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

William R. Taylor
University of Georgia

Abigail Borron
University of Georgia

Jessica Holt
University of Georgia

See next page for additional authors

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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 go-getters. 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.

Keywords

Best management practices, Q-methodology, Theory of Planned Behavior, Mixed methods, Farmer perceptions

Authors

William R. Taylor, Abigail Borron, Jessica Holt, and Scott Monfort

Introduction

Environmental stewardship, which involves key activities assumed by individuals and groups to ensure key outcomes in a variety of social-ecological contexts (Bennett et al., 2018), plays a critical role in ensuring the sustainability of the essential food and fiber system. Tied directly to these stewardship activities are best management practices (BMPs) that are 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 needs of a growing population, fertilizer and pesticide use have 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).

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, 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). This has led many Americans to believe that farmers put profits ahead of environmental stewardship (Harris, 2002). While American farmers tend to consider themselves as good stewards of the land (Ahnstrom et al., 2009), 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). 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).

BMP adoption among farmers across the U.S. has often been approached using incentivization that includes 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). In Georgia, the Georgia Soil and Water Conservation Commission GASWCC) and other state agricultural agencies work together to create a list of BMPs that serves to inform farmers and encourage voluntary 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). An example of a needed area for increased BMP adoption in Georgia is in conservation tillage, which increased 5% between 2012 and 2017, but only accounts for 49% of all harvested cropland (NASS, 2019).

Despite decades of substantial research and promotion efforts made by government and non-government programs, consistent predictors of BMP adoption behavior are lacking. Yet, 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). Further, a more insightful understanding of farmers' perceptions of BMPs is essential for future policymaking and outreach efforts (Braito et al., 2020; Dessart et al., 2019).

Research Gap

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; King & Baker, 2018; Prokopy et al., 2019; Reimer et al., 2012). While the majority of BMP adoption studies have taken place in the Midwest and Mid-Atlantic regions of the U.S., recent studies in the Southern U.S. are limited (Adusumilli & Wang, 2018; Quintana-Ashwell et al., 2020; Yehouenou et al., 2020), and none have taken place in Georgia. Regardless of geographic location examined, there is no consensus on what generally influences farmers' attitudes and willingness to adopt certain BMPs (Reimer et al., 2012; Wilson et al., 2014). A further review of the literature identified that economic and farm management needs, as well as current and previous experiences with conservation practices, are common motivations, but they can also serve as barriers to adoption (Ranjan et al., 2019). In addition, 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). Further, results from applied communication research examining BMP adoption suggest the use of community-based social marketing (King et al., 2017) as well as visual cues to help information processing (King & Baker, 2018) among livestock producers in Kansas and Oklahoma. While these variables and strategic approaches provide a more in-depth view to adoption, focusing on these alone is not sufficient to predict or ensure adoption. Czap et al. (2015) and Floress et al. (2017) argue that, to better understand the process of influencing adoption, it is important to consider cognitive and socio-psychological factors. However, while these factors—which are arguably the most complex—can influence farmer decisions, they are often left out (Liu et al., 2018; Martinez-Garcia et al., 2013; Zeweld et al., 2017).

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; Lalani et al., 2016; Reimer et al., 2012; Yoder et al., 2019). For example, Meijer et al. (2015) 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 predict decision-making. Bopp et al. (2019) examined how both intrinsic and extrinsic factors impact farmers' decisions. Further, 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). Finally, the majority of conservation practice adoption research has been confined to quantitative data, which has limited the ability to bring new perspectives to this field (Prokopy, 2010; Reimer et al., 2014). Therefore, despite the recent literature growth on conservation practice adoption, there is still a need to consider underutilized methodologies in this area of inquiry (Liu et al., 2018; Ulrich-Schad et al., 2017), specifically examining major row crops in the Southeastern U.S. like cotton and peanuts.

Purpose and Research Questions

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With a combined farm gate value of over $1.6 billion, the production of cotton and peanuts play a vital role in sustaining Georgia economy (Kane, 2021). This major contribution to the state economy and its rural communities 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 the National Resources Conservation Service (NRCS) and Cooperative Extension with a stronger comprehension of the perceptions farmers have toward conservation practices and how these are tied to the decision to adopt or reject them. Behavioral insights of farmers not only benefit practitioners who 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.

Therefore, 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

This study utilized the Theory of Planned Behavior (TPB; Ajzen, 1991), which 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 themself to perform a behavior, and the access a person has to non-motivational resources such as time, relevant experience, and money (Ajzen, 1991). In the case of BMPs, if a farmer feels that they have enough resources, which places the decision to adopt BMPs under their control, they will be more likely to have an increased intention to adopt BMPs.

While there has been success and wide application of studies using the TPB framework to examine farmers' behavioral intentions (Bechini et al., 2020; Daxini et al., 2019; Hall et al., 2019), subsequent studies have attempted to extend this theory with the inclusion of two additional constructs—moral norms and knowledge (Ataei et al., 2021; Bagheri et al., 2019; Chen & Tung, 2014; Hou & Hou, 2019; Tama et al., 2021). The addition of the constructs is intended to bring a higher predictive power to the model; and recent literature demonstrates an application of this extended model in agricultural research examining farmer behavior (Bagheri & Teymouri, 2022; Maleksaeidi & Keshavarz, 2019; Pandi et al., 2021; 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.

Because this study attempts to consider a deeper dive into participant subjectivity regarding the named TPB constructs, TPB was combined with Q methodology (Brown, 1980; Stephenson, 1953; Watts & Stenner, 2012). This methodology helps structure the framing of questions and the organization of the broad range of opinion statements presented to participants to organize according to their beliefs (Atkins, 2020; Mckenzie et al., 2011). The decision to combine Q methodology with the TPB enables a robust mixed methods research design that is well-organized and widely representative of the range of potential opinions about the topic being investigated. It also enables a grouping of perceptions to be considered when developing outreach and engagement messages and strategies with farmers.

Methods

Q Methodology Background

Q methodology is a mixed method approach that examines first-person perspectives to capture a more comprehensive story of the issue at hand (Brown, 1980; Stephenson, 1953; Watts & Stenner, 2012). With the foundation of this approach stemming from inverted factor analysis, William Stephenson (1953) 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, where the participants sort a list of opinion statements based on a given topic.

The series of opinion statements used in the Q sort are referred to as the Q set that is intended to be a thorough list of statements encompassing 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; (1) concourse development and the selection of statements to be used in the Q set, (2) development of the P set, (3) the Q sorting process, (4) data analysis consisting of correlations and factor analysis, and (4) interpretation of the analysis to identify themes found from the data (Mckeown & Thomas, 2013). While this method allows for the systematic analysis of subjectivity—capturing an individual's attitudes, beliefs, opinions, and the like (Brown, 1993; Taheri et al., 2020)—it also reduces researcher bias by eliminating leading questions and not relying strictly on the interpretive skills of the researcher (Mckeown & Thomas, 2013). This increases the robustness of the process as compared to other methods that try to measure subjectivity (Cross, 2005).

Q methodology demonstrates an attempt to identify patterns in the subjective viewpoints of collective groups of individuals rather than across entire populations (Coogan & Herrington, 2011), which supports the call to utilize it in agriculture communication research (Leggette & Redwine, 2016). Further, it has become more common in farmer adoption literature regarding the examination of nuanced contexts of conservation practices (Alexander et al., 2018; Forouzani et al., 2013; Lehrer & Sneegas, 2018; Pereira et al., 2016; Schall et al., 2018; Taheri et al., 2020), production decisions (Alexander et al., 2018), best management practices (Bumbudsanpharoke et al., 2010), farmer management styles (Brodt et al., 2006; Fairweather & Klonsky, 2009; Pereira et al., 2016), and other areas of farmer perceptions in agricultural and environmental science research (Davies & Hodge, 2007; Kristensen & Jakobsen, 2011; Kvakkestad et al., 2015).

Development of the Q set

To ensure the emphasis was placed on the most relevant BMPs for cotton and peanut production in Georgia, a BMP list was derived from two sources: the GASWCC manual on best management practices and informal interviews with University of Georgia Cooperative Extension cotton, peanut, and conservation specialists. Therefore, the eight selected BMPs examined in this study are represented in Table 1.

Table 1
Recommended Best Management Practices for Georgia Cotton and Peanut Production

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

Following the development of the BMP list, the initial concourse, or statements generated in an attempt to cover all available opinions relating to the list, was created from 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, which one member of the research team organized into six categories (attitudes, subjective norms, perceived behavioral control, intentions, knowledge, and moral norms) according to the framework of an extended TPB model (Ajzen, 1991). Two other team members reviewed this organization for accuracy within the extended model.

The research team then reviewed the statements for redundancy, as well as applicability within the identified BMPs (Table 1). This resulted in the concourse reduced to a Q set of 47 statements reflecting a diversity of influential decision-making variables for farmers' BMP adoption. The reduction process also ensured that the Q set was evenly dispersed among the six categories. After this Q set was established, two research design experts reviewed and further refined statements to reduce overlap and ensure clarity. Further, the University of Georgia Institutional Review Board (IRB) approved the study design in December 2021.

P set and Procedures

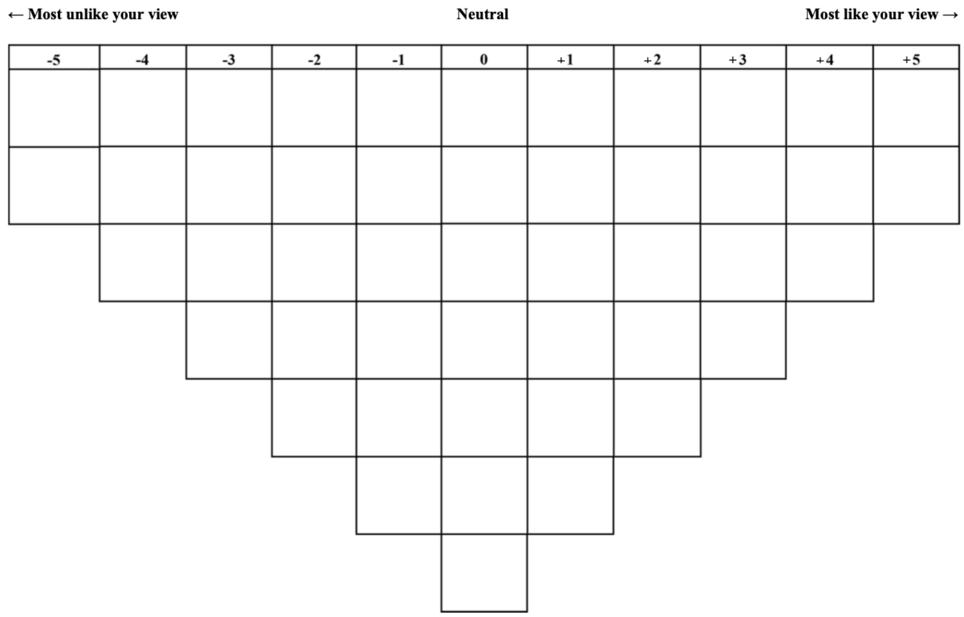
Unlike quantitative studies, the sample size for Q methodology is recommended to be much smaller with an emphasis on capturing various viewpoints to enhance quality; thus, the number of participants, or P set, is commonly that of half the number of opinion statements. However, the P set is also determined 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 convenience sampling to ensure the inclusion of a wide variety of farmers who produce cotton and/or peanuts. Typically, in Georgia, most farmers follow a two-year cotton and one-year peanut crop rotation to promote soil health. While planting both crops was expected, it was not a criteria in the sampling. 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 participating farmers in this study were identified by Extension agents in 17 counties located in the southwest Georgia Extension district.

For context, each participating farmer was provided the list of BMPs (Table 1) and then asked to perform the Q sorting exercise, followed by a researcher-led interview at each of their farms during February 2022. These meetings with participants ranged from 30 minutes to 1.5 hours. Participants first completed a pre-sort demographic questionnaire before being given an instruction sheet, paper statement cards with corresponding numbers, and a blank sorting grid (Figure 1).

Figure 1

Quasi-normal Distribution Grid



Note. Values are ranked in a range from -5 to 0 to +5. A total of 47 statement items can be accommodated on this illustrated distribution.

To complete the Q sorting exercise, the participants read through all 47 opinion statements and placed the statements into three piles according to their agreement, neutrality, and disagreement. The participants then ranked 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, the researcher interviewed each participant, asking them to discuss the rationale for their sorting of statements and provide any additional thoughts or opinions they had about the exercise. Each interview was recorded and field notes were captured. All recordings were only identified by letter labels to maintain confidentiality (ex: 'participant A').

Statistical Analysis

Following data collection, pictures were taken of each completed Q sorts before being uploaded into the software Ken-Q Analysis Desktop Edition v.1.2.1 (KADE; Banasick 2019) for analysis. An intercorrelation matrix was constructed to calculate the positive or negative relationships between each of the individual Q sorts. The matrix was then factor-analyzed on a by-person basis using principal components analysis (PCA) to identify correlations. To identify statistically significant factors and groups' very similar perspectives across Q sorts into corresponding factors, eight unrotated factors were initially yielded, accounting for 71% of the total variance. These factors consisted of merged Q sorts representing shared viewpoints to form a single Q sort through a weighted average. However, following Brown's suggestion (1980) to only keep factors with an eigenvalue greater than 1, four factors were maintained.

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 factors one and two. Therefore, these three corresponding Q sorts were not included for further analysis. The high levels of correlation between each of the factors in this study can be seen in Table 2.

Table 2

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 uncover patterns and unique viewpoints. To accomplish this step, the crib sheet method, as outlined by Watts and Stenner (2012), was used to holistically examine and interpret the results of this study through uncovering patterns and unique viewpoints within each of the factors selected for analysis. 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). 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. This 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

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. The demographic data of the farmers in this study sample presented in Table 3 is strictly meant to provide descriptive insights for this study across the three factors.

Table 3

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%)
Income & BMPs				
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.

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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%). 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; and a small portion of farmers claimed to receive off-farm income (10%), and nearly every farmer had previously engaged with BMPs (95%).

Table 4 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 or shared views between each of the factors.

Table 4

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

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No.	Statements	F1	F2	F3
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, specifically focusing on farmers' perceptions of best management practices, and considering which aspects of farm management farmers identify as having the greatest influence on their decision to utilize best management practices. 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 named "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 go-getters," 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 a primary consideration even before their financial goals are reached (S35: -3). They 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 they can continue their passion of being a farmer for a long time (S26: +4; S04: +4; S11: +3). The land preservers also want their farms to be visually appealing (S22: -5), as indicated by Participant L who attributes this to environmental stewardship. "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."

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), 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 positive inclination 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).

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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 this group are accomplished by using personal 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 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 nothing 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 Go-Getter (F3)

For the final factor, the four included participants were defined by their eagerness to become the best farmer possible (S14: +5). The principled go-getters 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 go-getters 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 [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). Like other factors, these farmers 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 go-getters are open to changing their farming practices (S37: -4) and are highly concerned with their impacts on natural resources (S33: -5). Their overall viewpoint 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 participating farmers 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). Further, all three were 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 go-getters 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 go-getters 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 go-getters 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. Also, 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 a 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 farm profitability (S25). Thus, the consensus of support for using BMPs was further evidenced by all factors agreeing that their farming practices 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

While the study design using TPB was not intended to measure each of the associated constructs, it did guide the development and categorization of opinion statements in the Q set, which represented a holistic list of structural, socio-economic, and socio-psychological influences on farmers' decision-making. As a result, this is the first study to apply an extended TPB model to a Q methodological study, as well as applying Q methodology to understand factors influencing adoption of BMPs among cotton and peanut farmers. Each factor demonstrated unique emphases with the extended TPB model constructs.

In this 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. We aim to elaborate on how these findings can both contribute to improved educational and outreach efforts, as well as inform policymakers about potential strategies to increase the use of BMPs.

One parallel that can be drawn with this study's "land preservers" is that of Pereira 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. 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) of tending to be more individualistic, and emphasize the importance of taking risks to succeed. Uniquely, 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 and strive to be the best, and believe 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, possible barriers to actively using BMPs could be their lack of knowledge regarding these practices, and needing more technical assistance with implementing them. 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).

Principled go-getters share qualities of both the land preservers and the ambitious self-starters. The principled go-getters' 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 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 principled go-getters in their pursuit of business success, it could also be the motivating factor to take risks in adopting new practices and technologies, and seek out agricultural experts when making production decisions like the "networking entrepreneurs" of Brodt et al. (2006). Like the "aspirant top farmer" of Pereira et al. (2016), the principled go-getters want the highest quality crops of their competitors and an enhanced farm appearance. Further, they seriously value their friends' and family's view their farming practices and feel 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

As the data show 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 go-getters 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 BMPs, farmers who are more like the ambitious self-starters may need increased educational opportunities 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, social media posts, and streamlined websites that clearly explain the practicality and benefits of specific BMPs (Brodt et al., 2006).

As all the study factors shared the belief that there should be more resources to help farmers implement BMPs, it is important to consider opportunities for knowledge sharing 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 go-getters both acknowledge the influence from their social network on their management decisions, this may point to the need for field days and farmer trainings to be led by farmers who are respected in their area for their success using BMPs (Avemegah, 2020).

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 efforts 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, n.d.). 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 agribusinesses and adapt its outreach measures to be able to stay relevant to the shifting agricultural landscape (Houser, n.d.). Furthermore, agriculture and conservation stakeholders should incorporate farmer-led discussions into educational efforts on BMPs, as this could potentially improve 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 can provide a wider-reaching dissemination of information that may 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

As stated previously, each factor demonstrated unique emphases in the extended TPB model constructs. From an applied standpoint, such findings inform the development of strategic communication and educational research projects. Even further, future studies should 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.

Regarding insufficient knowledge on 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 what their prevalent information sources are. 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 Q methodology 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 area for research is to engage with a variety of farmers, identifying unique information sources preferred among diverse groups. For example, as 34.3% of farmers in Georgia are female, and 4% 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 adapt and develop more effective and equitable outreach strategies.

Conclusion

This study described many similarities and differences in farmers' priorities for managing their farms and their views on the relationship between conservation and profitability. Thus, as the three 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. 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.

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