region of the U.S. is minimal, localized studies are needed to examine the determinants of BMP adoption across the primary areas of production in this region. And while few studies have investigated the motivations and barriers to adoption of BMPs in cotton and peanut farming (McNamara et al., 1991; Riar et al., 2013), there is a strong need to better understand the specific factors and decision-making processes that lead to effective implementation of BMPs in these staple crops of the Southeast (Liu et al., 2018; Mishra et al., 2018). Thus, as the number one producer of peanuts and the second highest producer of cotton in the country (Kane, 2021), the state of Georgia was determined to be an optimal location for this study.

Favorable climatic and topographic conditions have led to the production of these two crops on nearly 58% of all harvested acres of cropland in Georgia (NASS, 2019). And since these crops contribute $1.6 billion annually to the state economy (Kane, 2021), the sustained production of these crops is crucial for this state. But with droughts, multi-state water disputes, and the demands of producing enough food and fiber for a growing population, the widespread adoption of sustainable farm management practices like BMPs will be critical for the continued success of these crops in Georgia. Accordingly, as agricultural impacts on water quality continue to be met with calls for higher adoption of sustainable management practices that reduce water quality impairments (Mullen, 2019; Singh et al., 2017), this highlights the need for an increase in BMP adoption. BMPs are designed to be an effective measure in mitigating water quality impairments through reducing soil erosion, nutrient runoff and leaching, and water usage for irrigation (GASWCC, 2013; Liu et al., 2017). As prior BMP adoption research has improved our understanding of factors that influence adoption, this study serves to illuminate context-specific factors that influence farmer adoption, to provide a clearer understanding of this issue for local practitioners and policymakers to enhance their outreach efforts. Although there are numerous agricultural BMPs that can be applied to the various areas of crop and livestock production (GASWCC, 2013), this study will investigate the motivations and barriers to adoption of eight BMPs recommended for cotton and peanut farmers in Georgia as practical means for reducing NPS pollution to achieve water quality goals. These BMPs include cover crops, crop rotation, nutrient management plans, conservation tillage, field borders, water and sediment control basins, integrated pest management, and irrigation water management plans (GASWCC, 2013).

While various socio-economic and socio-psychological factors have major influences on farmers' BMP adoption behavior (Bagheri et al., 2019; Prokopy et al., 2019; Wauters et al., 2010; Wilson et al., 2014), there are many factors that can influence a farmer's decision to adopt BMPs (Delaroche, 2020; Dessart et al., 2019; Liu et al., 2018). For instance, a farmer may not perceive certain BMPs as practical or economically viable for their operation, or they may not have enough knowledge about the practice to adopt it. These various influences, as well as other socio-economic, demographic, and attitudinal factors have resulted in varying rates of BMP adoption throughout the U.S. and has also led to many studies looking into the conservation behavior of farmers (Delaroche, 2020; Mishra et al., 2018; Prokopy et al., 2019; Wade et al., 2015). As low adoption rates contribute to further NPS pollution, policymakers and researchers have cited a need for more clear and detailed recommendations to better inform practitioners' efforts to encourage adoption (Delaroche, 2020; Llewellyn, 2007; Pannell et al., 2006; Reimer et al., 2014; Reimer et al., 2012).

Theoretical Framework

As social science researchers have sought to identify why low rates of adoption continue, many approaches have been undertaken to better understand adoption decisions (Baumgart-Getz et al., 2012; Clay, 2020; Delaroche, 2020; Prokopy et al., 2019). The Theory of Planned Behavior (TPB) (Ajzen, 1991) has been found to be a useful framework for investigating the decision-making process of farmers and explaining their adoption behavior (Borges et al., 2014; Daxini et al., 2019; Delaroche, 2020; Ranjan et al., 2019). This socio-psychological approach has become the most consistently employed theoretical framework of quantitative studies investigating conservation practice adoption (Delaroche, 2020). Because of the variability and complexity of individual farms, understanding the decision-making process and determinants of BMP adoption are challenging (Liu et al., 2018). Although research has investigated farmer adoption behavior for decades, the factors that have been found to influence BMP adoption are widely varied, mostly context specific, and many times do not account for socio-psychological factors (Delaroche, 2020; Reimer et al., 2014; Reimer et al., 2012).

Further studies are needed to provide sufficient insights into the motivations and barriers that lead to adoption of BMPs for cotton and peanut farmers. While a variety of extrinsic factors have been found to influence adoption, intrinsic factors such as farmers' self-identity and stewardship mindsets play an important role in impacting adoption decisions (Delaroche, 2020; Lokhorst et al., 2011; Mastrangelo et al., 2013; Prokopy et al., 2019). This finding is in contrast with the idea that financial incentives are the primary driver of adoption behavior, which has been found to be an unrealistic expectation (Inman et al., 2018), and reiterates the importance of addressing calls from the literature to incorporate socio-psychological factors to predict individual behavior patterns, while also including proper structural factors (Prokopy et al., 2019; Shove, 2010).

BMP adoption research that takes a socio-psychological approach to better understand the decision-making process of cotton and peanut farmers is limited. No study was found that applied a socio-psychological approach to research targeting cotton and peanut farmers in Georgia. Therefore, this study seeks to respond to the call from the literature to incorporate socio-psychological factors into our investigation of the decision-making process of cotton and peanut farmers (Reimer et al., 2012). To do this, the Theory of Planned Behavior (TPB) (Ajzen, 1991) was applied as the framework guiding this study. As the TPB incorporates a socio-psychological lens to predict behavior based on an individual's reasoning (Sok et al., 2020), it is utilized in this study to identify potential influences on farmers' intention to adopt BMPs. Our application of this theory contributes to the literature by applying the TPB to investigate cotton and peanut farmers' behavioral intentions toward BMP adoption, while additionally examining the potential influences of additional constructs on this theoretical model.

Theory of Planned Behavior

The TPB is considered one of the most effective frameworks for analyzing the intentions and behavior of farmers (Despotovic et al., 2019; Lalani et al., 2016). This theory consists of three primary constructs that include *attitudes, subjective norms, and perceived behavioral control* (Ajzen, 1991). These constructs serve to predict the behavioral intention of individuals, which is the perceived likelihood an individual has about performing a behavior (Ajzen & Fishbein, 1980; Russell & Fielding, 2010). While behavioral intentions are an essential precursor to behavior, it is not an absolute predictor of it (Fishbein & Ajzen, 2011). Many of the studies that have investigated the relationship between behavioral intention and farmer behavior have found this variable to be a strong predictor for actual behavior (Daxini et al., 2019; Despotovic et al., 2019; Greiner, 2015; Greiner & Gregg, 2011).

According to the TPB, an understanding of behavioral intention is accomplished by exploring each of these three primary constructs that factor into an individual's beliefs (Ajzen, 1991): (a) *attitudes*—the individual's positive or negative beliefs toward the behavior and the perceived degree of impact the behavior will have on the individual; (b) *subjective norms*—the impact of perceived social expectations on whether the behavior is performed; (c) *perceived behavioral control*—the degree of ease or difficulty in which an individual feels toward performing the behavior (Ajzen, 1991). When each of these constructs are combined, they will either form a positive or negative intention toward a behavior (Tama et al., 2021). For example, if each construct is found to be more favorable toward a behavior, the intention to perform the behavior will be strong (Ajzen, 1991).

Various studies have noted the influence of attitudes in predicting farmer behavior in areas such as on-farm food safety management, best management practice adoption, and agricultural diversification (Reimer et al., 2012; Rezaei et al. 2018; Senger et al., 2017). In the context of this study, attitudes refer to farmers' positive or negative evaluation of performing the behavior of BMP adoption. While attitudes are an important variable to consider, subjective norms are the next variable that affects farmers' behavioral intention (Savari & Gharechaee, 2020). Since subjective norms include social norms and the internal and external social pressures that are faced when considering engaging in a behavior, subjective norms can influence an individual's perceptions and the likelihood of them performing a behavior (Bamberg et al., 2007; Bamberg & Moser, 2007).

Subjective norms in the context of this study can be defined as the perceptions a farmer has of whether the decision to adopt BMPs is socially acceptable and encouraged by individuals close to them. The third construct in the TPB is perceived behavioral control. For this study, perceived behavioral control is related to farmers' perceptions of how difficult it will be to adopt BMPs. This includes how a farmer judges their own capabilities in performing this behavior, and their confidence level in having enough resources or experience for this behavior to be in their control. As individuals feel like they have less control or confidence in performing a behavior, their intention toward the behavior will become less likely (Ajzen & Fishbein, 1980). This phenomenon can be seen in a study from Daxini et al. (2018) in finding that the higher perceived behavioral control an individual has for adopting nutrient management practices, the more likely they will be to do this behavior.

The TPB has been successfully applied to farmer decision-making research in numerous studies to better understand, explain, and predict behavior and intentions (Bonke & Musshoff, 2020; Daxini et al., 2019; Senger et al., 2017). For example, Borges et al. (2014) used the TPB framework to investigate farmers' beliefs and intentions toward adopting certain cattle grazing practices and found that farmers' intention was influenced by all three TPB constructs. Other studies that have applied the TPB model to establish a better grasp of why farmers make certain decisions and engage in behaviors include areas such as nutrient management planning (Daxini et al., 2019), ecological conservation behavior (Deng et al., 2016), engagement with Extension activities (Hall et al., 2019), agricultural diversification (Hansson et al., 2012), pro-environmental farming practices (Price & Leviston, 2014), conservation agriculture (Tama et al., 2021), soil conservation (Wauters et al., 2010), and water conservation practices (Yazdanpanah et al., 2014).

Extended Model of the Theory of Planned Behavior

While the TPB model is limited to the constructs of attitudes, subjective norms, and perceived behavioral control, Ajzen (1991) suggested this theory is open to including any additional explanatory variables that could potentially be used to better explain the variance of behavior and intentions, as well as increase the predictive power of the TPB model. Numerous agricultural and environmental studies have applied an extended version of the TPB model to examine farmers' intentions and behaviors in agricultural contexts such as pesticide use (Bagheri et al., 2019), sustainable agricultural practices (Price & Leviston, 2014), and water conservation practices (Yazdanpanah et al., 2014). As many studies have operationalized the suggestion from Ajzen (1991) and Chen (2017) to apply an extended model of the TPB to improve the prediction of behaviors, multiple attempts to incorporate the constructs of *moral norms* and *knowledge* have found an improved predictive power in this extended TPB model (Bagheri et al., 2019; Govindharaj et al., 2021; Rezaei et al., 2018). And while it can be argued that additional constructs such as these should instead be used as moderating or mediating variables, Rezaei et al. (2018) claimed that the effects captured by knowledge and moral norms cannot be found within the traditional constructs of the TPB model. With this backing from the literature, this study attempts to include these two additional constructs in the TPB model for the purpose of better understanding the influences on farmers' intentions and behavior regarding BMPs.

Moral norms, which are defined as a moral commitment felt by people toward performing a certain behavior (Bamberg & Moser, 2007), have been found to be a significant predictor of intention in several TPB studies analyzing farmers' intention and behavior (Ataei et al., 2021; Bagheri & Teymouri, 2022; Savari & Gharechaee, 2020). In the context of this study, moral norms refer to the moral commitment felt by farmers toward adopting BMPs. As agriculture undoubtedly has an impact on the environment, no matter what type of farming, farmers all hold beliefs and values regarding certain actions that they believe must be taken to maintain their farming goals. As various studies have supported the idea of including the variable of moral norms due to its influence on environmental behavioral intentions (Ataei et al., 2021; Bamberg & Moser, 2007; Chen & Tung, 2014), the inclusion of this additional variable can help to further explain the behavioral intentions of farmers regarding BMP adoption.

The knowledge construct in the context of this study is defined as the knowledge a farmer has regarding recommended BMPs and their potential benefits, as well as knowledge regarding strategies to conserve natural resources, and the potential impacts of agriculture on natural resources. The influence this additional variable can have on intention includes the potential to increase the predictive power of the TPB model (Bagheri et al., 2019; Govindharaj et al., 2021; Maleksaeidi & Keshavarz, 2019; Rezaei et al., 2018). Tama et al. (2021) included the knowledge construct in a TPB study investigating farmers' intention toward conservation agriculture and found that intention can be increased with higher levels of knowledge. After evaluating numerous peer-reviewed studies in this area of inquiry, to the best of our knowledge, this study is the first to apply the TPB with the additional constructs of moral norms and knowledge to assess cotton and peanut farmers' intentions toward the adoption of BMPs. The application of this extended TPB model in this study aims to improve the understanding of the motivations and barriers to adoption of BMPs in cotton and peanut production to policymakers, practitioners, and researchers.

Purpose and Research Objectives

The purpose of this study is to explore and describe Georgia cotton and peanut farmers' perceptions of BMPs. This study investigates potential influences on BMP adoption through examining sociopsychological and sociodemographic characteristics to provide practical recommendations for disseminating information and educating farmers about BMPs. The following research objectives were developed to guide this study:

1. Describe the sociodemographic characteristics of Georgia cotton and peanut farmers.
2. Describe Georgia cotton and peanut farmers' attitudes toward, subjective norms about, perceived behavioral control towards, and intent to adopt best management practices.
3. Describe Georgia cotton and peanut farmers' knowledge and moral norms related to best management practices.
4. Examine relationships between participants' attitudes, subjective norms, perceived behavioral control, knowledge, moral norms, to intent to adopt best management practices.

Methods

This study takes an exploratory approach for investigating influences on Georgia cotton and peanut farmers' intentions to adopt BMPs, therefore, we do not seek to provide generalizable conclusions. Instead, this study aims to produce insightful information that can assist the outreach and education efforts made by agricultural practitioners regarding BMPs, as well as to advance theoretical understandings of an expanded TPB model. Additionally, this study seeks to provide meaningful recommendations for researchers interested in advancing this field of inquiry. To understand the influential factors on farmers' perceptions of BMPs, a paper survey was administered to study participants. The population of interest was cotton and peanut farmers in Georgia who utilize Cooperative Extension services. As Cooperative Extension is one of the primary liaisons to educate farmers about BMPs, investigating the perceptions of farmers who interact with Cooperative Extension was a crucial aspect of this study as our aim is to use the findings to enhance educational efforts from Cooperative Extension. Data was collected from a convenience sample of participants by distributing the survey to cotton and peanut farmers who attended the Georgia Peanut Show, the Georgia Cotton Commission Annual Meeting, and Cooperative Extension production meetings in two Georgia counties. Out of an estimated 150 growers in attendance at these four events, a total of 41 surveys were completed for an estimated response rate of 27.3%. This response rate is not abnormal in this field of research as response rates from survey research with farmers tends to be very low, and is continuing to decline (Glas et al., 2019; Prokopy, 2011).

This survey was designed to accomplish the specific objectives of the study by measuring the constructs of an extended TPB model and relevant sociodemographic characteristics of our study sample. The data collection instrument developed for this study was structured in a similar survey format used by Rezaei et al. (2018) with an extended TPB model that included knowledge and moral norms as additional constructs to explore farmers' intent to adopt BMPs. A researcher developed questionnaire was adapted from previous studies (Avemegah, 2020; Bagheri et al., 2019; Borges et al., 2014; Despotovic et al., 2019; Maleksaeidi & Keshavarz, 2019; Rezaei et al., 2018; Savari & Gharechaee, 2020; Tama et al., 2021). Before administration of this survey, it was examined by a panel of agricultural social science experts, Institutional Review Board approval was obtained, and a small pilot study was conducted with Cooperative Extension agents to test the clarity of the survey questions. Following the pilot study, minor adjustments were made to the survey by rephrasing or removing items within each construct in the interest of clarifying each of the questions. The survey questionnaire was broken down into seven sections that were used for data analysis: (1) attitudes towards BMPs; (2) subjective norms regarding BMP use; (3) perceived behavioral control towards using BMPs; (4) intent to adopt BMPs; (5)

knowledge about BMPs; (6) moral norms regarding BMP use; (7) socio-demographic characteristics including farmer demographics and farm characteristics.

Theory of Planned Behavior Constructs

To measure participants' attitudes, four statement items were included in this scale that all began with the stem of *I believe BMPs…* and included statements about whether BMPs are beneficial for farmers and society, if BMPs should be regulated by government, if BMPs will increase their crop yields, if BMPs should be used by all farmers, and if BMPs can bring environmental benefits to their farm. The internal reliability estimate for this scale was α = .811. To identify participants' subjective norms, five items were included in this scale with each item statement using the stem *I feel like…* and asked participants to indicate if other people whose opinions they value want them to use BMPs, if it is important to listen to agricultural experts about BMPs, if people whose opinions they value would approve of them using BMPs, if farmers in their area are increasingly using BMPs, and if they felt under pressure to use BMPs. The internal reliability estimate for this scale was α = .757. The three item statements that were used to measure participants' perceived behavioral control included the stem *I believe that…* and asked participants about whether they have enough information to use BMPs, if they have enough confidence to use BMPs, whether the decision to use BMPs is up to them, if BMPs are difficult to implement, and if using BMPs are not beyond their control. The internal reliability estimate for this scale was α = .799. Participants' intent to adopt BMPs was measured with four statement items using the stem *I intend to…* and allowed participants to indicate their intentions to use BMPs on their farm this year, to regularly try to use BMPs on their farm in the near future, to seek out financial support for using BMPs, to not make any changes to the way they farm, and to strongly recommend BMPs to other farmers. The internal reliability estimate for this scale was

$\alpha = .800$. Responses for each of these construct scales were collected using a 5-point Likert scale: 1 = *strongly disagree*; 2 = *disagree*; 3 = *neutral*; 4 = *agree*; 5 = *strongly agree*. Overall means were calculated to represent participants' attitudes, subjective norms, perceived behavioral control and intent.

Additional Constructs in the Expanded Model of Theory of Planned Behavior

To reveal participants' knowledge, five statement items were used that included the stem *I am…* and included statements that allowed participants to indicate if they are sufficiently knowledgeable about BMPs, are familiar with the impacts of agriculture on natural resources, are aware of the importance of engaging with BMPs, are familiar with usual farming methods to protect natural resources, are aware of the environmental and financial benefits attributed to BMPs. The internal reliability estimate for this scale was $\alpha = .897$. The five item statements measuring the moral norms of participants used the stem *I think…* and asked participants to indicate if they think it is their responsibility to protect natural resources, think the use of BMPs is in agreement with their principles, values and beliefs, think they are morally obligated to use BMPs, think they would feel guilty if they did not use BMPs, and think they are not responsible for encouraging other farmers to use BMPs. The internal reliability estimate for this scale was $\alpha = .762$. Responses for both construct scales were collected using a 5-point Likert scale: 1 = *strongly disagree*; 2 = *disagree*; 3 = *neutral*; 4 = *agree*; 5 = *strongly agree*. Overall means were calculated to represent participants' knowledge and moral norms.

Demographic Characteristics

The last section of the survey questionnaire included 11 items describing the sociodemographic characteristics of participants. These items included multiple choice and fill in the blank questions that gathered data on participants age, race, sex, education level, off-farm income, farm size, ratio of owned to rented farmland, critical area farmland, farming experience, production areas, and BMP use.

Data Analysis

The convenience sample in this study resulted in the data not meeting normality assumptions. Accordingly, this did not allow inferential statistics to be used. Rather this led to the use of descriptive statistics and non-parametric tests as advised in (Field, 2013) to address the research objectives. Data for objective one was analyzed and reported using descriptive statistics. The data for objective two and three was analyzed and reported using descriptive statistics and following real limits for interpretation. The real limits that were set for the interpretation of responses were: 1.00 to 1.49 = *strongly disagree*; 1.50 to 2.49 = *disagree*; 2.50 to 3.49 = *neutral*; 3.50 to 4.49 = *agree*; and 4.50 to 5.00 = *strongly agree*. For research objective four, Spearman's Rho was the non-parametric test that was applied to examine relationships between the ordinal variables of each construct scale. This test is the most commonly used non-parametric correlation measure (Croux & Dehon, 2010). To interpret these correlations, the following guidelines were applied: $.01 \geq r \geq .09$ = negligible; $.10 \geq r \geq .29$ = low; $.30 \geq r \geq .49$ = moderate; $.50 \geq r \geq .69$ = substantial, $r \geq .70$ = very strong (Davis, 1971).

Results

Objective 1: Describe the sociodemographic characteristics of Georgia cotton and peanut farmers.

There was a similar uneven distribution by sex and race with the majority of participants being male and white. The largest proportion of participants were between the ages of 36-50. The largest proportion of participants either held a 4-year college degree or had attended some college. The majority of participants did not receive off-farm income. The largest proportion of farmers had a ratio of owned to rented farmland of 25 to 75%. The largest proportion of participants had a farm size over 1,000 acres. The majority of participants reported having critical areas on 0-25% of their farmland. The largest proportion of farming experience among participants was over 20 years. These results are displayed in Table 3.1.

Additionally, nearly all participants reported currently using BMPs 92.7% (*n* = 38); while 7.3% (*n* = 3) do not currently use BMPs but intend to in the future. While a requirement of this study was for participants to be cotton and/or peanut farmers, the majority of study participants reported producing peanuts 97.6% (*n* = 40), while 95.1% (*n* = 39) produced cotton, and 61% (*n* = 25) also produced other row crops. Nearly half of participants 41.5% (*n* = 17) also produced other specialty crops, while only 34.1% (*n* = 14) also produced livestock.

Table 3.1
Demographic and Socio-Economic Characteristics of Study Participants (N = 41)

	n	%
Sex		
Male	40	97.6
Female	1	2.4
Race		
Black	3	7.3
White	38	92.7
Age		
21-35	7	17.1
36-50	17	41.5
51-65	11	26.8
66+	6	14.6
Education		
High school graduate / GED	8	19.5
Some college	13	31.7
2-year college degree	3	7.3
4-year college degree	13	31.7
Graduate or Professional degree	4	9.8
Receives off-farm income		
Yes	15	36.6
No	23	56.1
Prefer not to answer	3	7.3
Owned-to-Rented ratio of farmland		
0 to 100%	3	7.3

25 to 75%	15	36.6
50 to 50%	12	29.3
75 to 25%	5	12.2
100 to 0%	6	14.6
Farm size		
<250 acres	2	4.9
250-500 acres	12	29.3
500-1,000 acres	11	26.8
>1,000 acres	15	36.6
Prefer not to answer	1	2.4
Critical area farmland		
0-25%	33	80.5
25-50%	5	12.2
50-75%	2	4.9
75-100%	1	2.4
Farming experience		
1-10 years	6	14.6
11-20 years	11	26.8
Over 20 years	24	58.5

Objective 2: Describe Georgia cotton and peanut farmers' attitudes toward, subjective norms about, perceived behavioral control towards, and intent to adopt best management practices.

The overall mean for attitudes was 4.16 (*n* = 41, *SD* = .538) (See Table 3.2), which notes an overall positive view toward BMPs among these farmers. Georgia cotton and peanut farmers agreed that BMPs will increase their crop yields (*M = 3.93*, *n* = 41, *SD* = .685), and that BMPs should be used by all farmers to protect natural resources (*M* = 3.93, *n* = 41, *SD* = .787). Participants also agreed that BMPs can bring environmental benefits to their farm (*M* = 4.22, *n* = 41, *SD* = .613). Georgia cotton and peanut farmers had the strongest agreement with the statement, "I believe BMPs are beneficial for farmers and society" (*M* = 4.56, *n* = 41, *SD* = .594).

For the subjective norms of Georgia cotton and peanut farmers, results indicated an overall mean of 3.61 (*n* = 41, *SD* = .552) (See Table 3.2). Participants were generally neutral about whether they feel like they are under pressure to use BMPs (*M* = 2.76, *n* = 41, *SD* = .830), and they agreed farmers in their area are increasingly using BMPs (*M* = 3.71, *n* = 41, *SD* = .602). Georgia cotton and peanut farmers also agreed that people whose opinions they value want them to use BMPs (*M* = 3.63, *n* = 41, *SD* = .942) and would approve of them using BMPs (*M* = 3.93, *n* = 41, *SD* = .818). The largest proportion of agreement was shared with the statement, "I feel like it is important to listen to agricultural experts about using BMPs (*M* = 4.05, *n* = 41, *SD* = .631).

Georgia cotton and peanut farmers generally agree that they have enough information to be able to use most BMPs (*M* = 3.73, *n* = 41, *SD* = .867). They also share in agreement for having enough confidence in their ability to use BMPs successfully (*M* = 3.98, *n* = 41, *SD* = .570). Participants indicated they agree that whether or not they use BMPs is completely up to them (*M* = 3.98, *n* = 41, *SD* = .724). As reported in Table 3.2, the overall mean for perceived behavioral control was 3.89 (*n* = 41, *SD* = .617).

As seen in Table 3.2, the overall mean for Georgia cotton and peanut farmers' intent was 3.91 (*n* = 41, *SD* = .544). Georgia cotton and peanut farmers reported a mean of 3.80 (*n* = 41, *SD* = .679) for their agreement with the statement, "I intend to strongly recommend that other farmers use BMPs." Participants agreed that they intend to seek out financial support for using BMPs (*M* = 3.68, *n* = 41, *SD* = .850). They also agreed that they intend to regularly try to use BMPs on their farm in the near future (*M* = 4.07, *n* = 41, *SD* = .608). Georgia cotton and peanut farmers shared the largest agreement with the statement, "I intend to use BMPs on my farm this year" (*M* = 4.10, *n* = 41, *SD* = .583).

Table 3.2
Means for Each Theory of Planned Behavior Scale

Construct Scales	*n*	*M*	*SD*
Attitudes			
I believe BMPs are beneficial for farmers and society	41	4.56	.594
I believe BMPs will increase my crop yields	41	3.93	.685

I believe BMPs should be used by all farmers to protect natural resources	41	3.93	.787
I believe BMPs can bring environmental benefits to my farm	41	4.22	.613
Overall Mean	41	4.16	.538
Subjective Norms			
I feel like the people whose opinions I value want me to use BMPs	41	3.63	.942
I feel like it is important to listen to agricultural experts about using BMPs	41	4.05	.631
I feel like the people whose opinions I value would approve of me using BMPs	41	3.93	.818
I feel like farmers in my area are increasingly using BMPs	41	3.71	.602
I feel like I am under pressure to use BMPs	41	2.76	.830
Overall Mean	41	3.61	.552
Perceived Behavioral Control			
I believe that I have enough information to be able to use most BMPs	41	3.73	.867
I believe that I have confidence in my ability to use BMPs successfully	41	3.98	.570
I believe that whether or not I use BMPs is completely up to me	41	3.98	.724
Overall Mean	41	3.89	.617
Intent			
I intend to use BMPs on my farm this year	41	4.10	.583
I intend to regularly try to use BMPs on my farm in the near future	41	4.07	.608
I intend to seek out financial support for using BMPs	41	3.68	.850
I intend to strongly recommend that other farmers use BMPs	41	3.80	.679
Overall Mean	41	3.91	.544

Note. Scores based on Likert scale with 1 = strongly disagree and 5 = strongly agree.

Objective 3: Describe Georgia cotton and peanut farmers' knowledge and moral norms related to best management practices.

As seen in Table 3.3, Georgia cotton and peanut farmers reported an overall mean for knowledge of 3.94 (*n* = 41, *SD* = .539). Participants shared in agreement that they are aware of the environmental and financial benefits attributed with BMPs (*M* = 3.95, *n* = 41, *SD* = .545) and the importance of engaging with BMPs (*M* = 4.00, *n* = 41, *SD* = .632). Georgia cotton and peanut farmers agree that they are sufficiently knowledgeable about BMPs (*M* = 3.63, *n* = 41, *SD* =

.799). Participants agree that they are familiar with usual farming methods to protect natural resources (*M* = 4.02, *n* = 41, *SD* = .612), and familiar with the impacts agriculture can have on natural resources (*M* = 4.10, *n* = 41, *SD* = .583).

For the moral norms of Georgia cotton and peanut farmers, results in Table 3.3 indicate an overall mean of 3.75 (*n* = 41, *SD* = .555). Participants felt neutral about if they would feel guilty for not using BMPs (*M* = 3.39, *n* = 41, *SD* = .919) and if they did not feel responsible for encouraging other farmers to use BMPs (*M* = 3.12, *n* = 41, *SD* = .872). Georgia cotton and peanut farmers agreed in thinking that they are morally obligated to use BMPs (*M* = 3.71, *n* = 41, *SD* = .750). They also agreed in thinking that the use of BMPs was in agreement with their principles, values and beliefs (*M* = 4.10, *n* = 41, *SD* = .700). Additionally, participants shared agreement that they think it is their responsibility as a farmer to protect natural resources (*M* = 4.41, *n* = 41, *SD* = .591).

Table 3.3
Means for the Expanded Theory of Planned Behavior Construct Scales

Construct Scales	*n*	*M*	*SD*
Knowledge			
I am sufficiently knowledgeable about BMPs	41	3.63	.799
I am familiar with the impacts agriculture can have on natural resources	41	4.10	.583
I am aware of the importance of engaging with BMPs	41	4.00	.632
I am familiar with usual farming methods to protect natural resources	41	4.02	.612
I am aware of the environmental and financial benefits attributed to BMPs	41	3.95	.545
Overall Mean	41	3.94	.539
Moral Norms			
I think it is my responsibility as a farmer to protect natural resources	41	4.41	.591
I think the use of BMPs is in agreement with my principles, values and beliefs	41	4.10	.700
I think I am morally obligated to use BMPs	41	3.71	.750
I think I would feel guilty if I did not use BMPs	41	3.39	.919
I think I am NOT responsible for encouraging other farmers to use BMPs*	41	3.12	.872

Overall Mean	41	3.75	.555

Note. Scores based on Likert scale with 1 = strongly disagree and 5 = strongly agree. Reverse coded statements are denoted with *.

Objective 4: Examine relationships between participants' attitudes, subjective norms, perceived behavioral control, knowledge, moral norms, to intent to adopt best management practices.

Further data analysis was conducted to examine the relationships between Georgia cotton and peanut farmers' attitudes, subjective norms, perceived behavioral control, knowledge, moral norms, and intent to adopt BMPs. At the .01 level, a Spearman's Rho revealed a substantial significant relationship between attitudes toward BMPs and intent to adopt (r = .502, p = .001). There was a moderate significant relationship between subjective norms regarding BMPs and intent to adopt at the .05 level (r = .350, p = .025). There was also a moderate significant relationship at the .05 level between perceived behavioral control toward BMPs and intent to adopt BMPs (r = .310, p = .049). Moderate significant relationships were also observed between knowledge of BMPs and intent to adopt BMPs at the .05 level (r = .331, p = .035), as well as between moral norms toward BMPs and intent to adopt BMPs at the .01 level (r = .461, p = .002).

Discussion

Like previous literature investigating socio-psychological influences on farmers intentions to adopt certain BMPs (Akkari & Bryant, 2017; Bagheri & Teymouri, 2022), this study sought to examine the socio-psychological influences on Georgia cotton and peanut farmers' intentions to adopt BMPs using an expanded model of the TPB. The expanded TPB framework employed in this study can be used to inform practitioners' and policymakers' understanding of the intrinsic motivations and capacity factors that influence Georgia cotton and peanut farmers’ intentions to adopt BMPs. The findings of this study are consistent with prior BMP adoption studies employing the TPB model (Borges et al., 2014; Daxini et al., 2019; Rezaei et al., 2018), as Georgia cotton and peanut farmers’ attitudes, subjective norms and perceived behavioral control were found to be positively associated with their intention to adopt BMPs. Additionally, while Georgia cotton and peanut farmers’ knowledge and moral norms toward BMPs were also found to be positively associated with their intent to adopt BMPs, additional research is still needed to better understand predictors of actual adoption behavior for cotton and peanut farmers. While there is a gap in literature investigating behavioral influences on cotton and peanut farmers’ adoption of conservation practices, the findings of this study could be applied to education and outreach efforts from agricultural entities seeking to increase the adoption of BMPs.

One notable finding from this study is that the attitudes of Georgia cotton and peanut farmers were overwhelmingly positive toward BMPs. Georgia cotton and peanut farmers felt that BMPs are not only beneficial for farmers and society, but they also believe that BMPs will increase their yields and bring environmental benefits to their farms. The positive attitudes Georgia cotton and peanut farmers held toward these practices even reaches as far as wanting all farmers to use BMPs to protect natural resources. As the Spearman’s Rho revealed attitudes to have the largest association with Georgia cotton and peanut farmers’ intent to adopt BMPs, this finding suggests that attitudes toward BMPs can play a major role in shaping farmers’ intentions to use BMPs.

Among the specific attitudinal variables examined, the insights from this study suggest that careful consideration should be given to farmers’ attitudes, and that it could be crucial for educational efforts to focus on promoting the feasibility and benefits of these practices to in turn promote positive attitudes among farmers. Thus, by educational efforts taking into consideration the need to explain the specific benefits, costs, risks, and prevalent management concerns regarding BMPs, this could fulfill some needed capacities of Georgia cotton and peanut farmers (Formiga, 2021; Miller et al., 2012). Once this openness to learning more about these practices is established, training farmers on BMPs may enable them to adopt BMPs and enhance their capacity to evaluate their management practices more efficiently (Despotovic et al., 2019).

According to Castillo et al. (2021) and Mills et al. (2017), the subjective norms and social pressures felt by individual farmers needs to be understood as these can have an impact on farmers' perceptions and decisions regarding BMPs. An interesting finding is that although Georgia cotton and peanut farmers did not feel like they were under pressure to use BMPs from anyone, not even the people whose opinions they value, they do believe farmers in their area are increasingly using these practices and that it is important to listen to agricultural experts about using BMPs. As all farmers in this study utilize Cooperative Extension, this finding could potentially mean that these farmers may already have been using BMPs for years without being aware that the management recommendations from this resource that they were following included the use of BMPs. These findings could support the idea that putting pressure on non-adopters may not actually be the best solution to increase adoption rates, but rather establishing knowledge networks between farmers and conservation leaders within a community may be a more effective solution to pursue (Franz et al., 2010; Singh et al. 2018). Additionally, this could point to a need for the development of new ways to document the use of BMPs on farms. Furthermore, whether approval was needed, Georgia cotton and peanut farmers felt that those whose opinions they value would be supportive of their decision to use BMPs. And while farmers' subjective norms toward using BMPs was found to be positively associated with intent to adopt BMPs, these findings could potentially add weight to the suggestion of Daxini et al. (2019) that agricultural experts and professional sources of information may be more influential on farmers' views toward BMPs than friends or family.

Past research has indicated that farmers' perceived behavioral control toward using best management practices is typically associated with their intentions to adopt BMPs (Daxini et al., 2018; Daxini et al., 2019; Doran et al., 2020). The results of this study concur with this common finding as the perceived behavioral control of farmers had a significant and positive association with intent to adopt BMPs. Although this finding could potentially be due to the majority of farmers in this study having over 20 years of farming experience, it should still be implied that farmers' beliefs of having enough information, confidence, and control over their decision to use BMPs are all important considerations when examining their intentions to use these practices. And although this suggests that practitioners can work to ensure that sufficient farmer education and training is accounted for, other potentially influential variables on farmers' capacity to adopt BMPs can include structural barriers such as expected costs, time, and labor that may also need to be addressed in outreach efforts.

Georgia cotton and peanut farmers shared an awareness and familiarity with BMPs, and of the potential impacts agriculture can have on natural resources. While awareness about a topic such as BMPs can have a notable influence on farmers' adoption behavior, knowledge about how to perform the behavior is a more relevant consideration for examining BMP adoption (Kaiser et al., 1999). In an investigation into farmers' intentions to use pesticides, Bagheri et al. (2019) found knowledge of pesticide use was the most important factor influencing intention. Accordingly, Georgia cotton and peanut farmers' knowledge of BMPs was found to be significantly and positively associated with intent to adopt BMPs. This finding could be explained by the fact that all participants in this study participate in Cooperative Extension activities and therefore are more likely to be knowledgeable about BMPs than farmers that do not utilize this service. Likewise, this finding may have implications for researchers as a comparison of the knowledge levels of BMPs between farmers that engage in Cooperative Extension services versus farmers that do not, could provide valuable insights into the most effective sources for disseminating information about BMPs. Moreover, one way for these agricultural agencies to potentially enhance the accessibility of information regarding BMPs would be to disseminate educational materials on their social media pages and websites, as this could reach audiences searching for this information.

Research investigating the impact farmers' moral norms have on their intentions to adopt a practice or technology has found that farmers who have stronger moral norms tend to have stronger intentions toward performing the behavior (Bagheri et al., 2019; Rezaei et al., 2018). And while Georgia cotton and peanut farmers share the altruistic feeling of being responsible for the protection of natural resources, the significant and positive relationship between moral norms and intent to adopt BMPs in this study concurs with this prior research in showing an influence between moral norms and intent. This finding could suggest that educational seminars and trainings for farmers should include discussions about how not utilizing BMPs can lead to detrimental impacts on natural resources. On the contrary, even if farmers do not have strong moral norms toward stewarding natural resources, they may still be willing to use BMPs if they have a strong understanding of the long term benefits these practices can provide.

Recommendations, Limitations, and Conclusions

The findings included in this study provide insights about the decision-making process of Georgia cotton and peanut farmers regarding the adoption of BMPs. This study could set the foundation for complementary studies to be conducted investigating conservation practice adoption. As agricultural entities like Cooperative Extension and NRCS would benefit from knowing the information sources that are most frequently used by cotton and peanut farmers, this may be a valuable area of inquiry. Establishing a better understanding of the primary BMP information sources being used by farmers may also assist Cooperative Extension in how it can overcome farmers perceiving the recommendations from this resource as lacking in personalization and flexibility (Houser et al., 2018). Although farmers in this study valued the expertise of agricultural practitioners such as Cooperative Extension, farmers' use of Cooperative Extension as their primary information source varies widely by state (Borrelli et al., 2018; Houser et al., 2018; McLeod et al., 2019).

It could be beneficial for research to further investigate the preferences targeted populations of farmers hold for specific educational and technical support approaches regarding conservation practices. Research could also explore the role of partnerships between the private sector and agricultural government entities in conducting on-farm field trials to educate farmers about certain conservation practices. And while most farmers in this study had over a decade of experience farming, it may also be valuable to examine the perceptions new farmers hold toward BMPs. As research with a contentious topic such as sustainability can be subject to social desirability bias, we recommend that researchers incorporate focus groups and carefully focus on the wording of survey questions to prevent disengagement from participants. Likewise, to reduce social desirability bias, it is crucial to ensure farmers feel that their survey responses are anonymous. Additionally, as family members or multiple farm operators on a single farm can have specific roles in terms of the decision-making on farms, it could be valuable for future studies to examine the unique decision-making roles among farm operators and family members to uncover who is truly making the various production and business decisions on farms.

The contributions this paper makes to the BMP adoption literature holds multiple implications for practitioners and researchers. First, this study is one of the first to analyze cotton and peanut farmers' adoption of BMPs using the conceptual model of the expanded TPB framework. As the expanded TPB model is well established in farmer adoption literature, the findings of this study reiterate the applicability of this framework for examining socio-psychological influences on farmers' intent to adopt conservation practices. Also, while much of the current literature investigating farmers' motivations and barriers to the adoption of conservation practices is focused on the Midwest and mid-Atlantic regions (Arbuckle & Roesch-McNally, 2015; Schall et al., 2018), this study contributes to the much-needed area of inquiry for this field of research to expand into different regions and types of production.

There are certain limitations of this study that must be addressed. While constraints to time, budget, and the settings of the research sites made a convenience sample necessary, the first limitation of this study is the small sample size. The low sample size could also be due to survey fatigue as this population, like all farmers are constantly requested to participate in surveys distributed by government agencies, private entities, and universities (Liu & Brouwer, 2022). It is suggested that an increased sample size and a random sampling procedure be pursued in future studies to establish generalizability and improve statistical power. Second, the survey method utilized in this study was based on a self-reporting of answers that could include issues with social desirability bias. Third, as the survey questionnaire used in this study only included some of the factors and potential influences on farmers' decision-making process regarding BMP adoption, we recommend future studies focus on other influential variables that were omitted from this study.

Also, while this study focused on investigating the relationships between farmers' socio-psychological variables regarding their intention to adopt BMPs, there is still a need for more studies to investigate determinants of conservation practice adoption behavior. Thus, future studies should examine whether certain demographic and socio-economic variables have significant impacts on farmers' willingness to adopt BMPs. While the convenience sample in this study included mostly white male farmers, research is needed that investigates the perceptions of farmers within other demographic groups to be fully representative of the greater farmer population. For example, according to (NASS, 2019) 4% of Georgia farmers are black, 1.34% of Georgia farmers are Hispanic, .67% of Georgia farmers are Asian, and 34.3% of farmers in Georgia are female. By conducting research with Georgia farmers among various demographic groups, this could reveal helpful insights into where these groups of farmers are seeking farm management information, as well as create a better understanding of how these different groups of farmers in Georgia view BMPs. This understanding can in turn lead to more comprehensive and equitable dissemination of BMP education and outreach efforts.

Although this study only includes certain BMPs recommended for cotton and peanut production in Georgia, future studies could benefit from including even fewer BMPs, as the relevance of specific practice characteristics for the decision-making process of farmers could then be examined in detail. It is also suggested that future research in this field focus on examining farmers' viewpoints toward one or two specific BMPs in a geographic area or type of production in which low adoption rates are evident. As BMPs play a crucial role in advancing sustainable agricultural intensification that is needed to meet global food and fiber demands, the continued development of this area of research will be critically important to be able to inform the best educational and outreach methods for facilitating higher adoption of BMPs.

CHAPTER 4

ASSESSING FARMERS' PERCEPTIONS OF BEST MANAGEMENT PRACTICES: AN EXPLORATION OF THE VIEWPOINTS OF COTTON AND PEANUT FARMERS IN GEORGIA USING Q METHODOLOGY[2]

[2] Taylor Jr., W. R., Borron, A., Holt, J., & Monfort, W. S. To be submitted to *Agriculture and Human Values*.

Abstract

While Georgia is one of the top producers of cotton and peanuts in the Unites States, much attention has been centered on ensuring sustainability in the production of these crops. The need to understand what drives farmers' decision to utilize voluntary best management practices is critical for the improvement of strategies focused on increasing farmers' adoption of these practices. Empirical evidence that identifies influential factors in farmers' decision to adopt best management practices have yet to produce consistent predictors of adoption behavior. This has led to increased calls for unique approaches examining how farmers' views and motivations impact their adoption decisions regarding these practices. This study builds on previous research using Q methodology to provide an in-depth investigation of the differences in farmers' views on best management practices for cotton and peanut production in southwest Georgia. A purposive sample of 21 participants completed the Q sorting exercise and semi-structured interviews. Analysis of the data revealed three primary viewpoints that were identified and labeled as the: (1) land preservers, (2) ambitious self-starters, and (3) principled bootstrappers. These perspectives show the differences in motivations for adoption behavior and denote the range of influential factors on farm management decisions. The findings of this study reveal key viewpoints held by Georgia cotton and peanut farmers toward best management practices, which can inform the development of strategically tailored educational resources and opportunities. These targeted educational approaches must account for the specific needs and preferences of farmers found in this study to potentially increase adoption.

Introduction

Conservation/best management practices (BMPs) are tools designed to reduce non-point source (NPS) pollution, such as nutrient runoff from production agriculture, and increase overall water quality goals (Jain & Singh, 2019). Agricultural and conservation agencies recommend these practices to farmers, and include strategies, such as developing nutrient management plans, planting cover crops, and reducing tillage (Campbell et al., 2011; GASWCC, 2013). Of course, as production demands increase to meet the demands of a growing population, fertilizer and pesticide use has also increased in recent decades (Nesme et al., 2018). Increasing inputs have resulted in ecological damage and water quality impairments as the soil is unable to absorb the excess nutrients, which leads to NPS pollution (Lu & Tian, 2017; Lun et al., 2018; Sutton et al., 2011). The adoption rates of BMPs among farmers are highly varied throughout the U.S. (Wade et al., 2015), which has led to declining water quality and serious concerns from policymakers (EPA, 2017; Llewellyn, 2007; Ribaudo, 2011). More awareness of persistent NPS pollution, primarily from nitrogen and phosphorous runoff (EPA, 2017), has led many state and federal agencies to develop strategies to combat agricultural NPS pollution through regulations, pay-for-performance plans, and voluntary adoption programs for farmers (Schall et al., 2018; Shortle et al., 2012; Shortle & Uetake, 2015).

Calls for higher adoption of BMPs have increased significantly in recent years as more attention has been focused on NPS pollution from agricultural runoff in the U.S. (Cassman & Grassini, 2020; Pretty & Bharucha, 2014). While agriculture is not alone in contributing to NPS pollution, common agricultural practices, such as deep tillage and intensive fertilizer and pesticide application, have been found to negatively impact the environment through water quality impairments and soil degradation (Bhan & Behera, 2014; Bopp et al., 2019; Sun et al., 2012; USDA NRCS, 2009). Throughout the U.S., agricultural NPS pollution remains a prevalent issue (EPA, 2017) and has been linked to negative consequences among watersheds throughout the Southeast (Garcia et al., 2011; Nagy et al., 2011). While substantial state and federal regulation and spending have gone toward water pollution control for many decades, water quality issues remain (Keiser & Shapiro, 2019).

In Georgia, statewide plans to control and prevent NPS pollution are developed every five years by the Environmental Protection Division of the Georgia Department of Natural Resources (GAEPD, 2019). These plans target NPS pollution from agriculture, as well as other sources of NPS pollution, like contaminated runoff from construction sites and residential areas. For controlling agricultural NPS pollution, this program works with the Georgia Soil and Water Conservation Commission (GASWCC) and other agricultural agencies throughout the state to promote voluntary adoption of BMPs (GAEPD, 2019). The GASWCC works with cooperating agencies to create a list of BMPs that serve to inform farmers and encourage adoption through highlighting the effectiveness of these practices in protecting water quality, as well as providing the relative cost of implementing the practices (GAEPD, 2019; GASWCC, 2013). The practices this study focuses on are derived from two sources: the GASWCC manual on best management practices and input from Cooperative Extension specialists to determine the most relevant practices for cotton and peanut production. This study includes eight selected BMPs: use of cover crops, crop rotation, nutrient management plans, conservation tillage, field borders, water and sediment control basins, integrated pest management, and irrigation water management plans.

Despite decades of substantial research and promotion efforts made by government and non-government programs, consistent predictors of adoption behavior are lacking, and in order to achieve the water quality goals set forth in the U.S., increased adoption of BMPs is needed (Baumgart-Getz et al., 2012; Burton, 2014; Palm-Forster et al., 2017; Ribaudo, 2015). Although adoption rates of individual BMPs vary, an example of a needed area for increased BMP adoption in Georgia can be seen in the adoption rates of conservation tillage, which increased 5% between 2012 and 2017, accounting for 49% of all harvested cropland in the state (NASS, 2019). The current approaches commonly used to reduce agricultural NPS pollution and promote the voluntary adoption of BMPs can include command-and-control regulations, voluntary environmental programs, and economic instruments such as input taxes, ambient taxes/subsidies, government financial assistance, tradable water quality permits, liability rules and performance bonds (Dowd et al., 2008). While these strategies have not motivated farmers to achieve the necessary increases in BMP adoption to improve water quality goals, a more insightful understanding of the perceptions of farmers regarding BMPs is essential for future policymaking and outreach efforts (Braito et al., 2020; Dessart et al., 2019). The cost-effectiveness of voluntary conservation programs is also a serious determinant to water quality improvements, as farmers will likely not be able to implement conservation practices if they are not economical for their operation (Ribaudo & Shortle, 2019). For sustainable agricultural practices to become established in conventional agriculture, policies and programs should consider the sociological and psychological motivations of farmers (Baumgart-Getz et al., 2012; Burton, 2014).

Review of the Literature

The research focusing on relevant predictors of adoption behavior has shown inconsistent findings (Reimer et al., 2012; Wilson et al., 2014), and there is no consensus on what generally influences farmers' attitudes and willingness to adopt certain BMPs (Wilson et al., 2014). Many scholars have explored the decision-making process related to BMP adoption by examining various influential factors such as behavioral, social, economic, structural, and ecological variables (Akkari & Bryant, 2017; Baumgart-Getz et al., 2012; Bopp et al., 2019; Feder et al., 2011; Prokopy et al., 2019; Reimer et al., 2012). As most BMP adoption studies tend to focus on farm characteristics and socio-economic variables, the cognitive and socio-psychological factors that can influence decisions of farmers are left out (Martinez-Garcia et al., 2013; Zeweld et al., 2017).

Liu et al. (2018) reviewed several studies investigating the growing literature on conservation practice adoption from around the world to determine the progress that has been made over the years. This review emphasized the complexity of the farmer decision-making process and recommended that future research examine how farmers' preferences for practices impact decision-making. Ranjan et al. (2019) reviewed all qualitative studies looking into determinants of conservation practice adoption conducted within the U.S. since 1996 to uncover trends and provide a synthesis of what has been found on this topic. They found economic and farm management needs are the most common motivations and barriers to adoption. Uniquely, it was also noted how other studies in the review (Czap et al., 2015; Floress et al., 2017) found that focusing on these variables alone is not sufficient to predict adoption as socio-psychological variables can also influence adoption. Other common factors Ranjan et al. (2019) found in this study to influence adoption included current and previous experiences with conservation practices, as well as behavioral intentions.

Although extrinsic factors like financial incentives and socio-economic demographics have been shown to influence decision-making and were the primary focus of many studies in recent decades (Burton, 2014; Drost et al., 1996; Rodriguez et al., 2009), a shift in the literature has placed an emphasis on investigating the role of intrinsic variables on decision-making

(Daxini et al., 2018; Greiner & Gregg, 2011; Lalini et al., 2016; Reimer et al., 2012; Yoder et al., 2019). An example of this can be seen in the work of Meijer et al. (2015), which investigated the role of attitudes, knowledge, and perceptions in farmers' adoption of new agricultural technologies in sub-Saharan Africa to determine if these intrinsic factors along with extrinsic factors are able to predict decision-making. Further, Bopp et al. (2019) examined how both intrinsic and extrinsic factors impact farmers' decisions. Despite the vast literature on BMP adoption, multiple attempts to synthesize the literature has not resulted in identifying a single factor that consistently predicts adoption behavior (Baumgart-Getz et al., 2012; Knowler & Bradshaw, 2007; Prokopy et al., 2019; Ranjan et al., 2019). As prior research has stated that policies seeking to increase adoption of conservation practices do not always account for the range of farmer perceptions (Taheri et al., 2020), the results of this study could potentially inform the development of outreach and educational strategies regarding BMPs.

Goals of the Study

Most of the research into conservation practice adoption has been confined to quantitative data which has limited the ability to bring new perspectives to this field (Prokopy, 2011; Reimer et al., 2014). Despite the literature growing in recent years with new approaches to measuring conservation practice adoption, there is still a need to include underutilized methodologies in this area of inquiry (Liu et al., 2018; Ulrich-Schad et al., 2017). Q methodology fills that void in this study by its ability to holistically consider the personal experiences and diverse contexts of participants to distinguish their viewpoints, and then scrutinize them to portray the full picture of influential factors on farmers' decision to use or not use BMPs. The primary goal of this research is to gain better insight into the decision-making process of farmers by identifying the individual perspectives held by cotton and peanut farmers regarding BMPs. More specifically, this study explores the perspectives of farmers in southwest Georgia with the following research objectives: (1) explore farmers' perceptions of best management practices, and (2) determine which aspects of farm management farmers identify as having the greatest influence on their decision to utilize best management practices.

Conceptual Framework

A growing interest has been shown from researchers in utilizing approaches that take the socio-psychological drivers of farmer decision-making into account (Wauters & Mathjis, 2013). Applying a conceptual framework in a Q methodology study can help structure the framing of questions and the organization of the broad range of opinions in the concourse (Atkins, 2020; Mckenzie et al., 2011). The conceptual framework in this study is guided by the theory of planned behavior (TPB), which is a well-known framework introduced by Ajzen (1991) that provides a conceptual model for understanding the socio-psychological factors that influence behavior. Empirical evidence demonstrates that previous research has successfully utilized the TPB to explore farmers' decision-making and explain behavior (Bonke & Musshoff, 2020; Borges et al., 2014; Despotovic et al., 2019; Senger et al., 2017).

The central tenant of the TPB framework posits that intentions are the primary driver of behavior, and intentions are influenced by an individual's *attitudes, subjective norms,* and *perceived behavioral control* (Ajzen, 1991). Further, intention is first impacted by *attitudes*, or an individual's overall favorable or unfavorable assessment of a behavior (Ajzen, 1991). This evaluation of the behavior is dependent on an individual's beliefs and perceptions of the behavior. Therefore, in the context of this study, if a farmer has more positive attitudes toward BMPs, the greater their intention will be to adopt them. The second construct, *subjective norms*, is a social factor that encompasses all social pressures an individual may feel regarding their decision to perform or not perform the behavior (Ajzen & Fishbein, 1980). This directly correlates to how the attitudes of other people can influence an individual's perception of the behavior. For example, if a farmer feels like they are under social pressure from their friends and family to adopt BMPs, they will be more likely to adopt these practices.

Perceived behavioral control is the third construct of the TPB that refers to the ease or difficulty an individual feels toward performing a behavior (Ajzen, 1991). This construct includes both the confidence a person has in themselves to perform a behavior, and the access to non-motivational resources such as time, experience, and money (Ajzen, 1991). In the case of BMPs, if a farmer feels that they have enough resources, placing the decision to adopt BMPs under their control, they will be more likely to have an increased intention to adopt BMPs.

Yet, despite the success and wide application of literature using the TPB framework to examine farmers' behavioral intentions (Bechini et al., 2020; Daxini et al., 2019; Hall et al., 2019), many studies have attempted to extend this theory with the inclusion of additional constructs (Ataei et al., 2021; Bagheri et al., 2019; Chen & Tung, 2014; Hou & Hou, 2019; Tama et al., 2021). This extended TPB model – which includes *moral norms* and *knowledge* to bring a higher predictive power to the model – has been used extensively in agricultural research examining farmer behavior (Bagheri & Teymouri, 2022; Govindharaj et al., 2021; Maleksaeidi & Keshavarz, 2019; Rezaei et al., 2018).

The additional construct of *moral norms* is included in this study to account for the influence of personal values and moral considerations that farmers face in their work. For this study, moral norms are defined as the moral commitment felt by farmers toward adopting BMPs (Bamberg & Moser, 2007). As higher levels of knowledge can influence farmers conservation behavior (Tama et al., 2021), the construct of *knowledge* in this study refers to the knowledge a farmer has regarding recommended BMPs for cotton and peanut production. While this study does not seek to test this theory, this conceptual framework was used to guide the development of the data collection instrument used to measure the viewpoints farmers hold regarding BMPs. To the best of our knowledge, this is the first study that applies an extended TPB framework to a Q methodology study to better understand the perspectives of cotton and peanut farmers toward the adoption of BMPs.

Methods

Q Methodology Background

Q methodology is a mixed method approach developed by William Stephenson in 1935 that serves to adjoin the strengths of qualitative methods with the rigor of quantitative research through examining first-person perspectives to capture the whole story of the issue at hand (Brown, 1980; Stephenson, 1953; Watts & Stenner, 2012). With the foundation of this approach stemming from inverted factor analysis, Stephenson developed this tool to analyze the similarities and differences between individual perspectives and compare the intercorrelations of these viewpoints among a group of subjects. These perspectives of the subjects are loaded onto factors that represent the overarching viewpoints of the group of subjects to then be analyzed holistically (Watts & Stenner, 2012). This comprehensive measurement of viewpoints is meant to provide a systematic analysis of individuals' subjectivity through an exercise known as a Q sort, in which the participants sort a list of opinion statements on the relevant topic.

The series of opinion statements used in the Q sort are referred to as the Q set, which is meant to be a thorough list of statements that encompass all potential viewpoints on the topic being studied. In the Q sort, subjects are asked to arrange the set of statements on a forced-choice frequency distribution grid based on their level of agreement or disagreement with each statement. This grid includes a space for each statement and allows subjects to rank-order statements in an approximately normal distribution. Once the sorting exercise is completed by participants, the arrangement of the completed Q sort is documented and evaluated by the researcher through factor analysis. Following the statistical analysis, researchers then apply a qualitative lens to interpret the factors and provide a thorough explanation for each factor array, which shows an averaged or composite Q sort for each significantly loaded factor to represent the perspectives within these, and to uncover any overlap and nuance between factors (Watts & Stenner, 2005; Watts & Stenner, 2012).

Q methodology is completed in five steps that include concourse development and the selection of statements to be used in the Q set, development of the P set, the Q sorting process, data analysis consisting of correlations and factor analysis, and interpretation of the analysis to identify themes found from the data (Mckeown & Thomas, 2013). This method has two major strengths that give it an edge over traditional research methods. The first is that researcher bias is reduced by eliminating leading questions and not relying strictly on the interpretive skills of the researcher (McKeown & Thomas, 2013). The other benefit of this method is the process is robust compared to other methods that try to measure subjectivity (Cross, 2005).

The Q methodology approach allows for the systematic analysis of subjectivity, which captures an individual's attitudes, beliefs, opinions, and the like (Brown, 1993; Taheri et al., 2020). While questions of validity are common in quantitative studies, the soundness of this study is achieved internally as this approach deals with individual perspectives for which there is no external measure for validity (Brown, 1980). Through looking into the broad variations of viewpoints uncovered by Q methodology rather than a limited set of potential survey answers used in traditional research methods, a better understanding of farmer motivations and barriers for the adoption of BMPs can be achieved.

Q methodology is becoming more commonly applied in farmer adoption literature as calls to investigate nuanced contexts of conservation practices have increased (Alexander et al., 2018; Forouzani et al., 2013; Lehrer & Sneegas, 2018; Pereira et al., 2016; Schall et al., 2018; Taheri et al., 2020). This method attempts to identify patterns in the subjective viewpoints of various individuals rather than across entire populations (Coogan & Herrington, 2011). This method is used in an interdisciplinary manner, ranging from fields such as nursing (Lim et al., 2021), to higher education (Ramlo, 2020) and rural studies (Duenckmann, 2010). While this study responded to a call from the literature for agricultural communication research to incorporate Q methodology into research efforts (Leggette & Redwine, 2016), there is a growing application of Q methodology in agricultural and environmental science research (Davies & Hodge, 2007; Kristensen & Jakobsen, 2011; Kvakkestad et al., 2015). These Q studies have investigated farmers' technology adoption (Pereira, 2011), production decisions (Alexander et al., 2018), and perspectives on best management practices (Bumbudsanpharoke et al., 2010). The strengths of Q methodology have also led to its application in various studies on farmer management styles (Brodt et al., 2006; Fairweather & Keating, 1990; Fairweather & Klonsky, 2009; Pereira et al., 2016).

Q set

As the focus of this study centered on understanding the perceptions of cotton and peanut farmers toward BMPs in Georgia, the concourse, or statements generated in an attempt to cover all available opinions relating to this topic, were created based off of informal interviews with Cooperative Extension specialists and an extensive review of the literature (Braito et al., 2020;

Brodt et al., 2006; Lehrer & Sneegas, 2018; Pereira et al., 2016; Prokopy et al., 2019; Reimer et al., 2012; Rezaei et al., 2018; Taheri et al., 2020). This initial list included 200 statements categorized into six themes (attitudes, subjective norms, perceived behavioral control, intentions, knowledge, and moral norms) according to the framework of an extended model of the theory of planned behavior (Ajzen, 1991). The concourse was then reduced to a Q set of 47 statements that reflected a diversity of influential decision-making variables for farmers' BMP adoption and were evenly dispersed among the six categorical themes. After this Q set was established, it was reviewed by two research design experts and further refined to reduce overlapping statements and ensure clarity. This research also gained Institutional Review Board (IRB) approval in December 2021.

P set and Procedures

Unlike quantitative studies, the sample size for Q methodology is recommended to be much smaller with an emphasis on capturing various viewpoints to enhance quality; thus, the number of participants, or P set, is commonly that of half the number of opinion statements, however, the P set is also determined once a salience of potentially unique viewpoints is reached (Brown, 1980; McKeown & Thomas, 2013; Watts & Stenner, 2005). While this does add some bias into the findings, it should be noted that this approach does not create generalizable conclusions but rather seeks to reveal the different perspectives that exist within a certain population (Brown, 2019). For this study, 21 cotton and peanut farmers in southwest Georgia were selected through purposive sampling to ensure the inclusion of a wide variety of cotton and peanut farmers. The goal of this type of sampling was to include different perspectives on BMPs through sampling across a population of farmers with different backgrounds, experiences, and farm characteristics. Using these inclusion criteria, all the farmers who participated in this study were identified through contact via Cooperative Extension agents in 17 counties located in the southwest Georgia Extension district. The participants performed the Q sorting exercise and were interviewed individually at each of their farms during February 2022. These meetings with the participants ranged from 30 minutes to 1.5 hours.

Participants first completed a pre-sort demographic questionnaire before being provided an instruction sheet, paper statement cards with corresponding numbers, and a blank sorting grid. Figure 4.1 displays the sorting grid that was used by participants during the Q sorting exercises.

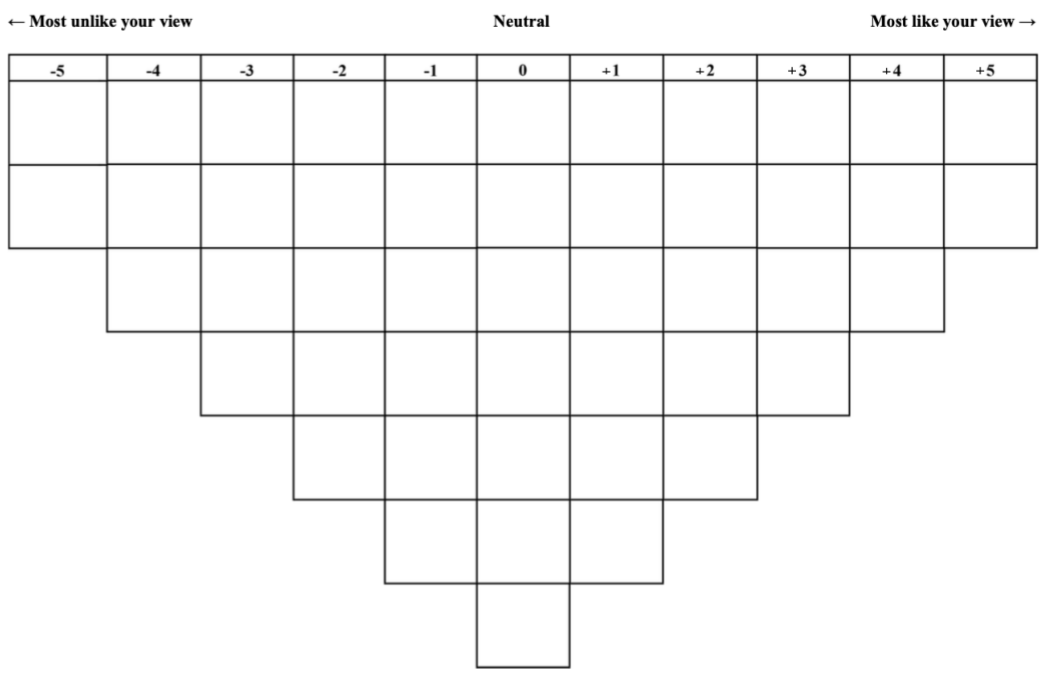

Figure 4.1
Example of the quasi-normal distribution grid. Values are ranked in a range from -5 to 0 to +5. A total of 47 items can be accommodated on this illustrated distribution.

To complete the Q sorting exercise, participants were asked to read through all 47 opinion statements and place the statements into three piles according to their agreement, neutrality, and disagreement. The participants were then asked to rank the statements on the Q sorting grid from most unlike their view (-5) to most like their view (+5), with neutral (0) in the center of the forced-choice frequency distribution (ex: ‘S12: -3’). Participants completed each of these steps in the exercise by responding to the guiding question, “What are your views on best management practices for cotton and peanut production?” Each participant was allowed to ask questions and think out loud during the Q sorting exercise (Watts & Stenner, 2012). Following the conclusion of the Q sorting, participants were briefly interviewed to discuss the rationale for their sorting of statements and provide any additional thoughts or opinions they had about the exercise. Each of these interviews was recorded and field notes were taken to provide further insights during interpretation. All recordings were only identified by letter labels to maintain confidentiality (ex: ‘participant A’).

Statistical Analysis

Following data collection, pictures were taken of each of the completed Q sorts before being uploaded into the software Ken-Q Analysis Desktop Edition v.1.2.1 (KADE) (Banasick, 2019) to analyze the results. After exporting the Q sorts into KADE, an intercorrelation matrix was constructed to calculate the positive or negative relationships between each of the individual Q sorts. Following this step, the matrix was subjected to principal components analysis (PCA) and factor-analyzed on a by-person basis to identify correlations. As this process identifies statistically significant factors and groups very similar perspectives across Q sorts into corresponding factors, eight unrotated factors were initially yielded that accounted for 71% of the total variance. These subsequent factors consist of merged Q sorts representing shared viewpoints to form a single Q sort that best represents each of the merged Q sorts through a weighted average. However, by following the suggestion from Brown (1980) to only keep factors with an eigenvalue greater than 1, four factors were identified that met this criterion.

Since the number of kept factors for final analysis is a crucial decision for the direction of the study (McKeown & Thomas, 2013), additional measures were taken to address potential concerns of the suitability of the kept factors. While there is no objective process for selecting the most appropriate number of factors to keep (Pereira et al., 2016), the measures taken to accomplish this step included applying the significance criterion, meaning each factor kept for rotation must have at least two significant Q sort loadings (Watts & Stenner, 2012), as well as considering the real-world reflection of the factors kept for analysis (Watts & Stenner, 2005). Upon these considerations, three meaningful factors were extracted for varimax rotation with 18 of the 21 Q sorts loading significantly onto one of these three factors and explaining 66% of the total study variance. With the minimum threshold for a loading value being at 0.38 (2.58 x 1/√ (number of statements) = 2.58 x $1/\sqrt{47}$), the remaining three participants did not load significantly onto a single factor, but rather shared many of the same viewpoints within factor one and two. As the views of the participants that did not load significantly onto a single factor were basically captured by the already existing factors, these three corresponding Q sorts were not included for further analysis. Since there are high levels of correlation between each of the factors in this study, it is no surprise that there are many shared views within all three factors as evidenced in Table 4.1.

Table 4.1
Correlations Between Each Identified Factor

	Factor 1	Factor 2	Factor 3
Factor 1	1	0.5257	0.6148
Factor 2	0.5257	1	0.6023
Factor 3	0.6148	0.6023	1

Note. A rather high correlation between each of the factors exceeds the study's significance level of 0.38, which reveals several similarities across the viewpoints held by each of the factors. Each factor represents the common viewpoints among a group of Q sorts that were ranked in very similar manners.

The final step of analyzing the data in this study applied a qualitative depiction of the individual perspectives within each of the extracted factors. To accomplish this step, the crib sheet method, as outlined by Watts and Stenner (2012), was employed to holistically examine and interpret the results of this study through uncovering patterns and unique viewpoints within each of the factors selected for analysis (Watts & Stenner, 2012). Originally created as a systematic approach to factor interpretation, the crib sheet method requires the author to consider every item within the factor array. In addition to examination of the factor array, this method calls for engagement with other potentially influential data, such as demographic data of the participants, post-sort interview transcripts, and field notes (Watts & Stenner, 2012). To uncover patterns and unique viewpoints within each of the factors selected for analysis (Watts & Stenner, 2012), the crib sheet method begins by organizing statements based on their relative rankings compared to the other factors. This is done by placing the statements in four groups: statements that were given the highest ranking in each factor, statements given the lowest ranking in each factor, statements ranked higher in one factor compared to any other factors, and statements ranked lower in one factor than by any other factor. The use of this method allows for an organized interpretation process that considers the implications of every statement placement to ensure any polarized statements are acknowledged and all statements with profound contributions to each individual factor are effectively identified (Watts & Stenner, 2012).

Results

Farm and Farmer Characteristics

The characteristics of the participants and farms represented in this sample were successfully diversified according to the purposive sampling measures meant to attain potentially varying perspectives. Farmers in this study spanned an age range of 25 to 69. Years of farming experience varied from 7 to 50 years, and the range of farm sizes were from 500 to 8,000 acres. Despite some minimally noticeable differences between the characteristics of farmers and farms in each of the study factors, no statistical tests were used for this data set. This demographic data presented in Table 4.2 is strictly meant to provide descriptive insights for this study.

Table 4.2
Demographic Characteristics of Study Participants in Each Identified Factor

	Factor 1	Factor 2	Factor 3	Total Sample
Number of farmers	10	4	4	21
Farmer Characteristics				
Average age (min-max)	48.9	48.75	46	47.67 (25-69)
Gender (male)	10	4	4	21 (100%)
Average years of farming experience (min-max)	28.9	27.25	21.75	26.67 (7-50)
Average farm size in acres (min-max)	2,035	2,550	1,050	2,312 (500-8,000)
Farmland containing critical areas (%)	28.7	20	28.75	(24%)
Owned farmland (%)	36.1	30	40	(36%)
Rented farmland (%)	63.9	70	60	(64%)
Level of education				
High school	3	3	0	6 (29%)
Some college	2	0	1	4 (19%)
Completed college	5	1	2	10 (48%)
Postgraduate	0	0	1	1 (5%)
Crops produced				
Cotton	10	4	4	20 (95%)
Peanuts	10	4	4	21 (100%)
Cattle	6	3	1	11 (52%)
Other row crops	8	1	4	15 (71%)
Other specialty crops	3	1	1	6 (29%)
Priority crops				
Cotton	1	0	1	3 (14%)
Peanuts	3	0	3	6 (29%)
Other	1	0	0	1 (5%)
None	5	4	0	11 (52%)
Receives off-farm income	1	0	1	2 (10%)
Used BMPs before	9	4	4	20 (95%)

Note. This table shows the averaged demographic characteristics for the three identified factors. Each factor represents the common viewpoints among a group of Q sorts that were ranked in very similar manners.

Farmers on average were in their late 40s with 26.7 years of farming experience. All farmers were male with the average farm size being 2,312 acres. About one fourth (24%) of the land on these farms contained critical areas and the majority of farmland was rented (64%) rather than owned (36%). While many farmers had completed college (48%), six only completed high school (29%), four had attended some college (19%), and just one farmer held a postgraduate degree (5%). Every farmer in our sample produced peanuts (100%), and nearly every farmer also produced cotton (95%). Roughly half of the farmers also had cattle (52%), and the majority of farmers also produced other row crops (71%), while only about one third of the farmers also grew other specialty crops (29%). The farmers varied in their responses to whether one crop was a priority over the others. Only (14%) of farmers identified cotton as having a priority over other crops, while (29%) selected peanuts, (5%) chose another crop, and (52%) claimed that no crop is a priority over the others. A small portion of farmers claimed to receive off-farm income (10%), and nearly every farmer had engaged with BMPs before (95%).

Table 4.3 reveals the factor scores of the Q sorts for the three extracted factors by denoting the respective statement scores. It also includes every statement ranking within each factor to highlight statements given the highest or lowest scores in each factor, statistically distinguishing statements for each factor (which signify the statements that differentiate one factor from the others), and consensus statements (shown in brackets), that reveal the overlap between factors.

Table 4.3
Factor Scores for All Opinion Statements by Each Identified Factor

No.	Statements	F1	F2	F3
1.	My goal in farming is to have the highest quality crops of all my competitors	-2	-1	3**
2.	[I think BMPs are only appropriate for large farms with plenty of money to spend]	-4	-4	-4

3.	[I avoid discussing my yields and business activities with others]	0	0	-3
4.	[When I retire, I want to stay in a rural/farm environment]	4	3	3
5.	It is important to me to have a network of farmers to share farming information, ideas, and experiences with	1	3	1
6.	Financial viability should be the judge of everything you do on a farm	-3**	3	3
7.	I am willing to sacrifice farm profitability to conserve natural resources	1**	-4	-3
8.	A good farmer puts production goals ahead of any other outside interests or concerns	-3**	1	1
9.	I am sufficiently knowledgeable about non-point source pollution	-1	1**	-1
10.	It is important that my friends and family have positive views about my farming practices	2**	0**	5**
11.	Beyond earning a reasonable income, the main joy in farming is the rural lifestyle	3	2	0*
12.	Farmers have the right to manage their own land however they wish	0**	4	3
13.	I feel like I am under social pressure to use BMPs on my farm	-2*	-4*	2**
14.	[My goal in farming is to be the best farmer I can be]	3	4	5
15.	It is important for me to farm the same way as other producers in my area	-2*	-5**	0*
16.	I feel morally obligated to engage in BMPs	1**	-2	-1
17.	[I avoid debt at all costs—I think having debt means poor business management]	-1	-3	-3
18.	I believe the use of BMPs can significantly reduce the quality of my production	-4	-5	-2
19.	When deciding about using BMPs, I rely solely on my own knowledge and experience	-2	1**	-3
20.	[My objective in farming is to have the highest yields in my area]	-1	-1	0
21.	[There are times when I think farmers must take risks to succeed]	3	5	2
22.	[As long as my production is doing well, I do not worry about how my farm looks]	-5	-2	-4
23.	[When farmers have more success, they should be willing to spend more effort and money on conserving natural resources]	0	0	-1
24.	I care about what others think of my farm—even if my business is doing well	1	0**	2
25.	[I believe that implementing BMPs is expensive and can reduce farm profitability]	-1	-2	-1
26.	I believe there is no better job than being a farmer	4	2	1
27.	I feel like my decision to be a farmer is a higher calling	0	4**	0
28.	[The best reason to use BMPs is the incentive-payments from conservation programs]	-1	-3	-2

29.	[Georgia's agricultural land is in a better state now than it has ever been]	0	2	0
30.	There are sufficient technical services and resources provided to farmers to help them implement BMPs	1**	-2	-1
31.	[It is important to me that my farming practices do not harm the environment]	2	1	2
32.	[I think the government should impose strict regulation of BMPs]	-5	-3	-5
33.	As long as production is doing well, I do not worry about my impacts on natural resources	-3	-2	-5
34.	[I believe BMPs are the best tool for farmers to balance production goals with nature conservation]	2	1	1
35.	Natural resource conservation should only be considered once a farmer reaches his/her financial objectives	-3**	-1	-1
36.	It is important to use the recommendations of agricultural experts (e.g. Cooperative Extension, NRCS) when making production decisions	5*	-1**	2*
37.	I try to avoid changing any of my farming practices—I prefer my way of doing things	-2	-1	-4**
38.	[I am sufficiently knowledgeable about the potential benefits of BMPs]	1	1	0
39.	I believe it is important to try to adopt new practices and technologies in farming	4	0**	4
40.	I plan on using BMPs for the foreseeable future	2	0	0
41.	[Many of the concerns environmentalists have about the environment are valid and should not be ignored]	0	-1	-2
42.	Whenever possible, recommended conservation practices should be implemented by farmers	3*	0	1
43.	Diversifying and maximizing profits are the most important aspects of running a farm	-1**	5	4
44.	I am actively planning to expand my business	0	2**	-2
45.	[Conservation programs (e.g. EQIP, CSP) should be more easily accessible/available to farmers]	2	2	1
46.	I intend to leave my farm for the next generation in a better condition than when I found it	5*	3	4
47.	[There is no compatibility between row crop production and nature conservation—to improve one you must disturb the other]	-4	-3	-2

Note. The three factors (represented in this table as F1, F2, and F3) were analyzed by examining which statements most represented the discriminating views and overlapping views between each group. Distinguishing statements are indicated with *$p < 0.05$ and **$p < 0.01$ to indicate significance levels. Consensus statements are bracketed.

Identifying Characteristics of Each Factor

The in-depth analysis of the data resulted in three unique factors considered to provide a general representation of the viewpoints captured through this study. Factor 1, which is named “the land preservers,” was distinguished from other factors by their valuing of conservation goals ahead of profitability, and their passion for protecting the rural lifestyle of being a farmer. Factor 2, which is name “the ambitious self-starters,” consisted of farmers who were highly motivated to accomplish their business goals and not be deterred by outside influences. And, finally, Factor 3, “the principled bootstrappers,” included farmers who hold high aspirations for their farms and stick to their core values in appreciating the social aspects of farming.

The Land Preservers (F1)

For the 10 farmers who loaded significantly onto this factor, conserving natural resources is something that needs to be considered even before their financial goals are reached (S35: -3), and they completely disagree with the notion that row crop production is not compatible with nature conservation (S47: -4). Their moral obligation to preserving the land is evidenced by their use of BMPs (S16: +1: S40: +2; S46 +5), so that they can continue their passion of being a farmer for a long time (S26: +4; S04: +4; S11: +3). The land preservers also have a compulsion for their farms to be visually appealing (S22: -5). “When people go by and see me farming, I want them to be able to recognize that I’m doing a good job at the production and I’m taking care of the environment” (Participant L).

In contrast to the other factors, the land preservers are the least concerned with maximizing profits (S43: -1), and instead are willing to sacrifice the profitability of their farms if it means natural resources are conserved (S07: +1). They do not believe finances and production goals should be the primary drivers of farm management decisions (S06: -3; S08: -3). Which is illustrated by Participant D, "Just because you're making the highest yields in the county don't mean it's going to last, you got to be still taking care of the land or, in the long run, it's gonna kill you."

While land preservers oppose having strict government regulations of their farming practices (S32: -5), they believe the autonomy farmers have in making farm management decisions should be viewed as a responsibility to promote conservation whenever possible (S42: +3; S39: +4). Accordingly, land preservers seriously value the recommendations from agricultural experts (S36: +5). "It would be ridiculous not to avail yourself for using the very best technical experts" (Participant G). These farmers have a general desire for conservation programs to be more easily accessible (S45: +2; S30: +1), and they hold a passion for using practices that do not harm the environment (S31: +2). This is seen in their belief that BMPs are the best way for farmers to balance production goals with conservation (S34: +2). "We need to live and die by best management practices […] we need to be able to justify what we're doing and explain to people why and how we're doing the best job we can" (Participant G).

The Ambitious Self-Starters (F2)

The primary characteristic of the four farmers in this group is their self-determination and inclination for accomplishing business objectives (S19: +1; S07: -4; S06: +3; S43: +5). Ambitious self-starters view the right to manage their land however they wish as very important (S12: +4), and they are actively expanding their business (S44: +2). This group feels called to be farmers (S27: +4). As Participant B said, "It's [farming] got to be in your blood to do it and enjoy it […] it's [farming] just something that I think is born into you, [and] with me, it is the only thing I have ever wanted to do." Additionally, ambitious self-starters agree that taking risks for the betterment of the farm is integral to having success (S21: +5).

The entrepreneurial pursuits of ambitious self-starters are accomplished by using their own knowledge and expertise (S15: -5; S36: -1), along with a valuable network of farmers (S05: +3). While the confidence these farmers hold in their abilities to manage a farm is unaltered by what their friends and families think (S10: 0), or any other social pressures and moral obligations to use BMPs (S13: -4; S16: -2), they also do not worry about how their farm looks (S22: -2). "I don't care nothin about what other people think. What I'm doing out here is my business" (Participant J).

In comparison to the other factors, ambitious self-starters are less adamant about the importance of farmers using recommended conservation practices (S42: 0). However, they do feel that there needs to be more resources and technical services for farmers (S30: -2), and that the use of BMPs will not hinder farm profitability or the quality of production (S25: -2; S18: -5). One likely explanation for this viewpoint is provided by Participant U, "I think there's not [enough resources] by a longshot [...] And it is so hard for us [farmers] to get good information."

The Principled Bootstrappers (F3)

For the final factor of this study, the four participants who significantly loaded into this factor were defined by their eagerness to become the best farmer possible (S14: +5). The principled bootstrappers want the highest quality crops of their competitors (S01: +3) and to maintain financial viability on their farms (S06: +3; S43: +4). A unique characteristic of these farmers is that they view many of the social influences of farming as important to achieving their goals. This is clarified by Participant H, "If you don't have support behind you, then you'll be mentally drained […] You won't be productive." The proclivity these farmers have for social interactions attributed with farming can be seen in their willingness to speak with others about their business activities (S03: -3) and their consideration of what other people think of their farms and farming practices (S24: +2; S10: +5). This feeling is emphasized by Participant H, "I really care a lot about how my farm looks […] I rent a lot of land, and that's a direct reflection on me when my farm does not look good."

Like the other factors, the principled bootstrappers do not support government regulations of BMPs (S32: -5), and they feel that the concerns environmentalists have about their farming practices are ill-conceived (S41: -2). "I don't believe it's [the concerns about sustainability] wrong, but I believe a lot of it is misinformed and misguided" (Participant N). They also feel the influence of social pressure to use BMPs (S13: +2). Other similarities these farmers share with other factors is that they feel they could learn more about BMPs (S09: -1; S38: 0; S19: -3), and they believe BMPs are valuable tools farmers should adopt to balance conservation with production goals (S34: +1; S39: +4). Principled bootstrappers are open to changing their farming practices (S37: -4) and are highly concerned with their impacts on natural resources (S33: -5). The overall viewpoint of principled bootstrappers is best summarized by Participant K, "I want my production to do well, and my business to do well, and I want to be able to profit and have high yields. But I do worry about the impact on natural resources—because my farm is my farm now, but it's somebody else's in the future."

Shared Opinions Across Factors

Although each extracted factor in this study holds several unique features, the farmers that participated in this study shared many opinions regarding BMPs, with 19 out of 47 statements being scored in a similar manner. Of these consensus statements, seven of them were strongly held beliefs with notable positive or negative rankings. All three factors were highly supportive of BMPs for farms of any size (S2), and despite this support for BMPs, each factor made it abundantly clear that they did not want the government to implement strict regulations on their management practices (S32). In addition, all three factors were particularly averse to the idea that there is no compatibility between row crop production and nature conservation (S47), and they all felt it is necessary to take risks to be successful in farming (S21). A common goal across each factor was to be the best farmer they are capable of being (S14), and both the land preservers and the principled bootstrappers felt more strongly than the ambitious self-starters about keeping their farms well-manicured whether production is thriving or not (S22). All three factors shared an affinity for nature, which was emphasized by their desire to remain in a farm or rural setting once they retire (S4). And while both the land preservers and the ambitious self-starters felt neutral about discussing their yields and business activities with others (S3), the principled bootstrappers mildly disagreed. Every factor moderately disagreed with the idea that farmers must avoid debt at all costs to have a successful business (S17), and they all were generally neutral about wanting to have the highest yields in their area (S20). Both the land preservers and the principled bootstrappers held neutral views about whether the state of Georgia's agricultural land is better than ever (S29), while the ambitious self-starters slightly agreed with this idea. Furthermore, every factor was generally unopinionated about the idea of wanting farmers to spend more effort and money on conserving natural resources when they start to have more success (S23). The feeling of neutrality was carried over in each factor acknowledging that they were neither sufficiently knowledgeable nor oblivious to the benefits of BMPs (S38).

Mild agreement was shared by all factors in believing that BMPs are the best tool for farmers to balance production goals with conservation (S34), as well as for each factor's desire for conservation programs to be more available to farmers (S45). Every factor slightly disagreed with the notion that BMPs are expensive and can reduce from farm profitability (S25). Thus, the consensus of support for using BMPs was further evidenced by all factors agreeing that it is important that their farming practices do not harm the environment (S31). Finally, there was moderate disagreement across every factor that the best reason to use BMPs is the incentive payments from conservation programs (S28), and they all were mildly skeptical of the validity of the concerns of environmentalists (S41).

Discussion

The decision to use Q methodology in this study is meant to provide detailed insights into how farmers view BMPs and reveal the most influential factors that guide farmers' decision making about BMPs. In our investigation of farmers' perceptions of BMPs, three general viewpoints were illustrated to exemplify the perspectives of Georgia cotton and peanut farmers across various farm contexts. While the results of this study are only directly applicable to the specific participants and settings in which it was conducted, these results are meant to establish a detailed depiction of how the decision-making process of this population of farmers directly identifies their specific barriers and drivers for adopting BMPs. By unpacking these thorough accounts of the diverse viewpoints captured in this study, we aim to elaborate on how these findings can both contribute to improved educational and outreach efforts, as well as inform policy makers about potential strategies to increase the use of BMPs.

The three depicted factors from this study reiterate the findings of previous studies by showing there are many influential factors that impact farmers' perceptions of BMPs (Reimer et al., 2012; Wilson et al., 2014). They also reveal just how flawed the perception is of farming being only about maximizing profits, or that all farmers only have goals focused on the business aspect of farming (Knowler & Bradshaw, 2007; Prokopy et al., 2019). Even with the diversity of farming goals and motivations present in this study, farmers across every study factor care about their impacts on natural resources and believe that conserving natural resources can be accomplished using BMPs. Each identified perspective on BMPs provided valuable and distinct insights into which aspects of farming have the greatest influence on the decision to utilize BMPs. Additionally, each factor shared some similarities with other viewpoints portrayed in Q methodology studies exploring farmers' perspectives.

One parallel that can be drawn with this study's "land preservers" is that of Periera et al.'s (2016) "committed environmentalist" and Braito et al.'s (2020) "nature participants." These factors represent farmers who place considerable value on being in a farm or nature environment and view conservation efforts as more important than production goals. Another notable parallel to the land preservers is with the "environmental steward" of Brodt et al. (2006), as both place a higher priority on natural resource conservation and worry less about having the highest yields. The land preserver, which was our highest loading factor, represented a type of farmer that is rarely seen in common portrayals of largescale conventional farmers. As the land preservers are not driven by financial viability or social pressure to conserve natural resources, it can be concluded that their intrinsic motivations of being a good farmer, preserving their way of life in a rural context, and leaving the land in a better condition for the next generation are all notable factors influencing their decision to utilize BMPs.

The ambitious self-starters take a productivism outlook when farming. Much like the "profit maximisers" of Braito et al. (2020), these farmers focus more on extrinsic motivations of diversifying, maximizing profitability, and expanding their business. This factor shares the characteristic of the "production maximisers" of Brodt et al. (2006) in tending to be more individualistic, and they emphasize the importance of taking risks to succeed. Perhaps the most surprising finding was that despite being more profit-oriented and risk-inclined, they did not feel it is important to try new farming practices. Although, like the “professional farmer” of Pereira et al. (2016), ambitious self-starters find joy in farming, strive to be the best, and they are unique from the other factors in feeling that farming is a higher calling. Hence, while BMPs are less of a priority for ambitious self-starters, they do not view BMPs as having a financial burden. As some farmers in this viewpoint explained a need for more educational opportunities on BMPs, a potential conclusion about why the ambitious self-starters do not feel more positive about BMPs could be their lack of knowledge regarding these practices, along with their feeling that they need more technical and financial assistance with implementing them.

Principled bootstrappers share qualities of both the land preservers and the ambitious self-starters. The principled bootstrappers’ intrinsic desire to conserve natural resources with BMPs and steward the land for future generations is shared with the land preservers, however, like the ambitious self-starters, they view maximizing profits and financial viability as key to accomplishing their goal of being the best farmer they can be. This viewpoint in seeing a direct connection between conservation and profitability resembles “the commodity conservationists” of Davies and Hodge (2007). As this strong recognition of the need for conservation drives the principles bootstrappers in their pursuit of business success, it could also be the motivating factor in why they are eager to take risks in adopting new practices and technologies and seek out the recommendations of agricultural experts for their production decisions like the “networking entrepreneurs” of Brodt et al. (2006). Similar to the “aspirant top farmer” of Pereira et al. (2016), the principled bootstrappers want the highest quality crops of their competitors and an enhanced farm appearance. A distinct feature of this group is they seriously value how their friends and family view their farming practices and feel they are under social pressure to use BMPs, which reveals an obligation to maintain a positive social reputation (Mills et al., 2017).

Implications for Policymakers and Conservation Practitioners

While many factors influence the voluntary adoption of BMPs, financial and technical assistance provided by state and federal agencies are the preferred tool of policymakers for increasing adoption (Bopp et al., 2019; Dayer et al., 2018; Rode et al., 2015). However, the constraints of increasingly limited budgets of government agencies bring concerns about how environmental quality goals can be met through cost-effective policy innovations (Ribaudo & Shortle, 2019). And while current efforts are missing the mark (Cassman & Grassini, 2020), some scholars claim that promoting financial incentives and subsidies for BMP adoption is needed to counter the costs and risks associated with implementing new practices to ultimately change behavior (Akkari & Bryant, 2017). Yet insufficient funding in conservation programs creates a major constraint to this behavior change (Ribaudo et al., 2011). Therefore, for business-oriented farmers such as the ambitious self-starters, monetary incentives may not be enough to result in their long-term utilization of BMPs (Bopp et al., 2019). The findings in this study provide implications for both policymakers and conservation practitioners such as NRCS and Cooperative Extension. The in-depth portrayals of each of the factors in this study give an enriched understanding of how recommended BMPs are being perceived by farmers, and the essential guidelines for strategies to promote BMPs more effectively to farmers.

As our data shows that all the identified factors in this study disapprove of the idea that incentive-payments are the best reason to use BMPs, it is fitting that efforts to increase the uptake of BMPs should be focused toward educational and outreach initiatives that promote the benefits of BMPs and address potential concerns of farmers. While the principled bootstrappers and land preservers are both largely conservation-oriented, they both, along with the ambitious self-starters generally do not feel like the concerns environmentalists have about the impact of agriculture on the environment are valid. This gives evidence to support Davies and Hodge (2007) conclusion that while farmers who are more sustainability minded may be more eager to adopt new practices like BMPs, farmers who are more like the ambitious self-starters may need increased educational opportunities or financial incentives to provide sufficient support for them to feel capable of implementing BMPs.

With the various management priorities and motivations present in each study factor, farmer trainings and production seminars on BMPs should include information that satisfies these differences by communicating how BMPs can potentially help farmers to maintain financial viability, sustainably accomplish their business goals, preserve their land for the future, and have a socially respected farm. Every study factor agrees that conservation programs should be more accessible to farmers, and farmers noted how finding out more about conservation programs and BMPs from government agencies were difficult due to a need for improved social media and online presence. As one participant stated, "I think they should have a better way of getting it [information] out, if it's by a Facebook page […] or if they just had a webpage—somewhere you could go to and get some updates and things." This could be another solution to increase engagement with the more individualistic farmers like the ambitious self-starters, as they may be more likely to engage with educational approaches like online seminars, informational fact sheets and social media posts, and streamlined websites that clearly explain the practicality and benefits of specific BMPs (Brodt et al., 2006).

Another insight this study provides for improved farmer outreach lies in taking a more hands-on approach to training and disseminating knowledge to farmers. As all the study factors shared an insufficient knowledge of BMPs and a belief that there should be more resources to help farmers implement them, it is important to consider opportunities for enhanced knowledge exchanges with farmers (Ingram, 2008). Farmers are generally in favor of expanding their knowledge regarding farming practices, and they tend to seek advice and exchange knowledge with their peers and other farmers (Blackstock et al., 2010; Braito et al., 2020). While the ambitious self-starters and the principled bootstrappers both acknowledge the influence from close ones and other farmers on their management decisions, this finding may point to the need for field days and farmer trainings to be led by farmers in the area that are respected for their success using BMPs (Avemegah, 2020).

This data shows that land preservers and principled bootstrappers prefer to receive farming information from agricultural experts, however, ambitious self-starters place higher value on receiving farming knowledge from other farmers. Therefore, while the traditional approaches agricultural agencies have taken to disseminate information to farmers about BMPs include face to face delivery such as expert-led trainings and field demonstrations at small-scale research plots (Norton & Alwang, 2020), an approach that could augment these current methods to potentially reach a larger population of farmers can come from using largescale on-farm BMP trials funded through collaborations with Cooperative Extension and agribusinesses to reduce costs and reach a wide network of farmers (Arbuckle & Ferrell, 2012; Braito et al., 2020; Houser et al., 2018). As public funding for Cooperative Extension is declining and competition with private industry to have the most cutting-edge recommendations continues, it will be crucial for Cooperative Extension to secure partnerships with private agribusinesses and adapt its outreach measures to be able to stay relevant to the shifting agricultural landscape (Houser et al., 2018). Through agriculture and conservation stakeholders like NRCS and Cooperative Extension incorporating farmer led discussions into their educational efforts on BMPs, this could prove effective in improving adoption rates since research has shown that farmers prefer to learn with their peers in social and on-farm settings (Franz et al., 2010; Singh et al. 2018). This participatory approach combines the expertise of agricultural researchers with the influence of established farmer social networks to promote experiential learning and provide a wider-reaching dissemination of information that can potentially reveal greater insights on the scalability of BMPs to farmers (Eshuis & Stuiver, 2005; Nerbonne & Lentz, 2003; Okumah et al., 2021).

Future Research Ideas and Limitations

In considering the implications of this study for future research, we found that designing our study using the conceptual framework of an extended TPB model provided a useful framework in guiding the development and categorization of opinion statements in the Q set to successfully create a holistic list of structural, socioeconomic, and socio-psychological influences on farmers' decision-making. The novel contribution this study makes to existing scientific literature is that it is the first to apply an extended TPB model to a Q methodological study, as well as being the first study to apply Q methodology to understand factors influencing adoption of BMPs among cotton and peanut farmers. As such, our hope is that the insights provided in this study will be utilized to guide efforts to promote BMPs and future research investigating drivers of farmer behavior. For future studies looking into farmer outreach approaches, it is recommended that interdisciplinary collaborations are pursued to best leverage the strengths of researchers and practitioners within both agriculture and outreach disciplines.

The trend in this study of insufficient knowledge regarding BMPs points to a need for future studies to identify and analyze prevalent information sources of cotton and peanut farmers. This study also revealed the preferences of some farmers to utilize other farmers as information sources. Therefore, we suggest researchers delve deeper into how farmers co-create knowledge to uncover where their prevalent information sources are, and how farmers are using this information. And while this study focused on a list of eight specific BMPs, we recommend future studies only focus on one or two relevant BMPs that have low adoption rates among a population of farmers. For example, if a study investigates farmers' opinions on the use of cover crops and conservation tillage, this provides practice-specific insights that can inform targeted educational and outreach work that addresses potential concerns or negative opinions about these practices. Additionally, we recommend future Q studies on this topic use by-hand factor rotation to focus on explaining the minority viewpoints among a sample population of farmers (Watts & Stenner, 2012).

While we argue that the application of Q methodology in this study provides a powerful method for capturing a wide range of viewpoints, we also note this method does have some limitations. Despite the ability of this method to provide a holistic portrayal of the perspectives regarding a certain topic, the range of opinions included within the Q set is limited to a certain number and may not be able to include every potential viewpoint (Watts & Stenner, 2012). Also, the factors depicted in this study reflect the perspectives of farmers who use Cooperative Extension services, and we cannot know for certain if our sample missed any existing viewpoints among Georgia cotton and peanut farmers. We are aware that some farmers do not utilize Cooperative Extension. This offers a potentially valuable study idea to investigate the viewpoints of farmers who do not utilize Cooperative Extension, to uncover how to best reach these farmers with BMP educational efforts. Likewise, another important topic of research that should be pursued is to engage with farmers of different demographic groups, to potentially identify the information sources used by different groups of farmers. For example, as 34.3% of farmers in Georgia are female, and 4% of Georgia farmers are black (NASS, 2019), it could be worthwhile to examine the information sources used by farmers in these groups so that practitioners can better understand the preferences of these groups to be able to adapt and develop more effective and equitable outreach strategies.

Conclusion

The goal of this study was to identify cotton and peanut farmers viewpoints on BMPs. As this study is one of the first to apply an intention/adoption theory to a Q study investigating farmer behavior, we recommend future studies build from this by using the theory of planned behavior (Ajzen, 1991) and other relevant frameworks like the diffusion of innovations theory (Rogers, 2003), and the value-beliefs-norms theory (Stern, 2000) to establish a stronger foundation of Q literature exploring the nuanced dynamics of farmers' decision making. Q methodology allowed us to uncover three prevailing perspectives among participants: the land preservers, the ambitious self-starters, and the principled bootstrappers. The identified variations and overlap in the uncovered factors reinforce the need to recognize that efforts to increase farmer engagement with BMPs should be tailored to account for the diverse needs and motivations of farmers (Baumgart-Getz et al., 2012). Hence, it may be beneficial to create educational resources that strategically guide farmers through the benefits of individual BMPs and provide in-depth messages on how common barriers to adoption of specific practices can be overcome.

While we found farmers have different motivations that influence their decision making, we also described some stark differences in farmers' priorities for managing their farms and their views on the relationship between conservation and profitability. Thus, as these identified perspectives allowed us to document viewpoints of Georgia cotton and peanut farmers toward BMPs, these viewpoints should be considered in the development of targeted outreach and education initiatives seeking to reduce the barriers to adoption of BMPs. Additionally, it is suggested that an emphasis of future studies be focused on delving into viewpoints similar to those represented in the ambitious self-starters, as this is a difficult to reach population of farmers. With the abundance of qualitative and quantitative literature on the topic of farmers' adoption of BMPs seeming to have hit a roadblock in providing nuanced findings, this creates a perfect opportunity for the application of the unique and underutilized approach of Q methodology (Watts & Stenner, 2012). The use of Q methodology in this study was favorably received by participants, which led to the rich generation of data that will hopefully serve as a springboard for the development of future work in this area seeking to account for the range of viewpoints held by a population of farmers toward BMPs.

CHAPTER 5

CONCLUSIONS

Introduction

As conversations surrounding the future of agriculture continue to center on sustainability and environmental impacts from intensive cultivation practices, the potential for strict regulations on farming may be imminent if voluntary conservation practice adoption rates do not increase (Liu et al., 2018; Shortle et al., 2012). Low levels of conservation practice adoption have been long evidenced across various types of crop and livestock production (McLellan et al., 2018; Wade et al., 2015), and there are still many needed improvements regarding soil health and water quality in the U.S. (Ribaudo & Shortle, 2019; Sadowski & Baer-Nawrocka, 2018). To improve environmental outcomes without causing major disruptions to food and fiber production, researchers, policymakers, and conservation practitioners must consider the motivations and barriers that influence farmers' adoption decisions to be able to design conservation programs and frame outreach and educational messages that effectively catalyze farmers' adoption behavior (Baumgart-Getz et al., 2012; Burton, 2014).

Focused on empirically based recommendations, the purpose of this research was to investigate influential factors on Georgia cotton and peanut farmers' decision-making toward BMPs. These studies yielded insights regarding a range of influences on farmers' intentions to adopt BMPs, as well as captured nuanced opinions farmers hold toward BMPs. In the broader scope of BMP adoption literature, there are three primary contributions from this research that should be reiterated. First, this research represents one of the first times an expanded theory of planned behavior framework was applied to examine influences on cotton and peanut farmers' adoption of BMPs. The application of an extended model of the theory of planned behavior in this research was found to be instrumental in extrapolating the findings of this research to be applied to practical recommendations for educational and outreach applications. The inclusion of the additional constructs of *knowledge* and *moral norms,* as seen in the work of Bagheri et al. (2019), Govindharaj et al. (2021), and Rezaei et al. (2018), proved beneficial in providing detailed insights into the influences on Georgia cotton and peanut farmers' decision-making toward BMPs. Second, this research expands on the current literature by focusing on farmers in Georgia, while most conservation adoption studies are conducted in the Midwest and mid-Atlantic regions (Arbuckle & Roesch-McNally, 2015; Schall et al., 2018). And lastly, this research includes one of the first times an intention/adoption theory was applied to a Q methodology study investigating farmer behavior. Through the pursuit of attempting to fill in these gaps in the literature, the findings of this research show that there are many different motivations and priorities that influence farmers' perceptions and decisions toward the use of BMPs.

There are five sections that organize this chapter. The first two sections summarize research articles one and two. The third section discusses recommendations for policymakers and conservation practitioners seeking to improve the adoption of conservation practices through the development of targeted BMP educational initiatives and resources. This section also offers practical recommendations for agricultural and environmental researchers by laying out opportunities for future research to build upon the findings of these studies. Section four details the limitations associated with this research. The fifth section recaps the key takeaways from this research.

Article One: Examining Influences on Cotton and Peanut Farmers' Intentions to Adopt Agricultural Best Management Practices

Using the Theory of Planned Behavior framework, the first study of this research examined how the intrinsic motivations and capacities of Georgia cotton and peanut farmers influence their intentions to adopt BMPs. This study found that the attitudes, subjective norms, perceived behavioral control, knowledge, and moral norms were all positively associated with Georgia cotton and peanut farmers' intent to adopt BMPs. However, the largest association with intent to adopt BMPs was found with Georgia cotton and peanut farmers' attitudes. This finding falls in line with many of the BMP adoption studies (Arbuckle & Roesch-McNally, 2015; Gillespie et al., 2007; Johnson et al., 2010; Mase et al., 2017; Nyaupane & Gillespie, 2010; Paudel et al., 2008), in showing how attitudes can often be the strongest influence on adoption decisions.

As empirical evidence shows that the ways farmers interpret BMP information can have a large impact on their adoption decisions (Jones et al., 2013; Prokopy et al., 2019; Schall et al., 2018), the findings of this study could point to the need for an enhanced focus on ways education and outreach efforts can promote the specific benefits of using BMPs, while simultaneously emphasizing the practicality of them and increasing positive attitudes toward BMPs among farmers. For example, during farmer trainings on BMPs, practitioners could provide lists of the specific equipment needed by the farmer, the estimated costs to implement each practice, and address common management concerns from farmers (Miller et al., 2012). In addition, practitioners could highlight the potential of these practices to bring numerous soil and crop health benefits to the typical conventional farming system of that area. This could be exemplified by practitioners presenting data comparing the crop quality, nutrient retention, and soil analyses of fields that utilize BMPs such as reduced tillage and cover crops to fields that implement deep tillage and do not use cover crops.

Article Two: Assessing Farmers' Perceptions of Best Management Practices: An Exploration of the Viewpoints of Cotton and Peanut Farmers in Georgia using Q Methodology

The second study, using a Q-sort analysis designed with a TPB-based data collection tool, compared Georgia cotton and peanut farmers' perceptions of BMPs to identify potential differences in farming goals and motivations. To accomplish this, this study sought to uncover farmers' opinions and viewpoints toward BMPs for cotton and peanut production. This study found that farmers throughout each study factor placed an emphasis on conserving natural resources. However, each study factor revealed differences in the approaches taken by farmers to balance their farming goals with their motivations toward conservation goals. Despite all study factors believing that the use of BMPs can successfully conserve natural resources, there were slight differences present in how each of the identified study factors view the role of BMPs on farms. These findings of differing motivations and management priorities range from maintaining steady profits, to preserving the longevity and health of their farmland.

And while the values and identities farmers attribute themselves with has been linked with adoption behavior (Floress et al., 2017; Reimer & Prokopy, 2012; Thompson et al., 2015), it may be necessary for educational seminars and trainings with farmers to include specific points regarding how each of the various motivations held by farmers can be fulfilled by using BMPs. For example, practitioners could tailor educational programs to include talks from well-established farmers who have successfully implemented BMPs. This would provide an opportunity for farmers to engage in knowledge sharing with trusted peers, as well as allow them to hear how other farmers dealt with specific barriers in implementing BMPs. As farmers' preferences for educational efforts have been shown to center around adapting to the everchanging nature of agriculture, peer learning, and comprehensive education opportunities, it is necessary for the development of BMP educational programs to include these preferences to be able to fulfill the needed capacities of farmers today (Franz et al., 2010).

Additionally, this study revealed that all factors did not agree with the idea that incentive-payments from conservation programs are the best reason to use BMPs, this could show that it may be worthwhile for educational initiatives to focus on addressing potential concerns farmers have about implementing BMPs to increase their capacity and confidence in adopting these practices. This could be seen in outreach efforts leveraging the trust of conservation leaders and innovative farmers that have overcome hurdles with implementing BMPs to provide an opportunity such as a field day showcasing BMPs, in which farmers could strengthen their confidence in adopting these practices by seeing and learning about the implemented practices firsthand. Also, as participants in this study desired an increase in available online resources from agricultural and conservation agencies about BMPs, it may prove beneficial to create brief fact sheets and online publications that break down the details of specific BMPs geared toward cotton and peanut production in Georgia.

Recommendations

With current BMP adoption literature placing an emphasis on examining farmers' information sources and awareness about BMPs (Liu et al., 2018), the findings of these studies align with the conclusions of literature from Arbuckle and Ferrell (2012), Bergtold et al. (2012), and Long et al. (2013) in recommending increases in educational resources and opportunities, Cooperative Extension partnerships with private agricultural entities like chemical and seed dealers, and opportunities for farmer-to-farmer knowledge sharing. Similar to the findings of Daxini et al. (2019), both of the present studies found that farmers hold a high value on the recommendations of agricultural experts such as Cooperative Extension. This could suggest that an increase in the strategic dissemination of BMP information from organizations like this may be needed. By providing educational resources to farmers that provide in-depth explanations of how the use of certain conservation practices can fulfill various intrinsic and extrinsic motivations, the efficacy of conservation practitioners' outreach work regarding BMPs could be enhanced. Specifically, practitioners could incorporate holistic descriptions of BMPs into brief online publications or farmer training materials that account for things like expected costs of implementation, and explanations of the benefits and opportunities BMPs provide compared to conventional grower practices (Miller et al., 2012).

In looking at the findings from this research on farmers' capacity to use BMPs, although most farmers noted a familiarity and knowledge of the benefits of BMPs, the farmers who did not find an importance in trying new farming practices also claimed to have less knowledge about how to implement these practices. One potential solution to this finding would be to coordinate farmer trainings and demonstrations at largescale BMP field trials by collaborating with private agricultural entities such as crop advisors and agribusinesses that have strong networks of farmers that they provide with technical assistance and crop inputs (Arbuckle & Ferrell, 2012; Braito et al., 2020; Houser et al., 2018). Through taking this multi-actor approach to disseminate information about BMPs, a broader population of farmers may be reached, and these other trusted sources of information for farmers who do not utilize Cooperative Extension could then potentially increase their knowledge and capacity on BMPs. Additionally, as farmers tend to want to learn from their peers and expand their farming knowledge (Blackstock et al., 2010; Braito et al., 2020), another potential way to increase farmers' capacity and positive views toward BMPs could be found in facilitating opportunities for farmer-to-farmer learning (Miller et al., 2012). This implementation could effectively reduce farmers' perceived barriers of adoption and increase their likelihood to adopt (Ramsey et al., 2019).

The findings of these studies provide many recommendations for future research. While this research investigated farmers' trust in agricultural experts such as Cooperative Extension, a potentially valuable area of inquiry for future work could be found in identifying prevalent information sources of cotton and peanut farmers. In addition to examining prevalent information sources, more attention should be focused on understanding farmers' preferences for receiving information and technical support regarding conservation practices. And despite all farmers in this research utilizing Cooperative Extension services, it should be noted that since many farmers do not use this resource, the preferences of all farmers should be considered when crafting future educational efforts for BMPs.

While farmers can be a difficult audience to access, researchers should find ways to build partnerships with agricultural entities such as Cooperative Extension and commodity groups, as these organizations tend to have well-established connections with farmers in an area. It is also recommended that future research in this area take into consideration that these studies can take a considerable amount of time to collect sufficient data due to the unpredictable and busy schedules of farmers. Additionally, further recommendations that can be derived from the findings of this research include investigating specific aspects of BMPs that farmers like or dislike, possibly revealing needed information for those who are designing the BMPs. Although farmers' preferences and motivations for why they decide to adopt or not adopt conservation practices is commonly researched, expanding this field of inquiry to new geographic areas and types of production can continue to advance the scope of knowledge pertaining to farmers' adoption decisions. Likewise, pursuing qualitative or mixed methods approaches to attempt to uncover nuances in farmers' motivations for adoption could provide more insightful findings than quantitative approaches that may leave room open for social desirability bias on contentious topics such as sustainability in farming.

Limitations

There were multiple limitations associated with each of these studies that should be noted. First, both studies investigated farmers' views regarding eight specific BMPs for cotton and peanut production out of 65 listed practices on the GASWCC manual for BMPs. While these eight enabled a strategic focus on reducing soil erosion and runoff in row crop production, they do not holistically encompass all BMPs potentially under consideration among cotton and peanut farmers. Therefore, the findings are all relative to the specific BMPs that were examined in these studies. Likewise, it should also be considered that almost all farmers in these studies had experience using BMPs in the past and could have held favorable views toward some of the included BMPs and not others. However, the purpose of this research was to understand the influences on farmers' viewpoints toward the common BMPs for cotton and peanut production rather than examine which specific BMPs cotton and peanut farmers hold the most favorable view. Also, while these studies focused on the socio-psychological influences on farmers' BMP adoption decisions, the researcher acknowledges that there are many other important structural and demographic factors that have been found to influence farmers' decision-making regarding BMP use. While this research sought to respond to a gap in the literature and uncover valuable insights about the viewpoints of cotton and peanut farmers toward BMPs, the small convenience samples in this work do not provide generalizable results, and therefore, future research is still needed to fully understand the vast complexity still surrounding farmers' adoption of BMPs.

In the first study, the most notable limitation is the sample size from the convenience sample used in this study. While farmers are a highly surveyed group (Liu & Brouwer, 2022), the small sample size in this study could partly be attributed to survey fatigue. As the researcher was bound by specific timeframes and financial resources, the data collection period for this study was limited to a few weeks. Accordingly, the findings of this study are not generalizable to the wider population of cotton and peanut farmers. This additionally led to a limitation of a lack of randomization within this study sample. This population of farmers was mostly homogenous in terms of demographics and cannot be considered representative of the overall population of Georgia cotton and peanut farmers. Also, to keep the data collection tool succinct for the feasibility of this study, it is possible that certain potential influences on farmers' BMP adoption were omitted. While impossible to confirm, social desirability bias is another potential limitation of this study as the topic of sustainable farming practices can be contentious.

The second study also included certain limitations that should be addressed. First, the application of Q methodology requires the creation of a Q set that is limited to only contain what is deemed to be an acceptable a range of opinions (Watts & Stenner, 2012). Therefore, it is possible that some potential viewpoints are omitted from the Q set for the feasibility of the study design. Next, as the researcher faced a difficulty in reaching and securing participants for this study, nearly all farmers who participated in this study currently use one or more BMPs. Ideally, the set of participants would have been evenly split to include farmers who have not used BMPs before, and farmers who currently use BMPs. Additionally, as Q methodology is a mixed methods approach that includes a qualitative interpretation process, this leaves room for the critique of potential researcher bias. Finally, although post-sorting interviews were conducted with each participant to establish clarity of their responses and perspectives, constraints to time and resources did not allow for follow-up interviews or focus groups to confirm the accuracy of each participants' placement into each factor or the interpretations of each factor.

Conclusion

Many insights into the BMP adoption decisions of Georgia cotton and peanut farmers are provided by this research. The findings from this research suggest that supplementing current BMP educational and outreach efforts could potentially enhance the efficacy of current educational programming seeking to increase adoption in cotton and peanut production. As this research captured a range of influences on BMP adoption decisions, agricultural stakeholders such as Cooperative Extension and NRCS can leverage these findings to supplement their current efforts in working to inform and assist farmers with the implementation of BMPs. This research illustrates the role positive attitudes toward BMPs play in farmers' decision making, as well as how farmers' motivations to adopt BMPs can be influenced by production- or conservation-oriented mindsets. Therefore, it is crucial for BMP information being shared with farmers to include specific attributes and benefits of these practices that account for the varying motivations and mindsets of cotton and peanut farmers.

As future research continues to expand in this field, there are certain topics that should be delved into deeper. Since much work is still needed on the motivations and barriers for farmers' adoption of conservation practices, studies examining farmers' trust in Cooperative Extension and other agricultural agencies, as well as comparing the best techniques for engaging with farmers about conservation practices, could uncover valuable insights into how the outreach work of conservation practitioners could increase BMP adoption rates across the agricultural industry. Additionally, research investigating the common information sources farmers seek out when searching for information about BMPs could determine relevant considerations for practitioners to emphasize in their work seeking to reduce the barriers to adoption of BMPs. The vast amount of time and resources spent by government agencies, land grant universities (LGUs), and non-governmental organizations (NGOs) seeking to increase the adoption of conservation practices over recent decades has revealed that there are many nuanced influences on farmers' adoption decisions (Prokopy et al., 2019; Ranjan et al., 2019). And while this research supports those conclusions, it also points to the need for an increase in strategic messaging through BMP educational opportunities that provide detailed explanations of specific BMPs that cover all the necessary influences noted in this research to be the most pertinent to farmers' adoption decisions.

While efforts continue to push the agricultural industry to a more sustainable future, it is important for researchers, practitioners, and policymakers to understand that increasing the adoption of BMPs could be one of the most promising initiatives to combat environmental degradation without bringing major production setbacks to conventional agriculture. As the findings from this research showcase the desire of Georgia cotton and peanut farmers to conserve natural resources, it is crucial that adequate support and awareness be provided to farmers so that a sustainable food and fiber supply can be attained. Ultimately, as this research attempted to provide a clearer understanding of BMP adoption decisions among Georgia cotton and peanut farmers, the findings of this research point toward supplementing current opportunities for learning about BMPs through tailoring educational initiatives to highlight the benefits of BMPs and address the needed capacities and preferences of farmers, creating more opportunities for farmers to share their knowledge and experiences with conservation practices, and expanding current outreach efforts by creating more readily accessible educational materials for farmers. As this research suggests that farmers have various viewpoints toward BMPs, it will be crucial for practitioners and policymakers to disseminate strategic information through various channels that emphasize the compatibility of BMPs with conventional farming methods to achieve farming productivity goals while also addressing soil and water degradation.

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