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Three Essays on U.S. Meat Goat Production: Goal Structure, Selection of Breeding Stock, and Meat Goat Marketing

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THREE ESSAYS ON U.S. MEAT GOAT PRODUCTION: GOAL STRUCTURE, SELECTION OF BREEDING STOCK, AND MEAT GOAT MARKETING

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I would like to dedicate this dissertation to my parents, my wife - Sangita, and our two beautiful children, Sambhav and Aarohi.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study investigates three major areas of U.S. meat goat production – goal structure, selection of breeding stock, and marketing, by using survey data received from U.S. meat goat producers. Of 1,600 producers surveyed, 584 usable responses were obtained with an adjusted response rate of 43%. The fuzzy pair-wise comparison method was used to determine producer goal structure. The results showed that profit maximization and leisure-related goals were highly considered goals and controlling weeds/vegetation and increasing farm size were the least considered goals by U.S. meat goat producers. A choice-based conjoint study was conducted to identify producer preferences for meat goat breeding stock attributes. The mixed logit results showed that producers preferred animals with high masculinity or femininity, with good structure and soundness, and the Boer breed. Furthermore, the latent class model suggested that Kiko goats were preferred by producers selling higher percentages of their animals for slaughter purposes or as meat whereas Boer goats were more likely to be preferred by breeders and/or show goat producers. Direct sale to consumer and live auction markets were two highly used marketing channels among U.S. meat goat producers. Probit results showed that several socio-economic, demographic, and farm characteristics impacted producer selection of marketing channels. Twenty-two percent of producers targeted their production for specific ethnic holiday sales. The farm size (number of animals), percentage sale of animals for slaughter purposes, and selling goat meat positively impacted the net profitability of the meat goat enterprise.

CHAPTER 1: INTRODUCTION

1.1. U.S. Goat Production: An Overview

In recent years, the meat goat industry has been one of the fastest growing animal agricultural industries in the United States. Its growth has been accompanied by increased immigration and resultant growing demand by U.S. consumers. Establishment of the American Meat Goat Association (1992) and American Boer Goat Association (1993) were significant initial organizational developments in the growth of the industry. Furthermore, upon the repeal of the 1954 Wool Act in 1993 (effective from 1995), producers lost government incentives for wool and mohair production, thereby contributing to a shift from the production of angora goats to meat goats (Shurley and Craddock 2005).

In 1987, there were 29,354 meat goat farms in the United States. This number increased to 100,910 in 2012, a 244% increase. During this period, the U.S. meat goat inventory increased from 415,196 to 2,053,228, a 395% increase. On the other hand, the number of dairy goat farms increased by 91.5%, far less than that of meat goat farms. The rates of Angora and Mohair goat production decreased over the period by >90% each (Tables 1.1 and 1.2). In 2000, there were 345 federally inspected plants slaughtering goats; this number increased to 419 in 2011, a 21% increase (Table 1.3). During the same period, there was a 7.2% increase in head slaughtered. Figure 1.1 shows the federally-inspected and non-federally inspected meat goat slaughter in the United States. Figure 1.2 shows the distribution of goat inventory by type. Of total meat goat inventory, 82% are meat goats, 12% are milk goats, and 6% are angora goats. These tables and figure clearly show the distribution and growth of meat goats in the U.S. over the last few decades, and suggest the increased importance for the development of this industry.

Table 1.1: U.S. Goat Farms and Goat Production (1987-2012)

	1987		1992		1997	
	Farms	Head	Farms	Head	Farms (Selling goats[1])	Head (Sold[2])
All farms	50,149	2,246,587	52,610	2,515,541	76,543	2,251,613
					(29,937)	(843,773)
Angora	5,352	1,702,166	6,150	1,799,280	5,485	829,263
					(1,883)	(238,674)
Mohair	(x)	13.2 (M. lbs.)	(x)	13.6 (M. lbs.)	(x)	(x)
					(3,826)	5.3 (M. lbs)
Dairy	15,443	129,225	11,559	124,718	15,451	190,588
					(5,163)	(72,307)
Meat/other	29,354	415,196	34,901	591,543	63,422	1,231,762
					(24,539)	(532,792)

	2002		2007		2012	
	Farms (Selling goats[1])	Head (Sold[2])	Farms (Selling goats[1])	Head (Sold[2])	Farms (Selling goats[1])	Head (Sold[2])
All farms	91,462	2,530,466	144,466	3,140,529	128,456	2,621,514
	(43,495)	(1,314,310)	(61,748)	(1,387,576)	(63,844)	(1,247,784)
Angora	5,075	300,753	7,215	204,106	9,479	154,746
	(1,662)	(91,037)	(1,645)	(50,017)	(1,798)	(39,388)
Mohair	(x)	(x)	(x)	(x)	(x)	(x)
	(2,434)	2.4 (M. lbs)	(4,312)	1.4 (M. lbs)	(3,530)	0.8 (M. lbs)
Dairy	22,389	290,789	27,481	334,754	29,570	413,540
	(8,850)	(113,654)	(9,095)	(102,775)	(13,282)	(173,861)
Meat/other	74,980	1,938,924	123,278	2,601,669	100,910	2,053,228
	(36,403)	(1,109,619)	(54,280)	(1,234,784)	(51,972)	(1,034,535)

Sources: (i) USDA-APHIS 2005, (ii) USDA-NASS 2007, 2012, Census of Agriculture, (iii) Solaiman 2007.

[1] This is the total number of farms selling goats in that particular year. Not all farms are assumed to sell goats.

[2] This is the total number of goats sold in that particular year.

Table 1.2: Percentage Changes in Goat Production (1987-2012)

	1987-1997		1997-2007		2007-2012		1987-2012	
	Farms	Head	Farms	Head	Farms	Head	Farms	Head
All farms	52.6	0.2	88.7	39.5	-11.1	-16.5	156.1	16.7
Angora	2.5	-51.3	31.5	-75.4	31.4	-24.2	77.1	-90.9
Mohair	x	-59.8	x	-73.6	x	-42.9	x	-93.9
Dairy	0.1	47.5	77.9	75.6	7.6	23.5	91.5	220.0
Meat/other	116.1	196.7	94.4	111.2	-18.1	-21.1	243.8	394.5

Source: Derived from Table 1.1.

Table 1.3: Plants and Meat Goat Slaughter, Numbers

	2000	2005	2010	2011	Percentage change (2000-2011)
Federally inspected plants	345	371	421	419	21.4
Head slaughtered	549,371	566,208	612,104	589,149	7.2

Source: USDA-NASS, Livestock Slaughter Summaries.

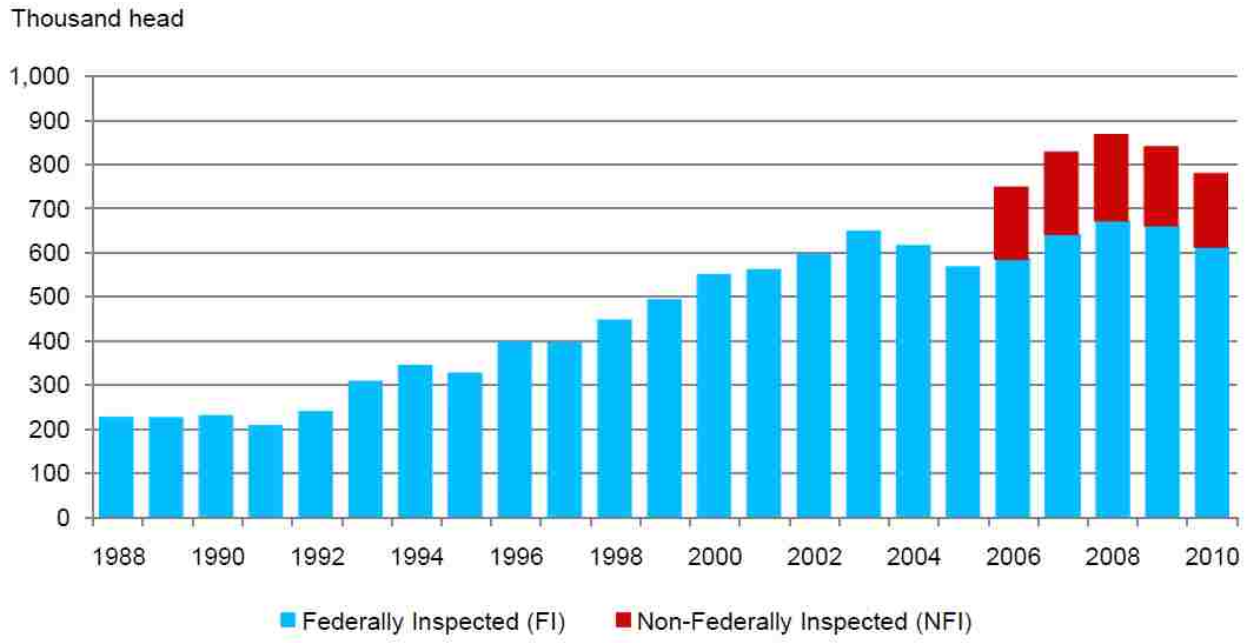

Figure 1.1: Goat Slaughter - United States

Source: USDA-NASS, Agricultural Statistics Board (2011)

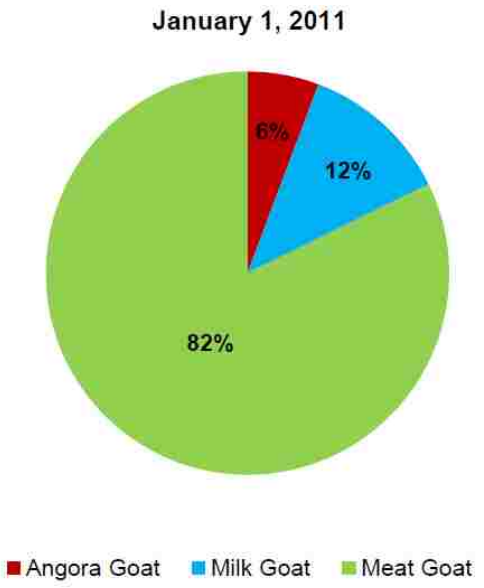

Figure: 1.2: Distribution of Goat Inventory by Type - United States

Source: USDA-NASS, Agricultural Statistics Board (2011)

1.2. U.S. Goat Meat Consuming Population: Current Mix and Projection

An understanding of current and projected population mix is important because of the diversified food habits and resultant demand across different ethnic groups coming from different origins. García-Jiménez and Mishra (2011) found significant differences in meat consumption patterns based on consumer ethnicity in the United States. They considered consumption patterns of beef, pork, chicken, and seafood, but did not incorporate one of the major meat products, goat meat, that is consumed primarily by immigrants to the U.S. Hispanics, Muslims, and Caribbean immigrants are the three largest goat meat consuming groups in the United States (Gipson 1999).

The United States population increased by 103% from 1950 (152.3 million) to 2010 (308.7 million). Comparing it to those of other industrialized countries such as Germany (21%) and Italy (30%) over the same period (Shrestha and Heisler 2011), population growth in the US has been higher primarily because of increased immigration. During the decade 1931-1940, net

immigration into the U.S. was negative. It slowly increased from 1940, increased by >2 million each in 50s and 60s, by >3 million in 70s, >5 million in 80s, and by >6 million each in two decades afterwards (Shrestha and Heisler 2011). In 2005, 12% of the total U.S. population (296 million) consisted of foreign-born people; this percentage has been projected to be 19% of the total (438 million) by 2050 (Passel and Cohn 2008, Table 1.4). In 2005, 14% of the total U.S. population was Hispanic, a number that has been projected to be 29% by 2050 (Passel and Cohn 2008). More than fifty percent of the total foreign born people in the U.S in 2010 came after 1990 (Grieco et al. 2012). Six states, California, Texas, New York, Florida, Illinois, and New Jersey, have been the primary destinations for immigrants. Sixty-two percent of all legal immigrants in 2009 came to those six states (Shrestha and Heisler 2011). Although meat goat production has been widely distributed throughout the country, major meat goat producing regions include TX and some of the southeastern states (Figure 1.3).

Table 1.4: U.S. Population (2005) and Projection (2050)

	Total (Million)	Foreign Born	White	Hispanic	Black	Asian
2005	296	12%	67%	14%	13%	5%
2050	438	19%	47%	29%	13%	9%

Source: Passel and Cohn 2008.

1.3. U.S. Goat Meat Imports

The U.S. was a net exporter of goat meat until 1990, but due to increased immigration and resultant domestic demand, it began importing goat meat after 1994 (Solaiman 2007). Australia has been the leading supplier of frozen goat meat to the United States. Australia harvests semi-wild (feral) goats from extensively managed production systems (Stanton 2012). Meat goat imports of 1,749 metric tons (1 MT = 2204.6 lbs) in 1991 increased to 8,462 metric tons in 2003, and to 15,752 metric tons in 2011 (Stanton 2012). Considering an average weight

of meat goats of 60 lbs and carcass yield of 55% (33 lbs), the total frozen goat meat imports in 2011 would be equivalent to approximately 1,052,340 live goats.

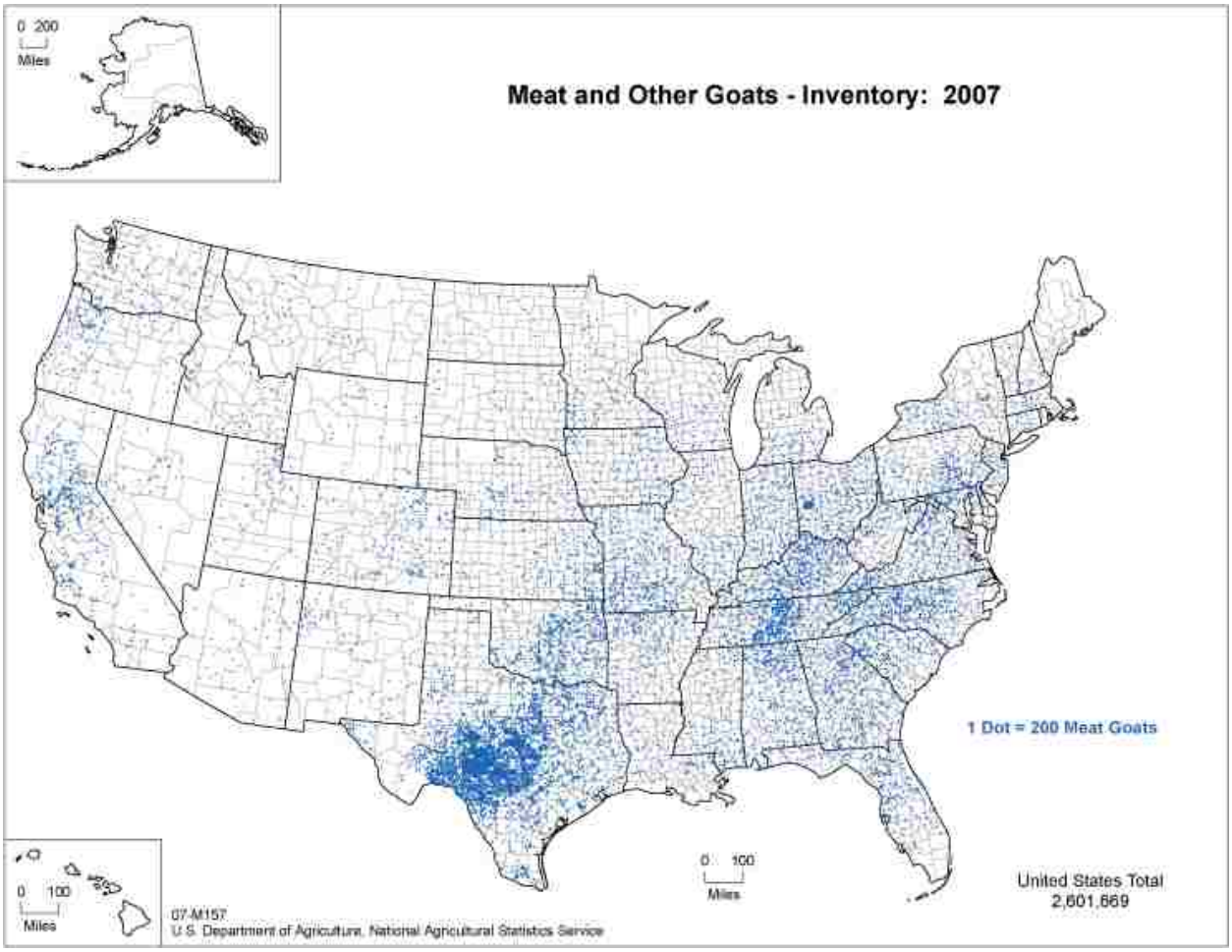

Figure 1.3: Distribution of Meat and Other Goat Farms in the United States in 2007 (Angora and Dairy Goat Not Included)

Source: USDA-NASS, Agricultural Statistics Board (2011)

1.4. Global Goat Production: An Overview

Historically, goat production has been conducted primarily in developing countries. Asia and Africa have been the major goat producers. According to FAOSTAT, China, India, Pakistan, and Bangladesh produced about 50% of the world's total goat production in 2005 (Solaiman 2007). China (42%) and India (10%) produced more than 50% of global goat meat in 2005. Of

the goat meat exporters in 2005, China (12%) fell second to Australia (50%), while France (8%) and New Zealand (4%) were the third and fourth, respectively (Solaiman 2007). The global goat population increased from 464 million in 1980 to 910 million in 2010 (FAOSTAT 2012). Goats are a strong source of income in developing countries (Peacock 2005). Development of the goat industry and establishment of a support system for goat production could be a big step towards poverty reduction (Peacock 2005). Research shows that goats can survive in harsh environments (Alexandre and Mandonnet 2005). Hardiness and adaptability are two major goat traits (Alexandre and Mandonnet 2005), but good management systems lead to more efficient production.

1.5. Dissertation Overview and Objectives

From the above discussion, we understand that, despite the increased meat goat production over the last several years in the United States, domestic production has not been able to meet demand. Having one of the major determinants of higher meat goat demand in the U.S. to be increased immigration, which is expected to increase further in the future, significant research and development efforts are required to improve domestic meat goat production. This study provides enhanced understanding of three major areas of US meat goat production: producer goal structure, producer preferences for breeding stock attributes, and meat goat marketing. This dissertation is divided into five chapters. Starting with a brief introduction of the US meat goat industry in the first chapter, we proceed to the first essay of this dissertation – goal structure of US meat goat producers. Since producer goals and motivations for meat goat farming could differ widely, we study the hierarchy of goal structure and the factors affecting producer goals. Further, the consistency of producer goals with overall farm performance is also investigated. The second essay of this dissertation, the third chapter, describes producer

preferences for meat goat attributes when selecting breeding stock. Using a choice-based conjoint analysis, we study the heterogeneity of preferences and producer willingness-to-pay for different attributes. The fourth chapter, the third essay, addresses meat goat marketing. Producer selection of different marketing channels and factors affecting their selection are studied. Further, the determinants of farm profitability are also identified.

Specific objectives of this study include:

Essay 1 (Chapter 2):

a. To determine the hierarchy of meat goat producer goals associated with their farming;
b. To assess the factors affecting meat goat farmer goal structures;
c. To assess the consistency between meat goat producer goals and farm performance;

Essay 2 (Chapter 3):

a. To determine producer preferences for meat goat breeding stock attributes;
b. To determine meat goat producer willingness to pay for specific meat goat breeding stock attributes when making purchase decisions;
c. To determine the heterogeneity of meat goat producer preferences for meat goat breeding stock;

Essay 3 (Chapter 4):

a. To assess the factors affecting meat goat producer selection of different marketing channels;
b. To identify the profitability drivers associated with meat goat production.

1.6. Data

The objectives will be met using meat goat producer responses obtained from a mail survey conducted nationally during July and August, 2012. Survey population addresses were

collected from nationwide online farm listings. Farmer names were listed as either members of meat goat associations in their respective states or in www.eatwild.com. A total of 1,600 producer addresses were collected from an extensive internet search. The internet search was conducted by entering phrases such as "meat goat producers in Louisiana", "meat goat association, LA", or "meat goat farms, Louisiana," and all of the links shown in the first 4-5 Google pages were visited to determine whether they included any meat goat producer listings. This process was repeated for all 50 U.S. states individually.

The survey was conducted following the tailored design method of Dillman et al. (2009). A cover letter clearly discussing the rationale of the study with an emphasis on strict confidentiality of the individual responses, a ten page questionnaire, a complementary pen, and a postage-paid return envelope were included in the first mailing. Farmers were reminded of the importance of their responses in a postcard sent out two weeks after the first mailing. Producers not responding two weeks hence were reminded a second time with a new cover letter, questionnaire and return envelope. Finally, a second postcard reminder was sent to non-respondents a week after the third mail-out.

A total of 584 completed responses were received, while 190 producers returned the survey indicating that they did not produce meat goat during 2011. A total of 52 surveys were undeliverable. Producers who did not produce meat goat during 2011 and the undeliverable surveys were removed from the total survey population. The adjusted response rate was 43%.

1.6.1. The Survey

The ten page questionnaire was divided into 8 sections. Three of those sections were used for our study chapters and the remaining 5 are briefly discussed below.

Production Practices

A number of questions were asked about the meat goat production systems used by producers. Questions regarding size of the farm, land used in the goat operation, working facilities used on the farm, numbers of goats of different breeds, and adoption of different production systems were asked. Information on animal identification methods adopted by the producers and other farm enterprises were also collected.

Breeding Practices

In this section, questions on meat goat breeding practices were asked. Numbers of does bred; numbers of kids born alive, stillborn, aborted, and lost to predators; and percentages of twins or triplets born were included. Farmer adoption of breeding technologies, methods of pregnancy testing, and information regarding whether does were bred such that kids would be produced only during certain times of the year and producers' reasons for doing so were also asked.

Price Differentials

Producers were provided with three representative meat goat pictures of 50-lb animals of different selection scores and descriptive notes on their physical characteristics. One representative picture of a 'selection 2' goat was first selected and Photoshop was used to create the other two pictures. Photoshop was used instead of taking three pictures of different goats so that the goats would look similar to each other in all aspects except for their confirmation and size. This was followed by questions on expected price differentials they would receive if they were selling a 50-lb 'selection 1' meat goat versus a 'selection 2' equal weight meat goat, and of a 'selection 2' versus a 'selection 3' meat goat of equal weight. The first two questions were asked if they were selling their goats at a live auction and the following two questions were

asked for their current market being used. Producers were also asked to indicate the percentage of goats they sold in 2011 in each selection category (score).

Perceptions of Important Challenges Facing the U.S. Meat Goat Industry

Producer perceptions of various challenges and their impacts on the goat industry were assessed using five-point Likert scales. Challenges included in the survey were: high cost of production, lack of a clear marketing system, no grading system, lack of processors close by, lack of steady demand, pasture management problems, diseases and parasites, predators, foreign goat meat supply, and insufficient government support. Producers were asked to indicate the degree to which they agreed or disagreed that these challenges had significant negative impacts on goat producers in their areas. Further information collected from this section included the quarantine procedures used when bringing a new animal into the farm. Challenges from specific predators and measures to control them were asked.

Producer Demographic and Financial Information

This section included questions describing the characteristics of meat goat producers and their farm operations. Producers' socioeconomic status such as gender, age, years raising goats, ethnic background, level of educational attainment, work in an off-farm job, whether they were retired, and their risk preference characteristics were collected. In addition, questions on whether they kept farm records and their debt-asset ratio, annual net household income, percentage of annual net household income from goats, and percentage of annual net farm income from goats were also included.

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CHAPTER 2: GOAL STRUCTURE OF U.S. MEAT GOAT PRODUCERS: IS FARM PERFORMANCE CONSISTENT WITH THE GOALS?

2.1. Introduction

The U.S. meat goat industry has been receiving increased research and development attention over the last few decades. Part of the reason for this is the increased demand for goat meat by the immigrant population. From 1987 to 2007, there were increases in total meat goat farms and total meat goat production of more than 300% and 500%, respectively (USDA-APHIS 2005, USDA-NASS 2007). Despite these increases, domestic production has not been able to keep up with increasing demand. Favorable policies and support strategies for producers are a prerequisite for sustainable growth of an industry and identifying production growth strategies starts with understanding current farm practices used by the producers, which are determined by producer goals and motivations. Greiner et al. (2009) argued that producer motivations and their risk perceptions are significantly correlated with the adoption of technologies. The U.S. meat goat industry, although one of the fastest growing agricultural industries in the U.S., lacks significant research efforts in identifying the motivations and goals of meat goat producers and whether the producers have been achieving those goals. This study aims to determine the goal structure of U.S. meat goat producers and investigates the factors influencing producer goal structure. Furthermore, by analyzing the profitability of meat goat enterprises, we study whether farm performance is consistent with producer goals.

Goals can be defined as ends or states in which a person wishes to be. Sometimes they are ultimate ends; sometimes they are building-blocks in the process of achieving other goals (Gasson 1973). Producers allocate their limited resources to meet their competing ends and an understanding of the goal hierarchies suggests producer priorities for allocating their limited

resources. Agricultural economists often assume profit maximizing or cost minimizing behavior to be the major economic goals of producers. This, however, is only partially true, as they are generally important considerations when establishing a farm, but not the only considerations (Kliebenstein et al. 1980). Motives cannot be entirely economic or non-economic in nature, but they can be more or less supportive of economic behavior (Gasson 1973). Social impacts made by the production practices used by one producer could be negligible, but if we look at an aggregate level, they have significant roles. Goal structure generally impacts the direction in which an industry moves.

Thompson (1986) argued that agricultural producers in industrialized nations consider food production as a significant social responsibility. Since most people in developed societies are associated with non-agricultural professions, unlike those in the developing world, agricultural producers face challenges in supplying enough food and nutrients to their fellow citizens so that the country does not suffer food security problems (Thompson 1986). Economic theory considers a producer as an individual who makes rational decisions directed only towards maximizing profit. In fact, an individual is encountered with several alternatives with his available resources to make decisions based on his or her subjective view of the situation and his or her values (Gasson 1973). Within a given preference system, an individual desires to maximize utility. This could happen in several ways: by maximizing profit, achieving social aspects of satisfaction, being close to the natural working environment, and many more. The individual could also have multiple goals at one time and could maximize utility by optimally allocating resources to achieve different benefits.

Fairweather and Keating (1994) discussed the complex and integrated nature of different goals and studied how producer management styles differ according to their goals. Producers

dedicated to maximizing output were intensively focused on certain output-oriented practices; flexible producers maintained the balance between on and off-farm work; and environmentalists enjoyed being close to nature without emphasizing production enhancing technology. They argued that business and way-of-life goals are interrelated. Patrick et al. (1983) considered the multidimensional nature of goals. They emphasized that the same goal could be highly important in one circumstance and least important in another.

After thoroughly reviewing the literature and discussing with farmers and industry experts, this study considers seven major goals that a typical meat goat producer is most likely to have. Those goals are: (1) *maximize profit* – that a producer wants to receive as much profit as possible, by using available resources, (2) *increase farm size* – that a producer wants to expand the size of his/her farm operation, (3) *avoid years of loss/low profit* – that a producer wants to maintain farm profitability each year by avoiding high losses or low profits, (4) *increase net worth* – that a producer wants to increase the net worth of his or her business enterprise, (5) *have time for other activities* – that a producer wants to have enough time for activities other than meat goat farming, (6) *control weeds/vegetation* – that a producer wants to use goats for controlling weeds and vegetation on the farm, and (7) *have family involved in agriculture* – that a producer wants to have his or her family involved in agricultural activities.

2.2. Eliciting Goal Hierarchies: Fuzzy Pair-wise Approach

There are four major methods used for goal hierarchy elicitation: basic pair-wise comparisons, magnitude estimation, the analytic hierarchy process (AHP) and fuzzy pair-wise comparisons (Basarir 2002). Using the basic pair-wise comparison, $n(n\text{-}1)/2$ possible pairs of goals are made (n = total number of goals), and respondents are asked to select one goal over the other in each pair. The major disadvantage of this method is that the respondents cannot be

indifferent between their choices; they must select one. Using the magnitude estimation method, developed by Stevens (1957), an arbitrary value is given to a goal and with respect to this value, other goals are rated accordingly (Van Kooten et al. 1986). The analytic hierarchy process (AHP) involves an eigenvalue approach to the pair-wise comparison (Vaidya and Kumar 2006). Using this method, a pair of goals is provided to the subject to make quantitative judgments based on their relative importance. The fuzzy pair-wise method is similar to the previously discussed pair-wise comparison method in that the subject is asked to compare a series of goals, each time as pairs. The major difference is that this method does not require respondents to strictly select one goal over the other; rather they can be indifferent between goals. Thus, this method captures the respondent's degree of preference between two alternatives. The scale value is estimated by comparing entire sets of compared pairs (Van Kooten et al. 1986). The fuzzy pair-wise comparison method was selected for this study because of its advantages over the others (Van Kooten et al. 1986).

2.3. Data and Methods

2.3.1. The Survey

The data for this study were collected by conducting a mail survey during Summer and early Fall, 2012, following Dillman et al. (2009). A total of 1,600 producer names were collected from nationwide online farm listings; either they were listed as members of a meat goat association or they were listed in www.eatwild.com. A cover letter, ten page questionnaire, complementary pen, and postage-paid return envelope were included in the first mailing followed by a postcard reminder two weeks later. A new cover letter, survey, and return envelope were sent two weeks hence and, finally, a second postcard reminder was sent to non-respondents a week later. The adjusted response rate was 43%, considering the 584 completed

responses, 190 additional responses from those who did not produce meat goats during 2011, and 52 additional surveys that were undeliverable.

A survey question was asked with a brief description as follows: "Goat producers may have multiple goals with respect to their farms. Below are some potential goals you may have for your entire farm operation. Some goals are likely to be more important to you than others. In this section, you will be asked to compare each of seven goals with each of the other goals. We are interested in how important each goal is when compared to the other goals. Questions will be worded similar to the one in the following example." This instruction was followed by three examples of possible answers. Producers were asked to indicate their preferences for a series of 21 goal pairs based on the examples shown.

2.3.2. Estimating Goal Scores and Econometric Methods

Using the fuzzy pair-wise method, two goals are put on a unit-distance line as in Figure 2.1 where respondents can mark an "X" anywhere across the line based on their preferences. The midpoint is shown so that respondents can locate their preference clearly. If respondents weigh both goals equally, then they can mark an "X" on the midpoint. Marking closer to one goal shows its degree of preference.

Figure 2.1.1: Goal A ----------I---X---------- Goal B

Figure 2.1.2: Goal A ----------X---------- Goal B

Figure 2.1.3: Goal A ---X----------I---------- Goal B

Figure 2.1.4: Goal A X----------I---------- Goal B

Figure 2.1: Fuzzy Pair-wise Comparison

Considering the total distance between Goal A and Goal B is a unit value, the degree of preference of Goal A over Goal B (R_{AB}) is denoted by the distance of mark "X" from Goal B. If

$R_{AB} < 0.5$, then B is preferred to A (Figure 2.1.1). If $R_{AB} = 0.5$, then A and B are equally preferred (Figure 2.1.2). If $R_{AB} > 0.5$, then A is preferred to B (Figure 2.1.3). If $R_{AB} = 1$, then A is absolutely preferred to B (Figure 2.1.4). With a total of *n* goals, there would be n*(n-1)/2 total pair-wise comparisons (Van Kooten et al. 1986).

The degree of preference, (R_{ij}, $i \neq j$), of one goal *i* over the other *j* is obtained for each pair and the degree of preference of goal *j* over *i* can be estimated as $R_{ji} = 1- R_{ij}$. As described in Basarir (2002), the individual's fuzzy preference matrix (*R*) is now constructed as follows:

$$R = \begin{bmatrix} 0 & r_{12} & r_{13} & . & . & . & r_{1j} \\ r_{21} & 0 & . & . & . & . & r_{2j} \\ r_{31} & . & 0 & . & . & . & r_{3j} \\ . & . & . & 0 & . & . & . \\ . & . & . & . & 0 & . & . \\ . & . & . & . & . & 0 & r_{(i-1)j} \\ r_{i1} & r_{i2} & . & . & . & r_{i(j-1)} & 0 \end{bmatrix}$$

From this matrix, the intensity of preference of goal *i* can be determined using the following formula:

$$(2.1) \quad I_j = 1 - \left(\sum_{i=1}^{n} R_{ij}^2/(n-1)\right)^{1/2}.$$

The intensity of preference ranges from 0 to 1. The greater the value, the more preferred is the goal, so after estimating I_j for all of the goals, we can rank them according to the degree of preference. Intensities of preference are the weights producers give to each of the goals, which ultimately resemble their degree of utility received. In this study, we will use Equation 2.1 to estimate U.S. meat goat producer preferences for each of the seven goals and rank those from most to least preferred.

Effects of farm descriptors and other socioeconomic variables on farmers' goal structure are determined by using ordinary least squares (OLS) regression. Although the seemingly

unrelated regression (SUR) was used in similar previous studies (Van Kooten et al. 1986; Basarir 2002), Greene (2008) argues that the use of SUR does not guarantee greater efficiency if the explanatory variables are same for all the equations. In fact, the OLS and SUR are equivalent by equation to equation and the efficient estimator is OLS if the regressors are identical (Greene 2008).

2.3.3. Independent Variables

Num_meatgoat is the total number of meat goats on the farm. Larger-scale producers are expected to invest considerably higher portions of their resources on the farm and are expected to more heavily weight profit maximization. More investment is also associated with greater income risk; therefore larger-scale producers are also expected to more heavily weight risk minimizing goals such as avoiding years of loss/low profit (Basarir and Gillespie 2006). *Sale_Slaugh%* is the percentage of goats sold for slaughter or as meat as opposed to for breeding stock, show, or other uses such as pets.

Age of a producer is considered as an important determinant of goal structure. Relatively younger producers are expected to be inclined towards profit maximizing goals whereas older producers might emphasize leisure-related goals. Although not expected, Basarir and Gillespie (2006) found younger producers were more likely to avoid years of loss/low profit. *Bachelor* is a dummy variable for producers holding at least a college bachelor's degree. Basarir and Gillespie (2006) found the level of education to be negatively associated with the producer goal of having the family involved in agriculture. In this study, we expected producers holding a college bachelor's degree to be more likely to consider leisure-related goals, such as *Have Time for Other Activities*. *Risk Averse* is a dummy variable indicating that producers tend to avoid risk when possible in their investment decisions. As developed by Fausti and Gillespie (2006),

producer risk preference was derived from the question, "Relative to other investors, how would you characterize yourself?," with the potential responses, "I tend to take on substantial levels of risk in my investment decisions," "I tend to avoid risk when possible in my investment decisions," and "I neither seek nor avoid risk in my investment decisions." Producers were considered as risk averse if they selected the second alternative. *Offfarmjob* is a dummy variable indicating the producer holds an off-farm job. Producers working outside their farms will have less time to spend on the farm business. Holding an off-farm job could suggest that the farmer considers agriculture as an alternative source of income, as a hobby, or as a leisure activity. *Farminc_goat* is the percentage of annual net farm income derived from the goat operation. The portion of net farm income derived from an enterprise shows the extent of diversification of the farm.

The percentages of total animals raised in different types of production systems are represented by *PAS_NotRot%* (pastured but not rotated), *PAS_Rot%* (pastured and rotated), and *Drylot%* (dry lot). In a *PAS_NotRot%* system, goats are pastured without using a management intensive rotational grazing system, whereas in *PAS_Rot%*, pastures are cross-fenced into "paddocks" so that goats can be rotationally grazed by periodically moving them to fresh pasture (Coffey 2006). Production systems require various extents of investment, time and managerial skills. Producers investing significant resources (*PAS_Rot%*) in their farming businesses are expected to more heavily weight profit maximizing goals.

Regional variables (*Southeast*, *Northeast*, *Midwest*, and *West*) capture the variation of land quality, climate, and market prices around the U.S. Producer goals may be influenced by their location and the surrounding environment; therefore regional variables were included.

2.4. Results

Table 2.1 shows the summary statistics of independent variables used in the analysis. On average, there were 61 meat goats per farm. In 2011, on average, producers sold 45% of their goats as slaughter goats, 30% as breeding stock, 16% as show goats, and 2% in other categories. These categories do not sum up 100% because the percentages provided by the farmers did not sum to 100%. The average age of producers responding to this survey was 52 years, 45% held bachelor's degrees, and 61% held off-farm jobs. On average, annual net farm income derived from the goat operation was 40%. Approximately 11% of the breeding-aged goats were raised under an extensive-range system, 29% were pastured but not rotated, 48% were pastured and rotated, and 13% were produced under a drylot system. Forty-five percent of respondents characterized themselves as tending to avoid risk when possible in their investment decisions. Thirty-six percent lived in the Southeast, 37% in the Midwest, 9% in the West, 7% in the Northeast, and 11% in Texas/Oklahoma.

Table 2.2 shows the ranking of goals according to the scores received. *Maximize Profit* was ranked as the most important goal for the meat goat producers with a goal score of 0.51, while the second most important goal was *Have Family Involved in Agriculture,* with a goal score of 0.50. *Avoid Years of Loss/Low Profit, Have Time for Other Activities, Increase Net Worth,* and *Control Weeds/Vegetation* were ranked as the third, fourth, fifth and sixth goals with goal scores of 0.49, 0.48, 0.46, and 0.40, respectively, whereas *Increase Farm Size* was found to be the least important among the seven goals with a goal score of 0.33.

Paired t-tests ($P \leq 0.10$) were used to determine whether there were significant differences among mean scores for each goal. In Table 2.2, superscripts of mean scores show the significant differences between different goals. *Maximize Profit*, *Control Weeds/Vegetation* and

Table 2.1: Means of Independent Variables Used in the Analysis

Variables	Description	Mean
Num_meatgoat	Total number of meat goats on the farm	60.84
Sale_slaugh%	Percentage of goats sold for slaughter or as meat	44.61
Sale_breed%	Percentage of goats sold for breeding stock	30.38
Sale_show%	Percentage of goats sold for show	16.18
Sale_others%	Percentage of goats sold for other than slaughter, breeding stock, or show purposes	2.32
Age	Producer age (years): (1) ≤30, (2) 31-45, (3) 46-60, (4) 61-75, (5) ≥76	51.91
Bachelor	*Dummy* = Whether producer holds at least a bachelor's degree	0.45
Offfarmjob	*Dummy* = Whether producer holds an off farm job	0.61
Farminc_goat	Percentage annual net farm income derived from goat operation: (1) 0-19% (2) 20-39% (3) 40-59% (4) 60-79% (5) 80-100%	39.86
Extensive%	Number of breeding-aged goats produced under this system	10.80
PAS_NotRot%	Number of breeding-aged goats produced under this system	28.56
PAS_Rot%	Number of breeding-aged goats produced under this system	47.81
Drylot%	Number of breeding-aged goats produced under this system	12.82
Riskaverse	*Dummy* = Producer self-characterization relative to other investors: (I tend to avoid risk when possible in my investment decision.)	0.45
Southeast	Producers reside in: AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, or WV	0.36
Northeast	Producers reside in: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, or VT	0.07
Midwest	Producers reside in: KS, IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, or WI	0.37
West	Producers reside in: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, or WY	0.09
Texas/Oklahoma	Producers reside in: TX, or OK	0.11

Table 2.2: Ranking of Producer Goals According to Scores Received, 488 Observations

Goals	Mean Score
A: Maximize Profit	0.51^{BCDEFG}
B: Have Family Involved in Agriculture	0.50^{AFG}
C: Avoid Years of Loss/Low Profit	0.49^{AEFG}
D: Have Time for Other Activities	0.48^{AFG}
E: Increase Net Worth	0.46^{ACFG}
F: Control Weeds/Vegetation	0.40^{ABCDEG}
G: Increase Farm Size	0.33^{ABCDEF}

Note: The mean score of a goal differs from others as indicated by superscripts. For example, goal 'A' differs from goals 'B, C, D, E, F, and G.'

Increase Farm Size were the only three goals that were consistently different from all of the other six goals, whereas *Avoid Years of Loss/Low Profit* was also different from *Increase Net Worth*.

2.4.1. OLS Run for Factors Affecting Producer Goal Structure

A multicollinearity test was conducted by estimating variance inflation factors for the independent variables used in the OLS regression; no problem of multicollinearity was found. Since the same set of independent variables was used for all seven equations, the omitted variable test (RESET) and model specification test (linktest) were conducted for all equations individually and no significant problem was found. Heteroskedasticity-consistent robust standard errors were estimated.

Table 2.3 shows the OLS results for the producer goals. Larger-scale producers were found to more likely have goals related to profit maximization, such as *Maximize Profit* and *Increase Farm Size*, whereas they were less likely to emphasize the goal, *Have Time for Other Activities*. Larger-scale producers would generally invest greater resources in the business, so it is not surprising to see them driven more by profit maximizing goals. The positive relationship between producer *Age* and *Maximize Profit* was unexpected, as older producers are generally assumed to be less motivated by profit maximizing goals and more likely to be motivated by leisure related goals (Van Kooten et al. 1986). As expected, however, *Age* was positively associated with *Have Time for Other Activities* and *Control Weeds/Vegetation* and negatively associated with *Increase Farm Size* and *Have Family Involved in Agriculture*. Producers holding *Bachelor's* degrees placed greater emphasis on *Have Time for Other Activities*. Producers holding an *Off-Farm Job* weighted the goal, *Avoid Years of Loss/Low Profit* lower and more heavily weighted the goal, *Have Time for Other Activities*. The off-farm job may serve as a

Table 2.3: The Regression of Goal Scores of Meat Goat Producers (Heteroskedasticity Robust Standard Errors in Parenthesis)

Variables	Maximize Profit	Increase Farm Size	Avoid Years of Loss/Low Profit	Increase Net Worth	Time for Other Activities	Control Weeds/Veg.	Family Involved in Ag.
Num_meatgoats	0.0006*	0.0011*	0.0005	0.0004	-0.0009***	-0.0006	-0.0001
	(0.0003)	(0.0007)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0006)
Sale_Slaugh%	-0.0002	-0.0026	0.0006	-0.0001	-0.0002	0.0011	-0.0008
	(0.0005)	(0.0019)	(0.0005)	(0.0005)	(0.0007)	(0.0008)	(0.0012)
Age	0.0931***	-0.1787***	-0.0041	-0.0268	0.1147***	0.2072***	-0.1619***
	(0.0238)	(0.0432)	(0.0206)	(0.0251)	(0.0312)	(0.0340)	(0.0362)
Bachelor	-0.0281	-0.0333	-0.0033	-0.0114	0.1082**	0.0810	-0.0616
	(0.0354)	(0.1190)	(0.0357)	(0.0373)	(0.0456)	(0.0533)	(0.0726)
Offfarmjob	-0.0046	0.1533	-0.0663*	-0.0500	0.0985*	0.0137	0.0449
	(0.0419)	(0.1396)	(0.0390)	(0.0401)	(0.0546)	(0.0603)	(0.0792)
Farmincome_goat	0.0317***	-0.0353	0.0032	-0.0159	0.0142	-0.0290**	-0.0262
	(0.0101)	(0.0310	(0.0115)	(0.0109)	(0.0130)	(0.0156)	(0.0265)
PAS_NotRot%	0.0016**	-0.0012	0.0007	0.0002	0.0025**	-0.0015	-0.0010
	(0.0008)	(0.0016)	(0.0008)	(0.0008)	(0.0011)	(0.0010)	(0.0012)
PAS_Rot%	0.0012*	-0.0007	0.0013*	-0.0002	0.0016	-0.0018**	-0.0013
	(0.0007)	(0.0015)	(0.0007)	(0.0007)	(0.0011)	(0.0009)	(0.0012)
Drylot%	0.0021**	0.0011	0.0010	-0.0001	0.0009	-0.0030**	-0.0003
	(0.0009)	(0.0032)	(0.0011)	(0.0012)	(0.0016)	(0.0013)	(0.0019)
Riskaverse	-0.0243	-0.0070	0.0456	-0.0330	0.0574	-0.0140	-0.0166
	(0.0378)	(0.0948)	(0.0367)	(0.0369)	(0.0452)	(0.0542)	(0.0720)
Southeast	0.1521**	-0.2708	0.0071	-0.0025	-0.0382	-0.1626*	0.2929
	(0.0695)	(0.3170)	(0.0602)	(0.0820)	(0.0854)	(0.0891)	(0.3115)
Northeast	0.1750**	0.3548	-0.1454	-0.0689	0.0373	-0.1307	0.3351
	(0.0873)	(0.3547)	(0.0960)	(0.0895)	(0.1001)	(0.1063)	(0.3236)
Midwest	0.0481	-0.2199	-0.0430	-0.0356	0.0009	-0.1274	0.3869
	(0.0715)	(0.3269	(0.0606)	(0.0833)	(0.0842)	(0.0909)	(0.2975)
West	0.0877	-0.3272	-0.0238	-0.0176	0.0004	-0.0636	0.3410
	(0.0841)	(0.3335)	(0.0861)	(0.0941)	(0.1117)	(0.1093)	(0.2828)
Constant	-2.2710***	-1.9945***	-1.8249***	-1.6450***	-2.3892***	-2.3573***	-1.5380***
	(0.1370)	(0.3520)	(0.1137)	(0.1388)	(0.2181)	(0.1820)	(0.3439)
Observations	436	436	436	436	436	436	436
R^2	0.11	0.04	0.04	0.02	0.10	0.13	0.06
P-value	0.00	0.01	0.09	0.63	0.00	0.00	0.00

Note: ***, **, and * indicate variables significant at $P < 0.01$, $P < 0.05$, and $P < 0.10$ levels respectively.

household income stabilizer, reducing the need to avoid risk for the farming operation. *Farminc_goat* was positively associated with *Maximize Profit* and negatively associated with *Control Weeds/Vegetation*. Producers receiving a greater share of their farm income from the goat enterprise were less diversified, concentrating their resources on meat goat production, having a goal of maximizing profit. On the other hand, as expected, these producers were less likely to use their animals primarily for controlling weeds/vegetation.

As compared to an *Extensive-range* production system, producers raising their goats in pastured but not rotated systems (*PAS_NotRot%*) were more oriented to *Maximize Profit* and *Have Time for Other Activities*. Producers raising their goats in a pastured and rotated system (*PAS_Rot%*) were found to more heavily weight the goals, *Maximize Profit* and *Avoid Years of Loss/Low Profit* and less likely to weight goal of *Controlling Weeds/Vegetation*. The increased control over the production environment with more intensive production systems is consistent with risk reduction, and the use of goats to control weeds and vegetation would typically be under a more extensive system. As compared to the extensive system, producers under a dry lot (*Drylot%*) system were found to more heavily weight the goal, *Maximize Profit* and to place less weight on the goal, C*ontrol Weeds/Vegetation*. These results are consistent with expectations, given the intensity of the dry lot system as compared to the extensive system. Compared to Texas and Oklahoma producers, producers in the *Southeast* and *Northeast* regions were more likely to place heavier weight on the goal, *Maximize Profit*, and to place lower weight on the goal, *Control Weeds/Vegetation*.

2.4.2. Consistency-Check of Producer Goals and Farm Performance

A consistency check of farm performance with respect to producer goals was conducted by studying the relationship between profit maximizing goals (Maximize Profit) and farm profit.

Farm profit was estimated by using 127 responses received from a follow-up survey which was sent to 433 of the respondents of the first survey who had agreed to participate. Cost and return estimates in various categories were collected. Total cost of production included those required for running the entire farm. Direct total cost of meat goat production included the following operating costs: purchases of meat goats, purchased feed, medical costs, fuels and electricity cost, maintenance and depreciation cost, wage, etc., and "marketing and storage costs." Other expenses shared with the entire farm, for instance farm supplies, equipment, rent, interest, and property taxes, etc., were estimated based on the percentage of total farm revenues from meat goats. Total meat goat related revenues included total sales of goats for meat, breeding stock, and goat meat. Other revenues included total sales of field crops, hay and silage, vegetables, fruit, cattle and calves, and animals and animal products other than meat goats / goat meat and beef cattle. Using the whole-farm (Kopke et al. 2008, Young et al. 2011) and enterprise approaches (McBride et al. 2004, Gillespie et al. 2009), farm profit and enterprise profit per doe, respectively, were estimated. Ordinary Least Squares regression showed no significant relationship between farm/enterprise profit and producer goals. Pearson correlation coefficients between enterprise profit and *Maximize Profit* also did not provide evidence to support the relationship between producer goals and farm financial performance.

2.5. Discussion and Conclusions

Understanding of goal structure could serve as a foundation for future research and development efforts as it helps in determining the direction of growth of an industry. The U.S. meat goat industry is in its initial phase of development and this study provides some valuable insights on producers' objectives for meat goat production. The major objectives of this study were to assess the U.S. meat goat producers' goal structure and the factors affecting those goals.

This study further investigates the consistency between producer goal and farm performance. Seven goals were selected for the study and a fuzzy pair-wise method was used in the survey to determine producer preferences. Comparing the average scores for all goals, the producer ranking of the seven goals with respect to their preferences were as follows: (1) *Maximize Profit*, (2) *Have Family Involved in Agriculture*, (3) *Avoid Years of Loss/Low Profit*, (4) *Have Time for Other Activities*, (5) *Increase Net Worth*, (6) *Control Weeds/Vegetation*, and (7) *Increase Farm Size*.

Several factors were found to impact goal structure of the meat goat producers. Producers having a profit maximizing goal (*Maximize Profit*) were more likely to be larger-scale, have greater shares of farm income derived from the goat operation, raise goats in more management-intensive production systems (*pastured rotated/not-rotated*, *drylot*) and live in the *Southeast* or *Northeast* relative to Texas and Oklahoma. On the other hand, producers who were raising meat goats either for *Controlling Weeds/Vegetation* or to *Have Time for Other Activities* were relatively smaller-scale, were older, ran less management-intensive production systems, and were more likely to operate in Texas or Oklahoma relative to the *Southeast*. Producers raising meat goats to *Avoid Years of Loss/Low Profit* were less likely to hold off-farm job and were more likely to use a pastured and rotated production system. Results suggest that the scale and systems of production, producer demographics, and socioeconomic characteristics were the key determinants of meat goat producers' goal structure.

Although we found that *Maximize Profit* was the most important goal of meat goat producers, according to Gillespie et al. (2013), profit-related reasons were considerably less important than other reasons for producers to have entered meat goat production. On the other hand, hobby/leisure-related reasons were highly important in these producers' decisions to enter

goat production. Gillespie et al. (2013) found that the four most important reasons that had led U.S. meat goat producers to select this enterprise as opposed to other agricultural enterprises were: "I enjoy working with goats," "I can raise goats on a relatively small acreage," "Goat production fits well into my land management plan," and "Goat grazing preferences are different from other species." The profit-related reasons, "Goat production is profitable" and "Low cost to purchase and raise goats" were ranked 12th and 13th among the 14 possible reasons they included in their study. Apparently, although producers had not entered goat production for profit reasons, the goal of profit maximization was important once they were involved in the enterprise.

This study found no significant relationship between the importance of the producer goal, *Maximize Profit* and farm performance (*profit*), suggesting that having the goal of profit maximization does not necessarily lead to greater profit for the meat goat producers. Considering the scale economy of meat goat production of >54 goats (Qushim et al. 2014) (our study found the average number of meat goats per farm was 61 and 64% had fewer than 54 goats), it appears that a large portion of producers are not benefiting from scale economies. It also appears there remains significant opportunity for meat goat research that can provide meat goat producers with prescribed management practices that will lead to greater profitability.

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CHAPTER 3: SELECTION OF BREEDING STOCK BY U.S. MEAT GOAT PRODUCERS: A CONJOINT APPROACH

3.1. Introduction

Purchasing breeding stock requires a significant initial investment and major consideration from producers who are establishing a meat goat farm. As the quality and quantity of meat goats produced depends partially on the farmer's initial investment in breeding stock (Casey and Webb 2010), producers are expected to select animals that will lead to maximum profit. Breeding goats and raising kids on the same farm is a common practice in meat goat industry; therefore breeding stock selection decisions have important economic implications for most meat goat producers. The production of meat goats in the United States has been increasing in recent years with increased demand from the immigrant population, subsequent organizational developments (establishment of the American Meat Goat Association (1992) and American Boer Goat Association (1993)), and repeal of 1954 Wool Act in 1993. An understanding of the major considerations of meat goat producers when they purchase breeding stock is important not only for identifying the current direction of meat goat production, but also for determining future breeding improvement strategies. We determine producer preferences for meat goat breeding stock using data from a 2012 choice-based conjoint survey conducted with U.S. meat goat producers. Some of the previous studies describing producer preferences of animal attributes using conjoint methodology include Sy et al. (1997), Tano et al. (2003), and Ouma et al. (2007), but no previous studies were found dealing with meat goat attributes.

The specific objectives of this study are to determine (1) producer preferences for the attributes of meat goat breeding bucks and does, (2) the heterogeneity of preferences across different producers, and (3) producer willingness-to-pay (WTP) for selected meat goat breeding

stock attributes. The purchase decision of initial breeding stock could depend largely upon several factors such as the scale of projected production, the types of meat goats one plans to produce, the intended market and consumer preferences, the expected market price, the cost of maintaining bucks and does, and many more (Coffey 2006). In other words, intentions of production and expected returns are major considerations when making initial purchasing decisions. Furthermore, there could be personal preferences for raising certain types of animals rather than others. The availability of animals and their suitability for local conditions could be other things to consider (Coffey 2006).

3.1.1. Conjoint Analysis

Conjoint analysis is a stated preference method where respondents evaluate a number of hypothetical products according to their preferences. Researchers can select rating, ranking, or choice-based methods for evaluating their hypothetical products depending upon the research objectives, number of hypothetical products under evaluation, and other concerns. Using a choice-based conjoint (CBC) analysis, respondents select a product they would be willing to purchase, assuming those provided as options are the only available products in the market. Although rating and ranking-based conjoint studies provide more information on relative rankings of product profiles, response bias and respondent fatigue increase as the number of alternatives increases (Louviere et al. 2000). On the other hand, CBC better reflects a real market situation where consumers face multiple products when selecting which product to purchase. One of the major advantages of CBC is that an ‘opt-out’ or ‘neither’ option can be included in the survey question so that consumers can select none of the products available if they would not purchase any of the products provided, which is actually reflective of the practical world.

Furthermore, by including a price attribute in the study, estimates of monetary values of each of the attributes can be made.

In recent years, conjoint methodology has been extensively used not only in marketing research but also in diverse research fields such as medicine (Ryan and Farrar 2000; Phillips et al. 2002), ecology and the environment (Hanley et al. 1998; Álvarez-Farizo and Hanley 2002; Alriksson and Öberg 2008; Arifin et al. 2009), energy (Beenstock et al. 1998), transportation (McFadden 1998), and many more. In agriculture, economists are using conjoint methodology especially when likability of a product and WTP for its attributes is to be measured. In contrast to the revealed preference method where observations are taken from real market situations, the stated preference method is advantageous in the sense that it provides a hypothetical market scenario and allows the study of consumer preferences for new products that are not yet in the market. One major advantage of conjoint analysis over hedonic price techniques is that it can be used in cases where there is not much transaction data available (Tano et al. 2003). Conjoint analysis also allows an opportunity to study hypothetical products and unique attributes of interest whereas other methods are largely applicable for real products with already established attributes.

3.1.2. Literature Review

Sy et al. (1997) studied producer preferences for cattle characteristics among three interdependent cattle production segments: purebred breeders, commercial cow-calf operators, and cattle feeders. Using rating-based conjoint analysis, they found that the different segments of the industry have diverse preferences for animal attributes. Tano et al. (2003) studied producer preferences for cattle attributes in the developing region of West Africa where literacy was low and commercial production was yet to be developed. Results suggested that fitness to traction,

disease resistance, and fertility were the most preferred traits of bulls, whereas traits preferred for cows included reproductive performance, disease resistance, and feeding ease. Ouma et al. (2007) conducted a choice-based conjoint study of cattle producers in Kenya and Ethiopia to determine producer preferences for cattle traits. They considered preference heterogeneity under different production systems using mixed logit and latent class models. Results suggested that environment and production system choice were the two major factors influencing cattle-owners' preference heterogeneity. The authors also argued that an understanding of preference heterogeneity among livestock producers would help in designing better breeding strategies for specific production systems.

3.1.3. Economic Theory

The fundamental principle of choice-modeling is based on Lancaster (1966) who argued that consumer preferences for goods are derived from the attributes they possess. By consuming (possessing) goods, consumers derive utility which can be decomposed into separate utilities with respect to each of the attributes and levels. Random utility theory can be applied to choice-modeling in the sense that consumers maximize their utilities with the choices they make (Louviere et al. 2000). Utility can be separated into two parts: the deterministic part (V_{nA}) and the random or stochastic part (ε_{nA}). It can be represented as follows:

(3.1) $U_{nA} = V_{nA} + \varepsilon_{nA}$

The basic assumption in choice experiments is that an individual (n) would select an alternative (A) over another alternative (B) if and only if the utility received from consuming alternative A were greater than or at least equal to that received from consuming alternative B. This can be represented as:

(3.2) $U_{nA} \geq U_{nB}$,

where U_{nA} and U_{nB} are utilities received from consuming alternatives *A* and *B*, respectively.

Utility received from consuming an alternative can be represented as the vector of attributes for that alternative:

(3.3) $U_{nA} = U(X_{nA})$

where X_{nA} represents the vector of attributes of the alternative *A*. The probability of individual *n* selecting choice *A* over other choice alternatives can be represented as:

(3.4) $P(A) = \text{Prob}\{V_{nA} + \varepsilon_{nA} \geq V_{nj} + \varepsilon_{nj}\}; A \neq j, \forall\, j \in k$

where *j* is a finite set of alternatives and *k* is a given choice set situation.

In this study, the utility each producer receives from selecting a buck or doe over a set of alternatives *j* in choice situation *t* can be represented as the following utility function:

(3.5) $U_{njt} = \beta_n x_{njt} + \varepsilon_{njt}$

where x_{njt} represents the buck/doe attributes and socioeconomic characteristics of meat goat producers, ε_{njt} represents identically and independently distributed (IID) random errors, and β_n is a coefficient vector that depends on the density function described below.

3.2. Data and Methods

3.2.1. Econometric Methods

The mixed logit model with latent classes is used in this study to analyze choice-based conjoint data. The mixed logit model is advantageous over others due to the following major characteristics: (1) it is flexible and incorporates any random utility models, (2) it does not require the independence of irrelevant alternatives (IIA) assumption and allows taste parameters to vary randomly, (3) it can have an unrestricted substitution pattern, and (4) it allows for correlation of unobserved factors over repeated choice situations (Train 2003). The mixed logit model (also called the random parameters logit model) is basically a modification of the

multinomial logit model (Train 2003; Greene 2008 p. 851). It can be derived under different behavioral specifications. Choice probabilities in the mixed logit can be expressed as:

$$(3.6) \quad P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta,$$

where $L_{ni}(\beta)$ is the logit probability evaluated at parameter β, and $f(\beta)$ is a density function.

$$(3.7) \quad L_{ni}(\beta) = \frac{e^{V_{ni}(\beta)}}{\sum_{j=1}^{J} e^{V_{nj}(\beta)}},$$

where $V_{ni}(\beta)$ is observed utility that depends upon β. If observed utility is linear in β, then $V_{ni}(\beta) = \beta' x_{ni}$. Then the mixed logit probability would be:

$$(3.8) \quad P_{ni} = \int \frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} f(\beta) d\beta$$

Conditional on n, an individual's probability of selecting a choice j is given simply by the conditional logit whereas unconditional probabilities would be achieved by integrating conditional probabilities over the distributions of β's. The mixed logit is a weighted average of logit models evaluated at different β's where the density function, $f(\beta)$, gives weights by acting as a mixing distribution. In this study, initially the model was estimated using 50 Halton draws whereas in the final model, we used 500 Halton draws for simulation. Time to run the model and the accuracy of estimation increase with the size of draws used (Hole 2007). Further details on Halton sequences and random draws for simulation-based integration can also be found in Greene (2008).

Boxall and Adamowicz (2002) argued that the random parameter logit/probit models (e.g. mixed logit) can estimate the heterogenous preferences by allowing model parameters to vary over respondents, but are unable to explicitly explain the sources of heterogeneity. Socioeconomic characteristics of the respondents are common sources of heterogeneity in most of the cases. As discussed by Boxall and Adamowicz (2002), two possible approaches to deal

with this problem were: (1) conduct multivariate cluster analysis of sociodemographic characteristics and estimate individual choice models for each of the homogeneous segments (Salomon and Ben-Akiva 1983), or (2) parameterize scales in the binary logit models (Cameron and Englin 1997). For both of these approaches, a common problem is that *a priori* knowledge of sources of heterogeneity is required. It may not always be the case that the socio-demographics are the only sources of heterogeneity; therefore an approach that can incorporate all possible sources of heterogeneity should be used when dealing with these issues. Latent class models are a possible solution to this. A number of similar previous studies have also used latent class models (Ouma et al. 2007; Ruto et al. 2008) in estimating preference heterogeneity.

Using the latent class model, the population is intrinsically divided into different classes. Preference is assumed to be homogenous within each class while it is heterogenous across classes. An individual is belonging to a class is probabilistic in nature. The number of classes used is endogenously determined (Greene and Hensher 2003); the researcher chooses the optimum number of classes based on Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) – the optimum number of classes where the value of the AIC / BIC value is the lowest (Pacifico and Yoo 2012). Researchers do not specify the nature of classes but only use important determinants for classes in the model. Based on the homogeneity among individuals, significance of the variables is observed, ultimately determining the nature of each class. The joint logit probability that an individual *n* associated with the latent class *l* chooses a set of alternatives (T_n) can be represented as follows:

$$(3.9) \quad P_{(Tn|l)} = \prod_{t=1}^{T_n} \frac{\exp(\beta_l' x_{nit})}{\sum_{j=1}^{J} \exp(\beta_l' x_{njt})}$$

where x_{nit} is a vector of alternative specific attributes, β_l' is a vector of class-specific parameters, and *t* is the number of choice situations faced by an individual. The class-specific parameter

vector (β_l') captures the heterogeneity of preferences that the different segments of U.S. meat goat producers might have (Pacifico and Yoo 2012).

Since the classes are latent such that an individual falling into one class cannot be described directly, the probability of an individual being associated with a class can be estimated using the multinomial logit model as follows:

$$(3.10)\quad P(_l) = \frac{\exp(\theta_l' Z_n)}{\sum_l^L \exp(\theta_l' Z_n)}$$

where Z_n is a vector of variables that enter the model of class membership and $\theta_l'(l = 1, 2, \ldots L)$ denotes the class-specific parameters. This model does not impose the IIA assumption. The parameters (probabilities) estimated by this model would be the expected value that an individual *n* would choose a buck/doe of particular attributes, given that the person belongs to a particular class membership. The estimation of these models was conducted by using the STATA modules developed by Pacifico and Yoo (2012).

Producer WTP for an attribute (*a*) of a breeding buck/doe can be estimated as the negative ratio of the attribute coefficient and price coefficient as described below:

$$(3.11)\quad WTP_a = -\frac{\beta_a}{\beta p}$$

where β_a and β_p are the coefficients of the attribute *a* and price, respectively.

3.2.2. Producer Survey

3.2.2.1. Selection of Attributes and Levels

To consider the important attributes for this study, 15 meat goat producers near Baton Rouge, Louisiana, were emailed and asked for their opinions about what they look for when selecting breeding stock. Seven producers replied and among the suggested attributes, the ten most common attributes were selected for further evaluation by a group of industry experts, animal scientists, and agricultural economists. Some of the attributes that most of the producers

considered to be important in selecting bucks were related to the size of head, strength of the animal, fertility, and shape and size of the scrotum. For does, the size of the head, fertility, and teats and udder were of importance. After thorough consideration, those attributes were collectively represented as "masculinity" and "femininity" for bucks and does, respectively. Therefore, a buck with high masculinity means it is powerful, has a wide/strong head, and has a smooth scrotum whereas a doe with high femininity means it has a round and feminine head, and has a sound udder. These descriptions would be provided in the questionnaire to accompany the conjoint questions. Some of the other common attributes included the shape and size of the animal, particularly the bone to muscle ratio, surface of the backbone, and horn spacing, which were collectively termed as "structure and soundness." An animal with good structure and soundness means it has good bone/muscle ratio, and is healthy. A description of what good "structure and soundness" means would also be included in the questionnaire.

Considering age to be one of the major determinants of a breeding buck or doe's productive life, it was also considered for this study. Age levels of ≤2 years and >2 years were included to determine preferences for mature and established or younger breeding stock. Three commonly used meat goat breeds - Boer, Kiko, and Spanish - were included and the rest were captured as "others." To estimate how much value producers gave to each of the attributes, breeding stock price was also considered as an attribute. The lowest and highest average prices were identified by reviewing the prices listed in various online sales and the middle two prices were selected on an interval basis. Price levels for bucks were $300, $700, $1100, and $1500, and for does, $200, $550, $900, and $1250. Table 3.1 provides the final attributes and their levels that were used in the conjoint study.

A conjoint design is balanced when all of the levels of an attribute are used an equal number of times in the survey. A balanced design minimizes the variance and covariance, as the intercept is orthogonal to each effect (Kuhfeld et al. 2010). Minimizing variance and covariance of the parameter estimates is the primary consideration in a design creation whereas maintaining orthogonality is the second. When a design is balanced and orthogonal, it is called an optimal design (Kuhfeld et al. 2010). We adopted an optimal design in this study.

Table 3.1: Traits and Trait Levels Used in the Study

Traits, Buck/Doe	Levels, Buck/Doe
Masculinity/Femininity	High
	Low
Structure & Soundness	Good
	Poor
Age	≤2 years
	>2 years
Breed	Kiko
	Spanish
	Boer
	Others
Price	$1500/$1250
	$1100/$900
	$700/$550
	$300/$200

3.2.2.2. The Survey

A total of five attributes with three attributes having two levels and the other two attributes having four levels would result in 128 hypothetical animal profiles (2*2*2*4*4). It is infeasible to incorporate all of these animal profiles into one study as respondent fatigue would be of concern. Thus, a balanced and orthogonal fractional factorial design was used (Kuhfeld et al. 2010). For both bucks and does, sixteen hypothetical animal profiles were created and from them 8 choice sets were created randomly to construct a choice-based conjoint study. The producers were divided into two groups, with one group receiving the survey with conjoint questions for bucks and the other receiving the questions for does; i.e., each producer received

questions about either bucks or does while the remaining questions in the survey were the same. The major reason for splitting the population was because of limitations on the size of the survey, where all of the conjoint questions for both bucks and does could not be included. In the survey, the attributes were defined as follows: (1) masculinity: "we mean that the buck is powerful, has a wide/strong head, and has a smooth scrotum," (2) femininity: "we mean that the doe has a round and feminine head, and has a sound udder," (3) structure and soundness: "we mean the buck/doe has good bone/muscle structure, and is healthy," and (4) others: "we mean breeds other than Boer, Spanish, and Kiko." Other than the characteristics provided, producers were asked to imagine that the animals were identical. Following the above instructions, a question for each choice set was asked as follows: "Which doe would you buy if these were the only does available in the marketplace?," with possible choices of "Doe A, Doe B," and "Neither" for does; and "Which buck would you buy if these were the only bucks available in the marketplace?," with possible choices of "Buck A, Buck B," and "Neither" for bucks.

The questionnaire was sent to U.S. meat goat producers during late summer - early fall, 2012. The producer list was developed from internet addresses of goat farmers. These farmers were advertising on the internet or were on posted lists as members of meat goat associations. The first round of mailing included a cover letter, the ten page questionnaire, a complementary pen, and a postage-paid return envelope, followed by a postcard reminder two weeks later. The second mailing included a new cover letter, questionnaire, and return envelope two weeks after the first postcard reminder. This was also followed by a second postcard reminder two weeks later. Thus, a total of four contacts were made to the producers. Of 1,600 surveys sent, 584 usable responses were obtained and 242 additional ones were removed because producers either

did not produce meat goats during 2011 or the surveys were undeliverable (bad addresses). Thus, the adjusted response rate was 43%.

3.2.3. Variables Used in the Study

Table 3.2 shows the coding of the trait-levels and their expected signs. Effect coding was employed instead of dummy variable coding so as to avoid multicollinearity problems resulting from the dummy variable trap (Bech and Gyrd-Hansen 2005). Strong fertility and reproductive abilities have been found to be preferred by producers (Tano et al. 2003, Ouma et al. 2007). Consistent with this, meat goat producers were expected to have positive preferences for higher levels of masculinity and femininity in meat goat breeding stock. Structure and soundness shows the overall health and body confirmation of the animal, with higher levels expected to be positively preferred. Older breeding stocks generally have less remaining productive life; therefore producers were expected to prefer younger animals. Since Kiko, Spanish, and Boer breeds are generally more popular than others, we expected them to be more preferred relative to other breeds. As usual, lower prices were expected to be preferred.

Table 3.2: Trait Codes, and Their Expected Signs

Traits	Levels (Codes)	Expected Signs
Masculinity	High = 1, Low = -1	Positive
Femininity	High = 1, Low = -1	Positive
Structure & Soundness	Good = 1, Poor = -1	Positive
Age	≤2 years = 1, >2 years = -1	Negative
Breed	Kiko = 1, Not Kiko = 0	Positive
	Spanish = 1, Not Spanish = 0	Positive
	Boer = 1, Not Boer = 0	Positive
	Others = -1, Not Others = 0	Negative
Price	Price in US $	Negative

To determine the heterogeneity of preference, farm descriptors, producer demographics, and regional variables were incorporated in the latent class model. *Number_meatgoats* is the total number of meat goats on the farm, representing farm size. Percentage of meat goats sold as

slaughter or as meat as opposed to sales for breeding stock, show or other was represented as a continuous variable, *%Sale_Slaugh*. Producer demographics were represented by *Age* and *Bachelor*, where *Age* is a continuous variable representing the age of the producers ranging in 15 year intervals and *Bachelor* is a dummy variable indicating whether a producer held at least a college bachelor's degree. Percentage of annual net farm income derived from the goat operation was included as *Farmincome_goat*, a continuous variable ranging from 1 to 5, each in 20% intervals.

The diversity of preferences across different geographic regions was captured by incorporating regional variables: *Southeast* - producers in the states AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV; *Northeast* - producers in the states CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT; *Midwest* - producers in the states KS, IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, and WI; *West* - producers in the states AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY; and *Texas and Oklahoma* - producers in the states TX and OK.

3.3. Results

Although the conditional logit and the mixed logit models could be interchangeably used in this type of study, we selected the mixed logit model to determine the heterogeneity of preferences across different types of producers and production systems used. The log likelihood values of conditional logit and mixed logit models were compared to determine whether the use of mixed logit model would be appropriate econometrically. In the model for bucks, the log likelihood for the conditional logit model was -1847.64 and in the mixed logit model, it was -1652.93. In the model for does, the log likelihood was -1711.10 for conditional logit and -1511.87 for the mixed logit. Having higher simulated log likelihood values of mixed logit models in both conditions, our selection was justified.

Table 3.3 shows the descriptive statistics of the variables used in the latent class run. There were, on average, 61 goats on the meat goat farms, with 45% of the total sales going for slaughter or as meat. Average age of the respondents was 52 years and 45% held at least a college bachelor's degree. On average, producers received 40% of their net farm income from the meat goat operation. Most of the respondents of this survey were from either the Southeast (36%) or the Midwest (37%), whereas the Northeast, West, and Texas/Oklahoma regions had 7%, 9%, and 11% respondents, respectively.

Table 3.3: Descriptive Statistics of the Variables Used in the Analysis

Variables	Description	Mean
Number_meatgoats	Total number of meat goats in the farm	60.84
%Sale_Slaugh	Percentage of goat sold for slaughter or as meat	44.61
Age	Producer age (years): (a) ≤30, (b) 31-45, (c) 46-60, (d) 61-75, (e) ≥76	51.91
Bachelor	*Dummy* = Whether producer holds at least a bachelor's degree: (a) Less than high school, (b) high school diploma/GED, (c) some college/technical college, (d) bachelor's degree, (e) advanced degree (M.S., Ph.D., J.D., M.D., etc.)	0.45
Farmincome_goat	Percentage annual net farm income derived from goat operation: (a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) 80-100%	39.86
Southeast	Producers belong to the states: AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV	0.36
Northeast	Producers belong to the states: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT	0.07
Midwest	Producers belong to the states: KS, IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, and WI	0.37
West	Producers belong to the states: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY	0.09
Texas/Oklahoma	Producers belong to the states: TX, and OK	0.11

Table 3.4 presents the simulated maximum likelihood estimation using mixed logit models for bucks and does. All of the mean coefficient values were found to be significant in both models except for *Age* and *Kiko* in the doe model. All signs for preference were consistent with expectations both models. Traits preferred were similar in both models: higher masculinity for bucks and femininity for does and better structure and soundness. Age, Kiko, Spanish, and

higher price were less likely to be preferred for bucks whereas Spanish and higher price attributes were found less likely to be preferred for does. Strong preference for breeding stock with high masculinity/femininity and good structure and soundness is not surprising since animals with these attributes are considered to be stronger, healthier, more fertile, and thus more productive. Producers showed a strong preference for the Boer breed as compared to others, which is probably because Boer goats have strong production ability and are relatively easier to handle (Coffey 2006).

Table 3.4: Simulated Maximum Likelihood Estimates from the Mixed Logit Model

Buck Traits	Mean Coefficient	Standard Deviation
Masculinity	0.9432***(0.0675)	-0.0867 (0.1641)
Structure & Soundness	1.8488***(0.0973)	-0.3653***(0.1334)
Age	-0.1110** (0.0503)	0.0043 (0.0685)
Kiko	-0.8352***(0.2251)	2.6663***(0.2728)
Boer	1.0198***(0.1324)	0.8652***(0.1833)
Spanish	-1.0262***(0.2212)	-1.6652***(0.2419)
Price	-0.0021***(0.0002)	-0.0013***(0.0001)
Observations	7242	
Likelihood Ratio Test	389.42***	
Simulated log likelihood at convergence	-1652.9295	
Doe Traits		
Femininity	0.4359***(0.0665)	0.2561 (0.2017)
Structure & Soundness	1.9553***(0.1174)	0.5799***(0.1243)
Age	-0.0153 (0.0544)	0.0168 (0.0951)
Kiko	-0.1348 (0.2188)	2.6375***(0.2800)
Boer	1.2820***(0.1670)	1.1999***(0.1992)
Spanish	-0.3507* (0.2073)	1.9016***(0.2523)
Price	-0.0031***(0.0002)	0.0020***(0.0002)
Observations	6312	
Likelihood Ratio Test	398.46***	
Simulated log likelihood at convergence	-1511.8693	

Note: Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The interpretation of the coefficients in the mixed logit model involves the estimation of the cumulative normal distribution of the ratio of the mean and standard deviation. In other words, it is estimated as $100*\Phi(-b_k/s_k)$, where Φ is the cumulative standard normal distribution and b_k and s_k are the mean coefficient and standard deviation of the k^{th} attribute (Hole 2007). The

shares of the population preferring a breeding buck with high masculinity and good structure and soundness were 99% each whereas 99% did not prefer animals >2 years old. Boer bucks were preferred by 88% of the producers whereas Kiko and Spanish bucks were preferred by 38% and 27%, respectively. In the case of does, 96% preferred highly feminine does, 99% preferred does with good structure and soundness, and 82% did not prefer does >2 years old. Eighty-six percent of producers preferred Boer does, whereas Kiko and Spanish does were preferred by 48% and 43% of the producers, respectively. As expected, price had a negative sign, indicating that most of the producers (94%) had an inclination for animals with lower price. Although the preference structures for both bucks and does were consistent, the results showed that the intensity of preference varies slightly by gender, especially with the age and the breed of the animal.

Table 3.5 shows the producer's willingness to pay for breeding stock attributes. Good structure and soundness was found to be the most highly valued attribute at $874.07 for bucks and $638.87 for does, meaning that producers would be willing to pay this much more for animals of good structure and soundness than those with poor structure and soundness. Producers considered the Boer breed to be the second most important attribute. They were willing to pay $482.10 and $418.88 more if the animal was a Boer buck or doe, respectively, relative to other breeds. The Boer goat has been gaining in popularity probably because of its ability to grow faster and produce desirable carcass characteristics (Coffey 2006). Masculinity and femininity were the third-most highly valued attributes of bucks and does with more masculine and feminine animals commanding $445.91 and $142.44 more, respectively, than those with low levels of masculinity/femininity. Age, Kiko, and Spanish had negative WTPs of $-52.50, $-394.86, and $-485.14 for bucks and $-5.01, $-44.03, and $-114.58 for does, respectively. This suggests that producers preferred to pay $52.50 less for >2 year old bucks than for ≤2 year old

bucks. Similar to this, producers preferred to pay $395 less for Kiko bucks as compared to other breeds. Although there was a preference for Boer over the other breeds, since the price of pure bred Boer breeding stock could be significantly higher, some producers are likely to use Boer bucks on Kiko does (Coffey 2006), which could be a cost effective strategy while producing desirable herd characteristics associated with both breeds. It could also be desirable from a breeding perspective to select for the hardy and parasite-resistant abilities of the Kiko and the growth and production abilities of the Boer goats.

Table 3.5: Willingness To Pay (WTP) for Meat Goat Attributes

Buck Traits	WTP	
Masculinity	445.91***	(38.94)
Structure & Soundness	874.07***	(56.31)
Age	-52.50*	(24.61)
Kiko	-394.86***	(113.05)
Boer	482.10***	(54.63)
Spanish	-485.14***	(119.77)
Doe Traits		
Femininity	142.44***	(22.23)
Structure & Soundness	638.87***	(40.52)
Age	-5.01	(17.82)
Kiko	-44.03	(72.00)
Boer	418.88***	(47.20)
Spanish	-114.58*	(70.28)

Note: Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.6 and 3.7 show the results of the latent class model for bucks and does. The total numbers of classes were determined by using the AIC/BIC criteria. The AIC (2951.74) and BIC (2893.74) values were minimized at 4 classes for the buck model, whereas for the doe model, the AIC (2982.25) was minimized at 3 classes and the BIC (2940.43) was minimized at 4 classes. Since the BIC values were lowest at 4 classes and the AIC values for 3 and 4 classes were close, 4 classes were selected for the doe model. Few class-specific variables were found to be significant. On the other hand, we tried to incorporate variables representing different production systems as well as other farm descriptors, but the models did not converge. The sets of variables

Table 3.6: Latent Class Model Run, Bucks

	Class 1	Class 2	Class 3	Class 4
Attributes	Coefficient (Std. errors)	Coefficient (Std. errors)	Coefficient (Std. errors)	Coefficient (Std. errors)
Masculinity	0.4339***(0.1248)	1.0727*** (0.1763)	0.7892*** (0.1651)	18.9390 (67.3156)
Structure & Soundness	0.9612***(0.1324)	1.0949*** (0.1695)	1.8973*** (0.2832)	46.2563 (168.2879)
Age	-0.0307 (0.1140)	-0.2627* (0.1545)	-0.7875***(0.2508)	-0.2898 (0.3629)
Kiko	0.1763 (0.2712)	0.5945** (0.2936)	4.4038*** (1.0036)	-17.8447 (50.4917)
Boer	1.9166***(0.2625)	-1.5318***(0.5668)	-0.8124** (0.4106)	37.7503 (151.4587)
Spanish	-0.0582 (0.2548)	-0.5194 (0.3997)	2.1481*** (0.5792)	-0.9101 (16.8643)
Price	-0.0004** (0.0002)	-0.0023***(0.0003)	-0.0022*** (0.0005)	-0.0439 (0.1683)
Class Specific Parameters				
Num_meatgoats	0.0051** (0.0026)	0.0008 (0.0027)	0.0036 (0.0030)	
%Sale_slaughter	-0.0010 (0.0065)	0.0240*** (0.0057)	0.0234*** (0.0061)	
Bachelor	-0.4479 (0.4417)	-0.0437 (0.3856)	0.1141 (0.4129)	
Age	-0.1854 (0.2381)	0.5737*** (0.2260)	0.1127 (0.2464)	
Farmincome_goat	-0.1553 (0.1314)	0.0907 (0.1056)	0.0601 (0.1205)	
Southeast	0.5321 (0.7488)	0.8927 (0.6346)	1.5719* (0.9172)	
Northeast	1.0628 (1.0801)	0.8941 (0.8975)	2.5066** (1.0509)	
Midwest	0.7870 (0.7087)	0.2975 (0.6287)	0.5565 (0.9319)	
West	0.2080 (0.9241)	0.0991 (0.8448)	-0.0400 (1.2069)	
Constant	-0.9949 (1.0629)	-4.4060***(1.0725)	-4.0305***(1.3293)	
Obs. (Class share)	277(0.14)	488(0.23)	372(0.16)	1053(0.47)
$AIC_{minimum(4)}$ = 2951.7399, $BIC_{minimum\ (4)}$ = 2893.7399, Log Likelihood = -1280.9805				

Table 3.7: Latent Class Model Run, Does

	Class 1	Class 2	Class 3	Class 4
Attributes	Coefficient (Std. errors)	Coefficient (Std. errors)	Coefficient (Std. errors)	Coefficient (Std. errors)
Femininity	0.6183*** (0.2386)	0.1922** (0.0848)	-0.8105 (0.5316)	9.0327 (33.3472)
Structure & Soundness	1.4864*** (0.1856)	1.0258***(0.1053)	0.9877***(0.2503)	29.2671 (119.0953)
Age	-0.0553 (0.1757)	0.0027 (0.0811)	-0.6976* (0.4175)	-0.0421 (0.1360)
Kiko	1.1454*** (0.3547)	1.3506***(0.2070)	-40.4508 (45.2753)	-15.7575 (66.6897)
Boer	-0.8649 (0.6980)	0.7337***(0.1872)	3.0587*** (0.6486)	11.8370 (33.3628)
Spanish	0.3466 (0.5029)	0.9335***(0.1804)	-1.6956** (0.7366)	-7.1515 (33.3469)
Price	-0.0040***(0.0005)	-0.0005***(0.0002)	-0.0027***(0.0007)	-0.0260 (0.0953)
Class Specific Parameters				
Num_meatgoats	-0.0024 (0.0092)	0.0017 (0.0033)	0.0006 (0.0048)	
%Sale_slaughter	0.0165** (0.0083)	0.0208***(0.0060)	-0.0018 (0.0090)	
Bachelor	1.1979*** (0.4708)	0.1499 (0.4021)	-0.1644 (0.5791)	
Age	0.1471 (0.2608)	-0.2211 (0.2207)	-0.2168 (0.3203)	
Farmincome_goat	-0.0683 (0.1223)	-0.0415 (0.1130)	-0.0272 (0.1667)	
Southeast	0.0981 (0.9057)	-0.1840 (0.8142)	-1.3149 (0.8781)	
Northeast	-0.0051 (1.1755)	-0.7700 (1.1172)	-1.4977 (1.3631)	
Midwest	-0.9761 (0.8883)	-0.5419 (0.7919)	-1.9206** (0.8722)	
West	-2.1098 (2.4006)	-1.5786 (1.0807)	-15.8647 (352.1285)	
Constant	-1.2528 (1.1546)	-0.2235 (1.0790)	0.9383 (1.3866)	
Obs. (Class share)	957(0.274)	1128(0.267)	216(0.091)	1272(0.368)
$AIC_{minimum(3)}$ = 2982.2475, $AIC_{(4)}$ = 2998.4282, $BIC_{minimum(4)}$ = 2940.4282, Log likelihood = -1308.2927				

presented in this study represent probably the best possible groups of economically and theoretically important variables that converged in the econometric analysis.

Larger-scale producers (Class 1) preferred Boer bucks, with high masculinity and structure and soundness. The intensity of preference for the Boer breed was relatively higher as compared to that for other attributes. Older producers who were selling higher percentages of their goats for slaughter, (Class 2) tended to prefer a younger, Kiko buck with high masculinity and good structure and soundness. Producers residing in Southeast or Northeast and selling higher percentages of their goats for slaughter (Class 3) were more likely to prefer Kiko and Spanish goats. The preferences for high masculinity and good structure and soundness were relatively higher in Classes 2 and 3 as compared to those in Class 1. The striking difference in the preference results for Class 3 was that the preference intensity of these producers for the Kiko breed was much higher than that in the other 2 classes. One possible explanation for this result could be that the production conditions in those regions may not be highly favorable for other meat goat breeds because of higher nematode problems in the Southeast and colder temperatures in the Northeast. Kiko goats are parasite resistant and have less hoof problems (Wade 2004; Coffey 2006) and they could be more appropriate in those conditions.

Producers selling more slaughter goats and holding bachelor's degrees (Class 1), were more likely to prefer Kiko does with high femininity and good structure and soundness. Producers selling more slaughter goats (Classes 2 and 3) preferred breeding does of two of the three major breeds, especially Kiko, Spanish, as compared to other breeds. High femininity and good structure and soundness were also among their preferred traits. Producers residing in Texas and Oklahoma relative to Midwest (Class 3) tended to prefer Boer does and were less likely to prefer Spanish does. Furthermore, these producers were more likely to select does with good

structure and soundness and less likely to select >2 year old does. Lower prices were preferred among all classes.

3.4. Discussion and Conclusions

Since the quality of animals produced depends partially upon the breeding stock used, it is important to identify the most desirable characteristics of animals so that the enhancement of those characteristics can be made and the commercial production of animals improved. This study investigates producer preferences for meat goat breeding stock attributes using a choice-based conjoint study of U.S. meat goat producers. Five major attributes selected for the study were masculinity/femininity, structure and soundness, age, breed, and price. A mixed logit model with latent classes was used for the analysis.

Strong preferences were found for masculinity/femininity, structure and soundness, and the Boer breed whereas animal age, Kiko, Spanish, and price were less likely to be preferred. Almost all of the producers considered masculinity, femininity and structure and soundness while purchasing breeding stock. The higher tendency to select animals with these attributes was probably because of their expected higher production potential and strong physical qualities that could be transferred into offspring. Although the Boer breed was almost equally preferred for both bucks and does, the share of the population that did not prefer Kiko and Spanish goats was smaller for does, indicating that more producers would purchase a Kiko/Spanish doe as compared to a Kiko/Spanish buck. One of the reasons for this could be that producers may choose to use a Boer buck for multiple Kiko and Spanish does so as to reduce the cost of production – as breeding Boer goats are considered relatively more expensive than others, and crosses can still produce goats with Boer qualities, i.e. muscular kids with red-heads (Coffey 2006).

WTP estimates showed that the attributes in this study were preferred in the order of structure and soundness, Boer, masculinity/femininity, age, Kiko, and Spanish. Results showed that preference differed according to farm characteristics, producer demographics and location of the farm. Further explaining the mixed logit results, the latent class model unveiled that there was a stronger preference for Kiko and Spanish goats among the slaughter goat producers as compared to breeders and show goat producers, whereas the preference for masculinity/femininity and structure and soundness remained positive for all classes. Overall, the results provided strong evidences of heterogeneity in producer selection of meat goat breeding stock. The meat goat industry could benefit by considering the niches of production, especially the types of breed preferred in certain production systems as well as the suitability of production region for those breeds.

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CHAPTER 4: THE IMPACT OF MARKETING CHANNELS USED BY U.S. MEAT GOAT PRODUCERS ON FARM PROFITABILITY

4.1. Introduction

The United States meat goat industry has been rapidly increasing in size over the past few decades, although total domestic production is yet to meet its total demand. Effective product marketing is one of the most important aspects of any business enterprise, and the meat goat industry is not an exception to this. To successfully market products, it is important for a producer to have answers to three questions: (1) what, (2) where, and (3) when (Jones and Raper 2012). To partially answer the "what" question, a significant portion of the U.S. goat meat demand is for live goats, a contrast to other livestock industries where most of the consumer demand is for meat. As for "where," most of the U.S. meat goat production occurs in Texas and the Southeast whereas the major goat meat consuming population resides on the west and east coasts of the country (Pinkerton et al. 1991). As for "when," goat meat demand is seasonal, as it is more heavily consumed during various ethnic holidays. Sound understanding of market dynamics helps not only in making immediate marketing decisions but also provides insights in designing future production strategies. This study further addresses each of these marketing questions.

A number of studies have addressed meat goat marketing dynamics and price seasonality in the U.S. and around the world (Aduku et al. 1991; Pinkerton et al. 1991; Degner and Lin 1993; Glimp 1995; Frasor 2004; Larson and Thompson 2005; Pandit and Dhaka 2005; Jodie and McCarter 2012; and Jones and Raper 2012), but we have found no previous studies dealing with the what, where, and when questions of marketing, which are prerequisites for a sustainable and competitive U.S. meat goat industry. Using data collected from a nationwide mail survey, this

study provides comprehensive information on the types of meat goats produced in the U.S., when producers market them, and where they market them. This study further investigates the factors affecting the profitability of U.S. meat goat farms.

The specific objectives of this study are to determine: (1) how meat goats are marketed in the U.S. and the factors affecting producer selection of marketing channels, (2) the interrelationship between the types of meat goats produced and the targeting of ethnic holidays, and (3) the factors affecting profitability of the meat goat enterprise, i.e., which marketing channels led to greater farm profit. Seven major meat goat marketing channels are analyzed in this study: (a) live auctions, (b) dealers, brokers, or meat packers, (c) wholesale and retail businesses, (d) selling of goat meat, (e) direct sale to consumers, (f) market pooling, and (g) cooperatives. A clear understanding of marketing channel selection decisions made by different segments of producers could have implications in that a more efficient marketing system could be developed. A better understanding of the ethnic markets and corresponding production strategies could help lead the meat goat industry to better marketing management.

4.1.1. U.S. Meat Goat Industry and Ethnic Demand

The U.S. population has increased significantly over the last 60 years (152.3 million in 1950 to 308.7 million in 2010) and a primary contributor has been immigration (Shrestha and Heisler 2011). The foreign-born population residing in U.S. in 2005 was 12% of the total; the percentage is projected to be 19% by 2050 (Passel and Cohn 2008). Hispanics and the Asian population were 14% and 5% of the total in 2005, respectively, expected to rise to 29% and 9%, respectively, by 2050. Having a significant increase in immigrants especially from goat meat consuming nations, the U.S. demand for meat goats has increased in recent years, and should continue to increase as long as there is growth in the immigrant population. Although there has

been considerably increased domestic meat goat production over the last few decades, the U.S. continues to fulfill its demand by importing frozen meat from Australia and New Zealand. Meat goat imports of 1,749 metric tons in 1991 increased to 15,752 metric tons in 2011, equivalent to approximately 1,052,340 live goats (Stanton 2012). Since most consumers prefer fresh meat over frozen, there is significant potential for growth and development of domestic meat goat production (Knudson 2006).

In a typical meat goat supply chain, first, meat goats are marketed to the nearby live auction markets. Second, dealers purchase them and sell them to meat packers, wholesale businesses, or via regional auctions. Third, meat packers (who also have slaughterhouses) sell meat cuts or carcasses to retailers and wholesale businesses arrange for further processing of animals (Stanton 2006). This typical scenario is by no means universally the case for all farms and locations, as some producers market direct to consumers, market goat meat, etc. In addition to the availability of markets, the advantages/disadvantages associated with alternative markets are also considered to have significant impacts on producer marketing decisions.

The type and quality of meat goat demanded varies with ethnicity. For instance, halal is preferred by Muslims; castrated males are preferred by Hindus, but in certain circumstances uncastrated young males are also accepted. According to the sheep and goat marketing calendar released by Cornell University (http://sheepgoatmarketing.info/calendar.php), on Christmas and Hispanic holidays, milk-fed kids (18 pounds) and suckling kids (15-30 pounds), respectively, are preferred. The Easter holidays require goats weighing 20 to 50 pounds, with 30 pounds optimum. For Ramadan, 45-120 pound kids with all their milk teeth (<12 months) are preferred. Both male and female kids are accepted. On the other hand, for Caribbean holidays, 60-80 pound bucks are preferred. Irrespective of the rigidity of consumer preferences, it is advantageous from the

producer side to supply the most preferred product to the market, which guarantees not only consumer satisfaction but also the chances of greater economic return.

4.2. Data and Methods

A mail survey was sent to 1,600 U.S. meat goat producers during July and August, 2012, using Dillman et al. (2009). Producer names were collected online. Phrases like "meat goat producers in Louisiana," "meat goat association, LA," or "meat goat farms, Louisiana" were entered for each state and 4-5 Google pages were thoroughly visited if there were any web-links available for the meat goat producers. Most of the producers were found as members of meat goat associations, or they were listed in www.eatwild.com. Some of the addresses were also collected by individually visiting the respective websites of the farms. The first round of mailing included a cover letter, a ten page questionnaire, a complementary pen, and a postage-paid return envelope. After one week, the first postcard reminder was sent to non-respondents. This was followed by a new cover letter, a survey, and a return envelope to non-respondents two weeks later. One week later, a final reminder (second postcard) was sent. All of the follow-ups were made only to the non-respondents as of the date. After removing 190 producers who did not produce meat goats during 2011 and 52 undeliverable from the total population, an adjusted response rate of 43% was received with the 584 completed responses.

To determine the marketing channels producers used, the following question was asked: "Which of the following marketing channels do you use to sell goats? (Check all that apply)," with possible choices: (a) Dealers, brokers, or meat packers, (b) Wholesale and retail businesses, (c) I sell goat meat, (d) Live auctions, (e) Market pooling, (f) Direct sale to consumers, and (g) Cooperatives. The above question was followed by: "If you answered that you sell goat meat [(c)], through what outlets do you market the meat?," with possible choices: (a) Farmers markets,

(b) Direct to consumers, (c) Grocery stores, (d) Restaurants, and (e) Other. To meet the second objective, a question was asked as follows: "Do you target your goat production for specific ethnic holiday markets?," with possible choices of "Yes" and "No." Producers responding "Yes" to the above question were directed to a follow-up question as follows: "For which of the following holiday seasons do you generally focus sales? (Circle all that apply)," with the following possible choices: (a) Easter, (b) Ramadan, (c) Id al Adha, (d) Hispanic holidays, (e) Christmas and/or New Year, (f) Dashain, (g) Caribbean holidays, and (h) Other. Most of these ethnic holidays have their own characteristic demands for specific types of meat goats. To study the consistency between the use of ethnic holiday markets and an annual goat sale, information on different types of meat goats sold were collected by the following question: "Please list the total number of goats you sold in each of the following categories during 2011." Possible choices were: "(a) Suckling kids, (b) Weaned kids (≤30 lbs), (c) Wethers (>30 lbs), (d) Bucks (31- 120 lbs), (e) Bucks (>120 lbs), (f) Does (31-100 lbs), (g) Does (>100 lbs), and (h) Other."

At the end of the survey, producers were asked if they were willing to participate in a follow-up survey related to production costs and returns. A total of 433 producers responded "yes." Two follow-ups were sent and 127 completed responses were received. Total dollar value received from selling meat goats, breeding stock, and goat meat was considered as meat goat enterprise return. Categories of operating expenses and marketing charges were summed as enterprise costs.

4.2.1. Producer Selection of Marketing Channels

Producer farm decisions are generally driven by economic concerns. Even if producers are heavily motivated by "hobby" farming and/or their affinity to nature and the environment, they are generally also concerned about the economic benefit they receive from farming and may

be assumed to be profit maximizers. Since marketing is one of the crucial stages of the production process, producers are expected to select marketing channels with respect to their availability, ease of use, and associated economic advantages. Generally, producers evaluate all possible alternatives that are available and make decisions that best represent their farming situations. In this study, we describe the producer selection decision using the following equation:

(4.1) *Selection of Marketing Channel(s) = f (Demographic Variables, Farming Characteristics, Production Systems, Economic Indicators, Regional Variables)*

Since the selection of a marketing channel can be described as a discrete choice (1 if selected; 0 if not selected), the probability distribution of their selection can be estimated by using the probit (normal distribution) function (Judge et al. 1988). In accordance with Greene (2008), the probability of a producer selecting a given marketing channel can be described as:

(4.2) $\text{Prob}(Y=1|\text{X}) = \int_{-\infty}^{x'\beta} \phi(t)dt = \Phi(\text{X}'\beta)$

The function $\Phi(.)$ is defined as the normal distribution function, *Y=1* denotes that the marketing channel has been selected, X is a vector of explanatory variables hypothesized to influence the selection decision, and β is the vector of parameter estimates.

Marginal effects for continuous and dummy variables are respectively estimated as follows (Greene, 2008):

(4.3) $\frac{\partial E[y|\text{X}]}{\partial \text{X}} = \phi(\text{X}'\beta)\beta$

where $\phi(.)$ is the standard normal density, and

(4.4) $\text{Prob}[Y = 1|\, \overline{X}_d, d = 1] - \text{Prob}[Y = 1|\, \overline{X}_d, d = 0]$

where $\overline{X}_d$, denotes the means of all the other variables in the model. Separate probit models were run for each of the market outlets.

4.2.2. Independent Variables Used in the Probit Models

Num_meatgoats is the average total number of meat goats raised on the farm, serving as a proxy for farm size. Gillespie et al. (2004) found that larger-scale producers selected video auction and alternative markets over the conventional auction in the beef industry. Schmitz et al. (2003) found that herd size in U.S. stocker production was positively correlated with video and internet auction usage and with private treaty sales. They also argued that larger-scale producers could take advantage of an increased number of marketing alternatives as compared to smaller-scale producers. In this study, it was expected that larger-scale producers would more likely select to market via dealers, wholesalers, and/or auction markets. *Sale_slaugh%* is the percentage of goat sales for slaughter or as meat. Direct selling of slaughter goats to consumers at the farm-gate is a common marketing practice in areas where ethnic groups reside. Auction markets, dealers, and direct selling of goat meat are expected to be more likely used when the percentage of sales going to slaughter rises. Lower percentages of sales to slaughter suggest higher percentages for breeding, show, and other purposes, which would tend to be sold direct to consumers.

Age is a continuous variable representing the producer's age in 15-year intervals, starting at 30 years. *Bachelor* is a dummy variable indicating whether a producer holds at least a college bachelor's degree. *Offfarmjob* is a dummy variable indicating the producer held an off-farm job. Producers with off-farm jobs are generally expected to have less time available to spend on farm activities so are expected to be less likely to sell meat goats direct to consumers or to sell goat meat. On the other hand, they are expected to be more likely to use marketing outlets that require relatively less marketing effort, such as cooperatives and market pooling where generally the major marketing responsibilities are taken by the market coordinator(s). *Risk averse* is a dummy

variable indicating that the producer tends to avoid risk when possible in investment decisions. It was derived from the question, "Relative to other investors, how would you characterize yourself?," with the potential responses, "I tend to take on substantial levels of risk in my investment decisions," "I tend to avoid risk when possible in my investment decisions," and "I neither seek nor avoid risk in my investment decisions," as developed by Fausti and Gillespie (2006). Producers selecting the second alternative were considered as risk averse. *Farm_income* is a continuous variable indicating the percentage of annual net farm income derived from the goat operation. The greater the *Farm_income*, the lower is the farm diversification.

Four basic production systems may be used on U.S. meat goat farms. In the pastured but not rotated system, *PAS_notrot%*, goats are pastured without using a management intensive rotational grazing system. In pastured and rotated, *PAS_rot%*, pastures are cross-fenced into "paddocks" so that the animals can be easily monitored in terms of grazing, forage supply, health, safety, etc. Animals are rotated in this system. In a dry lot, *Drylot%*, goats are kept in a dry lot where there is no growing forage. Goats are fed with purchased feed and/or hay. Extensive-range or pasture/woods, *Extensive%*, was used as the base. In the extensive system, goats are not handled much. They are kept on large tracts of pasture or rangeland, mostly "fending for themselves." Goats forage for food and care for young with minimal assistance (Coffey 2006).

Regional variables, *Southeast* (AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV), *Northeast* (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT), *Midwest* (KS, IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, and WI), and *West* (AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY) were used to explore the geographical differences in meat goat marketing around the nation. Land quality, market availability, prices, and other factors differ by

region; therefore producer selection of marketing channels is also expected to differ across the country. *Texas/Oklahoma* (TX and OK) was used as the base. Texas is the largest meat goat producing state and Oklahoma is the third largest.

4.2.3. Profitability Measures

There are two major approaches used in estimating farm profitability: the whole-farm approach (Kopke et al. 2008, Young et al. 2011), and the enterprise approach (McBride et al. 2004, Gillespie et al. 2009); sometimes both are used (Tauer and Knoblach 1997, Gillespie et al. 2010). Using the whole-farm approach, profit is estimated for the entire farm whereas in the enterprise approach it is estimated only for the particular enterprise of interest. Profit can be estimated per unit of land, per unit of output, per unit of breeding animals, or otherwise. Since land quality and output prices differ widely across the U.S., thereby requiring estimation adjustments, we chose to estimate profit per breeding doe. Similar to Tauer and Mishra (2006) with dairy, we found significant correlation between the total number of breeding animals (does) and their production (number of goats produced), with a correlation coefficient of 0.88. Advantages of using per unit breeding-animal-based analysis is that it is one major consistent measure of estimation and can be predetermined unlike other farm products, such as milk production, that are stochastic in nature and are possibly correlated to the error terms (Tauer and Mishra 2006).

4.2.3.1. Estimating Cost of Production

Costs associated only with meat goat production were measured directly and those measured for the entire farm were adjusted according to the share of meat goat revenue relative to total revenue. Direct total cost of meat goat production includes: operating costs (purchases of meat goats; purchased feed; bedding and litter expenses; medical supplies, veterinary, and

custom services; fuels, oils and lubricants; electricity; maintenance and repair for the upkeep of all farm buildings, land improvements, and all other farm/ranch improvements; depreciation of farm assets used for breeding goats; cash wages paid to hired farm and ranch labor plus payroll taxes and benefits; cash value of feed, farm commodities, fuel, housing, meals, other food, utilities, vehicles for personal use, and other non-cash payment for farm work) and marketing and storage expenses.

Other operating expenses shared for the entire farm include: seeds, sets, plants, seed cleaning and treatments, transplants, trees, and nursery stock; nutrients, fertilizer, lime, and soil conditioners; bio-controls and agricultural chemicals for crops, livestock, poultry, and general farm use; all other utilities and water for irrigation; water purchased for irrigation or otherwise, internet access etc.; farm supplies, marketing containers, hand tools, and farm shop power equipment; repairs, parts, and accessories for motor vehicles, machinery, and farm equipment; insurance for the farm business; interest and fees paid on debts for the operation; property taxes paid on farm real estate (land and buildings), livestock, machinery, and other farm production items; renting or leasing of tractors, farm vehicles, equipment, or storage structures; farm vehicle and licensing fees; custom work, performed by machines and labor hired as a unit; and professional or farm management services such as record-keeping, accounting, tax and business planning, farm product advice, conservation practices, etc. For most expenses, producers were asked to allocate the amount that was used for the meat goat enterprise. For those that were not, such as farm vehicle and licensing fees, they were allocated to the goat enterprise according to the percentage of total farm revenue from meat goats.

4.2.3.2. Estimating Returns

Total meat goat related revenue was estimated by summing the total sales of goats for meat, breeding stock, and goat meat. Other farm revenue was generated by the sale of field crops, hay and silage, fruits and vegetables, animals and animal products other than meat goats and their related products. Net enterprise profit was estimated by subtracting meat goat related total costs from those of total meat goat related revenue. Net enterprise profit was divided by the total number does bred in 2011.

4.2.4. Factors Affecting Farm Profitability

Enterprise profit per breeding doe was modeled as the following OLS equation:

(4.5) *Profit = f*(*Marketing Channels, Number of Meat Goats, Types of Animals Sold, Producer Demographics, Production Systems Used, Regional Variables*)

Independent variables used in this equation include the marketing channels analyzed in the first-stage probit runs. Since marketing channel selection and profit may be simultaneously determined, endogeneity was suspected. Testing for endogeneity was conducted for each of the marketing channels by using the Hausman test[3]. The first-stage probit models were run with the core variables and the respective instruments for each marketing channel. Then, the residuals from each of those models were included in the second-stage ordinary least squares regression

[3] Four different instruments, *smallacre*, *targmarket*, *foreign*, and *marketinfo*, respectively, were used for sales to dealers, selling of meat, direct to consumer, and auction market. *Smallacre* represents the extent of producers' agreement that 'they can raise goats on a relatively small acreage' as a reason of selecting goat enterprise as opposed to other agricultural enterprises. *Targmarket* indicates that producers target their goat production to specific ethnic holiday markets. *Foreign* indicates the extent to which producers agree or disagree that the surplus supply of foreign goat meat product has significant negative impacts on goat producers in their areas. *Marketinfo* indicates the total number of primary information sources producers use to gather information on market prices of goats, including extension service; media - TV, radio, or magazines; other farmers; the internet; farm organizations; and others.

models on farm profitability. The significance of the residuals in an OLS regression would serve as an indicator of endogeneity. No endogeneity problem was found.

To determine whether the follow-up cost and returns survey had any selection bias issues, producer demographics and other major socioeconomic variables from the two data sets were compared. There were 63 meat goats per farm according to the first survey, whereas in the follow-up survey the number was 54. Both surveys estimated the average age of the producers to be 52 years. Producers holding college bachelor's degrees were 42% and 55% in first and second surveys, respectively. According to the first survey, 60% of the producers held off-farm jobs whereas in the second survey, the percentage was 65%. Forty-six percent and 43% of the producers considered themselves to be risk averse, according to first and second survey, respectively. According to the first survey, on average, 45% of the animals were sold for slaughter or as meat whereas for the second survey, the estimate was 42%. No significant differences at $P \leq 0.10$ were found for any of the variables.

4.2.5. Monte Carlo Simulation for Profitability Measures

Since the profitability analysis was conducted using a relatively smaller sample size (127 observations), basic sampling properties of the data could be a possible issue of consideration. We conducted a skewness/kurtosis test for normality, and it failed to prove that the enterprise profit was normally distributed, hence suggesting a simulation run for better investigating the finite-sample distribution of OLS estimators (Cameron and Trivedi 2010). A Monte Carlo (MC) simulation method was selected. More details about this method can be found in Cameron and Trivedi (2010), Adkins and Gade (2012), and Kiviet (2012). Considering the normal distribution of errors and using the coefficients derived from OLS run, the following data generating process (DGP) was conducted:

(4.6) $$Total\ Profit\ per\ Doe = 1 + 37.2942 * Dealer + 340.9718 * Sell\ Meat - 191.2445 * Direct\ to\ Consumer + 192.2797 * Live\ Auction + 4.438433 * Number\ of\ Meat\ Goats + 5.066669 * \%Sale\ Slaughter + 19.93627 * Age + 143.5451 * Bachelor's\ Degree + 420.7979 * Off\ Farm\ Job + 191.417 * Risk\ Averse + 39.18986 * Farm\ Income\ from\ Goat\ Operation - 0.7522 * \%PAS\_NotRot - 0.2824 * \%PAS\_Rot - 7.1010 * \%Drylot + 196.3402 * Southeast + 172.8548 * Northeast - 325.644 * Midwest + 28.90363 * West + u_i$$

where, $u_i \sim N(0, 1)$ is the error term derived from a standard normal (*rnormal* (0, 1)) variable, and *N* is the total number of observations in the profit model. Simulation was conducted twice for 500 and 10,000 replications, so that the validity of the results could be tested for both a relatively smaller sample size and a considerably larger population. We used a t-test of $P \leq 0.10$ to determine if the coefficients estimated from the OLS were equivalent to those with the MC simulations.

4.3. Results

Table 4.1 shows the use of different marketing channels by U.S. meat goat producers. The two marketing channels found to be the most commonly used were *direct to consumer* (79%) and *live auction* (65%), whereas others were used by relatively smaller portions of the population. Fifteen percent of the producers used *dealers, brokers, or meat packers*, 11% *sold goat meat*, 5% used *market pooling*, 3% used *wholesale and retail businesses*, and 3% used *cooperatives*. Since very few farms used 3 marketing channels (*wholesale and retail businesses, market pooling, and cooperatives*), only the 4 more frequently used marketing channels (*direct*

sale to consumer, *live auction*, *dealers, brokers, or meat packers*, and *I sell goat meat*) were used in the profitability runs.

Table 4.2 shows the percentage of producers targeting their sales for different ethnic holiday markets. Only 22% of producers targeted their meat goat sales to any of these specific ethnic holiday markets. Of those, most producers (18%) targeted Easter, followed by Ramadan and Christmas/New Year (11% each). Hispanic holidays were targeted by 9% of the producers. Other holiday markets Id al Adha, Caribbean holidays, Dashain, and others were used by considerably smaller percentages of the population, 3%, 1%, <1%, and <1%, respectively.

Table 4.1: Percentage Use of Marketing Channels

Marketing Channels	Percent using (First survey 583 obs.)	Percent using (Second survey 127 obs.)
Direct sale to consumer	79	81
Live auction	65	63
Dealer, brokers, or meat packers	15	15
I sell goat meat	11	15
Market pooling	5	5
Wholesale and retail businesses	3	2
Cooperatives	3	5

Table 4.2: Percentage of Producers Targeting Sales to the Specific Ethnic Holidays

Ethnic holidays	Percent Targeting
Easter	18
Ramadan	11
Christmas and/or New Year	11
Hispanic holidays	9
Id al Adha	3
Caribbean holidays	1
Dashain	<1
Other	<1

Note: A total of 22% producers targeted ethnic holidays

Table 4.3 provides the means and standard deviations of the total numbers of goats sold by the producers under different categories. Does weighing 30-100 pounds were the most commonly sold animal category with an average of more than 10 animals, followed by wethers weighing >31 pounds with an average of more than 9 animals per year. Averages of 7.5 bucks weighing 31-120 pounds were sold, followed by does weighing >100 pounds with an average of 4.9 animals, and weaned kids weighing ≤30 pounds with an average of 4.2 animals. Few bucks were sold (1.3 animals) weighing >120 pounds. On average, less than one suckling kid was sold.

Table 4.3: Summary Statistics of Total Numbers of Goats Sold in 2011 under Different Categories

Categories	Mean	Std. Dev.
Suckling kids	1.0	5.5
Weaned kids (≤30 lbs)	4.2	15.9
Wethers (>30 lbs)	9.4	22.0
Bucks (31-120 lbs)	7.5	18.1
Bucks (>120 lbs)	1.3	4.3
Does (31-100 lbs)	10.4	20.0
Does (>100 lbs)	4.9	10.6

4.3.1. Summary Statistics of the Variables Used in This Study

Table 4.4 describes the summary statistics of the independent variables used in the probit models for producer selection of marketing channels. On average, there were 61 meat goats per farm. The average age of survey respondents was 52 years and 45% of the respondents held at least a bachelor's degree. Sixty-one percent of the respondents held an off farm job and 45% considered themselves as risk averse. The average annual net farm income derived from the goat operation was 40%. Forty-five percent of the goats sold in 2011 were slaughter goats. Geographically, most of the respondents were in the *Southeast* (36%) and *Midwest* (37%); and significantly smaller shares were in the *Northeast* (7%), *West* (9%), and *Texas/Oklahoma* (11%).

Table 4.4: Means of Independent Variables Used in the Probit Runs

Variables	Description	Mean
Num_meatgoat	Total number of meat goats in the farm	60.84
Sale_Slaugh%	Percentage of goat sold for slaughter or as meat	44.61
Age	Producer age (years): (a) ≤30, (b) 31-45, (c) 46-60, (d) 61-75, (e) ≥76	51.91
Bachelor	*Dummy* = Whether producer holds at least a bachelor's degree: (a) Less than high school, (b) high school diploma/GED, (c) some college/technical college, (d) bachelor's degree, (e) advanced degree (M.S., Ph.D., J.D., M.D., etc.)	0.45
Offfarmjob	*Dummy* = Whether a producer holds an off farm job	0.61
Riskaverse	*Dummy* = Producer self-characterization relative to other investors: (I tend to avoid risk when possible in my investment decision.)	0.45
Farminc_goat	Percentage annual net farm income derived from goat operation: (a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) 80-100%	39.86
Extensive%	Percentage of meat goats raised under this system	10.53
PAS_NotRot%	Percentage of meat goats raised under this system	28.59
PAS_Rot%	Percentage of meat goats raised under this system	47.84
Drylot%	Percentage of meat goats raised under this system	13.03
Southeast	Producers belong to the states: AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV	0.36
Northeast	Producers belong to the states: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, and VT	0.07
Midwest	Producers belong to the states: KS, IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, and WI	0.37
West	Producers belong to the states: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY	0.09
Texas/Oklahoma	Producers belong to the states: TX, and OK	0.11

4.3.2. Factors Affecting Producer Selection of Meat Goat Marketing Channels

Probit results in Table 4.5 suggest that larger-scale producers were generally greater users of dealers and wholesale markets, with 100 additional goats increasing the probability of producers using dealers by 0.07. Producers selling higher percentages of slaughter animals were greater users of dealers, live auctions, cooperatives, and selling goat meat, and were lesser users of direct sale to consumers. An additional percentage of slaughter animal sales increased the probability of the producer using dealers and live auctions by 0.002 each, selling goat meat by

Table 4.5: Probit Runs on Producer Selection of Marketing Channels

	Dealers		I Sell Goat Meat		I Sell Directly to Consumers		Auction	
	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)
Num_meatgoats	0.0030***	0.0007***	0.0002	0.0000	-0.0006	-0.0002	0.0010	0.0003
	(0.0011)	(0.0002)	(0.0012)	(0.0002)	(0.0011)	(0.0003)	(0.0010)	(0.0004)
Sale_slaugh%	0.0091***	0.0020***	0.0046**	0.0007**	-0.0098***	-0.0026***	0.0052***	0.0018***
	(0.0020)	(0.0004)	(0.0023)	(0.0003)	(0.0020)	(0.0005)	(0.0017)	(0.0006)
Age	0.0167	0.0036	-0.1258	-0.0185	-0.0076	-0.0020	-0.1683**	-0.0583**
	(0.0821)	(0.0179)	(0.0980)	(0.0147)	(0.0812)	(0.0211)	(0.0722)	(0.0247)
Bachelor	0.2357*	0.0513*	0.2209	0.0325	0.1936	0.0504	-0.3414***	-0.1183***
	(0.1429)	(0.0312)	(0.1675)	(0.0244)	(0.1356)	(0.0351)	(0.1196)	(0.0405)
Offfarmjob	0.1926	0.0419	-0.5261***	-0.0775***	0.0155	0.0040	-0.0448	-0.0155
	(0.1579)	(0.0342)	(0.1726)	(0.0258)	(0.1433)	(0.0373)	(0.1310)	(0.0454)
Farminc_goat	0.0232	0.0051	0.0065	0.0010	0.0114	0.0030	0.0137	0.0048
	(0.0432)	(0.0094)	(0.0511)	(0.0075)	(0.0409)	(0.0106)	(0.0354)	(0.0123)
PAS_Notrot%	0.0009	0.0002	-0.0010	-0.0001	0.0002	0.0001	0.0054**	0.0019**
	(0.0030)	(0.0007)	(0.0035)	(0.0005)	(0.0026)	(0.0007)	(0.0024)	(0.0008)
PAS_Rot%	0.0015	0.0003	0.0048	0.0007	0.0010	0.0003	0.0036	0.0012*
	(0.0029)	(0.0006)	(0.0032)	(0.0005)	(0.0025)	(0.0007)	(0.0022)	(0.0008)
Drylot%	0.0058	0.0013	-0.0022	-0.0003	0.0025	0.0006	0.0025	0.0009
	(0.0036)	(0.0008)	(0.0045)	(0.0007)	(0.0034)	(0.0009)	(0.0030)	(0.0010)
Southeast	1.0584**	0.2305**	0.7075*	0.1042*	0.0639	0.0166	-0.2188	-0.0758
	(0.4590)	(0.0983)	(0.4135)	(0.0626)	(0.2553)	(0.0665)	(0.2064)	(0.0713)
Northeast	1.0003*	0.2178**	2.3072***	0.3398***	0.0904	0.0235	-0.5691*	-0.1972**
	(0.5240)	(0.1126)	(0.4446)	(0.0689)	(0.3449)	(0.0897)	(0.2951)	(0.1012)
Midwest	1.2054***	0.2625***	1.0100**	0.1488**	-0.2086	-0.0543	-0.0923	-0.0320
	(0.4582)	(0.0977)	(0.4074)	(0.0624)	(0.2520)	(0.0653)	(0.2092)	(0.0725)
West	0.8047	0.1752*	1.4131***	0.2081***	0.2988	0.0777	-0.5153*	-0.1786**
	(0.4893)	(0.1052)	(0.4374)	(0.0675)	(0.3184)	(0.0830)	(0.2636)	(0.0904)
Constant	-3.1980***		-2.2145***		1.2102***		0.6150	
	(0.6081)		(0.6383)		(0.4542)		(0.3988)	
Observations	512		512		512		512	
Pseudo R^2	0.1078		0.2071		0.0801		0.0566	

Note: ***, **, and * indicate variables significant at $P < 0.01$, $P < 0.05$, and $P < 0.10$ levels respectively.

Table 4.5: Probit Runs for Producer Selection of Marketing Channels, Continued

	Wholesale		Cooperatives		Market Pooling	
	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)	Coeff. (Robust S.D.)	Marg. Eff. (Std. Err.)
Num_Meatgoats	0.0021*	0.0001	0.0003	1.4E-05	-0.0017	-0.0002
	(0.0012)	(0.0001)	(0.0013)	(7.3E-05)	(0.0014)	(0.0001)
Sale_slaugh%	-0.0023	-0.0001	0.0070**	0.0004*	0.0034	0.0003
	(0.0028)	(0.0002)	(0.0033)	(0.0002)	(0.0025)	(0.0002)
Age	0.0016	0.0001	0.2340	0.0132	0.1637	0.0152
	(0.1326)	(0.0074)	(0.1432)	(0.0090)	(0.1049)	(0.0100)
Bachelor	0.4776*	0.0265*	0.1324	0.0075	-0.1295	-0.0120
	(0.2761)	(0.0151)	(0.2394)	(0.0135)	(0.2046)	(0.0189)
Offfarmjob	-0.1061	-0.0059	0.6911**	0.0389**	-0.2769	-0.0257
	(0.2709)	(0.0150)	(0.2974)	(0.0192)	(0.1990)	(0.0186)
Farminc_goat	0.1814**	0.0101**	-0.0065	-0.0004	0.0084	0.0008
	(0.0752)	(0.0043)	(0.0750)	(0.0042)	(0.0589)	(0.0055)
PAS_Notrot%	-0.0099**	-0.0005**	-0.0089*	-0.0005*	-0.0047	-0.0004
	(0.0045)	(0.0003)	(0.0046)	(0.0003)	(0.0037)	(0.0003)
PAS_Rot%	-0.0065	-0.0004	-0.0032	-0.0002	-0.0031	-0.0003
	(0.0040)	(0.0002)	(0.0039)	(0.0002)	(0.0034)	(0.0003)
Drylot%	-0.0090	-0.0005	-0.0020	-0.0001	-0.0019	-0.0002
	(0.0057)	(0.0003)	(0.0055)	(0.0003)	(0.0054)	(0.0005)
Southeast	4.7682***	0.2647***	0.2717	0.0153	4.9702***	0.4608***
	(0.6273)	(0.0722)	(0.4385)	(0.0249)	(0.5410)	(0.0916)
Northeast	6.2586***	0.3475***				
	(0.6268)	(0.0844)				
Midwest	5.1734***	0.2872***	0.4213	0.0237	5.3066***	0.4920***
	(0.6140)	(0.0757)	(0.4262)	(0.0247)	(0.5729)	(0.0965)
West	4.9330***	0.2739***	1.0920**	0.0615**	4.8314***	0.4479***
	(0.6884)	(0.0736)	(0.4456)	(0.0279)	(0.5651)	(0.0903)
Constant	-7.1633		-3.5851***		-6.7608	
	(0.0000)		(0.6535)		(0.0000)	
Observations	512		511		512	
Pseudo R^2	0.2444		0.1628		0.0981	

Note: ***, **, and * indicate variables significant at $P < 0.01$, $P < 0.05$, and $P < 0.10$ levels respectively.

0.0007, and using cooperatives by 0.0004, and decreased the probability of direct sale to consumers by 0.003. Older producers were less likely to use live auctions, with an additional 15 years of age decreasing the probability of using a live auction by 0.06. Producers selling larger numbers of slaughter goats were less likely to *direct sell to consumers* but to sell via *live auction*, which is understandable in that dealing with consumers for individual animals would be cumbersome as the volume of sale increased. One of the limitations of selling directly to consumers is that one needs to be skillful in dealing with customers and to be willing to either bargain or hold firm on the price.

Producers holding a *bachelor's* degree were greater adopters of dealers and lesser adopters of live auction markets, with holding a bachelor's degree increasing the probability of using dealers by 0.05 and decreasing live auctions by 0.12. The producer holding an *off farm job* was negatively associated with selling goat meat and positively associated with marketing via cooperatives. The holding of an off-farm job decreased the probability of selling goat meat by 0.08 and increased the use of cooperatives by 0.04. A possible explanation for this result is that producers holding off farm jobs may have less time to be involved in selling goat meat. In the other hand, they would prefer participating in cooperatives, which mostly assign market coordinators and may require less individual marketing effort.

Producers receiving higher percentages of net farm income from the goat enterprise (*Farminc_goat*) sold more goats via wholesale markets; with a 20% increase in net farm income from goats increasing the probability of using a wholesale market by 0.01. As compared to the producers using extensive-range production systems, the probability of selling via a live auction market was increased by 0.002 if producers were using pastured but not rotated systems (*PAS_NotRot%*) and by 0.001 if they were using pastured with rotation systems (*PAS_Rot%*).

The probability of selecting a wholesale market and selling via cooperatives decreased by 0.0005 each if producer used a pastured but not rotated system.

Results for the regional variables show that, as compared to the producers in *TX* and *OK*, producers in the other regions (*Southeast*, *Northeast*, *Midwest*, and *West*) were greater users of dealers and wholesale markets, and sold goat meat. Producers residing in the *Northeast* and the *West* were more likely to sell meat goats via live auction markets. Producers in the *Southeast, Midwest,* and *West* were more likely to use market pooling. Producers in the *West* were also more likely to form cooperatives in marketing their meat goats. *Northeast* was automatically dropped from the regression by the software for the market pooling and cooperatives. Overall, this result shows that the producer selection of marketing channels varied significantly based on region, which could be primarily because of the availability of the markets, population density and its diversity, and differential cost of production/marketing. The pseudo R-square values ranged from 0.06 to 0.24 across different marketing models, and numbers of observations used were 511-512.

Table 4.6 shows the factors affecting the profitability of the meat goat enterprise. As mentioned earlier, only the four most commonly used marketing channels were used in this analysis. The only marketing outlet that was more likely to lead to greater profit was '*I sell goat meat*'. Producers selling goat meat received $341 more profit per doe in a year, as compared to those who did not sell goat meat. *Selling goat meat* requires significant time searching and maintaining business relationships with clients, maintaining inspection standards, and having reliable sources of regular meat supply. Although producers were inclined towards the marketing channels requiring less marketing effort, the more profitable route found from this study was rather time demanding - *selling goat meat*.

Table 4.6: Profitability Run; OLS Results

Variables	Coefficient	Robust Std. Error
Dealers	37.29	210.44
I sell goat meat	340.97*	174.57
Consumer	-191.24	209.66
Auction	192.28	212.64
Num_meatgoats	4.44*	2.30
%Sale_slaugh	5.07*	2.81
Age	19.94	87.16
Bachelor	143.55	203.20
Off farm job	420.80	285.12
Risk averse	191.42	189.68
Farmincome_goat	39.19	47.21
%PAS_NotRot	-0.75	3.18
%PAS_Rot	-0.28	3.90
%Drylot	-7.10	6.10
Southeast	196.34	265.66
Northeast	172.85	325.50
Midwest	-325.64	384.90
West	28.90	390.54
Constant	-1527.97**	676.49
Observations		94
R^2		0.20

Note: ***, **, and * indicate variables significant at $P < 0.01$, $P < 0.05$, and $P < 0.10$ levels respectively.

Size of the farm (*Num_meatgoats*) and percentage sale of slaughter goats (*Sale_slaugh%*) were also positively associated with enterprise profit. An additional meat goat or a one percent increase in the percentage of goats sold for slaughter increased meat goat enterprise profitability by $4.4 and $5.1, respectively. This suggests that there were significant economies of size and larger producers who sold greater portions of their animals for slaughter purposes or sold goat meat were more likely to receive greater profit from the meat goat business. A total of 94 observations were used in this analysis and the R-square value was 0.20.

All of the simulated means were found to be very close to the OLS coefficients, and no significant difference was found (see Appendix E). Furthermore, all OLS coefficients were found

within the interval of the minimum and maximum range of simulated means, suggesting that the OLS run provided consistent parameters.

4.4. Discussion and Conclusions

Using nationwide survey data, this study examines three major aspects of meat goat marketing in the United States: the extent of and the factors affecting producer use of marketing channels, the type of animals sold and the extent of producers targeting meat goat production to ethnic holiday markets, and the factors affecting profitability of a meat goat enterprise. Results showed that *direct sale to consumer* and *live auction* were the two most commonly used marketing channels in the industry. Very few producers, 11% and 15%, were found to sell goat meat and market via dealers, brokers, or meat packers, respectively, whereas other marketing channels were used by less than 5% each. Farm size, type of animals sold, producer demographics, production systems, and regional variables were found to be significant determinants in producer selection of marketing channels. Only 22% of producers targeted their production for specific ethnic holiday markets. Of those, more than 80% targeted Easter. The indicators of enterprise profit in the meat goat industry were found to be selling goat meat, farm size, and the percentage of meat goat sales for slaughter purposes.

Inconsistency between producer tendency to use specific meat goat marketing channels (*direct sale to consumers* and *live auction*) and associated profitability (higher profit from *selling goat meat*) suggests the need to consider reasons other than economic for the current pattern of producer selection of these channels. Improvements in the efficiency and accessibility of all marketing channels would improve profitability in the industry. Further studies could focus on the reasons for producers using and not using alternative marketing channels so that the improvements needed to each marketing channel could be addressed.

Considering that the majority of meat goat consumers are immigrants and/or part of ethnic groups, the percentages of producer targeting their production for specific ethnic holidays seem rather low. Identifying the possible reasons for this - whether it is lack of producer awareness of those markets or associated higher cost of production (or lower returns) could be another important step for the production of animals with specific attributes of interest.

4.5. References

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CHAPTER 5: SUMMARY AND CONCLUSIONS

Although the U.S. meat goat industry has been rapidly increasing over the last few decades, domestic production has not been able to meet the total demand. As a result of this, the U.S. heavily relies on goat meat imports, primarily from Australia and New Zealand. Considering the very limited previous research available, the U.S. meat goat industry has a need for research and development that will enhance the industry. This study seeks to provide greater understanding of three major areas of U.S. meat goat production: producer goal structure, selection of breeding stock, and marketing.

A mail survey was conducted during July and August, 2012, with U.S. meat goat producers who advertised their farm via the internet or were listed as the members of meat goat associations. Of 1,600 producers surveyed, 774 producers responded, 190 indicating that they did not produce meat goats during 2011 and 584 with completed surveys. Considering 52 undeliverable surveys due to incomplete or changed addresses, the total usable response rate of this survey was 43%.

The first chapter of this dissertation provides a brief introduction of the U.S. meat goat industry. The history of meat goat production and the impacts of the recent trend of immigration are discussed. The second chapter, the first study, determines the goal structure of meat goat producers and the factors affecting goal structure. Producers could choose a meat goat enterprise for a variety of reasons and their investment decisions could vary according to their goal structure. The type of goats produced and their marketing strategies could also be interrelated. In other words, the goals that a producer sets when he/she enters the business could guide his/her farm decisions and production strategies. Seven goals selected for the study that a typical meat goat producer is most likely to consider were: (1) *maximize profit*, (2) *increase farm size*, (3)

avoid years of loss/low profit, (4) *increase net worth*, (5) *have time for other activities*, (6) *control weeds/vegetation*, and (7) *have family involved in agriculture*. We used a fuzzy pair-wise comparison method to determine how farm and farmer characteristics affect meat goat producer goal structure.

The third chapter, the second study, uses choice-based conjoint analysis to elicit producer preferences for meat goat attributes when purchasing breeding stock. Since the quality and quantity of meat goats produced largely depends on the breeding stock used, producers are expected to select breeding stock with certain attributes. By corresponding with meat goat producers, animal scientists, and industry experts, we selected 5 attributes and their levels for breeding bucks and does. Three of those attributes (levels) similar for both bucks and does included: (1) *structure and soundness* (good, poor), (2) *age* (≤2 years, >2 years), and (3) *breed* (Kiko, Spanish, Boer, others), whereas the other two attributes (levels) included: *masculinity* (high, low) and *price* ($1500, $1100, $700, $300) for bucks and *femininity* (high, low) and *price* ($1250, $900, $550, $200) for does. Using an orthogonal and balanced (optimal) design, 16 product profiles were created for both bucks and does, resulting in 8 choice sets for each. A mixed logit with latent class model was used for the analysis.

The fourth chapter, the third study, determined the extent of and factors affecting meat goat producer selection of different marketing channels. Furthermore, determinant of profitability of the meat goat enterprise was also investigated. The marketing channels used in this study include: (1) *dealers, brokers, or meat packers*, (2) *wholesale and retail businesses*, (3) *I sell goat meat*, (4) *live auctions*, (5) *market pooling*, (6) *direct sale to consumers*, and (7) *cooperatives*. Data for the profitability estimation were received via a follow-up survey that was conducted with 433 respondents from the previous survey who agreed to participate in the

follow-up. A total of 127 responses were received. OLS regression was conducted to determine how marketing channel selection impacted meat goat enterprise net profit.

Results suggested that *maximize profit* was the primary goal of meat goat producers followed by *have family involved in agriculture* and *avoid years of loss/low profit*. Two of the top four goals were associated with profit maximization whereas the other two were leisure-related. The two least considered goals were *control weeds/vegetation* and *increase farm size*. Several socio-economic and demographic factors were found to impact producer consideration of goals. Finding no significant relationship between the importance producers placed on the profit maximizing goal and enterprise profit suggested that the U.S. meat goat producers are not necessarily achieving the farm performance consistent with their ultimate goals.

U.S. meat goat producers preferred breeding stock having attributes of high masculinity/femininity, good structure and soundness, and the Boer breed. Age, Kiko, Spanish, and price were found to be less likely to be preferred. Comparing the WTPs for those attributes, structure and soundness had the highest WTP, with "good" structure and soundness being worth $874 for bucks and $639 for does. The Boer breed and high masculinity/femininity had WTP of $482 and $446 for bucks and $419 and $142 for does, respectively. Other attributes had negative WTP values. Latent class results showed that producers selling primarily slaughter goats were more likely to prefer Kiko breed whereas producers selling breeding stock and/or show goats were more likely to prefer the Boer breed.

The two most commonly used marketing channels in the U.S. meat goat industry were direct sale to consumer (79%), and live auction (65%). Dealers, brokers, or meat packers were used by 15% of the producers whereas 11% sold goat meat. The other three marketing channels, market pooling, wholesale and retail businesses, and cooperatives were used by ≤5% of the

producers each. Twenty-two percent of the producers targeted their production to ethnic holiday markets, among which Easter, Ramadan, and Christmas and/or New Years were the most common. Several socio-economic, demographic, and farm characteristics were found to influence producer selection of marketing channels. The size of the farm, percentage sale of slaughter goats, and selling goat meat were found to impact profitability of the meat goat enterprise.

Although the results showed evidence of size economies in this industry, no consistency was found between producers' profit maximizing goals and enterprise profit. Most of the results suggested either negative or low profitability. The most profitable marketing channel found in this study was 'selling goat meat,' which was adopted by a significantly smaller share of the meat goat farmer population (11%). Further study could be directed to more heavily used marketing channels so that they could be made more efficient in terms of marketing. On the other hand, introducing cost-effective production technologies or government support programs could be also useful in improving production as well as the profitability associated to it.

APPENDIX A

"MEAT GOAT PRODUCER SURVEY"

U.S. Meat Goat Production

A Survey

LSU AgCenter Research & Extension

Throughout this survey, you will be asked questions about your goat farm and how you make production decisions. Please circle the answer that best reflects your situation. All information will be held as *strictly confidential.* This is a condition of the grant funding for this project. Thank you!

Section I. Production Practices

1. Did you produce meat goats on your farm during 2011? (a) Yes (b) No

If you answered "Yes" to Question 1, please proceed to Question 2. If you answered "No" to Question 1, please discontinue the questionnaire, place it in the enclosed postage-paid envelope, and mail it back to us. Thank you.

2. Approximately how many acres of land do you farm? _____ acres

3. Approximately how many acres of land are used for your goat operation?_____ acres

4. Of the total land you farm, what percentage do you own? (Circle one)
   (a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) ≥ 80%

5. Do you have the following facilities on your goat farm? (Circle "Yes" or "No" for each)

➢ Working pen	(a) Yes	(b) No	➢ Weaning pen	(a) Yes	(b) No
➢ Breeding pen	(a) Yes	(b) No	➢ Quarantine pen	(a) Yes	(b) No
➢ Kidding pen	(a) Yes	(b) No	➢ Scale	(a) Yes	(b) No
➢ Working Chute	(a) Yes	(b) No	➢ Sheds/barns	(a) Yes	(b) No

6. Please indicate the numbers of goats you have that are of each of the following breeds.

(a) Boer	_____	(d) Myotonic	_____	(g) Savanna	_____	(j) Other	_____
(b) Kiko	_____	(e) Angora	_____	(h) Pygmy	_____		
(c) Spanish	_____	(f) Cashmere	_____	(i) Mixed	_____		

7. Please indicate the total numbers of breeding-aged goats on your farm in each of the following systems.

No. of Breeding-aged Goats	Production System
_____	*Extensive-range or pasture/woods, not handled much:* Goats kept on large tracts of pasture or rangeland, mostly "fending for themselves." Goats forage for food and care for young with minimal assistance.
_____	*Pastured but not rotated:* Goats pastured without using a management intensive rotational grazing system.
_____	*Pastured and rotated:* Pastures cross-fenced into "paddocks" so goats can be restricted to areas and periodically moved to fresh pasture. Management intensive rotational grazing system.
_____	*Dry lot:* Goats kept in a dry lot where there is no growing forage. Purchased feeds and/or hay fed.

8. Other than commercial meat goat production, which of the other following goat production enterprises do you have on your farm? (Circle any that apply)
   (a) Dairy goat
   (b) Fiber goat (mohair)
   (c) Breeding stock sales for commercial herds
   (d) Breeding stock sales for show herds
   (e) Goats purely for brush control
   (f) Other _____

9. What percentages of your goat ***sales*** in 2011 were in the following categories?
   (a) Goats sold for slaughter or as meat _____ %
   (b) Goats sold for use as breeding stock _____ %
   (c) Goats sold for show _____ %
   (d) Others _____ %

10. Is your meat goat operation certified organic? (a) Yes (b) No (c) No, but I am transitioning to it

11. Which of the following animal identification methods do you use? (Circle all that apply)
   (a) Tattooing (c) Microchips (e) Chalk (g) Body branding
   (b) Ear notches (d) Painting (f) Tagging (h) Horn branding

12. Which of the following practices do you apply on your goat herds? (Circle all that apply)
   (a) Castration (b) Disbudding (c) Hoof trimming

   [If you circled (a)], please answer the following. If not, please skip to Question 13.
   Which of the following castration tools do you commonly use? (Circle all that apply)
   (a) Elastrator (b) Burdizzo (c) Knife

13. In what other farm enterprises are you also involved? (Circle all that apply)
   (a) Beef cattle (d) Horses (g) Field crops
   (b) Dairy cows (e) Sheep (h) Forestry
   (c) Exotic animals (f) Other livestock/poultry (i) Fruit and/or vegetables

Section II. Breeding Practices

1. Do you breed does in your operation? (a) Yes (b) No **[Please skip to Section III, Page 3]**

2. How many does did you breed on your farm in 2011? _____ number

3. Please indicate the numbers of kids born alive, stillborn, aborted, and lost to predators during 2011.
   (a) Kids born alive _____ (b) Kids stillborn _____ (c) Aborted _____ (d) Lost to predators _____

4. Of your does that kidded during January-December, 2011, what percentage had twins or triplets? (Circle one)
   (a) ≤ 19 % (b) 20-39% (c) 40-59% (d) 60-79% (e) ≥ 80%

5. What is the average age at which you wean kids on your farm?
   (a) Buck kids: _____ weeks (b) Doe kids: _____ weeks

6. Which of the following reproductive practices were used on your goat herd in 2011? (Circle any that apply)
   (a) Artificial insemination
   (b) Embryo transfer
   (c) Flushing does
   (d) Examine breeding soundness of bucks
   (e) Expose non-cycling females to sterile bucks to induce ovulation
   (f) Use a controlled lighting system to manipulate the breeding season.

7. How do you detect goat pregnancy? (Circle all that apply)

(a) Vulva examination
(b) Cervical examination
(c) Ultrasound scanner
(d) Blood or urine test
(e) Bumping (detect "firmness" within abdomen of doe)
(f) I do not check goat pregnancy
(g) Other _____

8. Do you time the breeding of your does such that goats will kid only during certain times of the year?

(a) Yes (b) No **[Skip to Section III]**

[If Yes to 8] What are your major reasons for timing breeding? (Circle all that apply)

(a) Market timing
(b) Efficient use of bucks
(c) Efficient use of facilities
(d) Efficient use of pastures
(e) Uniform kid weight at sale
(f) Efficient use of artificial insemination/embryo transfer
(g) Other_____

[If Yes to 8] How many defined breeding seasons do you use?

(a) One/year (b) Two/year (c) Three every two years (d) Other _____

Section III. Marketing Practices

1. Please list the total numbers of goats you sold in each of the following categories during 2011.

(a) Suckling kids _____
(b) Weaned kids (≤30 lbs) _____
(c) Wethers (>30 lbs) _____
(d) Bucks (31-120 lbs) _____
(e) Bucks (>120 lbs) _____
(f) Does (31-100 lbs) _____
(g) Does (>100 lbs) _____
(h) Other _____

2. Which of the following marketing channels do you use to sell goats? (Circle all that apply)

(a) Dealers, brokers, or meat packers
(b) Wholesale and retail businesses
(c) I sell goat meat
(d) Live auctions
(e) Market pooling
(f) Direct sale to consumers
(g) Cooperatives

3. If you answered that you sell goat meat **[(c) in Question 2]**, through what outlets do you market the meat?

(a) Farmers markets
(b) Direct to consumer
(c) Grocery stores
(d) Restaurants
(e) Other _____

4. Do you target your goat production for specific ethnic holiday markets?

(a) Yes (b) No **[Skip to 5]**

[If Yes to 4] For which of the following holiday seasons do you generally focus sales? (Circle all that apply)

(a) Easter
(b) Ramadan
(c) Id al Adha
(d) Hispanic holidays
(e) Christmas and/or New Year
(f) Dashain
(g) Caribbean holidays
(h) Other _____

5. What are your primary sources of information for market prices for goats? (Circle all that apply)

(a) Extension service (d) Internet (g) Other_____

(b) Media: TV, radio, magazines (e) Farm organizations

(c) Other farmers (f) I do not attempt to obtain price information.

Section IV. Price Differentials

The following pictures show the three major selection categories of a marketable boer meat goat.

Selection 1 ***Selection 2*** ***Selection 3***

Selection 1 = Pronounced bulging outside hind leg; full, rounded back strip; moderately thick outside shoulder.
Selection 2 = Slightly thick outside leg; slightly full back strip; slightly thick to slightly thin outside shoulder.
Selection 3 = Narrow legs, back, and shoulder with angular and sunken appearance; inferior meat conformation.

1. If you were selling a 50-lb **Selection 1** meat goat ***at a live auction*** today, how much ***more*** money would you expect to receive as compared to that of an equal weight **Selection 2** meat goat? _____ $/animal

2. If you were selling a 50-lb **Selection 2** meat goat ***at a live auction*** today, how much ***more*** money would you expect to receive as compared to that of an equal weight **Selection 3** meat goat? _____ $/animal

Please Answer Questions 3 and 4 *if you sell in markets other than live auctions.* Otherwise, skip to Question 5.

3. If you were selling a 50-lb **Selection 1** meat goat using your current market outlets today, how much ***more*** money would you expect to receive as compared to that of an equal weight **Selection 2** meat goat? _____ $/animal

4. If you were selling a 50-lb **Selection 2** meat goat using your current market outlets today, how much ***more*** money would you expect to receive as compared to that of an equal weight **Selection 3** meat goat? _____ $/animal

5. In 2011, what percentages of your goats sold do you believe were in each of the following categories?

(a) Selection Category Percentage of Goats Sold (b) I don't know

Selection 1 _____ %

Selection 2 _____ %

Selection 3 _____ %

Section V. Perceptions of Important Challenges Currently Facing the Goat Industry

1. To what extent do you agree or disagree that the following challenges are having *significant negative impacts* on goat producers *in your area*? Please select a number in each category based on the headings provided.

Challenges	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
High cost of goat production	1	2	3	4	5
Lack of a clear marketing system for goats	1	2	3	4	5
No grading system for goats	1	2	3	4	5
Lack of a goat meat processor close by	1	2	3	4	5
Lack of steady demand for goat meat	1	2	3	4	5
Pasture management problems	1	2	3	4	5
Diseases	1	2	3	4	5
Internal parasites	1	2	3	4	5
Predators	1	2	3	4	5
Surplus supply of foreign goat meat product	1	2	3	4	5
Insufficient government support for the industry	1	2	3	4	5

2. When bringing new goats into your herd, which of the following practices do you use? (Circle all that apply)
   (a) Determine disease history of the herd of origin
   (b) Determine pre-purchase disease status of the animal
   (c) Acclimatize new animals to the local environment
   (d) Expose a small sentinel group of animals to the new one(s)
   (e) Keep new goats in quarantine for a period of time

   [If you circled (e)]
   How many days do you generally quarantine new goats for observation?
   (a) ≤5 days (c) 11-15 days (e) 21-25 days
   (b) 6-10 days (d) 16-20 days (f) ≥ 26 days

   Do you conduct a physical examination on new goats at a midpoint during the quarantine? (a) Yes (b) No

3. Which of the following predators do you consider to be significant threats to your goats? (Circle all that apply)
   (a) Coyotes (d) Red foxes (g) Other _____
   (b) Bobcats (e) Feral hogs (h) I experience no predator threat
   (c) Mountain lions (f) Domestic and feral dogs

4. Do you use animals to protect your goats from predators? (a) Yes (b) No **[Skip to 5.]**

   [If Yes to 4] Which of the following animals do you use? (Circle all that apply)
   (a) Dogs (b) Donkeys (c) Llamas (d) Alpacas (e) Other_____

5. Do you use high-powered electric fence to protect your goats from predators? (a) Yes (b) No

Section VI. Goal Structure

1. Goat producers may have multiple goals with respect to their farms. Below are some potential goals you may have for your entire farm operation. Some goals are likely to be more important to you than others. **In this section, you will be asked to compare each of seven goals with each of the other goals.** We are interested in how important each goal is when compared to the other goals. Questions will be worded similar to the one in the following example.

> Example: Assume you are asked to compare two goals, **maximize profit** and **increase farm size**. If the goal **maximize profit** were much more important to you than the goal **increase farm size**, then you would place an "X" very near the goal **maximize profit**.
>
> Maximize profit ---**X**----------I---------- Increase farm size.
>
> On the other hand, if the goal **increase farm size** were slightly more important to you than the goal **maximize profit,** then you would place an "X" nearer to the goal **increase farm size**, but closer to the middle.
>
> Maximize profit ----------I---**X**---------- Increase farm size.
>
> If both goals were almost equally important, you would place an "X" at the middle of the line.
>
> Maximize profit ----------**X**---------- Increase farm size.
>
> *Where the "X" is marked on the line will indicate how much more important one goal is than the other.*

As shown above, please indicate your preference for each of the following goals by placing an "**X**" **at the point on the line that best represents your preferences** for each comparison.

Maximize profit ----------I---------- Increase farm size
Maximize profit ----------I---------- Avoid years of loss/low profit
Maximize profit ----------I---------- Increase net worth
Maximize profit ----------I---------- Have time for other activities
Maximize profit ----------I---------- Control weeds/vegetation
Maximize profit ----------I---------- Have family involved in Agriculture
Increase farm size ----------I---------- Avoid years of loss/low profit
Increase farm size ----------I---------- Increase net worth
Increase farm size ----------I---------- Have time for other activities
Increase farm size ----------I---------- Control weeds/vegetation
Increase farm size ----------I---------- Have family involved in Agriculture
Avoid years of loss/low profit ----------I---------- Increase net worth
Avoid years of loss/low profit ----------I---------- Have time for other activities
Avoid years of loss/low profit ----------I---------- Control weeds/vegetation
Avoid years of loss/low profit ----------I---------- Have family involved in Agriculture
Increase net worth ----------I---------- Have time for other activities
Increase net worth ----------I---------- Control weeds/vegetation
Increase net worth ----------I---------- Have family involved in Agriculture
Have time for other activities ----------I---------- Control weeds/vegetation
Have time for other activities ----------I---------- Have family involved in Agriculture
Control weeds/vegetation ----------I---------- Have family involved in Agriculture

2. To what extent do you agree or disagree that your **selection of a goat enterprise as opposed to other agricultural enterprises** is because of the following reasons? Please circle a number for each statement based on the headings provided.

	Strongly agree	**Somewhat agree**	**Neutral**	**Somewhat disagree**	**Strongly disagree**
Strong market demand and prices for goats	1	2	3	4	5
Low cost to purchase and raise goats	1	2	3	4	5
Sustainable control of weeds and brush	1	2	3	4	5
Goats are prolific breeders	1	2	3	4	5
Goats combine well with cattle enterprises	1	2	3	4	5
Goat production is profitable	1	2	3	4	5
Goat production is fun / a hobby	1	2	3	4	5
My family can be involved in the goat enterprise	1	2	3	4	5
I can raise goats on a relatively small acreage	1	2	3	4	5
I enjoy working with goats	1	2	3	4	5
Goat production fits well into my land management plan	1	2	3	4	5
Goat grazing preferences are different from other species	1	2	3	4	5
Goats have shorter production cycles than other agricultural enterprises	1	2	3	4	5
A high level of skill is not mandatory for producing goats	1	2	3	4	5

Section VII. Grading System and Breeding Stock

1. Body Condition Scoring (BCS) gives an indication of available fat reserves that can be used by the animal. BCS ranges on a scale from 1 to 5. Do you regularly measure BCS on your goats? (a) Yes (b) No **[Skip to 2.]**

[If Yes to 1] What percentages of your total goats generally have BCS ≥ 3? (Circle one)
(a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) ≥ 80%

2. **Breeding Stock**

In this section, we ask you to compare several hypothetical profiles of breeding bucks. Each animal in the following comparisons has different characteristics. *Other than the characteristics provided,* imagine that the animals are identical.

Note: By '***Masculinity***', we mean that the buck is powerful, has a wide/strong head, and has a smooth scrotum.

By '***Structure and Soundness***', we mean the buck has good bone/muscle structure, and is healthy.

By '***Others***', we mean breeds other than Boer, Spanish, and Kiko.

You will be asked to choose between bucks for breeding with different characteristics. For each choice, please indicate whether you would actually purchase the buck if it were the only available option in the marketplace.

Breeding Bucks

Choice 1

Attributes	Buck A	Buck B
Masculinity	Low	Low
Structure & Soundness	Good	Good
Age	≤2 Years	>2 Years
Breed	Kiko	Boer
Price	$300	$1500

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 2

Attributes	Buck A	Buck B
Masculinity	Low	High
Structure & Soundness	Poor	Poor
Age	>2 Years	≤2 Years
Breed	Boer	Spanish
Price	$1100	$1100

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 3

Attributes	Buck A	Buck B
Masculinity	High	Low
Structure & Soundness	Good	Poor
Age	≤2 Years	≤2 Years
Breed	Spanish	Kiko
Price	$1500	$700

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 4

Attributes	Buck A	Buck B
Masculinity	High	Low
Structure & Soundness	Poor	Poor
Age	>2 Years	>2 Years
Breed	Kiko	Spanish
Price	$1500	$300

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 5

Attributes	Buck A	Buck B
Masculinity	Low	Low
Structure & Soundness	Good	Poor
Age	>2 Years	≤2 Years
Breed	Spanish	Others
Price	$700	$1500

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 6

Attributes	Buck A	Buck B
Masculinity	High	Low
Structure & Soundness	Poor	Good
Age	≤2 Years	≤2 Years
Breed	Boer	Others
Price	$300	$1100

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 7

Attributes	Buck A	Buck B
Masculinity	High	High
Structure & Soundness	Good	Poor
Age	>2 Years	>2 Years
Breed	Kiko	Others
Price	$1100	$700

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Choice 8

Attributes	Buck A	Buck B
Masculinity	High	High
Structure & Soundness	Good	Good
Age	≤2 Years	>2 Years
Breed	Boer	Others
Price	$700	$300

- Which buck would you buy if these were the only bucks available in the marketplace?

☐Buck A ☐Buck B ☐Neither

Section VIII. Demographic and Financial Information

1. Are you a male or female? (a) Male (b) Female

2. Please indicate your age. (Circle one)
   (a) ≤30 yrs (b) 31-45 yrs (c) 46-60 yrs (d) 61-75 yrs (e) ≥76 yrs

3. How many years have you been raising goats? (Circle one)
   (a) ≤10 yrs (b) 11-20 yrs (c) 21-30 yrs (d) 31-40 yrs (e) ≥41 yrs

4. Which of the following best describes your racial or ethnic background? (Circle one)
   (a) American Indian (c) Black (African American) (e) White (Caucasian)
   (b) Asian or Pacific Islander (d) Hispanic (f) Other _____

5. Please indicate your highest level of education. (Circle one)
   (a) Less than high school (c) Some college/technical college (e) Advanced degree (M.S., Ph.D., J.D., M.D., etc.)
   (b) High school diploma/GED (d) Bachelor's degree

6. Do you hold an off-farm job? (a) Yes (b) No **[Skip to 7.]**

   [If Yes to 6] How many hours per week do you typically work off the farm? _____ hours

7. Do you consider yourself to be "retired"? (a) Yes (b) No

8. Do you maintain individual records of your goats to track the performance of offspring? (a) Yes (b) No

9. What is your debt-to-asset ratio? (100*total debts / total assets) (a) ≤ 29% (b) 30-59% (c) ≥ 60%

10. Which of the following best describes your annual **net household income**? (Circle one)
    (a) ≤ $49,999 (b) $50,000 - $99,999 (c) ≥ $100,000

11. What **percentage** of your annual **net household income** comes from your goat operation? (Circle one)
    (a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) 80-100%

12. What **percentage** of your annual **net farm income** comes from your goat operation? (Circle one)
    (a) 0-19% (b) 20-39% (c) 40-59% (d) 60-79% (e) 80-100%

13. Relative to other investors, how would you characterize yourself? (Please circle one)
    (a) I tend to take on substantial levels of risk in my investment decisions.
    (b) I tend to avoid risk when possible in my investment decisions.
    (c) I neither seek nor avoid risk in my investment decisions.

Within the next two months, we will be sending a follow-up survey on production costs to those who indicate they are willing to participate. This will allow us to analyze industry profitability. We would greatly appreciate your participation in that survey. Would you be willing to participate in that 4-page survey?
(a) Yes (b) No

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY!

APPENDIX B
"COMPLEMENTARY DOCUMENTS SENT TO THE U.S. MEAT GOAT PRODUCERS"

"FIRST EMAIL SENT TO MEAT GOAT PRODUCERS NEAR BATON ROUGE AREA TO IDENTIFY IMPORTANT ATTRIBUTES FOR THE CONJOINT STUDY"

Dear Mr. / Mrs. _____:

My name is Narayan Nyaupane, a Ph.D. student in the Department of Agricultural Economics and Agribusiness with the LSU AgCenter, working with Professor Jeffrey Gillespie. For my dissertation, I am working on a project that will determine production practices, marketing strategies, and opinions of goat producers in the U.S. For this project, I will be sending a mail survey to meat goat producers throughout the US.

One of the questions in the survey will deal with the major characteristics of breeding stock that goat producers are generally looking for when they purchase breeding stock. At this point, I am requesting that several Louisiana goat producers tell me about their preferences for goat characteristics when they purchase breeding stock. This will help me in crafting my questions for the survey so that my results will be most useful to the goat industry.

I would greatly appreciate it if you could please respond to this e-mail by listing the most important characteristics of breeding stock that you look for when buying bucks and does for breeding purposes. I realize that the most important characteristics of bucks may differ from those for does, so if you can separate them out by buck / doe, that would be helpful.

Thank you very much for your help.

Mr. Narayan Nyaupane
Graduate Student
Dept. of Agricultural Economics & Agribusiness
Louisiana State University Agricultural Center
Baton Rouge, LA

"SECOND EMAIL SENT TO MEAT GOAT PRODUCERS NEAR BATON ROUGE AREA TO IDENTIFY IMPORTANT ATTRIBUTES FOR THE CONJOINT STUDY"

Dear Mr. / Mrs. _____:

Few days ago, I wrote you regarding goat characteristics you generally look for when purchasing breeding stock. I haven't yet heard from you, so I am writing again to request your response.

The information we are gathering from a handful of producers will help us to understand common goat characteristics producers generally look for when making breeding stock purchasing decisions. Understanding this basic information will help us to proceed with our research regarding the economics of U.S. goat production.

In the event you did not receive the email (i.e., it might have gone to spam), I will gladly resend the first email. I would be most happy to answer any questions you might have. Please write or call. The telephone number is (225) 252 – 1731.

Thank you for your cooperation.

Sincerely,

Narayan P. Nyaupane
Ph.D. Student
Department of Agricultural Economics
Martin D. Woodin Hall
Louisiana State University
Baton Rouge, LA 70803,
USA.

"FIRST CORRESPONDENCE SENT TO THE U.S. MEAT GOAT PRODUCERS"

July 2, 2012

PRODUCER'S NAME/ADDRESS

Dear PRODUCER'S NAME:

As you are probably aware, the U.S. meat goat industry has expanded significantly in recent years, with federally inspected meat goat slaughter increasing four-fold over the last 25 years and nearly 2.5 million head in inventory during 2011. Despite the increased importance of the industry, little is known about the structure of U.S. goat farms, typical production practices used, concerns of meat goat producers, and goat marketing. As a result, the industry is limited in developing more efficient markets for goat meat, many extension agents are unaware of potential educational opportunities for goat producers, and governmental assistance to the industry has been limited. Through this survey, our objective is to provide information the industry can use to further its goal of becoming more efficient and expanding its markets.

You are one of a limited member of goat farmers that has been chosen to solicit your opinions about the industry and your production practices used. In order for our estimates be as accurate as possible, your participation is vital. We request that the individual with primary decision-making authority for the goat operation complete the survey. Summary results of this study will be made available to farmers and other stakeholders in the goat industry.

All responses will be kept **strictly confidential and will not be traced back to any individual.** The questionnaire has an identification number (at the bottom of the cover page) for mailing purposes only. This is so that we can check your name off the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

If you no longer raise goats, please indicate this on the questionnaire and return it to us. We expect it will take about **30 minutes** to fill out the questionnaire.

I would be most happy to answer any questions you might have. Please write or call. The telephone number is (225) 578-2759 and my e-mail address is jgillespie@agcenter.lsu.edu.

Thank you very much for helping with this important study.

Sincerely,

Jeffrey M. Gillespie, Ph.D.
Martin D. Woodin Endowed Professor

"FIRST POST-CARD REMINDER SENT TO THE U.S. MEAT GOAT PRODUCERS"

July 9, 2012

Dear Goat Producer:

Last week, a questionnaire requesting information about your goat farming practices was mailed to you. Unfortunately, we mistakenly included too little postage on the envelope and learned that some of the questionnaires required additional postage for pick-up. ***We sincerely apologize for our mistake!*** We sincerely thank those of you who picked up the survey with additional payment.

If you received the survey and have already returned it, thank you! If you received the survey but have not yet responded, please do so today. It is highly important that we receive your completed questionnaire so that study results will represent the production characteristics of the goat industry. If you did not receive the questionnaire or it has been misplaced, we will be sending you another copy in the next two weeks – with correct postage! Thank you.

Sincerely,

Jeffrey Gillespie
Martin D. Woodin Endowed Professor
(225) 578-2759; jgillespie@agcenter.lsu.edu

"SECOND CORRESPONDENCE SENT TO U.S. MEAT GOAT PRODUCERS"

July 23, 2012

PRODUCER'S NAME/ADDRESS

Dear PRODUCER'S NAME:

About three weeks ago, I wrote to you asking for your help in a study concerning the U.S. goat industry. This study is being conducted to determine the breadth of production and management practices used in the industry, as well as goat producer preferences and opinions regarding their operations. As of today, we have not yet received your completed questionnaire.

Information gathered about the current state of the goat industry will be of significant value as industry leaders plan for the future. As you are probably aware, there has been increased interest by consumers in goat meat over the past couple of decades, providing more opportunities for the industry. For the results of our research to be representative, it is important that each questionnaire be completed and returned, as the survey was sent to a relatively small number of producers.

All responses will be kept **strictly confidential and will not be traced back to any individual.** The questionnaire has an identification number (at the bottom-right of the cover page) for mailing purposes only. This is so that we can check your name off of the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

In the event that your questionnaire has been misplaced, a replacement is enclosed, along with a return postage-paid envelope. If you have already responded to the survey and we haven't yet received your response, please accept our sincerest thanks.

I would be most happy to answer any questions you might have. Please write or call. The telephone number is (225) 578-2759 and my e-mail address is jgillespie@agcenter.lsu.edu

We greatly appreciate your cooperation.

Sincerely,

Jeffrey M. Gillespie, Ph. D.
Martin D Woodin Endowed Professor

"SECOND POST-CARD REMINDER SENT TO THE U.S. MEAT GOAT PRODUCERS"

August 2, 2012

Dear Goat Producer:

I am writing to you about our U.S. Meat Goat Survey, as we have not yet received your completed questionnaire. This is our final reminder that you fill out the survey and return. As our ability to accurately estimate goat production results entirely depends upon the survey responses from goat producers like you, it's highly important that you complete the survey and return.

If you have already returned the questionnaire but we haven't yet received it, please disregard this note and accept our sincerest thanks. If you haven't filled out the survey yet, please do so as soon as possible. Your contributions to this study are greatly appreciated. Thank you.

Sincerely,

Jeffrey Gillespie
Martin D. Woodin Endowed Professor
(225) 578-2759; jgillespie@agcenter.lsu.edu

APPENDIX C
"SAMPLE QUESTIONS USED IN THE CHOICE-BASED CONJOINT STUDY"

Breeding Does

Choice 1

Attributes	**Doe A**	**Doe B**
Femininity	Low	Low
Structure & Soundness	Good	Good
Age	≤2 Years	>2 Years
Breed	Kiko	Boer
Price	$200	$1250

- Which doe would you buy if these were the only does available in the marketplace?

□Doe A □Doe B □Neither

Choice 2

Attributes	**Doe A**	**Doe B**
Femininity	Low	High
Structure & Soundness	Poor	Poor
Age	>2 Years	≤2 Years
Breed	Boer	Spanish
Price	$900	$900

- Which doe would you buy if these were the only does available in the marketplace?

□Doe A □Doe B □Neither

APPENDIX D
"INSTITUTIONAL REVIEW BOARD APPROVAL"

LSU AgCenter Institutional Review Board (IRB)
Dr. Michael J. Keenan, Chair
School of Human Ecology
209 Knapp Hall
225-578-1708
mkeenan@agctr.lsu.edu

Application for Exemption from Institutional Oversight

All research projects using living humans as subjects, or samples or data obtained from humans must be approved or exempted in advance by the LSU AgCenter IRB. This form helps the principal investigator determine if a project may be exempted, and is used to request an exemption.

- Applicant, please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the LSU AgCenter IRB. Once the application is completed, please submit the original and one copy to the chair, Dr. Michael J. Keenan, in 209 Knapp Hall.

- A Complete Application Includes All of the Following:
  - **(A)** The original and a copy of this completed form and a copy of parts B through E.
  - **(B)** A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
  - **(C)** Copies of all instruments and all recruitment material to be used.
    - If this proposal is part of a grant proposal, include a copy of the proposal.
  - **(D)** The consent form you will use in the study (see part 3 for more information)
  - **(E)** Beginning January 1, 2009: Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing and handling data, unless already on file with the LSU AgCenter IRB.
    Training link: (http://grants.nih.gov/grants/policy/hs/training.htm)

1) Principal Investigator: Jeffrey Gillespie Rank: Professor Student? Y/N NO
Dept: Ag Econ & Agribus Ph: 578-2759 E-mail: jgillespie@agcenter.lsu.edu
2) Co-Investigator(s): please include department, rank, phone and e-mail for each
Ken McMillin, Animal Science, 578-3241, kmcmillin@agcenter.lsu.edu
Wes Harrison, Ag Econ & Agribus, 578-2727, wharrison@agcenter.lsu.edu

3) Project Title: Developing the Goat Industry by Improving Market Chanel Communication

NOTE: This project was funded via AFRI. In the proposal stage, it was sent through Human Subjects IRB, where it was agreed that all surveys would be sent through IRB when ready to send out.

4) Grant Proposal?(yes or no) NO. **If Yes, Proposal Number and funding Agency**_____
Also, if Yes, either: **this application completely matches the scope of work in the grant Y/N**__
OR
more IRB applications will be filed later Y/N___
5) Subject pool (e.g. Nutrition Students) U.S. Goat Farmers

- Circle any **"vulnerable populations" to be used:** (children<18, the mentally impaired, pregnant women, the aged, other). Projects with incarcerated persons cannot be exempted.

6) PI signature _____ ****Date** 5/29/12 (no per signatures)
****I certify that my responses are accurate and complete.** If the project scope or design is later changed I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU AgCenter institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at the LSU AgCenter for three years after completion of the study. If I leave the LSU AgCenter before that time the consent forms should be preserved in the Departmental Office.
Committee Action: Exempted X Not Exempted____ **IRB#** HE12-12
Reviewer Michael Keenan **Signature** Michael Keenan **Date** 6-5-2012

APPENDIX E
"SIMULATION RUNS"

Variables	500 Replications				1000 Replications			
	Mean (S.E.)	Std.Dev. (S.E.)	Minimum	Maximum	Mean (S.E.)	Std.Dev. (S.E.)	Minimum	Maximum
Dealers	37.2783	0.1334	36.8216	37.6937	37.2939	0.1312	36.8606	37.8333
	(0.1301)	(0.0080)			(0.1303)	(0.0084)		
I sell goat meat	340.9720	0.1594	340.5450	341.4790	340.9743	0.1584	340.3447	341.6221
	(0.1564)	(0.0131)			(0.1568)	(0.0134)		
Consumer	-191.2511	0.1154	-191.5327	-190.8873	-191.2446	0.1140	-191.7178	-190.7938
	(0.1155)	(0.0067)			(0.1158)	(0.0066)		
Auction	192.2808	0.0975	191.9436	192.5974	192.2788	0.1008	191.9040	192.6710
	(0.0993)	(0.0044)			(0.0994)	(0.0042)		
Num_meatgoats	4.4384	0.0007	4.4365	4.4410	4.4384	0.0007	4.4356	4.4414
	(0.0007)	(0.0001)			(0.0007)	(0.0001)		
%Sale_slaugh	5.0667	0.0014	5.0626	5.0721	5.0667	0.0014	5.0611	5.0718
	(0.0014)	(0.0001)			(0.0014)	(0.0001)		
Age	19.9391	0.0541	19.7814	20.0838	19.9362	0.0542	19.7371	20.1577
	(0.0539)	(0.0030)			(0.0538)	(0.0030)		
Bachelor	143.5506	0.0958	143.2739	143.8136	143.5467	0.0925	143.1514	143.8670
	(0.0924)	(0.0034)			(0.0925)	(0.0034)		
Off farm job	420.8047	0.0974	420.5116	421.0864	420.7989	0.1001	420.4071	421.1921
	(0.0997)	(0.0041)			(0.0997)	(0.0043)		
Risk averse	191.4244	0.0914	191.1585	191.6436	191.4168	0.0896	191.0759	191.7856
	(0.0903)	(0.0032)			(0.0903)	(0.0031)		
Farmincome_goat	39.1895	0.0264	39.0995	39.2578	39.1896	0.0271	39.0853	39.3023
	(0.0268)	(0.0011)			(0.0269)	(0.0011)		
%PAS_NotRot	-0.7523	0.0018	-0.7580	-0.7470	-0.7522	0.0018	-0.7593	-0.7446
	(0.0018)	(0.0001)			(0.0018)	(0.0001)		
%PAS_Rot	-0.2825	0.0017	-0.2871	-0.2775	-0.2824	0.0017	-0.2888	-0.2759
	(0.0017)	(0.0001)			(0.0017)	(0.0001)		
%Drylot	-7.1011	0.0024	-7.1081	-7.0943	-7.1010	0.0023	-7.1094	-7.0925
	(0.0023)	(0.0002)			(0.0023)	(0.0002)		
Southeast	196.3434	0.1552	195.8549	196.8252	196.3403	0.1575	195.7524	196.9046

	(0.1589)	(0.0119)			(0.1587)	(0.0118)		
Northeast	172.8473	0.2275	172.2080	173.4961	172.8533	0.2350	171.8826	173.9561
	(0.2337)	(0.0177)			(0.2326)	(0.0183)		
Midwest	-325.6445	0.1569	-326.0703	-325.0825	-325.6430	0.1605	-326.2307	-325.0095
	(0.1611)	(0.0117)			(0.1610)	(0.0117)		
West	28.8990	0.1984	28.3374	29.4888	28.9054	0.2066	27.9878	29.7417
	(0.2062)	(0.0144)			(0.2052)	(0.0142)		
Constant	0.9972	0.3097	0.0399	2.1113	0.9987	0.3194	-0.2066	2.2337
	(0.3195)	(0.0207)			(0.3196)	(0.0197)		
Replications	500				10,000			

VITA

Narayan P. Nyaupane was born in Syangja district (Mid-hill region) of Nepal. When he was seven, his family migrated to Ramnagar, Nawalparasi (Terai region), where he started his schooling. He completed his high-school (School Leaving Certificate – SLC) from Shree Wakwani High School, Jargaha - 5, Nawalparasi. After being selected for national level scholarship in 1997, he joined Intermediate of Science in Agriculture (I.Sc. Ag.) at the Institute of Agriculture and Animal Sciences (IAAS) – Paklihawa Campus. In 2003, He completed his Bachelor of Science in Agriculture (B.Sc. Ag.) from the same institution (which was under Tribhuvan University by then but now is under Agriculture and Forestry University). He then moved to the United States of America for his higher studies. He joined the Department of Agricultural Economics and Agribusiness at Louisiana State University in January, 2008. After completing his M.S. in Agricultural Economics, he continued for Ph.D. in the same program in 2010. During his graduate school at LSU, he authored six peer-reviewed journal articles and made a number of conference presentations. Currently, he is the doctoral candidate and is in-route to graduate in August, 2014.