Blueberry growers’ willingness to adopt alternative production practices

By

Susan Elizabeth Head

A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Agriculture
in the Department of Agricultural Economics

Mississippi State, Mississippi

August 2012
Blueberry growers’ willingness to adopt alternative production practices

By

Susan Elizabeth Head

Approved:

Kimberly L. Morgan
Assistant Professor of Agricultural Economics
(Co-Major Advisor of Thesis)

John Michael Riley
Assistant Extension Professor of Agricultural Economics
(Co-Major Advisor of Thesis)

Ardian Harri
Assistant Professor of Agricultural Economics
(Committee Member)

Barry J. Barnett
Professor of Agricultural Economics
(Graduate Coordinator)

George Hopper
Dean of College of Agriculture and Life Sciences
The Blueberry Promotion, Research, and Information Order enacted in August of 2000 resulted in increased production and consumption of blueberries in the United States. As blueberry plantings increased, grower profitability was threatened. A mail survey addressed to blueberry growers of four Southeastern states. A binary logit model analyzed the grower’s decision of organic adoption and a cumulative logit analyzed those growers not producing organic blueberries but indicated some likelihood in the future. Results were based on 234 eligible responses. Positive significant relationships existed between organic blueberry growers and total acres of blueberry production, transfer of ownership of the blueberry operation and the average fresh price received of blueberries. Growers that indicated some likelihood of adopting organic blueberries in the future showed significant positive relationships with those willing to take more risks, transfer of ownership of the blueberry operation, concern about stability of blueberry prices and those of Hispanic descent.
DEDICATION

I would like to dedicate this research to my entire family. Mom and Dad, you have always been so incredibly encouraging in whatever I chose to do. You have instilled in me the rewards of hard work and dedication. Thank you for all of the life lessons and being wonderful role models. I would also like to thank my brother, Jason, for all the advice you have given me throughout the years.
ACKNOWLEDGEMENTS

I would like to give many, many, thanks to my committee. To my co-major advisors, Dr. Morgan and Dr. Riley, and committee member, Dr. Harri; thank you for the unwavering support over the past two years. Without your help and patience this research could not have happened. I have enjoyed working with you and the inordinate amount of knowledge you taught me will be carried wherever life may lead. I would also like to thank the rest of the faculty, staff, and fellow students for all the wonderful memories during my time at Mississippi State.
TABLE OF CONTENTS

DEDICATION ........................................................................................................................ ii
ACKNOWLEDGEMENTS ....................................................................................................... iii
LIST OF TABLES ................................................................................................................ vi
LIST OF FIGURES .............................................................................................................. vii

CHAPTER

I. INTRODUCTION .............................................................................................................. 1

II. LITERATURE REVIEW .................................................................................................. 9

Blueberry Industry in the Southeast ................................................................................. 9
Technology Adoption ....................................................................................................... 12

III. THEORY ...................................................................................................................... 19

Research Survey Methodology ....................................................................................... 19
Random Utility Theory ................................................................................................. 21
Discrete Choice Models ............................................................................................... 21
Binary Logit Model ......................................................................................................... 22
Cumulative Logit Model ............................................................................................... 23

IV. DATA AND METHODS .............................................................................................. 24

Survey Data ..................................................................................................................... 24
Survey Questions and Responses ................................................................................... 26
Summary Statistics ........................................................................................................ 29
Methods-Discrete Dependent Models ............................................................................ 31

V. RESULTS ..................................................................................................................... 39

Representativeness of Survey ......................................................................................... 39
Coefficients, Standard Deviation, Significance Levels and Marginal Effects ............... 40
Predicted Probabilities ................................................................................................... 53
VI. CONCLUSIONS....................................................................................................73
   Interpretations ........................................................................................................74
   Combined Model Findings ....................................................................................77
   Results Relevant to Previous Literature .............................................................77
   Future Research ....................................................................................................78

REFERENCES .............................................................................................................80

APPENDIX

A. 2011 BLUEBERRY INDUSTRY SURVEY .................................................................84
# LIST OF TABLES

4.1. Disposition of mailed questionnaire and response rates ........................................26
4.2. Census data compared to obtained survey data ...................................................28
4.3. Summary statistics of all variables used in estimation .........................................30
4.4. Choice set for organic blueberry adoption, Model #1 .........................................37
4.5. Choice set of non-adopters’ likelihood of organic blueberry adoption,
    Model #2 ........................................................................................................38
5.1. Farm/Farmer characteristics comparison of 2007 Census of
    Agriculture and 2011 Blueberry Industry Survey ..............................................39
5.2. Model #1, binary logit parameter estimates, standard error and
    significance levels of organic adoption ...............................................................41
5.3. Model #1, average marginal effects of variables on the adoption of
    organic production (in percent) ...............................................................43
5.4. Model #2, multinomial logit parameter estimates, standard error and
    significance levels of likelihood of organic adoption ..........................46
5.5. Model #2, average marginal effects of variables on the probability of
    adoption of organic production choice decision (in percent) .................48
LIST OF FIGURES

5.1. Predicted probability of adopting organic production practices by number of years growing blueberries ..................................................58

5.2. Predicted probability of adopting organic production practices by total acres in blueberry production...............................................................58

5.3. Predicted probability of adopting organic production practices by average fresh price received for 2010 blueberries .................................59

5.4. Individual predicted probability of likelihood of adopting organic production practices by number of years growing blueberries..........59

5.5. Cumulative predicted probability of likelihood of adopting organic production practices by number of years growing blueberries.........60

5.6. Individual predicted probability of likelihood of adopting organic production practices by total acres in blueberry production.............60

5.7. Cumulative predicted probability of likelihood of adopting organic production practices by total acres in blueberry production............61

5.8. Individual predicted probability of likelihood of adopting organic production practices by number of informational sources used ........61

5.9. Cumulative predicted probability of likelihood of adopting organic production practices by number of informational sources used ........62

5.10. Individual predicted probability of likelihood of adopting organic production practices by age of blueberry grower .........................62

5.11. Cumulative predicted probability of likelihood of adopting organic production practices by age of blueberry grower .....................63

5.12. Individual predicted probability of likelihood of adopting organic production practices by average yield per acre of 2010 blueberries............................................................................................63
5.13. Cumulative predicted probability of likelihood of adopting organic production practices by average yield per acre of 2010 blueberries ................................................................. 64

5.14. Individual predicted probability of likelihood of adopting organic production practices by average fresh price received for 2010 blueberries ................................................................. 64

5.15. Cumulative predicted probability of likelihood of adopting organic production practices by average fresh price received for 2010 blueberries ................................................................. 65

5.16. Individual predicted probability of likelihood of adopting organic production practices by amount of land/establishment costs financed in 2010 ................................................................. 65

5.17. Cumulative predicted probability of likelihood of adopting organic production practices by amount of land/establishment costs financed in 2010 ................................................................. 66

5.18. Individual predicted probability of likelihood of adopting organic production practices by amount of income generated from farm production ................................................................. 66

5.19. Cumulative predicted probability of likelihood of adopting organic production practices by amount of income generated from farm production ................................................................. 67

5.20. Cumulative predicted probability of likelihood of adopting organic production practices by gender, age or blueberry grower, and concern of stable price of blueberries ................................................................. 67

5.21. Cumulative predicted probability of likelihood of adopting organic production practices by gender, average price received, and the concern of average price of blueberries ................................................................. 68

5.22. Cumulative predicted probability of likelihood of adopting organic production practices by gender, average fresh price received, and concern of stable price of blueberries ................................................................. 68

5.23. Cumulative predicted probability of likelihood of adopting organic production practices by gender, total farm income, and amount of land financed, part 1 ................................................................. 69

5.24. Cumulative predicted probability of likelihood of adopting organic production practices by gender, total farm income, and amount of land financed, part 2 ................................................................. 69
5.25. Cumulative predicted probability of likelihood of adopting organic production practices by gender, willingness to accept risk, and amount of land financed.............................70

5.26. Cumulative predicted probability of likelihood of adopting organic production practices by gender, willingness to accept risk, and average blueberry yield per acre ..........................................................70

5.27. Cumulative predicted probability of likelihood of adopting organic production practices by Hispanic ancestry, number of years growing blueberries, and number of informational sources used, part 1 ...........................................................................................71

5.28. Cumulative predicted probability of likelihood of adopting organic production practices by Hispanic ancestry, number of years growing blueberries, and number of informational sources used, part 2 ...........................................................................................71

5.29. Cumulative predicted probability of likelihood of adopting organic production practices by gender, number of years growing blueberries, and total acres of blueberries, part 1 ........................................72

5.30. Cumulative predicted probability of likelihood of adopting organic production practices by gender, number of years growing blueberries, and total acres of blueberries, part 2 ........................................72
CHAPTER I
INTRODUCTION

On August 16, 2000, the Blueberry Promotion, Research, and Information Order was enacted under the Commodity Promotion, Research, and Information Act of 1996. The reasoning behind this program was to develop a plan to promote, research, and inform the public to expand the markets for fresh and cultivated blueberries, in the United States and international markets (Merrigan, 2000). The North American Blueberry Council (NABC) was responsible for initiating the request of this generic proposal. U.S. blueberry producers and importers of an annual minimum volume of 2,000 pounds of fresh and cultivated blueberries voted to approve the promotion and agree to fund it at a rate of $12 per ton of berries produced/imported. Generic promotion programs offer a way to market commodities for the entire industry, especially for small to medium scale growers that would otherwise be unable to promote their product due to lack of resources and market power (Merrigan, 2000).

The Blueberry Order is administered by the United States Highbush Blueberry Council (USHBC) under the supervision of the United States Department of Agriculture (USDA). The 13 volunteer members of the USHBC are voted on by producers and appointed by the Secretary of Agriculture. Each member and alternate member serves a three year term with a maximum of two consecutive terms. The duties of the USHBC
members include creating marketing programs and research projects, form committees, hire employees; anything needed to carry out the objectives of the marketing order (Merrigan, 2000).

Since the formation of the U.S. generic blueberry promotion order, the blueberry industry in the United States has witnessed significant growth. Increased consumer awareness of the health benefits as well as increased regional availability and health-focused marketing and promotional activities likely led to the per capita fresh blueberry consumption increasing from an average 0.25 pounds in the 1990’s to 1.11 pounds in 2010 (Perez, et al., 2011). Blueberries are predominantly sold in two forms, fresh and frozen, with fresh berries attracting a larger premium and higher harvest costs compared to the frozen berries (Perez, et al., 2011). From 1995 to 2009, the total domestic utilization of U.S. produced blueberries rose 6.7% annually, with fresh blueberry consumption increasing 13.1% annually (Perez, et al., 2011). U.S. blueberry consumption reached its highest level in history at 1.11 pounds per capita in 2010, and total crop value reaching 640.7 million in 2010, second only to strawberries, evidence that this fruit is vital to U.S. agriculture (Perez, et al., 2011). This decade-long rising trend in blueberry consumption revealed volume preferences for fresh exceeding frozen for the first time in 2001-2 (Perez, et al., 2011).

U.S. wild blueberries, predominantly grown in Maine, are almost all sold in the frozen market, with less than one percent sold in the fresh market. The blueberries typically sold for fresh market are the cultivated varieties, highbush (Northern and Southern) and rabbiteye. An increase in domestic cultivar production reached peak output at 413 million pounds in 2010, with 244.4 million pounds sold for fresh-market use and
168.6 million pounds used for processing (Perez, et al., 2011). Although the rabbiteye is ideal for production in the South, with its versatility and drought tolerant nature along with a longer shelf life, new Southern highbush plantings are still exceeding rabbiteye plantings. This is largely because the Southern highbush varieties ripen earlier and bloom later than the rabbiteye resulting in early market arrival which garners higher prices (Spiers, Magee, and Sampson, 2000).

In response to elevated consumer demand, blueberry plantings have increased across the Southeastern and Northwestern United States since the mid-2000’s. Faced with an increased supply of cultivated blueberries of 413 million pounds in 2010 compared with 182.9 million pounds in 2000 (Perez, et al., 2011), supply is expected to reach full production output by the 2012 season. As a result, industry concerns related to consistent labor availability and maintaining profitability levels are widespread (Morgan, 2011). A shortage of labor was experienced during the 2011 Florida harvesting season which was delayed 3-4 weeks due to the late-season cooler weather (Bouffard, 2011). Competition for adequate harvest labor is heavy especially for other fresh produce crops that pay relatively higher wages over a longer harvesting season and concentrated production areas. Florida blueberry growers harvest for six to eight weeks, while the citrus market extends from October to June and strawberries from November to April (Bouffard, 2011). This labor demand creates intense competition for access to hand-harvesting labor particularly if weather delays harvesting of peak volumes when labor population is moving northward.

A major industry concern focuses on immigration regulations and enforcement of labor laws and wage rates which are undergoing major changes, especially in relation to
migrant workers employed by Southern and Western specialty crop producers (Braswell, 2008). Georgia growers have witnessed huge labor shortage dilemmas after Georgia legislature enacted a new immigration law that took effect in June 2011. This immigration law allows police to question workers that are suspects in criminal investigations about their immigration status; this law also implements consequences to those knowingly transporting or harboring illegal immigrants (Valdes, 2011). A survey conducted by the University of Georgia reported a deficit of labor by 40% and a $390 million economic loss impact on the state’s economy since this law was enacted (Georgia Fruit and Vegetable Growers, 2012).

As labor availability decreased due to increased regulations by the government and worker mobility, mechanization of harvesting fresh fruit presented a unique set of challenges for many varieties (Cook, 2011). However, machine harvesting of blueberries has been implemented by many large acreage producers, particularly in wild berry production process. This practice was historically limited to berries destined for the frozen market due to berry damage and shelf life reduction of larger, juicier fresh market berries. The machine harvester was introduced in the mid 1960’s and offered growers the potential to reduce labor costs by 30-45% (Boyette, et al., 1993). One machine harvester is estimated to replace about 100 manual labor pickers (Boyette, et al., 1993). The typical over-the-row machine harvester shakes the bush as the berries fall into a capturing device (Boyette, et al., 1993).

In an article published by USA Today (Canfield, 2007), Maine wild blueberry growers were interviewed on their success with the machine harvester, revealing that 80% of Maine blueberry acreage was harvested with mechanization techniques in 2007.
One grower described the efficiency of the machine harvester, indicating he harvested 10,000 pounds of blueberries a day with the machine, almost 10 times that of a hand picker (Canfield, 2007). As technology has improved since the harvesters were first introduced, so have the quality of these machine harvesters, where continued improvements led to less fruit on the ground and less bruising and damage to the fruit and plants. Machine harvesting reduced grower costs by about 6 to 7 cents; handpicked berries cost approximately 16 to 17 cents per pound, compared to 10 cents per pound with a machine harvester (Canfield, 2007). In the Southeastern U.S., blueberry hand harvest averages $0.72 per pound versus a custom machine harvest cost of about $0.18 per pound (G. Krewer, personnel correspondence, November 2010).

A second pressing concern for blueberry growers is maintaining profits given anticipated future supply increases (Morgan, 2011). Although demand for blueberries has doubled in the past decade, the flood of new growers and added plantings threaten the potential for sustained profitability in the industry. Interviews with Southeastern growers revealed that organic production is one way to insure relatively higher and more stable prices relative to conventionally grown berries. Wholesale prices of organic blueberries typically range 20-100% higher than conventionally grown blueberries (Krewer and Walker, 2006). The organic market has grown from $1 billion in 1990 to $26.7 billion in 2010 (Organic Trade Association, 2011). From 2009 to 2010 alone, organic sales increased 7.7 percent, with fruits and vegetables representing the largest growth in the organic sector of 11.8 percent over that one year period (Organic Trade Association, 2011). These numbers revealed that organically produced food items are meeting the needs of one of the fastest growing U.S. consumer markets. As produce is listed as the
leader in organic food sales, transitioning to organic production practices may provide a profitable niche market to blueberry growers. Southeastern blueberry organic producers could secure higher premiums, with warmer weather conditions resulting in earlier harvest dates in mid-March for Florida growers and Georgia fresh blueberries reaching markets by mid-May (Plattner, et al., 2008).

A grower’s willingness to adopt technologies or production practices such as organic production or mechanized harvesting may potentially offer significant positive returns to the individual grower, particularly in Southeastern U.S. early season markets. Consumer preferences are the driving force for the blueberry industry, whether it is the option of a niche market such as organics or implementing alternate harvesting methods due to labor laws or other factors resulting in a decreased profit. The purpose of this research was to investigate the factors that influence blueberry producers’ decision to adopt alternative practices of organic blueberry.

Specifically, the goal of this research was to understand the determining factors which significantly impact blueberry grower willingness to adopt organic production practices in the Southeast. Historically, the Southeastern states have held the geographic advantage which enabled growers to receive higher prices due to provision of high quality fresh blueberries during early marketing windows. Florida, for example, has a relatively long warm, dry climate, and has been the primary producer of early harvested blueberries to be shipped and sold commercially (Williamson, et al., 2009). Blueberries in Florida and Southern Georgia have the greatest potential to attract optimal prices since these are the two states that are the first to ripen in North America. After mid to late May, the price of blueberries decreased significantly due to the heavier production
volumes to the market which are harvested throughout summer months from Northern states such as New Jersey and Michigan (Williamson, et al., 2009).

Given the inherent production and financial risk that agricultural producers continually face, particularly in the Southeast, a second goal of this research was to determine how grower perceptions of future outcomes alter their adoption of alternative production practices. Extension personnel, researchers, and the blueberry industry producers will garner a better understanding of the direction of the blueberry industry as it relates to producer management practices. Baerenklau and Knapp (2007) confirm that identifying the determinants of technology investments and adoption rates are important to the design of agricultural policies.

A mail survey was distributed to members of four state blueberry associations with the goal of defining those factors that affect growers’ decision to consider alternative production practices of organic production. The results of this research will be distributed to the national blueberry industry to deliver timely information for farmers seeking alternate and profitable production opportunities. Results are expected to provide agricultural Extension personnel and other agricultural professionals an objective assessment of producer adoption for future innovations and technologies. Additionally, these research results may be extended beyond the scope of the blueberry industry and prove applicable for many other specialty crop agricultural enterprises seeking this niche market.

This thesis is organized as follows: the literature review of relevant and recent research related to adoption of alternative technology or farm practices; conceptual
framework outlining the economic theory; methods and data; results of the research; and finally the concluding remarks.
CHAPTER II
LITERATURE REVIEW

This chapter outlines a brief summary of the blueberry industry in the Southeastern United States. In addition, previous studies in the literature are presented that provide historical perspectives related to those significant factors which influence grower adoption of agricultural technology or production practices.

Blueberry Industry in the Southeast

As stated previously, U.S. blueberry plantings have significantly increased. According to NASS, total U.S. cultivated bearing acreage of blueberries increased from 40,320 acres in 2000 (USDA, “Noncitrus Fruits,” 2001) to 72,000 in 2011 (USDA, “Noncitrus Fruits,” 2012). Acreage in the Southeast has increased due in large part to the introduction of several Southern highbush varieties such as Sweetcrisp, Meadowlark, and Farthing. Southern highbush cultivars are specifically bred to be successfully grown in warmer areas of the U.S., along with the historically predominant rabbiteye cultivars like Vernon, Climax and Premier. While both produce similar fruit, the rabbiteye variety represents the majority of cultivated blueberry plants in the Southeast and is more drought tolerant than the highbush (Pollack and Perez, 2003). The southern highbush
blueberry was developed to tolerate less “chill hours” with similar characteristics of the Northern highbush, such as a late bloom date and early ripening period. With this later bloom date, the risk of losing a crop to frost is much lower and the shorter ripening period enables the harvest to occur mid-April through late May, earlier than the rabbiteye varieties (Pollack and Perez, 2003). This allows producers to have access to an earlier marketing window and receive premium prices before the supply of fresh blueberries reaches the season’s maximum due to the ripening of crops further north in New Jersey and Michigan (Pollack and Perez, 2003).

The organic food industry has been growing steadily, over a period of ten years from 1997 to 2008, organic sales rose from $3.6 billion to $21.1 billion (Greene, et al., 2009). According to a publication from the Nutrition Business Journal in 2008, organic sales have increased over this ten year period by a rate of 12 -21% annually (Greene, et al., 2009). Establishing new organic blueberry plantings or transitioning from conventional to organic production requires at least a three year period to meet the USDA 100 percent organic certification requirements (Greene, et al., 2009). Steps to gain organic certification include: application and development of an Organic System Plan (OSP); implementation of the OSP once an accredited USDA certified agent has given permission; remain subjected to and pass regular inspections by the certified agent to ensure the grower has followed the National Organic Plan’s (NOP) regulations; and finally the certified agent makes the executive decision on the organic certification of the grower’s operation (USDA, “Instruction Five Steps,” 2010). The OSP should include practices to protect biodiversity, tillage, cultivation, crop rotation, and pest management practices. Keeping records of any chemicals and additives applied in production of
blueberries such as fertilizers or pest and weed control are required. Monitoring methods are used to verify the OSP has been implemented. These include soil tests to ensure ample organic matter is present and test for moisture content, quality and pest management (USDA, “Instruction Five Steps,” 2010).

According to the USDA, a 2008 Organic Production Survey listed 526 certified organic farms growing cultivated blueberries, with total organic production reaching 5.9 million pounds (Geisler, 2010). Sales of 516 organic farms totaled $16.4 million (Geisler, 2010). Interest in establishing blueberry organic acreage increased as growers sought to diversify market risks; just as with any commodity, variety divides risk among the operation. Producers are aware of the growing demand for access to locally grown blueberries sold directly to final consumers, where premiums exist for organic and value-added products (Kuepper and Diver, 2004). The ERS (Low and Vogel, 2011) conducted a study using 2008 Agricultural Resource Management Survey (ARMS) data on the trends in local market sales of both direct to consumer markets and intermediated markets. Direct to consumer markets include roadside stands, farmers markets, farm stores, and community-supported agriculture programs. Intermediated markets include farmers selling for local retail, restaurants, and regional distribution chains or grocery stores. Together these two markets accounted for more than 4.8 billion in sales in 2008 (Low and Vogel, 2011). A report published by the USDA in 2009 indicated organic produce prices were on average higher than conventional produce. In this report, ERS (Greene, et al., 2009) analyzed organic prices for multiple fruits and vegetables, blueberries exceeded all other produce in organic premiums. Organic blueberry retail prices occasionally exceeded conventional prices by more than 100 percent (Greene, et
al., 2009). Rabbiteye varieties, in particular, have been researched for organic production practices in Georgia due to their ability to grow in many soil types while producing stable yields and incurring relatively less pest damage (Austin, 1994). Finally, organic production has become more and more economically viable for Southeastern U.S. growers as more insect and disease control aids and methods have proven successful (Kuepper et al., 2004). Therefore, organic fresh market blueberry production targets an optimal niche market for producers for Southeast growers, (particularly Florida and Georgia, the first to enter the market), when combined with the early ripening period in the Southeast and relatively higher price premium for their efforts (Plattner, et al., 2008).

Technology Adoption

Genius, Pantzios and Tzouvelekas (2006) studied farmers’ decisions to convert land from conventional to organic production practices in Crete, Greece. Data for this study was obtained from a broader survey of randomly selected multi-crop farms on Crete Island. The data collected were divided into four main categories: farmer’s personal characteristics, economic variables such as income, institutional factors and environmental conditions. A simultaneous trivariate probit choice model was estimated to determine if the probability of organic adoption was related to where and how farming information was gathered. The three decision choice model included: (1) if the farmer was passively collecting information or otherwise, (2) if the farmers was actively collecting information or otherwise, and (3) if the farmer had full land conversion, partial land conversion or no land conversion of organic adoption. The results showed that adoption of organic production and origin of information gathered were correlated and
therefore should not be estimated separately (Genius, Pantzios and Tzouvelekas, 2006). This positive relationship showed that more information-seeking farmers are more likely to adopt organic modes of production. Farmer’s education level, subsidies received, environmental awareness, and the number of extension offices positively affected the probability of adoption. Results also show the existence of correlation between the two possible types of information gathering and organic adoption, ensuring that information acquired should not be an exogenous variable in adoption estimation (Genius, Pantzios and Tzouvelekas, 2006). The concluding remarks suggested organic adoption would be positively influenced by certain policies that would encourage retirement of older farmers, improve farmer’s education, environmental awareness, access to information resources, farm diversity, extension services, and informational workshops and meetings (Genius, Pantzios and Tzouvelekas, 2006).

A study conducted in Germany by Bruestedt, Müller-Scheßel and Latacz-Lohmann (2007) observed the factors of a farmer’s willingness to adopt genetically modified (GM) rapeseed before its commercial release and estimated the demand for this new technology. Data were collected through an online survey to identify specific characteristics of farmers who are more likely to adopt GM rapeseed crop and estimate the demand for the new technology. Because this technology was not released to the public at the time of the study, it was vital to obtain primary data directly from the farmers; otherwise the study could not be completed. The subjects had to choose between one of three decisions, which prompted the use of a multinomial probit model along with a defined random utility function. The decision choice set consisted of three rapeseed alternatives, two GM and one conventional. The farmers were assumed to be
risk neutral, and the results showed adoption decisions were persuaded by profit expectations and personal and farm characteristics (Breustedt, Müller-Scheeßel and Latacz-Lohmann, 2007). Farmers that had neighbors that opposed GM technology or were thought to be hostile were less likely to adopt the GM technology. The farm size, a higher educational degree, and planned farm succession resulted in a positive adoption decision of GM technology (Breustedt, Müller-Scheeßel and Latacz-Lohmann, 2007).

Keelan et al. (2009) studied the adoption decisions of genetically-modified (GM) technology of Ireland farmers. Data used for this study were taken from the 2006 Teagasc National Farm Survey that analyzed farming activities in Ireland. Another survey conducted in the summer of 2007 dealt with farmer’s attitudes toward GM adoption. In this study a binary choice probit model was used to determine if a farmer was willing to grow GM crops if it resulted in cost savings or flexibility of crop management or otherwise (Keelan et al., 2009). The results showed that the early farm adopters were those that had the following characteristics: large farm acreage, formal agricultural education and those with higher quality soils (Keelan et al., 2009). Farm size had a positive effect on adoption of GM technology. Agricultural education of the farmer was highly significant; farmers that completed a formal agricultural education were 13% more likely to grow GM crops. Soil type was also significant, farmers with wide use range soil were 14% more likely to grow GM crops and those with mixed use range soil were 17% more likely to grow GM crops (Keelan et al., 2009).

Daberkow and McBride (2003) used farm level survey data to determine how awareness related to precision agriculture (PA) adoption. PA technology has been available since the early 1990’s although adoption has been rather slow in the United
States as many farmers were unaware or unfamiliar with the technology. Data used in this study were acquired from the USDA 1998 Agricultural Resource Management Study (ARMS). Farms selected for the survey represented a known number of similar farms and characteristics of size, production type, and land use. The decision to adopt PA technology was modeled by jointly observing awareness and adoption, through a bivariate logit model; if the grower adopted one or more PA technologies or not and if the grower was aware of PA or not (Daberkow and McBride, 2003). The results showed human capital, farm size, farm occupation, farm type and location were significant on the probability of being aware of the PA technology (Daberkow and McBride, 2003). A higher education level, computer literacy, and farm size increased the likelihood of PA awareness (Daberkow and McBride, 2003). However PA awareness was not found to be statistically significant in the adoption decision (Daberkow and McBride, 2003). Farmers that were more likely to adopt PA were already aware of the technology and increasing awareness levels did not increase the rate of adoption (Daberkow and McBride, 2003). The results from the study proved to be consistent with the view that precision agriculture vendors and extension personnel, target their information and promotion activities primarily to those farmers for whom precision agricultural technologies would likely be profitable (Daberkow and McBride, 2003).

Burton, Rigby, and Young (1999) used survey data to determine the adoption decisions of organic production in the United Kingdom (UK). The data obtained for the study were from organic farms and conventional farms, the adopters and non-adopters, respectively. Variables from the survey included physical characteristics of the farm and farmer, cropping patterns, input use, farm sales and assets or other income sources,
information sources, and attitudes on environmental issues. A multinomial logit model was used to determine the attributes of the two decisions: adopt or not adopt; in which the farmer had three choices: conventional, convert to organic and gain certification, or convert to organic and not acquire certification. Results indicated the significant variables included: gender, with females more likely to adopt and age, organic farmers were younger and had been in the agriculture industry six to ten years after conventional farmers (growers relatively newer to production in general) (Burton, Rigby, Young, 1999). Other significant variables are information sources and attitudes, which revealed that organic adoption was not only about higher profits, but also lifestyle decisions of the grower (Burton, Rigby, and Young, 1999).

Zepeda (1994) conducted a study that observed factors that affected California dairy farmers’ technology adoption behavior. A generalized probit model was estimated to determine how productivity affected technology adoption. The authors noted that economic theory indicated that technology affects productivity, so these should be jointly determined. Since these are jointly determined, a simultaneous system of equations were used to analyze data acquired via a phone survey. The subjects were randomly selected California Grade-A milk producers representing seven percent of the dairy producers of California. Factors observed included milk production per cow, producer’s management ability, education, experience, farm size, feed inputs, frequency of milking, region or climate, and industry involvement. Results showed that record keeping increased productivity, and vice versa. When the farmer experienced increased productivity, the use of record keeping continued (Zepeda, 1994). Education was important in record
keeping and productivity affected amount of concentrate or feed fed per cow (Zepeda, 1994).

Doss (2006) discussed agricultural technology adoption as it applied to developing countries and its effect on productivity. A collection of studies were analyzed to determine the most appropriate way that policy, institutions, markets, and infrastructure would affect adoption of technologies and the question areas to successfully understand adoption behavior. Microstudies were used to gather basic information of the technology and any associated constraints. These microstudies are helpful for policy and are often relatively cheaper than a census (Doss, 2006). Doss (2006) suggested that adopting technologies does depend on the growers’ financial situation, it is therefore important to determine whether the potential adopter has access to credit in addition to their income levels. Income measures included farm and nonfarm outlets, as well as assets and savings. A lack of these would signify that a grower was less likely to adopt because of initial investments and startup costs (Doss, 2006). Throughout the process of technology adoption, grower access to information should be continually relayed as many problems, questions, etc., arise with time (Doss, 2006). Access to labor markets was another variable that Doss (2006) deemed useful in this article. Overall, the important factors when conducting a survey were market access and distance, information, labor, and credit access, measures of land use and population density, and farmer’s perception on shortage of land or if additional land is available (Doss, 2006).

Lynne et al. (1995) conducted a study on farmers’ perceived control of the decision to adopt water saving irrigation technology and if adopted, the influence of
perceived control on how much capital was actually invested. A random sample of 110 Florida strawberry growers were personally interviewed for this study. A tobit model was used to analyze the attitudes and subjective norm questions (behavior thought to be appropriate), perceived behavioral controls (how much control the respondent thinks they have over installing drip irrigation system), and actual controls of the farmer (Lynne et al., 1995). Attributes of the farm and farmer were also analyzed. These included age, education, income, years farming, debt to asset ratio, taxable farming income, all taxable income, and total acres utilized. Results of the tobit model indicated that planned behavior was more relevant than reasoned action in relation to the adoption decision (Lynne et al., 1995). Perceived control was relative to explaining adoption and how much to invest in conserving water technology (Lynne, et al., 1995). However, information about micro-technology was familiar to farmers likely due to Extension educational efforts (Lynne et al., 1995). It is suggested that farmers did not have a choice in the decision to invest in micro-irrigation because of the significance of the perceived behavioral control (Lynne et al., 1995). Farmers were more likely to adopt and adopted more intensely when influenced by the community (Lynne et al., 1995). The perceived control variable was another community influence that slowed the adoption and reduced the intensity of adoption as well (Lynne et al., 1995). It was suggested that these farmers needed to perceive some control in order to for them to adopt and adopt more intensely (Lynne et al., 1995). The authors also agreed with previous studies that showed investment decisions were ultimately the consumers’ decision. In order to increase grower participation, incentive programs should be implemented for these conservation practices (Lynne et al., 1995).
This chapter discusses the economic theory relevant to the research and outlines the appropriate research survey methodology. The random utility theory was discussed to understand consumer’s choices and the framework for the two discrete models that are used in econometric estimation. Research survey methodology was followed by Salant and Dillman (2004).

Research Survey Methodology

Numerous studies have performed surveys to gather data used to study grower adoption decisions, such as Burton, Rigby, and Young (1999); Daberkow and McBride (2003); Egelkraut (2006); Genius, Pantzios and Tzouvelekas (2006); Breustedt, Müller-Scheefel and Latacz-Lohmann, (2007); Keelan et al (2009); Läpple and Kelley (2010); Rees et al (2010) to name a few. As discussed in Läpple and Kelley (2010), using planned behavior to measure people’s beliefs in relation to a decision in the study, a survey is the proper instrument to use. Surveys typically occur in two stages, the first being an assessment of perceived main beliefs pertaining to the decisions obtained by in-person interviews (such as perceived problems, information sources, expected advantages and disadvantages, etc.) The second step is to take this gathered information from the
interviews and establish the feedback in a quantitative manner that can be modeled from a survey instrument (Läpple and Kelley 2010).

According to Salant and Dillman (1994), mail questionnaires are challenging because the authors are not physically there to aid the respondent if questions or confusion arise. The authors suggested that the questionnaire should be visually appealing and communicate to the potential respondent that it is worth their time and effort to participate. They outline recommendations for achieving the highest response rates possible and suggest the instrument printed in a booklet style format with a front cover that is visually appealing. The cover should contain four elements: title, picture, sponsor, and the return address. Just as the front is extremely important because it is the first thing the respondent sees, the back is also equally important in order to thank the respondent and leave room for any additional comments the respondent may feel is necessary (Salant and Dillman, 1994). Inside the ordering of the questions become the important task. Salant and Dillman (1994, 109-10) suggest,

“The questions asked first should be the most important and most relevant to the topic at hand, with the most objectionable questions at the end. Questions along the same subject should be lumped together in addition to those with the same structure, such as yes/no, fill in the blank, etc. Transitions are needed from section to section so the questionnaire sounds more conversational. The most important thing to remember in the question layout is make sure to be consistent throughout.”
**Random Utility Theory**

Following McFadden (1980), the assumption was that producers are rational and make decisions from the available choices under given conditions of resource availability, and these choices are made with the intention to maximize their individual utility.

According to Greene (2003, 719), “for an \(i\)th consumer with \(J\) possible choices, the utility of choice \(j\) was”:

\[
U_{ij} = x'_i \beta + \epsilon_{ij}
\]

(3.1)

where \(x\) was a vector of farm and farmer characteristics and \(\beta\) was a vector of parameter estimates. If the subject chooses choice \(j\), it was assumed that \(U_{ij}\) maximized utility out of the \(J\) set of alternatives. The probability that choice \(j\) was made:

\[
\text{Prob}(U_{ij} > U_{ik}) \quad \text{for all other } k \neq j.
\]

(3.2)

where the probability of choice \(j\) was greater than the utility from the other alternatives, \(k\).

**Discrete Choice Models**

The two models analyzed in this research were discrete choice models, meaning the outcomes were of discrete nature, not continuous. This is also known as a qualitative response model, where the dependent variable represents a discrete choice, such as yes or no. (Greene, 2003).

The general framework used in this research to analyze grower adoption decisions as a function of a set of explanatory factors was based on the probability model:

\[
\text{Prob (event } j \text{ occurs}) = \text{Prob } (Y=j) = F[\text{relevant effects, parameters}]
\]

(3.3)
where the probability of the choice the individual choses was a probability among all possible choices (Greene, 2003).

**Binary Logit Model**

The binary logit model was used to model the organic adoption decision of blueberry growers in the Southeast. This was a qualitative choice since we equate $j = 0$ with ‘no, the blueberry grower does not grow organic blueberries’, and $j = 1$ with ‘yes, the blueberry grower does grow organic blueberries’.

As Greene (2003) suggested a decision was explained by certain factors ($x$) and parameters ($\beta$) to ensure the probabilities lie in the zero to one interval:

\[
\lim_{x,\beta \to +\infty} \text{Prob}(y = 1|x) = 1
\]

\[
\lim_{x,\beta \to -\infty} \text{Prob}(y = 1|x) = 0
\]

(3.4)

In order to properly determine the probabilities that reflect the predictions, we will use the logistic cumulative distribution, $\Lambda(\cdot)$:

\[
\text{Prob}(y = 1|x) = \frac{e^{x'\beta}}{1 + e^{x'\beta}} = \Lambda(x'\beta)
\]

(3.5)

The probability of $y$ given $x$:

\[
E[y|x] = 0[1 - \Lambda(x'\beta)] + 1[\Lambda(x'\beta)] = \Lambda(x'\beta)
\]

(3.6)

The log model estimation:

\[
\log \left[ \frac{E(y|x)}{1 - E(y|x)} \right] = \alpha + x'\beta
\]

(3.7)
The parameters that were estimated were not the marginal effects, because this was a nonlinear estimation, therefore the derivatives are taken to appropriately interpret results.

To determine the marginal effects of the model, the derivative was taken:

\[
\frac{\partial E(y|x)}{\partial x} = \Lambda(x'\beta)[1 - \Lambda(x'\beta)]\beta
\]  

(3.8)

**Cumulative Logit Model**

The cumulative logit model was used to model the growers’ own perceived likelihood of adopting organic production practices in the next five years. The dependent variable in this case took on a value of one to five, with one being very unlikely and five being very likely. This was also called an ordered response, each response taking on a higher value than the last. Because of this property, the cumulative logit model can have simpler interpretation and greater power than other logit models, according to Agresti (2007). The cumulative probability of \( y \) falling at or below outcome \( j \):

\[
P(y|x \leq j) = \pi_1 + \ldots + \pi_j, \ j = 1, \ldots, J
\]

\[
\pi_j = P(y|x = j)
\]  

(3.9)

Probabilities sum to 1, only \( J \) parameters needed to solve \( J+1 \):

\[
P(y|x \leq 1) \leq P(y|x \leq 2) \leq \ldots \leq P(y|x \leq J) = 1
\]  

(3.10)

Model will have \( J-1 \) equations:

\[
\text{logit}
\left[P(y|x \leq j)\right] = \log \left[\frac{P(y|x \leq j)}{1 - P(y|x \leq j)}\right] = \alpha_j + x'\beta, \ j = 1, \ldots, J - 1
\]  

(3.11)

where \( \alpha \) will have separate parameters for each equation and the model assumes \( x \) was identical for all \( J-1 \) cumulative logits (Agresti, 2007).
CHAPTER IV
DATA AND METHODS

This chapter describes the methods used to obtain the data used in the econometric model. The estimation models of the binary and cumulative logit model are also presented as well as a detailed description of the variables in each model.

Survey Data

Institutional Review Board (IRB) approval was obtained in order to collect data for this study. The survey instruments were distributed via mail to membership lists acquired from four Southeastern state blueberry associations. The states included were Florida, Georgia, Mississippi, and North Carolina. The USDA census data from 2002 and 2007 outlined states that produced cultivated blueberries; these four states garnered the largest portion of blueberry production in the Southeast. The 2007 Census reported total acres of cultivated blueberries in Georgia, North Carolina, Florida, and Mississippi were 8,848, 6,367, 3,357, and 2,230 respectively (USDA, “Berries 2002 and 2007,” 2007).

Individual executive blueberry interviews were conducted in the summer of 2010, as Läpple and Kelley (2010) recommended, in order to better comprehend current and potential problems, perceptions, and characteristics that pertain to the Southeastern
blueberry industry. Once the executive interviews were completed and results summarized, the mailed survey instruments were designed and pre-tested. Addresses of the blueberry growers were obtained from the respective growers’ state associations, with the exception of Georgia. For Georgia, materials were prepackaged and sent to the Extension County Director’s Office in Southeast Georgia where the mailing lists were compiled and distributed by the County Director, at the request of the Georgia Blueberry Growers Association. On Tuesday, February 22, 2011, 250 survey research announcement letters were mailed to Georgia (196 actually distributed) and on Friday February 25, 2011, all letters (n=668) were mailed to the growers in all four states. Seven days later on Tuesday, March 1, 2011, the first round of survey questionnaires were mailed to Georgia County Director’s Office, and on Friday, March 4, 2011 all four state survey questionnaires were simultaneously mailed to blueberry growers. The questionnaire packet included an informative letter, describing the purpose of the effort of the survey, the actual questionnaire, and a prepaid return envelope provided to return the questionnaires to the Mississippi State University researchers. A third mailing consisted of a reminder postcard was sent to Georgia County Director’s Office on Thursday, March 17, 2011 and on Friday, March 18, 2011 all postcards were simultaneously mailed to growers in all four states. The fourth mailing consisted of a second set of the survey questionnaires mailed to non-respondents and/or lost or misplaced questionnaires postmarked to the Georgia County Director’s Office on Monday, March 21, 2011, and on Thursday, March 24, 2011, all surveys were simultaneously mailed to growers in all four states. A fifth mailing consisted of a third set of the survey instruments and were sent to Georgia County Director’s Office on
Tuesday, April 5, 2011, and all surveys were out Friday, April 8, 2011 to all growers in all four states.

Survey Questions and Responses

The survey instrument was comprised of 33 questions, which were based on findings from previous studies and, questions specific to behavior and practices revealed during executive interviews of blueberry growers were incorporated (Morgan, 2011). Previous studies attempted to explain adoption decisions by observing age, education, gender, farm size, land ownership, location, farm succession, risk, and information acquisition. With the addition of price expectations and other risk perception questions about the 2011 growing season, recent acquisition of land, likeliness of adopting alternative technologies specific to blueberry production, and labor workers per each stage of production, this survey expected to provide a greater understanding of adoption decisions. The survey is available in Appendix A.

Response rates by state of the mailed questionnaires are listed below (Table 4.1).

Table 4.1  Disposition of mailed questionnaires and response rates

<table>
<thead>
<tr>
<th></th>
<th>Georgia</th>
<th>Florida</th>
<th>Mississippi</th>
<th>North Carolina</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivered</td>
<td>192</td>
<td>230</td>
<td>149</td>
<td>77</td>
<td>648</td>
</tr>
<tr>
<td>Returned</td>
<td>43.23%</td>
<td>40.00%</td>
<td>37.58%</td>
<td>35.06%</td>
<td>39.81%</td>
</tr>
<tr>
<td>Useable</td>
<td>34.19%</td>
<td>35.90%</td>
<td>18.80%</td>
<td>11.11%</td>
<td>36.11%</td>
</tr>
</tbody>
</table>

Note: Mailed 668 surveys, 20 undeliverable
Of returned surveys, 24 ineligible
Overall, a total of 668 survey instruments were mailed; 20 or 2.99% were undeliverable either due to a closed mailbox, wrong address, or nonexistent address. The total questionnaires delivered were determined by subtracting the undeliverable surveys from the total mailed; 97.00% or 648 were delivered to some physical address. Total questionnaires returned were 258 or 39.81% of the total delivered. Ineligible respondents totaled 24 or 9.30% of the total returned questionnaires. These respondents either returned the survey or contacted the researcher via phone or email, indicating that the grower was deceased, retired, no longer produced blueberries, a member of the association but had yet to start producing berries, very small operations and suggested they were not viable for survey purposes, and/or worked in the blueberry industry but did not actually produce. Total usable questionnaires used for data analysis and model estimation totaled 234 or 36.11% (ineligible subtracted from questionnaires returned).

Survey data obtained using state grower association membership lists were compared to the 2007 Census of Agriculture (USDA, “Berries 2002 and 2007,” 2007) and 2007 Organic Production Survey (USDA, “Organic Berries,” 2007), to determine representativeness of respondents relative to the geographic areas targeted by the survey effort (Table 4.2).
<table>
<thead>
<tr>
<th></th>
<th>Census</th>
<th></th>
<th>Survey</th>
<th></th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Farms</td>
<td>Acres</td>
<td>Farms</td>
<td>Acres</td>
<td></td>
</tr>
<tr>
<td>Conventional</td>
<td>2077</td>
<td>20,802</td>
<td>187</td>
<td>9,327.58</td>
<td>9.00%</td>
</tr>
<tr>
<td>Acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44.84%</td>
</tr>
<tr>
<td>Organic</td>
<td>68</td>
<td>360*</td>
<td>24</td>
<td>569.05*</td>
<td>30.88%</td>
</tr>
<tr>
<td>Acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>158.07%</td>
</tr>
</tbody>
</table>

*: Organic acres in Mississippi were withheld to avoid disclosing data for individual farms.

Data from the 2007 census and organic survey were compared to the 2011 Blueberry Industry Survey for farm and acreage data. Nine percent of conventional blueberry farms in the Southeast were accounted for by questionnaire respondents while 44.84% of acres were represented in 2011 survey results. One interpretation of this relationship may imply blueberry growers have expanded their acreage, or many of the growers answering the survey are extremely large; conversely, those growers that responded to the census may be particularly small and may not be a member of their state growers’ association. Likewise in organic production 30.88% of growers were accounted for by questionnaire respondents yet 158.07% of acreage was accounted for in the survey sample. Mississippi acreage was withheld in the 2007 census; in order to make as accurate comparison as possible, Mississippi acreage was also withheld in Table 4.2 from our survey data; the numbers of farms however are all accounted for. Survey results reported indicate that organic production in these four states had likely increased since the 2007 census.
Summary Statistics

Summary statistics of the variables used in estimation include the count of respondents who answered the question, and the minimum value, maximum value, mean and standard deviations for each variable (Table 4.3).
Table 4.3  Summary statistics of all variables used in estimation

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Experience</td>
<td>228</td>
<td>0</td>
<td>75</td>
<td>11.597</td>
<td>11.585</td>
</tr>
<tr>
<td>Total Acres</td>
<td>234</td>
<td>0</td>
<td>650</td>
<td>55.099</td>
<td>107.904</td>
</tr>
<tr>
<td>Dummy: transfer to non-family</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.043</td>
<td>0.203</td>
</tr>
<tr>
<td>Dummy: transfer to family</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.658</td>
<td>0.475</td>
</tr>
<tr>
<td>Dummy: education</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.500</td>
<td>0.501</td>
</tr>
<tr>
<td>Gender</td>
<td>228</td>
<td>1</td>
<td>2</td>
<td>1.171</td>
<td>0.377</td>
</tr>
<tr>
<td>Age</td>
<td>229</td>
<td>21</td>
<td>65</td>
<td>55.367</td>
<td>8.960</td>
</tr>
<tr>
<td>Average Yield</td>
<td>234</td>
<td>0</td>
<td>26</td>
<td>3.399</td>
<td>3.773</td>
</tr>
<tr>
<td>Average Fresh Price</td>
<td>234</td>
<td>0</td>
<td>11</td>
<td>1.711</td>
<td>1.845</td>
</tr>
<tr>
<td>Dummy: University Personnel</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.846</td>
<td>0.362</td>
</tr>
<tr>
<td>Dummy: Concern Stabile Price =2-4</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.808</td>
<td>0.395</td>
</tr>
<tr>
<td>Dummy: Concern Average Price =3-4</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.564</td>
<td>0.497</td>
</tr>
<tr>
<td>Financed land/establishment costs</td>
<td>220</td>
<td>0</td>
<td>1</td>
<td>0.212</td>
<td>0.348</td>
</tr>
<tr>
<td>Dummy: Race=White</td>
<td>228</td>
<td>0</td>
<td>1</td>
<td>0.943</td>
<td>0.232</td>
</tr>
<tr>
<td>Total Farm Income</td>
<td>191</td>
<td>0</td>
<td>1</td>
<td>0.414</td>
<td>0.401</td>
</tr>
<tr>
<td>Dummy: Willingness to Accept Risk=3-4</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.467</td>
<td>0.500</td>
</tr>
</tbody>
</table>
Table 4.3 (continued)

<table>
<thead>
<tr>
<th>State</th>
<th>N</th>
<th>y</th>
<th>x</th>
<th>β1</th>
<th>β2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.359</td>
<td>0.481</td>
</tr>
<tr>
<td>Georgia</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.342</td>
<td>0.475</td>
</tr>
<tr>
<td>Mississippi</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.188</td>
<td>0.392</td>
</tr>
<tr>
<td>North Carolina</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.111</td>
<td>0.315</td>
</tr>
<tr>
<td>Dummy: Crop Insurance=3-4</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.162</td>
<td>0.370</td>
</tr>
<tr>
<td>Number of informational sources</td>
<td>234</td>
<td>0</td>
<td>6</td>
<td>3.637</td>
<td>1.399</td>
</tr>
<tr>
<td>Dummy: Transfer ownership</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.679</td>
<td>0.468</td>
</tr>
<tr>
<td>Dummy: Concern Average Price=2-4</td>
<td>234</td>
<td>0</td>
<td>1</td>
<td>0.808</td>
<td>0.395</td>
</tr>
<tr>
<td>Dummy: Hispanic Ancestry</td>
<td>228</td>
<td>0</td>
<td>1</td>
<td>0.035</td>
<td>0.184</td>
</tr>
</tbody>
</table>

Methods—Discrete Dependent Models

Discrete choice models were used in this analysis of Southeast blueberry growers’ decision to adopt machine harvesters or organic production. A discrete choice model limit the decision alternatives one can make instead of a continuous measure of activity (Greene, 2003). Discrete models are those where the dependent variables take on a discrete outcome, such as ‘yes or no’, count data, rankings, or categorical data (Greene, 1993). Many of the discrete dependent variables mentioned take on a quantitative value that represents a qualitative outcome (Greene, 2003). The equations below represent Model #1 and Model #2, equations 4.1 and 4.2, respectively.
The binary logit model estimation, denoted as Model #1:

\[
\log \left[ \frac{E(y|x)}{1 - E(y|x)} \right] = \alpha + \beta x
\]  

(4.1)

where \( y = 1 \): yes (planted or produced organic); 0: no (did not plant or produce organic)

and \( x \) was a vector of 20 variables:

- years experience growing blueberries
- total acres in blueberry production
- transfer of ownership to non-family member (1=yes; 0=no)
- transfer of ownership to family member (1=yes; 0=no)
- education level (1=college graduate, some graduate school, completed graduate school; 0=all others)
- gender (1=male; 0=female)
- age
- average yield per acre 2010 production (divided by 1000)
- average fresh price received for 2010 blueberries
- used informational resources from university personnel (1=yes; 0=no)
- concern about average price for 2011 season relative to other blueberry growers (1=more concerned; 0=all others)
- concern about stability of price for 2011 season (1=more concerned; 0=all others)
- percent of land/establishment costs financed in 2010
- race (1=white, 0=all others)
- percent of 2010 income generated from blueberry production and other farm production areas
willingness to accept risk relative to other growers (1=more willing, 0=all others)

Florida dummy (1=yes; 0=all others) (North Carolina =base)

Georgia dummy (1=yes; 0=all others) (North Carolina =base)

Mississippi dummy (1=yes; 0=all others) (North Carolina =base)

number of times purchased crop insurance since 2000 (1=seven or more; 0=all others)

The explanatory variables chosen resulted from previous studies as well as important issues and factors determined after the grower interviews were completed. The discrete dependent variable was the adoption decision, 1=the grower had adopted organic production practices and 0=the grower had not. Years experience was a continuous variable describing the number of years of experience growing blueberries. Total acres, a continuous variable displayed the number of acres owned and leased in blueberry production. A dummy variable described whether the grower planned on transferring ownership of the blueberry operation to a non-family member, 1=yes, 0=otherwise. A dummy variable described whether the grower planned on transferring ownership of the blueberry operation to a family member, 1=yes, 0=otherwise. Education was a dummy variable, 1=the grower had completed college, some graduate school or completed graduate school, 0=otherwise. Gender was a dummy variable, 1=male, 0=female. Age of the grower was measured as a continuous variable. Average yield per acre of 2010 blueberry production divided by 1000, was a continuous variable. Average fresh price received for 2010 blueberries was displayed as a continuous variable. A dummy variable represented whether growers obtained informational sources from university personnel, 1=yes, 0=otherwise. The grower’s level of concern of average blueberry prices for the
2011 season relative to other growers, was measured on a 0-4 scale, 0 being much less concerned and 4 being much more concerned and was represented as a dummy; 1=growers more concerned were indicated by a 2, 3, or 4 and 0=otherwise. The grower’s level of concern of stability/variation of blueberry prices for the 2011 season, relative to other growers on a 0-4 scale, with 0 being much less concerned and 4 being much more concerned was represented as a dummy; 1=growers more concerned were indicated by a 3 or 4 and 0=otherwise. The percent of blueberry land and establishment costs financed in 2010 was a continuous variable. A dummy variable represented race, 1=white, 0=otherwise. Total farm income was a continuous variable representing the amount of income generated from blueberry production and any other farm production. The grower’s willingness to accept risk in their blueberry operation, relative to other blueberry growers measured on a 0-4 scale, with 0 being much less willing and 4 being much more willing, was represented by a dummy; 1=growers more willing were indicated by a 3 or 4 and 0=otherwise. The state the grower produced blueberries was represented by dummies for each state, with North Carolina being the base category to avoid the dummy variable trap; dummy for Georgia, 1=yes, 0=otherwise; dummy for Florida, 1=yes, 0=otherwise; dummy for Mississippi, 1=yes, 0=otherwise. The number of times crop insurance was purchased since 2000, was represented as a dummy with 1=purchased crop insurance seven to ten times since 2000, 0=otherwise. Crop insurance was available for both conventional blueberries and organic blueberries.

The cumulative logit estimation model, denoted as Model #2:

\[
\logit\left[P(y \leq j)\right] = \log \left[ \frac{P(y \leq j)}{1 - P(y \leq j)} \right] = \alpha_j + x' \beta_j, \quad j = 1, ..., J - 1
\]

(4.2)
where $y = 0-4$ (the likelihood of considering planting organic blueberries in the next five years), and $\mathbf{x}$ was a vector of 18 variables:

- years experience growing blueberries
- total acres in blueberry production
- number of informational sources grower used
- willingness to accept risk relative to other growers ($1=\text{more willing}, 0=\text{all others}$)
- transfer of ownership to anyone ($1=\text{yes}, 0=\text{no}$)
- education level ($1=\text{college graduate, some graduate school, completed graduate school; 0=all others}$)
- gender ($1=\text{male}, 0=\text{female}$)
- age
- average yield per acre 2010 production (divided by 1000)
- concern about stability of price for 2011 season ($1=\text{more concerned}, 0=\text{all others}$)
- concern about average price for 2011 season relative to other blueberry growers ($1=\text{more concerned}, 0=\text{all others}$)
- percent of land/establishment costs financed in 2010
- Hispanic descent ($1=\text{yes}, 0=\text{no}$)
- percent of 2010 income generated from blueberry production and other farm production areas
- Florida dummy ($1=\text{yes}, 0=\text{all others}$) (North Carolina = base)
- Georgia dummy ($1=\text{yes}, 0=\text{all others}$) (North Carolina = base)
- Mississippi dummy ($1=\text{yes}, 0=\text{all others}$) (North Carolina = base)
- number of times purchased crop insurance since 2000 ($1=\text{seven or more}, 0=\text{all others}$)
The discrete dependent variable was the likelihood to adopt organic production practices over the next five years on a 0-4 scale, with 0 being very unlikely and 4 being very likely. Years experience was a continuous variable describing the number of years of experience growing blueberries. Total acres, a continuous variable displayed the number of acres owned and leased in blueberry production. An ordinal variable indicated the number of informational sources the blueberry grower has used. The grower’s willingness to accept risk in their blueberry operation, relative to other blueberry growers on a 0-4 scale, with 0 being much less willing and 4 being much more willing, was represented by a dummy; 1=growers more willing were indicated by a 3 or 4 and 0=otherwise. A dummy variable described whether the grower plans on transferring ownership of the blueberry operation, 1=yes, 0=otherwise. Education was a dummy variable, 1=the grower had completed college, some graduate school or completed graduate school, 0=otherwise. Gender was a dummy variable, 1=male, 0=female. Age of the grower was measured as a continuous variable. Average yield per acre of 2010 blueberry production divided by 1000, was a continuous variable. Average fresh price received for 2010 blueberries was displayed as a continuous variable. A dummy variable represented whether growers obtained informational sources from university personnel, 1=yes, 0=otherwise. The grower’s level of concern of average blueberry prices for the 2011 season, relative to other growers on a 0-4 scale, 0 being much less concerned and 4 being much more concerned was represented as a dummy; 1=growers more concerned were indicated by a 2, 3 or 4 and 0=otherwise. The grower’s level of concern of stability/variation of blueberry prices for the 2011 season, relative to other growers measured on a 0-4 scale, with 0 being much less concerned and 4 being much more
concerned was represented as a dummy; 1=growers more concerned were indicated by a 2, 3 or 4 and 0=otherwise. The percent of blueberry land and establishment costs financed in 2010 was a continuous variable. A dummy variable represented Hispanic ancestry, 1=yes, 0=otherwise. Total farm income was a continuous variable representing the amount of income generated from blueberry production and any other farm production. The state the grower produced blueberries, was represented by dummies for each state, with North Carolina being the base category to avoid the dummy variable trap; dummy for Georgia, 1=yes, 0=otherwise; dummy for Florida, 1=yes, 0=otherwise; dummy for Mississippi, 1=yes, 0=otherwise. The number of times crop insurance was purchased since 2000, was represented as a dummy with 1=purchased crop insurance seven to ten times since 2000, 0=otherwise.

The following charts represent the distribution of choices of the dependent variables for Model #1 and Model #2. The yes/no choice of adopting organic production practices (Table 4.4) and if a non-adopter, the likelihood the grower will adopt organic production practices in the next five years (Table 4.5).

Table 4.4  Choice set for organic blueberry adoption, Model #1

<table>
<thead>
<tr>
<th>Quantitative Value</th>
<th>Description of Choice</th>
<th>N=180</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Grower did not plant or produce organic blueberries in 2010.</td>
<td>162</td>
<td>90.00%</td>
</tr>
<tr>
<td>1</td>
<td>Grower did plant and/or produce organic blueberries in 2010</td>
<td>18</td>
<td>10.00%</td>
</tr>
</tbody>
</table>
Table 4.5  Choice set of non-adopters’ likelihood of organic blueberry adoption, Model #2

<table>
<thead>
<tr>
<th>Quantitative Value</th>
<th>Description of Possible Alternatives</th>
<th>N=162</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grower did not plant or produce organic blueberries in 2010 and/or likelihood to consider planting organic blueberries in the next 5 years is 0.</td>
<td>123</td>
<td>75.93%</td>
</tr>
<tr>
<td>2</td>
<td>Grower did not plant or produce organic blueberries in 2010 and likelihood to consider planting organic blueberries in the next 5 years is 1.</td>
<td>15</td>
<td>9.26%</td>
</tr>
<tr>
<td>3</td>
<td>Grower did not plant or produce organic blueberries in 2010 and likelihood to consider planting organic blueberries in the next 5 years is 2.</td>
<td>13</td>
<td>8.02%</td>
</tr>
<tr>
<td>4</td>
<td>Grower did not plant or produce organic blueberries in 2010 and likelihood to consider planting organic blueberries in the next 5 years is 3.</td>
<td>8</td>
<td>4.94%</td>
</tr>
<tr>
<td>5</td>
<td>Grower did not plant or produce organic blueberries in 2010 and likelihood to consider planting organic blueberries in the next 5 years is 4.</td>
<td>3</td>
<td>1.85%</td>
</tr>
</tbody>
</table>
CHAPTER V
RESULTS

This chapter outlines the results from the econometric estimation. A representativeness of the survey conducted is first established. Coefficient estimations, marginal effects and predicted probabilities are reported.

Representativeness of Survey

A brief comparison of farm and farmer characteristics of the 2007 Census of Agriculture and the 2011 Blueberry Industry Survey was displayed to show representativeness (Table 5.1).

Table 5.1 Farm/Farmer characteristics comparison of 2007 Census of Agriculture and 2011 Blueberry Industry Survey

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2007 Census of Agriculture</th>
<th>2011 Blueberry Industry Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age of Farmer</td>
<td>57.10</td>
<td>55.36</td>
</tr>
<tr>
<td>Average Size of Farm</td>
<td>418.00 acres</td>
<td>55.10 acres</td>
</tr>
<tr>
<td>Farmers not of the white race or Hispanic descent</td>
<td>7.00%</td>
<td>2.63%</td>
</tr>
<tr>
<td>Female Farmers</td>
<td>14.00%</td>
<td>17.11%</td>
</tr>
</tbody>
</table>
The numbers of from the 2007 Census of Agriculture are for all farms in the United States. The average age of farmers was similar for both studies; however, the average size of farm was much different. This was expected because of the variety of farming operations configured in the census where the average was 418.00 acres compared to the blueberry survey of 55.10 acres (USDA, “New Farms”, 2007). There was more diversity of respondents in the census that the blueberry industry survey, but the blueberry industry had a larger percentage of female farmers (USDA, “Women Farmers,” 2007).

**Coefficients, Standard Deviation, Significance Levels, and Marginal Effects**

The parameter estimates, standard error and significance levels for the binary logit, Model # 1, the organic production adoption decision are provided below (Table 5.2). The variables listed were all included in the estimation; however, discussion only includes those variables that were revealed to have a statistically significant effect on the adoption decision of organic blueberry production. Econometric analysis of the decision to adopt organic production practices revealed that growers’ decisions were influenced by the number of years growing blueberries, total number of acres (owned and leased) in blueberry production, transfer ownership to a family member, education level, gender, average fresh price received of blueberries, information obtained from university personnel, the producer level of concern about the average price of blueberries compared to other growers, race, location, specifically the state of Georgia, and number of times crop insurance was purchased.
Table 5.2  Model #1, binary logit parameter estimates, standard error and significance levels of organic adoption

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>Pr&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.109</td>
<td>2.920</td>
<td>0.704</td>
</tr>
<tr>
<td>Years Experience</td>
<td>-0.121</td>
<td>0.066*</td>
<td>0.068</td>
</tr>
<tr>
<td>Total Acres</td>
<td>0.011</td>
<td>0.004***</td>
<td>0.003</td>
</tr>
<tr>
<td>Dummy: transfer to non-family</td>
<td>0.780</td>
<td>0.841</td>
<td>0.354</td>
</tr>
<tr>
<td>Dummy: transfer to family</td>
<td>0.846</td>
<td>0.448*</td>
<td>0.059</td>
</tr>
<tr>
<td>Dummy: Education</td>
<td>-0.942</td>
<td>0.398**</td>
<td>0.018</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.676</td>
<td>1.077***</td>
<td>0.001</td>
</tr>
<tr>
<td>Age</td>
<td>-0.003</td>
<td>0.045</td>
<td>0.949</td>
</tr>
<tr>
<td>Average Yield</td>
<td>0.034</td>
<td>0.104</td>
<td>0.745</td>
</tr>
<tr>
<td>Average Fresh Price</td>
<td>0.690</td>
<td>0.230***</td>
<td>0.003</td>
</tr>
<tr>
<td>Dummy: University Personnel</td>
<td>-1.633</td>
<td>0.596***</td>
<td>0.006</td>
</tr>
<tr>
<td>Dummy: Concern Stabile Price =2-4</td>
<td>-0.564</td>
<td>0.508</td>
<td>0.267</td>
</tr>
<tr>
<td>Dummy: Concern Average Price =3-4</td>
<td>-1.348</td>
<td>0.514***</td>
<td>0.009</td>
</tr>
<tr>
<td>Financed land/establishment costs</td>
<td>1.514</td>
<td>1.197</td>
<td>0.206</td>
</tr>
<tr>
<td>Dummy: Race=White</td>
<td>-1.345</td>
<td>0.712*</td>
<td>0.059</td>
</tr>
<tr>
<td>Total Farm Income</td>
<td>0.325</td>
<td>1.132</td>
<td>0.774</td>
</tr>
<tr>
<td>Dummy: Willingness to Accept Risk=3-4</td>
<td>0.744</td>
<td>0.472</td>
<td>0.115</td>
</tr>
</tbody>
</table>
Table 5.2 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Florida</th>
<th>Georgia</th>
<th>Mississippi</th>
<th>Dummy: Crop Insurance=3-4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.707</td>
<td>1.229</td>
<td>0.565</td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td>-2.732</td>
<td>1.477*</td>
<td>0.064</td>
<td></td>
</tr>
<tr>
<td>Mississippi</td>
<td>-0.001</td>
<td>1.412</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Dummy: Crop Insurance=3-4</td>
<td>-1.508</td>
<td>0.810*</td>
<td>0.063</td>
<td></td>
</tr>
</tbody>
</table>

Observations: 180  
R-Square:0.2679  
-2LogL (Intercept and Covariates): 60.907

Note: ***, **, * denote significance at the 1%, 5%, 10% levels respectively.

Marginal effects were then calculated to readily interpret our econometric results. The marginal effects were calculated based on each variable’s average of the means and the probability of adoption was shown as a percent in Model #1 (Table 5.3). Following the table is a brief explanation of the variables that have a statistically significant effect of the adoption decision of organic blueberries. Probabilities were discussed in relation to growers that had already adopted organic production practices. Likewise for those who are non-adopters, the interpretation was the same however, with the opposite sign (i.e. positive or negative).
As the number of years growing blueberries increased by one, the probability of that grower being an organic blueberry producer decreased by 0.54%. Younger growers had a greater probability of growing organic blueberries, a result shown significant in

<table>
<thead>
<tr>
<th>Decision (_dependent variable)</th>
<th>Yes, did plant or produce organic blueberries in 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>1</td>
</tr>
<tr>
<td>Years Experience</td>
<td>-0.54</td>
</tr>
<tr>
<td>Total Acres</td>
<td>0.06</td>
</tr>
<tr>
<td>Dummy: transfer to non-family</td>
<td>7.91</td>
</tr>
<tr>
<td>Dummy: transfer to family</td>
<td>4.13</td>
</tr>
<tr>
<td>Dummy: Education</td>
<td>-6.53</td>
</tr>
<tr>
<td>Gender</td>
<td>-20.99</td>
</tr>
<tr>
<td>Average Fresh Price</td>
<td>3.23</td>
</tr>
<tr>
<td>Dummy: University Personnel</td>
<td>-12.83</td>
</tr>
<tr>
<td>Dummy: Concern Stabile Price</td>
<td>=2-4 -3.54</td>
</tr>
<tr>
<td>Dummy: Concern Average Price</td>
<td>=3-4 -16.32</td>
</tr>
<tr>
<td>Financed land/establishment</td>
<td>10.03</td>
</tr>
<tr>
<td>costs</td>
<td></td>
</tr>
<tr>
<td>Dummy: Race=White</td>
<td>-15.75</td>
</tr>
<tr>
<td>Dummy: Willingness to Accept</td>
<td></td>
</tr>
<tr>
<td>Risk=3-4</td>
<td>7.82</td>
</tr>
<tr>
<td>Georgia</td>
<td>-9.26</td>
</tr>
<tr>
<td>Dummy: Crop Insurance=3-4</td>
<td>-19.58</td>
</tr>
</tbody>
</table>
other studies. As total acres increased by an acre owned or leased, the probability of the growers being an organic adopter increased by 0.06%. This was a small percent but can be interpreted as these larger acreage growers had more leverage to add or convert to organic acreage, whereas it could be more risky for smaller acreage growers to convert their acreage to organic production practices. By planning to transfer ownership of a growers blueberry operation to a family member, probability increased by 4.13% of the grower being an organic producer. As education level changed from less educated to more educated, the probability of the grower being an organic producer decreased by 6.53%. The probability of the grower being a male organic blueberry producer compared to a female producer decreased by 20.99%. As the average price received for fresh blueberries in 2010 increased by one unit the probability of the grower being an organic producer increased by 3.23%. Research had supported this result as organic produce prices are higher than conventionally grown produce. Growers that obtained information from university personnel decreased probability of being an organic blueberry producer by 12.83%. Growers that were more concerned about the average prices of blueberries in 2011 were 16.32% less likely to be an organic adopter. Growers who were white were 15.75% less likely to be organic blueberry growers when compared to other races. Georgia blueberry growers were 9.26% less likely to be organic producers when compared to the base category, North Carolina. Growers that purchased crop insurance seven to ten times since 2000, where 19.58% less likely to be organic blueberry growers, when compared to growers that did not or purchased crop insurance one to six times since 2000.
The parameter estimates, standard error and significance levels for the multinomial logit, Model #2 for the non-adopters’ likelihood of organic blueberry adoption in the future are outlined below (Table 5.4). The likelihood of organic blueberry adoption was measured out of five possible choices. Choice one included conventional growers that did not plant or produce organic blueberries in 2010, nor were they willing to in the next five years. Choice two included growers who did not plant or produce organic blueberries in 2010 and their likelihood of considering planting organic blueberries in the next five years was one. Choice three included growers who did not plant or produce organic blueberries in 2010 and their likelihood of considering planting organic blueberries in the next five years was two. Choice four included growers who did not plant or produce organic blueberries in 2010 and their likelihood of considering planting organic blueberries in the next five years was three. Choice five included growers who did not plant or produce organic blueberries in 2010 and their likelihood of considering planting organic blueberries in the next five years was four. Econometric analysis of the likelihood to adopt organic production practices revealed that growers’ decisions were influenced by the number of informational sources used by the grower, willingness to accept risk relative to other blueberry growers, transfer of blueberry operation ownership, gender, average yield per acre, the producer’s level of concern about the stability/variation of blueberry prices, the producer’s level of concern about the average price of blueberries compared to other growers, the percent of blueberry land and establishment costs financed, Hispanic ancestry, and the number of times crop insurance was purchased.
Table 5.4  Model #2, multinomial logit parameter estimates, standard error and significance levels of likelihood of organic adoption

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
<th>Pr&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept 1</td>
<td>-5.039</td>
<td>1.852***</td>
<td>0.007</td>
</tr>
<tr>
<td>Intercept 2</td>
<td>-4.241</td>
<td>1.834**</td>
<td>0.021</td>
</tr>
<tr>
<td>Intercept 3</td>
<td>-3.073</td>
<td>1.815*</td>
<td>0.090</td>
</tr>
<tr>
<td>Intercept 4</td>
<td>-1.393</td>
<td>1.857</td>
<td>0.453</td>
</tr>
<tr>
<td>Years Experience</td>
<td>0.027</td>
<td>0.021</td>
<td>0.204</td>
</tr>
<tr>
<td>Total Acres</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.331</td>
</tr>
<tr>
<td>Number of Informational Sources</td>
<td>0.435</td>
<td>0.205**</td>
<td>0.034</td>
</tr>
<tr>
<td>Dummy: Willingness to Accept Risk=3-4</td>
<td>0.480</td>
<td>0.220**</td>
<td>0.029</td>
</tr>
<tr>
<td>Dummy: Transfer ownership</td>
<td>0.771</td>
<td>0.294***</td>
<td>0.009</td>
</tr>
<tr>
<td>Dummy: Education</td>
<td>-0.037</td>
<td>0.230</td>
<td>0.871</td>
</tr>
<tr>
<td>Gender</td>
<td>1.324</td>
<td>0.680*</td>
<td>0.051</td>
</tr>
<tr>
<td>Age</td>
<td>0.037</td>
<td>0.023</td>
<td>0.102</td>
</tr>
<tr>
<td>Average Yield</td>
<td>0.144</td>
<td>0.075*</td>
<td>0.053</td>
</tr>
<tr>
<td>Average Fresh Price</td>
<td>-0.154</td>
<td>0.131</td>
<td>0.239</td>
</tr>
<tr>
<td>Dummy: Concern Stabile Price =2-4</td>
<td>0.778</td>
<td>0.466*</td>
<td>0.095</td>
</tr>
<tr>
<td>Dummy: Concern Average Price=2-4</td>
<td>-1.084</td>
<td>0.456**</td>
<td>0.017</td>
</tr>
<tr>
<td>Financed land/establishment Costs</td>
<td>1.165</td>
<td>0.669*</td>
<td>0.082</td>
</tr>
</tbody>
</table>
Table 5.4 (continued)

| Dummy: Hispanic Ancestry | 1.812 | 0.525*** | 0.001 |
| Total Farm Income        | -0.462 | 0.572    | 0.419 |
| Florida                  | -0.382 | 0.411    | 0.353 |
| Georgia                  | 0.071  | 0.378    | 0.851 |
| Mississippi              | -0.315 | 0.429    | 0.463 |
| Dummy: Crop Insurance=3-4 | -0.550 | 0.316*  | 0.082 |

Observations: 162
Chi-Square: 218.7213
R-Square: 0.2364
-2LogL (Intercept and Covariates): 233.096

Note: ***, **, * denote significance at the 1%, 5%, 10% levels respectively.

The marginal effects of the likelihood of organic adoption were calculated based on each variable’s average of the means and the probability of adoption is shown as a percent. The following is a brief explanation of the variables that have a statistically significant effect of the likelihood of adopting of organic practices of blueberries. The varying levels of growers’ adoption likelihood were represented in the table below for Model #2 (Table 5.5).
### Table 5.5  Model #2, average marginal effects of variables on the probability of adoption of organic production choice decision (in percent)

<table>
<thead>
<tr>
<th>Decision (dependent variable)</th>
<th>No, do not and will not plant organic blueberries in the next five years</th>
<th>No (some degree of likelihood to plant/produce organic blueberries in the next five years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>1 (likelihood of one)</td>
<td>2 (likelihood of two)</td>
</tr>
<tr>
<td>Years Experience</td>
<td>0.39</td>
<td>-0.11</td>
</tr>
<tr>
<td>Total Acres</td>
<td>-0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Number of informational sources</td>
<td>6.37</td>
<td>-1.69</td>
</tr>
<tr>
<td>Dummy: Willingness to Accept Risk=3-4</td>
<td>-13.99</td>
<td>3.71</td>
</tr>
<tr>
<td>Dummy: Transfer ownership</td>
<td>-22.62</td>
<td>6.00</td>
</tr>
<tr>
<td>Gender</td>
<td>18.91</td>
<td>-5.02</td>
</tr>
<tr>
<td>Age</td>
<td>0.53</td>
<td>-0.14</td>
</tr>
<tr>
<td>Average Yield</td>
<td>2.11</td>
<td>-0.56</td>
</tr>
<tr>
<td>Average Fresh Price</td>
<td>-2.20</td>
<td>0.58</td>
</tr>
<tr>
<td>Dummy: Concern Stabile Price =2-4</td>
<td>-23.14</td>
<td>6.14</td>
</tr>
<tr>
<td>Dummy: Concern Average Price=2-4</td>
<td>31.72</td>
<td>-8.42</td>
</tr>
<tr>
<td>Financed land/establishment costs</td>
<td>17.09</td>
<td>-4.53</td>
</tr>
<tr>
<td>Dummy: Hispanic Ancestry</td>
<td>-52.80</td>
<td>14.01</td>
</tr>
</tbody>
</table>
Table 5.5 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Total Farm Income</th>
<th>Florida</th>
<th>13.06</th>
<th>-3.47</th>
<th>-4.41</th>
<th>-3.59</th>
<th>-1.60</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mississippi</td>
<td>10.91</td>
<td>-2.89</td>
<td>-3.68</td>
<td>-3.00</td>
<td>-1.33</td>
</tr>
<tr>
<td>Dummy: Crop Insurance=3-4</td>
<td></td>
<td>16.30</td>
<td>-4.32</td>
<td>-5.50</td>
<td>-4.48</td>
<td>-1.99</td>
<td></td>
</tr>
</tbody>
</table>

As the number of informational sources increased by one, the probability of the grower’s likelihood of not adopting organic technology (decision one) increased by 6.34%, the probability of the grower’s likelihood being one (decision two) decreased by 1.69%, probability of the grower’s likelihood being two (decision three) decreased by 2.15%, the probability of the grower’s likelihood being three (decision four) decreased by 1.75%, and the probability of the grower’s likelihood being four (decision five) decreased by 0.78%.

As the blueberry growers’ willingness to accept risk was much more willing compared to other growers, the probability of not adopting organic technology (decision one) decreased 13.99%. The probability of the grower’s likelihood of adopting being one (decision two) increased by 3.71%, probability of the grower’s likelihood being two (decision three) increased by 4.72%, the probability of the grower’s likelihood being three (decision four) increased by 3.84%, and the probability of the grower’s likelihood being four (decision five) increased by 1.71%. Blueberry growers were more likely to consider organic adoption if they believed themselves to be much more willing to take risks in their operation, compared to other growers.
Transfer of ownership to either a family or non-family member witnessed the probability of the likelihood of the grower not adopting organic production practices decrease by 22.62%, compared to those growers that are not planning to transfer ownership to anyone in the future. The probability of the likelihood being one (decision two) increased by 6.00%, probability of the grower’s likelihood being two (decision three) increased by 7.64%, the probability of the grower’s likelihood being three (decision four) increased by 6.21%, and the probability of the grower’s likelihood being four (decision five) increased by 2.77%, compared to growers not transferring ownership of their blueberry operation. Blueberry growers that planned to transfer ownership of their blueberry operation were more likely to consider organic adoption in the future.

If the gender of the grower was male, the probability of the growers’ likelihood of not adopting organic technology (decision one) increased by 18.91% when compared to female respondents. The probability of the grower’s likelihood being one (decision two) decreased by 5.02%, probability of the grower’s likelihood being two (decision three) decreased by 6.39%, the probability of the grower’s likelihood being three (decision four) decreased by 5.19%, and the probability of the grower’s likelihood being four (decision five) decreased by 2.31%, when compared to female respondents. Male blueberry growers were less likely to consider organic adoption.

As the average yield of the growers’ blueberry operation increased by one unit, the probability of the growers’ likelihood of not adopting organic technology (decision one) increased by 2.11%, the probability of the grower’s likelihood being one (decision two) decreased by 0.56%, probability of the grower’s likelihood being two (decision three) decreased by 0.71%, the probability of the grower’s likelihood being three
(decision four) decreased by 0.58%, and the probability of the grower’s likelihood being four (decision five) decreased by 0.26%. As blueberry yield per acre increased, growers were less likely to consider organic adoption of blueberries.

As the growers’ concern about 2011 blueberry price stability/variation relative to other blueberry growers increased, growers that were much more concerned garnered a decreased probability of 23.14% of a likelihood of zero (decision one) or not adopting organic production practices, when compared to those growers’ that were much less concerned. The probability of the likelihood being one (decision two) increased by 6.14%, probability of the grower’s likelihood being two (decision three) increased by 7.81%, the probability of the grower’s likelihood being three (decision four) increased by 6.34%, and the probability of the grower’s likelihood being four (decision five) increased by 2.83%, compared to growers much less concerned about price stability/variation. Growers more concerned about the price stability/variation of blueberries were more likely to consider organic adoption.

As the growers’ concern about average 2011 blueberry prices relative to other blueberry growers increased, growers that were much more concerned garnered an increased probability of 31.72% of a likelihood of zero (decision one) or not adopting organic production practices, when compared to those growers’ that were much less concerned. The probability of the likelihood being one (decision two) decreased by 8.42%, probability of the grower’s likelihood being two (decision three) decreased by 10.71%, the probability of the grower’s likelihood being three (decision four) decreased by 8.71%, and the probability of the grower’s likelihood being four (decision five) decreased by 3.88%, compared to growers much less concerned about average prices.
Blueberry growers were less likely to consider organic adoption if they were more concerned about blueberry prices, compared to those less concerned.

As the percent of blueberry land and establishment costs increased by one unit, the probability of the likelihood of the grower not adopting organic production practices increase by 17.10%. The probability of the likelihood being one (decision two) decreased by 4.53%, probability of the grower’s likelihood being two (decision three) decreased by 5.77%, the probability of the grower’s likelihood being three (decision four) decreased by 4.69%, and the probability of the grower’s likelihood being four (decision five) decreased by 2.09%. If more blueberry land and establishment costs were financed, growers were less likely to consider organic adoption.

If the grower was of Hispanic ancestry the probability of the growers’ likelihood of not adopting organic technology (decision one) decreased by 52.80% when compared to growers’ that were not of Hispanic ancestry. The probability of the likelihood being one (decision two) increased by 14.01%, probability of the grower’s likelihood being two (decision three) increased by 17.83%, the probability of the grower’s likelihood being three (decision four) increased by 14.50%, and the probability of the grower’s likelihood being four (decision five) increased by 6.46%, compared to growers that are not of Hispanic ancestry. Growers of Hispanic descent were more likely to consider organic adoption.

As the number of times crop insurance purchased increased by one unit, the probability that the grower purchased crop insurance seven to ten times since 2000 and had a likelihood of zero (decision one) or not adopting organic production practices increased by 16.30%, when compared to those growers that purchased crop insurance
none to six times since 2000. The probability of the likelihood being one (decision two) decreased by 4.32%, probability of the grower’s likelihood being two (decision three) decreased by 5.50%, the probability of the grower’s likelihood being three (decision four) decreased by 4.48%, and the probability of the grower’s likelihood being four (decision five) decreased by 1.99%, compared to growers that purchased crop insurance zero to six times since 2000. If the blueberry grower purchased crop insurance seven to ten times in the past ten years, they were less likely to consider organic adoption, compared to those who have purchased crop insurance less.

*Predicted Probabilities*

The following figures highlight the predicted probabilities of each continuous variable beginning with the binary logit, Model #1 (Figures 5.1-5.3), and followed by the multinomial logit, Model #2 (Figures 5.4-5.30). The individual predicted probabilities figures were modeled after growers that have adopted organic production practices of blueberries, Model #1 (Figures 5.1-5.3). Due to the fact that there were few organic respondents, some of these graphs may not be useful in determining specifics of variables impacts on organic adoption. The findings highlighted in Figure 5.1, however, indicated that organic blueberry growers were going to be those that have been growing blueberries fewer years, compared to those growers with more years of experience. As age increased the probability of the grower being an organic adopter decreased. Figure 5.2 represented the probability of a grower being an organic adopter as total acres increased. The probability of being an organic adopter was already very high for those growers with fewer acres and increased as total acres increased. However, after total acres reaches
about 200, there is no change in the probability and was therefore not helpful once it reached that point. The same scenario occurs in Figure 5.3, where the probability of being an organic grower increased as average price of blueberries increased. As the average price received of fresh blueberries reached four dollars, there was no change in probability of growers being organic..

The individual and cumulative predicted probabilities are shown for the likelihood of adopting organic production practices, Model #2 (Figures 5.4-5.19). When observing the predicted probabilities it was important to keep in mind that most of the respondents were non-adopters. Figures 5.4 and 5.5 represent the likelihood of adopting by number of years growing blueberries. The probability of respondents being adopters of organic production practices (choice 2-5) decreased as number of years increased.

Figures 5.6 and 5.7 represented the likelihood of adopting by number of acres in blueberry production. The probability of respondents being adopters of organic production practices (choice 2-5) increased as the number of acres increased. This result could account for the idea that large farms can absorb more risk of new or different technologies as compared to smaller farms, where the impact would be much greater.

Figures 5.8 and 5.9 represented the likelihood of adopting by number of informational sources used for assistance in blueberry production. The probability of respondents being adopters of organic practices (choice 2-5) decreased as the number of informational sources increased.

Figures 5.10 and 5.11 represented the likelihood of adopting by age of blueberry grower. The probability of respondents being adopters of organic practices (choice 2-5) decreased as age increased. More probable adopters were going to be younger growers
as they may be in the industry longer and will most likely be thinking about long term production and what is best for their operation.

Figures 5.12 and 5.13 represented the likelihood of adopting by blueberry average yield per acre. The probability of respondents being adopters of organic practices (choice 2-5) decreased as average yield per acre increased.

Figures 5.14 and 5.15 represented the likelihood of adopting by the average fresh price received of blueberries. The probability of respondents being adopters of organic practices (choice 2-5) increased as average price of fresh blueberries received increased.

Figures 5.16 and 5.17 represented the likelihood of adopting by amount of land/establishment costs financed in 2010. The probability of respondents being adopters of organic practices (choice 2-5) decreased as amount of land/establishment costs financed increased.

Figures 5.18 and 5.19 represented the likelihood of adopting by the amount of income generated from blueberry operations and other farm productions. The probability of respondents being adopters of organic practices (choice 2-5) increased as amount of income generated from the farm increased.

Figure 5.20 represented the probability of adopting organic production practices based on gender, age of blueberry grower and concern about blueberry price stability. As age increased, the probability of the grower having no likelihood of adopting (choice 1) increased. Growers that were more concerned about the stability of blueberry prices have a greater probability of being an organic grower (choice 2-5), especially females.

Figure 5.21 represented the probability of likelihood of adopting organic production practices based on gender, average fresh price received, and concern about
average prices of blueberries. As the average price of fresh blueberries increased, the probability decreased for growers having no likelihood of adopting organic production practices (choice 1). Growers that were female and were less concerned about the average price of blueberries witnessed an increasing probability of adopting organic production (choices 2-5) as fresh price increased.

Figure 5.22 represented the probability of adopting organic production practices based on gender, average fresh price received, and concern about blueberry price stability. As the average price of fresh blueberries increased, the probability decreased for growers having no likelihood to adopt organic production practices. Growers that were more concerned with stability of prices had a greater probability of likelihood of adopting organics (choices 2-5), especially females.

Figures 5.23 and 5.24 represented the probability of adopting organic production practices based on gender, amount of land/establishment costs financed and total farm income. As the amount of land/establishment costs financed increased, the probability of those growers adopting organic production (choices 2-5) decreased, a little less in females than males.

Figure 5.25 represented the probability of adopting organic production practices based on gender, willingness to accept risk, and amount of land financed. As amount of land financed increased, the probability increased for growers of no likelihood of adopting (choice 1) and decreased for growers of some likelihood of adopting (choices 2-5), more so for females and those that were more willing to take risks.

Figure 5.26 represented the probability of adopting organic production practices based on gender, willingness to accept risk, and average blueberry yield per acre. As
average yield increased, probability increased overall for growers with no likelihood of adopting (choice 1) and decreased for growers of some probability of adopting (choices 2-5), a more prominent decrease for females of Hispanic descent.

Figures 5.27 and 5.28 represented the probability of adopting organic production practices based on Hispanic ancestry, number of years growing blueberries, and number of informational sources used. As number of years increased the probability for growers with no likelihood increased. The major distinguishing factors in these graphs were the likelihood adopters (choices 2-5); a larger likelihood of adopting occurred when they were of Hispanic descent (but still decreased overall as years increased).

Figures 5.29 and 5.30 represented the probability of adopting organic production practices based on gender, number of years growing blueberries, and total acres in blueberry production. As number of years increased the probability for growers with no likelihood (choice 1) of adopting increased, and growers of some probability of adopting (choices 2-5) increased as total acreage increased, especially for females.
Figure 5.1 Predicted probability of adopting organic production practices by number of years growing blueberries

Figure 5.2 Predicted probability of adopting organic production practices by total acres in blueberry production
Figure 5.3  Predicted probability of adopting organic production practices by average fresh price received for 2010 blueberries

Figure 5.4  Individual predicted probability of likelihood of adopting organic production practices by number of years growing blueberries
Figure 5.5  Cumulative predicted probability of likelihood of adopting organic production practices by number of years growing blueberries

Figure 5.6  Individual predicted probability of likelihood of adopting organic production practices by total acres in blueberry production
Figure 5.7  Cumulative predicted probability of likelihood of adopting organic production practices by total acres in blueberry production

Figure 5.8  Individual predicted probability of likelihood of adopting organic production practices by number of informational sources used
Figure 5.9  Cumulative predicted probability of likelihood of adopting organic production practices by number of informational sources used

Figure 5.10  Individual predicted probability of likelihood of adopting organic production practices by age of blueberry grower
Figure 5.11  Cumulative predicted probability of likelihood of adopting organic production practices by age of blueberry grower

Figure 5.12  Individual predicted probability of likelihood of adopting organic production practices by average yield per acre of 2010 blueberries
Figure 5.13  Cumulative predicted probability of likelihood of adopting organic production practices by average yield per acre of 2010 blueberries

Figure 5.14  Individual predicted probability of likelihood of adopting organic production practices by average fresh price received for 2010 blueberries
Figure 5.15  Cumulative predicted probability of likelihood of adopting organic production practices by average fresh price received for 2010 blueberries

Figure 5.16  Individual predicted probability of likelihood of adopting organic production practices by amount of land/establishment costs financed in 2010
Figure 5.17  Cumulative predicted probability of likelihood of adopting organic production practices by amount of land/establishment costs financed in 2010

Figure 5.18  Individual predicted probability of likelihood of adopting organic production practices by amount of income generated from farm production

66
Figure 5.19  Cumulative predicted probability of likelihood of adopting organic production practices by amount of income generated from farm production

Figure 5.20  Cumulative predicted probability of likelihood of adopting organic production practices by gender, age of blueberry grower, and concern of stable price of blueberries
Figure 5.21  Cumulative predicted probability of likelihood of adopting organic production practices by gender, average fresh price received, and concern of average price of blueberries

Figure 5.22  Cumulative predicted probability of likelihood of adopting organic production practices by gender, average fresh price received, and concern of stable price of blueberries
Figure 5.23  Cumulative predicted probability of likelihood of adopting organic production practices by gender, total farm income, and amount of land financed, part 1

Figure 5.24  Cumulative predicted probability of likelihood of adopting organic production practices by gender, total farm income, and amount of land financed, part 2
Figure 5.25  Cumulative predicted probability of likelihood of adopting organic production practices by gender, willingness to accept risk, and amount of land financed

Figure 5.26  Cumulative predicted probability of likelihood of adopting organic production practices by gender, willingness to accept risk, and average blueberry yield per acre
Figure 5.27  Cumulative predicted probability of likelihood of adopting organic production practices by Hispanic ancestry, number of years growing blueberries, and number of informational sources used, part 1

Figure 5.28  Cumulative predicted probability of likelihood of adopting organic production practices by Hispanic ancestry, number of years growing blueberries, and number of informational sources used, part 2
Figure 5.29  Cumulative predicted probability of likelihood of adopting organic production practices by gender, number of years growing blueberries, and total acres of blueberries, part 1

Figure 5.30  Cumulative predicted probability of likelihood of adopting organic production practices by gender, number of years growing blueberries, and total acres of blueberries, part 2
CHAPTER VI

CONCLUSIONS

In summary, the purpose of this study was to analyze significant factors that impacted blueberry growers’ decisions to adopt organic blueberry production practices. Interest for this study originated from the significant increase in blueberry consumption realized after the industry adoption of the Blueberry Promotion, Research, and Information Order in August of 2000. As blueberry production and consumption increased and plantings increased domestically, grower profitability was threatened. To address these research goals, two models were analyzed, the first focused on the current binary decision of whether or not the blueberry grower planted or produced organic blueberries in 2010; and the second, of those growers not currently planting/producing organically, what factors influenced their likelihood of planting organic blueberries sometime over the next five years. Questionnaires mailed to members of respective states’ blueberry growers’ association supplied the data for this analysis.

Growers that adopted organic production practices (Model #1) had significant positive relationships with total acres in blueberry production, transfer of ownership to a family member, and the average fresh price received of blueberries. Significant negative relationships existed between organic adopters and number of years growing blueberries, higher educated growers, males, information obtained from university personnel, growers
more concerned with the average price of blueberries, growers of white race, growers from Georgia, and those that purchased crop insurance seven to ten times over the past ten years.

Growers that had not adopted organic production practices in 2010 but implied some likelihood of adopting (Model #2) in the next five years (choices 2-5) showed a significant positive relationship with growers more willing to take risks, a plan to transfer ownership of their blueberry operation, growers more concerned about stability of blueberry prices, and growers of Hispanic ancestry. Negative significant relationships existed with number of informational sources used, males, average yield per acre, growers more concerned with the average price of blueberries, amount of land/establishment costs financed, and growers that purchased crop insurance seven to ten times since 2000.

Interpretations

From the results of the 2011 Blueberry Industry Survey, organic adopters (Model #1) are those that had large blueberry farms. This interpretation can mean they were able to take on more risk compared to smaller farms. Organic growers had planned for farm succession to a family member. Because these growers had already planned to transfer ownership of their operation, it is likely they were thinking about the future, and thinking about the future of the blueberry operation. In order to remain profitable in years to come, they had already adopted organic practices. Organic adopters were those that had also received higher prices for their blueberries, this was backed by evidence found in the local grocery store. Organic prices are typically higher than conventional, and growers
are getting that added benefit. The growers of organic blueberries were typically going to be newer to the industry; this was because they may be more knowledgeable about new techniques of the industry because they were just starting out. Given the required three-year transition period when converting conventional land and plants into an organic operation, it can be assumed that the decision to adopt organic production might be relatively more likely in new growers. It is typically easier to start out growing organic than to convert later on. Growers that purchased crop insurance less, less than seven times since 2000, were also going to be organic blueberry growers. This result can be interpreted because they may be newer to the industry and have not had the opportunity to purchase insurance the optimal amount of times asked in the survey booklet. Crop insurance was a measure of risk, and those that purchased crop insurance less were thought to be risk takers, a characteristic of technology adopters in general, because any kind of adoption has risks associated. Compared to the base state of North Carolina, organic adopters were not going to be growers located in Georgia. Females, growers of other races besides white, and those less educated (those that did not complete college or beyond) were going to be organic adopters according to the findings from the survey instrument. The research showed organic adopters were not going to obtain information for university personnel, such as extension agents. Because the adopters were less educated, this can allude to why they had not obtained information from university personnel or it can be because there is not much information for organic adoption in the Southeast.

Results from the survey instrument concluded that the potential or likelihood adopters (Model #2) were going to be more willing to take risks. From this finding, it
can be concluded that organic production adoption was viewed as a risk-taking move and those that considered adoption in the future appear to classify themselves as more willing to take risks. Growers potentially adopting in the future had already planned to transfer ownership of their operation, which showed they are planning for the future and want to remain profitable for years to come and enable their successor to as well. Growers more concerned about stability of blueberry prices were shown to be potential adopters of organics in the next five years; studies and grower interviews had shown that marketing fresh organic blueberries may offer more price stability and less price variation when compared to conventionally grown blueberries. Those growers having a lower average yield were going to consider organic adoption. The author would not expect growers of higher yields to consider organics because one would infer they already know how to get the most out of their berries and are likely to be making large profits already, so there would not be any need to change. Those growers with less land and establishment costs financed were going to be thinking of organic adoption in the future, because they have the opportunity, growers with a larger portion of their blueberry operation financed were going to be more likely concentrated on their current practices to lower their debt. Growers that purchased crop insurance less were more likely to be a potential adopter, because they were a risk taker or because they may be newer to the blueberry industry and have not had the opportunity to purchase crop insurance on an annual basis. Growers less concerned about the average price of blueberries were more likely to show a potential to adopt organic production practices in the future. This interesting finding could be interpreted that these particular growers had confidence in their current price
risk management practices. Growers of Hispanic descent and those that utilized fewer informational sources were going to be those likely to adopt in the future as well.

**Combined Model Findings**

By observing the characteristics of growers indicating a likelihood of adopting organic production practices in the future to those that had already adopted organic practices, the similarities of the two models were observed. Transfer of ownership and crop insurance purchases linked the two models together, meaning that if a grower with some likelihood to consider future establishment of an organic blueberry operation possessed a plan of farm succession and less crop insurance purchases, they had the same characteristics of transferring ownership and crop insurance purchasing habits of those that had already adopted organic practices.

**Results Relevant to Previous Literature**

Results from this blueberry industry survey had many similarities and also some differences related to previous literature. Farm size was positively significant in this study as well as Daberkow and McBride (2003), Bruestedt, Müller-Scheeßel and Latacz-Lohmann (2007), and Keelan et al (2009). Farm succession showed positively to organic adoption in this study as well as Bruestedt, Müller-Scheeßel and Latacz-Lohmann (2007). Female growers and younger growers were organic adopters found to be significant in this study and in Burton, Rigby, and Young (1999). Financed land showed to be significant not only in this study but also in Doss (2004). The findings of information acquisition were different in this study compared to Lynne et al. (1995), Burton, Rigby,
and Young (1999), Doss (2004), and Genius, Pantzios and Tzouvelekas (2006); these studies tended to show a positive relationship to information acquisition whereas this research showed a negative relationship. Education level showed conflicting results in this study compared to Zepeda (1994), Genius, Pantzios and Tzouvelekas (2006), Bruestedt, Müller-Scheeßel and Latacz-Lohmann (2007), Keelan et al (2009); these studies showed a positive relationship of technology adoption to education level, whereas this research showed a negative relationship.

**Future Research**

Future research featuring data from a larger pool of organic blueberry producers would enable a more detailed estimation which could examine both growers’ characteristics and organic operations characteristics as well. This study focused on the Southeastern United States production region because of its unique climate, early market window, pest pressures, and increasing production trends. In the future, a national survey effort would be useful to better explain grower adoption of organic blueberry production practices particularly as new plantings arrive in 2012-3 markets.

These results will be useful to researchers who are charged with understanding technological adoption behaviors of fresh produce growers. Literature exploring those factors that influence grower adoption decision had typically focused on processed foods and meat or grain crops. This study is unique in that the producer side of the industry is analyzed after a successful, decade-long generic promotional program of a fresh produce commodity resulting in documented increase in consumer demand and awareness of the health benefits of fresh blueberries. These results will aid Extension personnel who work
with new and established blueberry growers across the Southeastern United States that are interested in understanding the unique opportunities and challenges associated with adoption of organic production practices.

A second unique contribution of this research was the significance of grower risk management behavior and perceptions to technology adoption decisions. This research finding resulted from the subjective ranking of a grower’s perception of his/her own concern about price stability and average price variations relative to other growers, which suggests that future research efforts devoted to understanding grower adoption decision-making process would benefit from analysis of risk management techniques of an individual grower. Extension specialists charged with disseminating educational programs and publications related to the technological tools available to specialty crop growers may benefit from establishing an initial understanding of the grower audience risk management concerns.
REFERENCES


APPENDIX A

2011 BLUEBERRY INDUSTRY SURVEY
2011 BLUEBERRY INDUSTRY SURVEY
Q1. In what County are the majority of your blueberry acres located?
   ____________ COUNTY

Q2. How many years have you been growing blueberries?
   _________ NUMBER OF YEARS GROWING BLUEBERRIES

Q3. How many acres of blueberry land did you own in 2010?
   _________ NUMBER OF BLUEBERRY ACRES OWNED IN 2010

Q4. How many acres of blueberry land did you lease in 2010?
   _________ NUMBER OF BLUEBERRY ACRES LEASED IN 2010

Q5. Since 2005, have you acquired new land to grow blueberries?
   □ NO, I HAVE NOT ACQUIRED NEW LAND TO GROW BLUEBERRIES SINCE 2005
   □ YES, I ACQUIRED NEW LAND TO GROW BLUEBERRIES IN _________ (YEAR)

Q6. Have you ever used any of the information sources listed below? Please circle all sources that you have used. If you use an information source that is not listed, please add it to the OTHER category and specify the information source.
   A. OTHER BLUEBERRY GROWERS
   B. UNIVERSITY PERSONNEL
   C. INTERNET WEBSITE (SPECIFY ____________________)
   D. BROKER/COOPERATIVE
   E. NORTH AMERICAN BLUEBERRY COUNCIL
   F. STATE GROWER ASSOCIATION
   G. OTHER (SPECIFY ____________________)

Q7. Of the possible information sources listed in Q6, which do you feel are the most important? (Please write the LETTER from Q6 in the appropriate box)
   □ MOST IMPORTANT □ 2ND MOST IMPORTANT □ 3RD MOST IMPORTANT
Q8. For 2011, please indicate your expected LOW, AVERAGE and HIGH yields and prices for fresh and processed blueberries:

**2011 BLUEBERRY PRICE AND YIELD EXPECTATIONS**

<table>
<thead>
<tr>
<th></th>
<th>LOW</th>
<th>AVERAGE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPECTED YIELD</td>
<td>LBS/AC RE</td>
<td>LBS/AC RE</td>
<td>LBS/AC RE</td>
</tr>
<tr>
<td>EXPECTED FRESH</td>
<td>$___________ PER LB</td>
<td>$___________ PER LB</td>
<td>$___________ PER LB</td>
</tr>
<tr>
<td>PRICE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPECTED</td>
<td>$___________ PER LB</td>
<td>$___________ PER LB</td>
<td>$___________ PER LB</td>
</tr>
<tr>
<td>PROCESSED PRICE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q9. Relative to other blueberry growers, how would you describe your willingness to accept RISK in your blueberry farm business? *Circle the number that best represents your answer.*

0---------------------1---------------------2---------------------3---------------------4

[MUCH LESS WILLING ------------------------------------ MUCH MORE WILLING]

Q10. Relative to other blueberry growers, how concerned are you about AVERAGE blueberry prices during 2011 season? *Circle the number that best represents your answer.*

0---------------------1---------------------2---------------------3---------------------4

[MUCH LESS CONCERNED ---------------------------------- MUCH MORE CONCERNED]

Q11. Relative to other blueberry growers, how concerned are you about the stability/variation of blueberry prices during 2011 season? *Circle the number that best represents your answer.*

0---------------------1---------------------2---------------------3---------------------4

[MUCH LESS CONCERNED ---------------------------------- MUCH MORE CONCERNED]
Q12. For your 2010 RABBITEYE production, complete the table for CONVENTIONAL and ORGANIC production (If you did not produce rabbiteyes, SKIP TO Q13):

<table>
<thead>
<tr>
<th></th>
<th>2010 CONVENTIONAL RABBITEYE</th>
<th>2010 ORGANIC RABBITEYE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL ACRES</td>
<td>___________________ ACRES</td>
<td>___________________ ACRES</td>
</tr>
<tr>
<td>AVERAGE YIELD</td>
<td>___________________ LBS/ACRE</td>
<td>___________________ LBS/ACRE</td>
</tr>
<tr>
<td>SOLD FRESH</td>
<td>___________________ PERCENT</td>
<td>___________________ PERCENT</td>
</tr>
<tr>
<td>FRESH PRICE RECEIVED</td>
<td>$ __________________ PER LB</td>
<td>$ __________________ PER LB</td>
</tr>
<tr>
<td>PROCESS PRICE RECEIVED</td>
<td>$ __________________ PER LB</td>
<td>$ __________________ PER LB</td>
</tr>
</tbody>
</table>

Q13. For your 2010 HIGHBUSH production, complete the table for CONVENTIONAL and ORGANIC production:

<table>
<thead>
<tr>
<th></th>
<th>2010 CONVENTIONAL HIGHBUSH</th>
<th>2010 ORGANIC HIGHBUSH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL ACRES</td>
<td>___________________ ACRES</td>
<td>___________________ ACRES</td>
</tr>
<tr>
<td>AVERAGE YIELD</td>
<td>___________________ LBS/ACRE</td>
<td>___________________ LBS/ACRE</td>
</tr>
<tr>
<td>SOLD FRESH</td>
<td>___________________ PERCENT</td>
<td>___________________ PERCENT</td>
</tr>
<tr>
<td>FRESH PRICE RECEIVED</td>
<td>$ __________________ PER LB</td>
<td>$ __________________ PER LB</td>
</tr>
<tr>
<td>PROCESS PRICE RECEIVED</td>
<td>$ __________________ PER LB</td>
<td>$ __________________ PER LB</td>
</tr>
</tbody>
</table>
Q14. In 2010, did you hand-pick any of your blueberry plants?

- NO -- HOW LIKELY ARE YOU TO CONSIDER HAND PICKING YOUR BLUEBERRIES IN THE NEXT FIVE YEARS? PLEASE CIRCLE THE NUMBER INDICATING YOUR LIKELIHOOD:

0----------------- 1------------------ 2---------------- 3----------------- 4
[VERY UNLIKELY ----------------------------------------- VERY LIKELY]

- YES -- PLEASE INDICATE THE FOLLOWING CONCERNING YOUR HAND-PICKED BLUEBERRIES:

HAND-PICK RABBITYES? _______________ NUMBER OF ACRES
HAND-PICK HIGHLUSH? _______________ NUMBER OF ACRES

Q15. In 2010, did you machine harvest any of your blueberry plants?

- NO -- HOW LIKELY ARE YOU TO CONSIDER MACHINE HARVEST OF YOUR BLUEBERRIES IN THE NEXT FIVE YEARS? PLEASE CIRCLE THE NUMBER INDICATING YOUR LIKELIHOOD:

0----------------- 1------------------ 2---------------- 3----------------- 4
[VERY UNLIKELY ----------------------------------------- VERY LIKELY]

- YES -- PLEASE INDICATE THE FOLLOWING CONCERNING YOUR MACHINE-HARVESTED BLUEBERRIES:

MACHINE HARVESTED RABBITYES? _______________ NUMBER OF ACRES
MACHINE HARVESTED HIGHLUSH? _______________ NUMBER OF ACRES
MACHINE HARVESTERS YOU OWN: __________ NUMBER OF MACHINES OWNED
MACHINE HARVESTERS YOU LEASE: __________ NUMBER OF MACHINES LEASED
Q16. In 2010, did you plant or produce organic blueberries? Check all that apply:

☐ NO -- how likely are you to CONSIDER planting organic blueberries in the NEXT FIVE years? Please circle the number indicating your likelihood:

0----------------- 1------------------ 2---------------- 3----------------- 4

[Very Unlikely ------------------------------- Very Likely]

☐ YES, planted organic blueberries in 2010_______________ number of acres

☐ YES, produced organic blueberries in 2010_______________ number of acres

Q17. For 2010, please indicate the percentage of your blueberry production you sold through each of the marketing channels. Check that your responses total 100% of your total 2010 blueberry sales.

<table>
<thead>
<tr>
<th>2010 BLUEBERRY SALES</th>
<th>PERCENT OF TOTAL 2010 SALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 SALES TO COOPERATIVE</td>
<td>____________________________ PERCENT</td>
</tr>
<tr>
<td>2010 SALES TO WHOLESALER (BROKER)</td>
<td>____________________________ PERCENT</td>
</tr>
<tr>
<td>2010 SALES DIRECT TO FINAL CUSTOMER</td>
<td>____________________________ PERCENT</td>
</tr>
</tbody>
</table>

Q18. Thinking about each of these same marketing channels, how satisfied or dissatisfied were you with each channel that you used in 2010? Circle your level of satisfaction with each marketing channel that you used in 2010.

<table>
<thead>
<tr>
<th>2010 MARKETING CHANNEL</th>
<th>HOW SATISFIED? (PLEASE CIRCLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOPERATIVE</td>
<td>NOT</td>
</tr>
<tr>
<td>WHOLESALER (BROKER)</td>
<td>NOT</td>
</tr>
<tr>
<td>DIRECT TO FINAL CONSUMER</td>
<td>NOT</td>
</tr>
</tbody>
</table>
Q19. In 2010, did you use any of these technologies? Check all that apply:

- Drip-tape irrigation
- Overhead irrigation
- Soil analysis
- Plant leaf analysis
- Wind machines
- High tunnels

Q20. Thinking about each of these same technologies, do you plan to implement any of these in the next five years? Circle YES or NO as it applies for each technology.

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>PLAN TO IMPLEMENT IN NEXT FIVE YEARS?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drip-tape irrigation</td>
<td>YES</td>
</tr>
<tr>
<td>Overhead irrigation</td>
<td>NO</td>
</tr>
<tr>
<td>Soil analysis</td>
<td>DON'T KNOW</td>
</tr>
<tr>
<td>Plant leaf analysis</td>
<td>YES</td>
</tr>
<tr>
<td>Wind machines</td>
<td>NO</td>
</tr>
<tr>
<td>High tunnels</td>
<td>DON'T KNOW</td>
</tr>
</tbody>
</table>

Q21. Do you have onsite cold storage facilities?

- NO, I DO NOT HAVE ONSITE COLD STORAGE
- YES, I HAVE ONSITE COLD STORAGE, APPRX. _______ SQ FT.
Q22. How often have you purchased blueberry crop insurance in the last ten years?

- [ ] NO, I HAVE NEVER PURCHASED BLUEBERRY CROP INSURANCE SINCE 2000
- [ ] YES - 1 TO 3 TIMES SINCE 2000
- [ ] YES - 4 TO 6 TIMES SINCE 2000
- [ ] YES - 7 TO 9 TIMES SINCE 2000
- [ ] YES - 10 TIMES SINCE 2000

Q23. In 2010, what percent of your blueberry land and establishment costs were financed?

__________________________ PERCENT BLUEBERRY LAND/ESTABLISHMENT COSTS FINANCED IN 2010

Q24. Upon your retirement, do you plan to transfer ownership of your blueberry operation to family or non-family member? Please check all that apply:

- [ ] NO, I DO NOT PLAN TO TRANSFER OWNERSHIP TO ANYONE
- [ ] YES, I DO PLAN TO TRANSFER OWNERSHIP TO FAMILY MEMBER
- [ ] YES, I DO PLAN TO TRANSFER OWNERSHIP TO NON-FAMILY MEMBER
**Q25.** For 2010, please complete the table indicating the number of family and non-family members employed in each stage of your blueberry operation. *(If someone works in more than one category, please indicate the category where that person dedicates the majority of their time)*:

<table>
<thead>
<tr>
<th></th>
<th>FAMILY</th>
<th>NON-FAMILY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(# FULL-TIME)</td>
<td>(# PART-TIME)</td>
</tr>
<tr>
<td><strong>PRE-HARVEST - FIELD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HARVEST - PICKERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HARVEST - PACKING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MANAGEMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OTHER</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Q26.** Indicate the percentage of your 2010 family income that was generated from each of the following employment opportunities:

<table>
<thead>
<tr>
<th>2010 FAMILY INCOME</th>
<th>PERCENT OF 2010 FAMILY INCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 GENERATED FROM BLUEBERRY PRODUCTION</td>
<td>___________________________ PERCENT</td>
</tr>
<tr>
<td>2010 GENERATED FROM OTHER FARM PRODUCTION</td>
<td>___________________________ PERCENT</td>
</tr>
<tr>
<td>2010 GENERATED FROM OFF-FARM EMPLOYMENT</td>
<td>___________________________ PERCENT</td>
</tr>
</tbody>
</table>
Q27. What is the highest level of education that you have completed?

- Some high school
- Completed high school
- Some college
- Completed college
- Some graduate school
- Completed graduate degree

Q28. Are you:

- Male
- Female

Q29. Please indicate your age range?

- 18-24 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55-64 years
- 65 years and up

Q30. Please select your race:

- Black/African-American
- White
- Asian
- American Indian/Aleut
- Other ____________________ (please specify)
Q31. Would you say you are of Hispanic ancestry?

☐ YES
☐ NO

Q32. Just for statistical purposes, please indicate your 2010 blueberry operation gross sales (before taxes).

☐ UNDER $10,000
☐ $10,000 TO $24,999
☐ $25,000 TO $49,999
☐ $50,000 TO $99,999
☐ $100,000 TO $199,999
☐ $200,000 TO $499,999
☐ $500,000 TO $999,999
☐ $1 MILLION OR MORE
Q33. Listed below are some ideas suggested as possible goals for future research priorities. Please indicate whether you feel that each goal should NOT be a priority, should be given a LOW priority, MEDIUM priority, or HIGH priority:

<table>
<thead>
<tr>
<th>GOAL NUMBER</th>
<th>POSSIBLE RESEARCH</th>
<th>HOW MUCH PRIORITY, IF ANY, SHOULD EACH GOAL HAVE? (PLEASE CIRCLE YOUR ANSWERS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weed control</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>2</td>
<td>Insect control</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>3</td>
<td>Labor regulations</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>4</td>
<td>Consumer demand</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>5</td>
<td>Food safety regulations</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>6</td>
<td>Increase consumer demand</td>
<td>Not, Low, Medium, High</td>
</tr>
<tr>
<td>7</td>
<td>Government regulations</td>
<td>Not, Low, Medium, High</td>
</tr>
</tbody>
</table>

ARE THERE ANY OTHERS? (PLEASE LIST BELOW):

8  ________________

9  ________________

THANKS SO VERY MUCH FOR TAKING THE TIME TO COMPLETE THIS SURVEY. YOUR RESPONSES WILL SERVE TO FOCUS RESEARCH EFFORTS TOWARDS PROFITABLE ALTERNATIVE SUGGESTIONS FOR MEMBERS OF THE BLUEBERRY INDUSTRY IN SOUTHEASTERN U.S.