

THE IMPACT OF THE TEXAS DEER BREEDING INDUSTRY ON THE LOCAL
ECONOMY

A Thesis

by

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ABSTRACT

The popularity of deer breeding operations has grown significantly over the past couple of years. In particular, rural communities across the state of Texas have seen the benefits of this growing industry. The primary objective of this study is to provide representative cost estimates of deer farms to gain a better understanding of the industry and its impact on the Texas economy. A survey conducted by the Texas Deer Association provided the data necessary for this study. Due to the nature of the data, two different methods were used to estimate total annual expenditures for the industry. The first method involves estimating the total number of different types of operations in the state of Texas: breeding only, breeding and hunting, and hunting only. This was calculated using the percent of each type of operation based on the total number of surveys received, multiplied by the total number of distributed surveys. The total number of each type of operation was then multiplied by the corresponding annual estimated operating expense per operation. The second method estimates the total annual expenditures for each type of operation by calculating the total operational costs for each farm type and dividing it by the response rate. This study uses the average of the two estimated total annual production expenses to provide the most accurate estimate of expenses for projecting the economic impacts of the industry on the Texas economy.

IMPLAN was used to calculate the economic impact and understand the effect it has on other industries across the different sectors of the economy.

The Texas deer breeding industry generates an estimated \$1.09 billion in total economic impacts. This added economic activity supports jobs for 14,351 Texans. The deer breeding industry has proven to be a significant contributor to the state's economic activity and vital to the stability of rural economies across the state of Texas.

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CHAPTER 1

INTRODUCTION

While deer farming has been a well-established industry for nearly a century, recent years have seen a spike in interest concerning the demand and supply of this non-traditional agricultural sector. The production side of the industry is represented by operations involved in breeding and raising deer. Other industry breeders and hunting operations represent the consumption side. This developing industry has become vital to the economic growth and stability of many rural communities across the country.

In 2007, the North American Deer Farmers Association (NADeFA) reported 7,828 deer farms across the nation. Texas was reported as one of the largest contributors and is continuing to grow. In 2006 there were 946 breeding facilities. When new analysis was available in the spring of 2007, Texas reported 1,006 permitted facilities. In Texas, the majority of the facilities are permitted for breeding and hunting. Breeding operations involve the scientific breeding and raising of deer with the intention of selling to other breeding operations or hunting facilities. Hunting operations purchase deer to stock their facilities.

The U.S. Fish and Wildlife Service (USFWS) 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation reported 13.7 million hunters over the age of 16. The survey also found that 1.1 million resident and nonresident hunters, 16 years or older hunted in Texas. Estimating the impact of hunting expenditures with hunters as

consumers of deer products, hunters generate \$129 million to the deer breeding industry (Anderson, Frosch, and Outlaw, 2007). With such large numbers of hunters throughout the state of Texas, there is high demand for trophy bucks. Trophies include the antlers, the entire head can be mounted, or a taxidermist can pose the entire body. Trophy hunting typically involves hunting on a high-fenced operation. This nontraditional hunting practice prevents free range of the animals. While this allows hunting operations to manage their herds, captive environments create a potential for disease threats such as Chronic Wasting Disease.

Chronic Wasting Disease (CWD) is a progressive fatal and transmittable neurologic disease. CWD is neither caused by a virus or bacteria, but rather a misfolded protein particle called a prion (Fryer and McLean 2011). The two primary ways the disease can be spread is through contact with a CWD infected animal and exposure to a CWD contaminated environment. Severe population reductions would be the most effective in scenarios where CWD appears to be recently introduced and has not likely become established in the environment (Brown et al., 2005). Implications of CWD are centered on the unknown potential impacts. Specifically, the decline in deer population resulting from infected herds. Other implications of CWD include concern for human health and safety along with the well being of the animal. Chronic Wasting Disease poses a serious threat to the economic stability of the many rural communities the deer farming industry supports. Recently, new CWD management rules have been adopted and put into effect by the Texas Parks and Wildlife Commission to help eradicate or

control the disease. The new rules most prominently include an 80% minimum level on post-mortem CWD testing.

As the industry continues to grow, understanding its economic impact becomes increasingly relevant. Lawmakers have grown interested in industry regulations, legalizations, and restrictions, as well as aid in conservation efforts by preserving space for wildlife. With most of the regulation governed by the states, much variability exists across the industry nationwide. Recent amendments to the Agricultural Act of 2014 have provided support for the growth of the industry. However, as the industry continues to grow, legislative support is becoming increasingly important.

Objectives

The primary objective of this study is to provide representative cost estimates of deer farms to gain a better understanding of the industry and its impact on the economy. This will be accomplished by analyzing a survey of industry participants. The survey data will provide information related to the operation of deer farms and annualized cost. To achieve the overall objective, the study will address two secondary objectives. The data will be used to estimate the industry's overall economic impact at the state level as well as the impact it has on, specifically, rural communities

CHAPTER II

LITERATURE REVIEW

While a great deal of research has been done on the scientific breeding aspect of the industry, very little has been conducted on its economic impact. Mjelde et al. (1992) conducted a survey to examine the general aspects of current exotic livestock operations and attitudes of current producers. The study identifies two areas of the industry, game (deer) ranching and game (deer) farming. Data for this study was collected through a survey of 195 livestock producers in the fall 1989 and the winter of 1990. The average reported gross income was between \$80,000 and \$89,000. Mjelde et al. (1992) reported responses about the manageability and success of the operations, stating deer producers are particularly concerned with the climate, fencing costs, processing costs, size of the herd, and production costs. The study provided data regarding the percentage of total gross income obtained by various enterprises within their operation. The report also assessed the role of exotic livestock. Mjelde et al. (1992) reported sales of brood stock provided an average of 45% of gross revenue, trophy hunting provided an average of 28% of gross revenue and the production of exotic venison provided 19% of gross revenues. Recreational viewing accounted for 1% of gross income and the remaining 7% was contributed by other sources. Eighty-six percent of respondents stated they raised exotics because they felt it was a profitable business (Mjelde et al., 1992). Other important factors were the availability of labor, the location of veterinarians, availability

of grazing land, and government regulations. The study also makes a point of discussing farmers optimism about the market as well as the growth and stability of the industry.

Two studies, conducted by the Agricultural and Food Policy Center at Texas A&M University, have analyzed the economic impact of the deer breeding and cervid farming industry. Anderson, Frosch, and Outlaw (2007) conducted an industry study to understand the economic impact of the deer breeding industry. IMPLAN (Impact Analysis for Planning), an input/output model, was used to estimate the impact of the deer breeding industry on the national economy. The results stated a total impact of the deer breeding and hunting industries is \$652 million annually. The breeding industry also provides 7,335 jobs in rural areas across the United States (Anderson, Frosch, Outlaw, 2007). Anderson, Frosch, and Outlaw (2007) estimated the annual expenses for a typical breeding operation averaged \$306,000. The study by Anderson, Frosch, and Outlaw (2007) found that the deer breeding industry generate \$318.4 million in direct economic impacts. An additional \$177 million of value added is contributed in the form of employee compensation, proprietor income, and indirect business taxes. Hunting operations have an evident impact on local economies as well. Hunters purchase goods such as guns, food, and fuel as well as services like deer processing and taxidermy. Anderson, Frosch, and Outlaw (2007) state that hunters provide a direct economic impact of \$73 million.

A second study by the Agricultural and Food Policy Center and Texas A&M University examined the economic impact of the United States cervid farming industry.

Data was collected through site visits and a national survey sent to 1,300 members of the Texas Deer Association and 700 members of the North American Deer Farmers Association. Anderson, Frosch, and Outlaw (2007) found that cervid operations combined with hunters' economic contribution generate \$3 billion of economic activity and output in the United States.

A study from the Department of Agricultural Economics at Purdue University looked at the economic impact of the deer and elk farming industry in Indiana. The data was collected from a survey created by the Indiana Deer and Elk Farmers Association. The survey was broken into two parts, breeding operations and breeding and hunting operations. IMPLAN was used to analyze the economic impact. Lee and English (2011) found that Indiana's deer and elk farming industry employs about 575 people and total labor income is around \$10,215,156. Lee and English (2011) also reported the total economic impact to be estimated at \$49,327,223. This significant economic contribution proves the importance of the cervid industry in rural communities across the United States.

With Chronic Wasting Disease cases reported in the United States, research on the topic has surged. While the scientific aspect of the disease has been previously discussed, researchers are looking at the impact it has on the deer hunting and breeding industries. According to the Texas Parks and Wildlife department, CWD poses a significant threat to the Texas deer population. A set of emergency rules has been adopted to avoid the spread of this disease. Parks and Wildlife Code, Chapter 43,

Subchapter L, authorizes the department to regulate the possession of whitetail and mule deer for scientific, management, and propagation purposes (TPWD, 2016). This set of rules has implemented CWD testing requirements and restricted deer movement across the state. A professor from the Department of Agricultural and Applied Economics at the University of Wisconsin-Madison estimated the economic impact CWD would have on Wisconsin's economy. Richard Bishop (2004) estimates a 10% to 20% decline in the number of hunting days and \$68 million to \$105 million drop in consumer surplus for the remaining hunting days.

The proposed research will provide updated information about the economic impact of the emerging deer breeding industry. In conjunction with the supplemented research, this paper will include research on the impact of Chronic Wasting Disease. The study will be designed to understand the impact deer breeding operations and deer hunting operations have on the local economy. With the limited and outdated data available, new research is vital to understanding the recent developments for this specialized niche industry.

CHAPTER III

METHODOLOGY

Primary data was collected through a statewide survey. The survey was constructed by the North American Deer Farmers Association and the Texas Deer Association during the summer of 2016. Surveys were sent to 1,300 Texas deer farmers and members of the Texas Deer Association. The overall response rate was 3.6%.

To realize a more in-depth understanding of the industry, the study is divided into three specific parts; scientific breeding only, scientific breeding and hunting, and hunting only. Farms labeled scientific breeding only are those that handled the breeding and rearing of deer only. Those operations defined as hunting only are farms that purchase deer from breeding farms and provide a preserve on which to release the animals. Scientific breeding and hunting farms are those that participate in breeding their own stock as well as purchasing breeding stock to populate their own hunting operation. The surveys are detailed and customized according to operation to obtain a better understanding of the industry and its impact on the economy.

The survey completed by breeding operations was broken down into ten sections. Farmers are first asked to specify the type of operation; breeding only, breeding and hunting, and hunting only. Breeding operations are then asked to specify the type of animals on the property. The options include whitetail and non-whitetail cervids. If non-whitetail cervids is checked the farmers are asked to specify. This section helps

determine the number of operations breeding whitetail and the number breeding other species of deer.

Section I of the survey pertains to the operation. It asks the year the operation was started, the total acres the operation covers, and the total land valuation.

Section II is used to collect information about the 2015 herd inventory. Questions revealed information about the total number of breeder deer, the number of bucks, the number of stocker bucks, the number of does, the number of fawns, and the operations annual mortality rate. Breeder bucks are purchased to improve the size and quality of the herd. These deer have superior genetics and are purchased to produce quality offspring. Stocker deer are those that cannot be sold as breeders. However, they are still quality deer purchased to increase the size of the herd and sometimes to hunt. Bred does are those already pregnant by a quality breeder buck. These deer are purchased with the hope of producing superior offspring. Open does are deer that are mature enough to become pregnant, but that are not pregnant yet. These does typically have quality bloodlines and are capable of producing a superior offspring. Operations may also choose to purchase fawns. A farmer may choose to purchase male fawns bred from a breeder buck. A farmer may also choose to purchase female fawns to increase the size of the herd and provide more does to be bred with the breeder bucks. An operation may also choose to purchase semen straws. The semen would typically come from a very high quality breeder buck and be used to artificially inseminate a doe the farmer already owns.

This section also provides information about sales figures in 2015. It is broken down to provide information about the quantity and income received from breeder bucks, stocker bucks, open does, bred does, fawns, and semen straws. The section also includes questions about purchases from 2015. It asks to provide the quantity and cost of breeder bucks, stocker bucks, open does, bred does, fawns, and semen straws. These figures will aid in understanding input costs as well as income derived from the animals.

Section III relates to the operation's facilities. Information is collected about the number of pens and the area of the pens. The size of the pen plays an important role during the process of mating. Typically, a smaller pen would hold one dominant breeder buck. However, if multiple breeder bucks are present in a single pen, it is suggested that the pen be significantly larger to avoid conflict between dominant males.

This section also includes the capital cost of fencing, shelters and buildings, the capital cost of other improvements such as roads and waterlines, and the annual cost of maintenance and repairs. Fencing plays a significant role in the layout of a deer breeding operation. Perimeter fencing is typically higher than internal paddock fencing. The Food and Agriculture Organization of the United Nations suggest a 2.0 meters high external fence and sub-divisional fencing should be about 1.6 meters high. Sheltered areas across the operation provide shade and comfort from the sun, wind, and cold for both the animals and workers. Buildings on the land are typically used for storage.

Section III also required information be provided about the capital cost of handling facilities. Handling facilities include chutes and runways, holding areas for

artificial breeding, vaccination, or transportation, and some facilities even include heated and air-conditioned stalls for fawns. Handling facilities provide a safe method for deer farm management practices. An alternative to a handling facility is anesthetizing the animals.

The survey also looked at the capital cost of misting systems. Some operations choose to use this method while others may choose an insect fogger or sprayer. Both options spray insecticides to help protect the herd from pests and potential diseases.

All of the operation's facilities play an important role in herd management. Assessing the cost of these facilities will aid in understanding the investment required by farmers.

Section IV pertains to the price of equipment purchased. Breeders were asked to describe the cost incurred when purchasing large equipment, ranch vehicles, ATVs, all implements combined, and trailers and transport crates. Large equipment, such as tractors and bobcats, ATVs, and ranch vehicles are used to build/maintain fences and shelters as well as move and manage the herds. Trailers and shipping crates are important when purchasing or selling deer. These items also represent significant costs to the operation. Other equipment covered in this section includes feeding bins, feeding and watering equipment, and camera and video equipment. Cameras and video recorders give operations the ability to efficiently survey the herd and land as well as track movement and growth of the animals. This section asks about annual cost for any rental equipment, cost of insect fogger/sprayer, as well as the cost of a dart gun and any

dart/sedation equipment. Dart guns are used to anesthetize the animals. This can be necessary when vaccinating, assessing wounds or health issues, trapping for transportation, or breeding.

Section V is concerned with veterinary and animal supplies. This section covers the cost of operating supplies, feed and hay, medical supplies, and veterinary expenses. This section tends to be quite costly, however necessary to the health and well being of the animals as well as the success of the operation. The section also asks about the number and annual cost of sedations, does that are artificially inseminated, animals that are tested for chronic wasting disease, animals that are DNA tested, and the annual cost for I.D. tags or microchips. When assessing the cost of CWD testing, several factors must be taken into account. Currently, there are not any screening tests available to detect the disease. Testing for chronic wasting disease requires a farmer to submit a sample of tissue from the lymph nodes and brainstem. A veterinarian can do this or the farmer can submit the entire head of the deer. This process tends to be quite costly. Identification tags that use a numbering system are used to help track and manage deer. Alternatives to I.D. tags are microchips or radio frequency identification tags. These tags are required when moving any CWD susceptible animal across the state. This section also contains information about the cost of semen storage, insecticides, and other related miscellaneous costs.

Section VI covers labor, specifically information about the number of employees, the total wages paid for employees, and the annual expense for outsourced services.

Operations are asked to specify the number of salaried, hourly, and part-time employees. Outsourced services cover a broad range of topics.

Section VII relates to utilities. The section provides information about the annual cost of utilities and fuel and diesel.

Section VIII is for miscellaneous expenses. Such expenses include annual insurance expenses, the cost of advertising and marketing, annual taxidermy expenses, travel and meeting expenses, and property taxes. Advertising and marketing expenses also cover booths, sponsorships, ads, and websites operations may manage. This section also includes the cost of any permits required by the Texas Parks and Wildlife Department and the Texas Animal Health Commission. Such permits include a Deer Management Permit (DMP) that allows the temporary management of a free-ranging whitetail deer for breeding purposes. If the operation is looking to transport any whitetail deer, A Trap, Transport, and Transplant (TTT) Permit can be acquired.

Section IX relates to the cost of feeding. Breeders answer whether or not they bottle-feed fawns. If yes, there are questions related to the cost of milk replacers, fawn supplement feed, the annual cost of fawn care products and cost for outside fawn care services. Typically, bottle-feeding tends to be up to the farmer. However, if a fawn refuses to nurse or a doe refuses to allow the fawn to nurse, milk replacers can be used and the fawn can be bottle-fed. Fawn supplement feed is also used. This feed is typically rich in vitamins, protein, and energy. Other fawn care products include bottles, nipples, and fawn cradles and masks which help calm and restrain the deer. This section also

covers the cost of protein feed, textured/treated feed, and alfalfa hay for breeder penned animals. Breeders may choose to use a protein feed for their animals. The exact nutrient value of the feed depends on the area in which the animals are located. It is up to the operation to survey the land and decide which nutrients and minerals could be lacking in a natural foliage diet. Calcium and phosphorus are particularly important to body and antler growth. Textured and treated feed is similar in that it provides a well-balanced, nutrient rich diet to support growth and strength.

Section X is simply other expenses. Operators were asked to list and explain any additional costs not previously covered in the other sections.

The survey for hunting operations was quite similar to that of breeding. First, the survey determines the purpose of the hunting operation. The options include personal use, corporate clients that do not pay a fee, and paying clients. Personal use simply means solely the owners use the operation. Corporate client use refers to a group that is not the owner but does not pay a fee. Typically hunters will bring friends and family and not make them pay. Paying clients are those who pay a fee to hunt on the operation. Fees vary depending on the size of the operation and the quality and luxury of the amenities provided.

Section I was about the operation. Questions were: the year the operation was started, the area of the hunting operation, the number of acres purchased, the number of acres inherited, and the total land valuation.

Section II contains information about facilities. Such information includes the cost of lodges or guest facilities, the cost of peripheral fencing, habitats, roads, water improvements, other guest conveniences, the cost of other buildings on the property, and the cost of maintenance and repairs. Hunting operations provide a lodge or guest facilities to hunters. The size and elaborateness of these lodges varies and income from these facilities can be substantial.

The section also includes questions about the approximate area of food plots, the estimated cost of labor to maintain them, and the annual cost of seed and fertilizer. The main use of food plots is to supply nutrition to the deer so it tends to attract a lot of deer to the area. Typically this is a no-hunting area and is great for buck viewing.

Section III refers to equipment. This category covers large equipment, farm implements, ATVs, ranch vehicles, and trailers and transport crates. All of these are important to the success of the operation. Large equipment such as tractors are needed for building fences, moving objects, and managing the land. ATVs provide workers with efficient transportation and trailers and shipping crates are necessary when purchasing or selling animals. The category also provides information about video and recording equipment, dart guns and sedation equipment, rental equipment, the price of a freezer or cooler, the price of hunting blinds, and any other miscellaneous equipment an operation purchases. Video recorders are important to the operation because they allow hunters to track the movement of the animals as well as view the size and quality of the deer on the land. Dart guns and sedation equipment allow hunting operations to sedate an animal to

tend to a wound, vaccinate, or trap for transportation. Freezers and coolers are typically large and capable of holding many carcasses. Coolers are also used to hold semen. Hunting blinds are used to reduce the risk of being seen by the animal. There are a large variety of types. Some blinds are on the ground, some are raised up, and some are located in trees. The size, complexity, and style ultimately determine the price.

Section IV is for the cost of supplies. Supplies are related to operating supplies necessary for guest accommodations, food and beverages for guests, protein feed, and corn or bait for pasture animals. Supplies for guest accommodations would include anything necessary to keep guests comfortable in the lodge. Protein feed includes nutrient-rich food that encourages the growth and strength of the animals, while corn or bait can be used to attract animals.

Section V covers labor and the costs associated with hiring employees. This section asks about the number of employees, whether they are salaried, hourly, or part-time, and the total wages paid. The section also looks at the annual expenses for outsourced services.

Section VI is for utilities. Operations provide information about the annual cost for utilities as well as the annual cost for fuel and diesel.

Section VII is for miscellaneous expenses. These expenses cover the annual cost of insurance, advertising and marketing expenses, taxidermy expenses, and the cost of travel for meetings. Advertising and marketing expenses include everything from signs, booths, sponsorships, and ads. The section also includes questions relating to the annual

cost of property taxes, permits and licenses, and the cost of hunting leases for land that is not owned.

The Texas Parks and Wildlife Department requires hunting operations to acquire permits and licenses. A Deer Management Permit (DMP) and a hunting license are required. A Deer Management Permit allows management of wild deer for breeding practices. A Trap, Transport, and Transplant (TTT) permit can also be acquired. This permit allows whitetail deer to be moved across the state of Texas. Another cost incurred by hunting operations is the cost of leasing land. Hunting leases vary in price based on the size and the quality of deer that reside.

Section VII is for other expenses. Operations are asked to list and explain any other cost incurred.

Section VIII pertains to hunters and guests. Questions ask about the number of hunters and non-hunters, annual deer hunter income, annual exotic hunter income, and annual non-hunter income. Other questions cover the number of deer and exotics harvested, the annual number of stocker deer released into the hunting area, and the cost of those stocker deer. Questions also ask about the number of exotics released and the cost of those exotic animals. Further, the section covers the approximate percentage of harvested animals sent to taxidermy, the average taxidermy cost per animal, and the average meat processing cost per animal. The last questions ask if other game species are harvested on the property. If the operation does harvest other species, a question about the income derived from harvesting the different species follows. Finally, it asks

about any other outdoor enthusiasts' activity on the hunting property that would provide additional income.

Economic Impact

IMPLAN will be used to estimate the economic impact of the deer breeding and hunting operations in Texas. IMPLAN (Impact Analysis for Planning) was initially developed by the USDA Forest Service. One of the most common uses of IMPLAN is in determining the size or importance of an industry (Leones, Schluter, Goldmen, 1994). The IMPLAN model uses economic transactions within a defined sector of the economy for a specific period of time.

In determining the overall economic impact, IMPLAN uses economic multipliers. Using a multiplier allows analysis of the breakdown of the economic effect into three areas: (1) direct (initial) effects; (2) indirect effects; and (3) induced effects.

The direct effects are associated with the impact the industry has on the economy. This effect is the dollar value added to the economy because of industry activity. The indirect effects involve the secondary impacts caused by a change in the input needs of the directly affected industries. These effects can be seen as how other industries have changed to meet new supply and demand from the deer industry. This also describes the impact on increased labor demand. Finally, induced effects reflect changes in household spending as a result of industry income changes. These impacts describe changes in spending as the consequence of changes to the income of directly

and indirectly affected industries.

An input multiplier can also be used to estimate the total change in income throughout the economy from a dollar-unit change in final demand. First, the Type I Multiplier is used. The Type I Multiplier measures both the direct and indirect effects on the economy caused by the increase in purchases of directly affected industries. This can also be described as the total amount each industry must produce to supply the producing industry, so it can produce one dollar's worth of output to the final demand. The Type I Multiplier is calculated by dividing the sum of the direct and indirect effects by the direct effects. The Type SAM Multiplier takes into account the effect of the increase in expenditures due to the change in household income. An output multiplier is used to measure the sum of direct and indirect requirements needed to deliver an additional dollar-unit of output to the final demand. The result of each multiplier measures the ripple effect of a dollar increase in final demand.

Once all data are put into the model, it produces a set of output tables to show the direct, indirect, and induced impacts. IMPLAN also calculates three different types of impacts. The first impact refers to output. Output is the industries' total economic value. This is the total gross value of goods produced by the industry. The second impact is employment. Employment refers to the total number of jobs resulting from the industry's economic output. The final impact is value added and is the same as Gross Domestic Product (GDP). Value added measures the local economic activity as well as the total income generated by the industry. Value added also includes employee compensation,

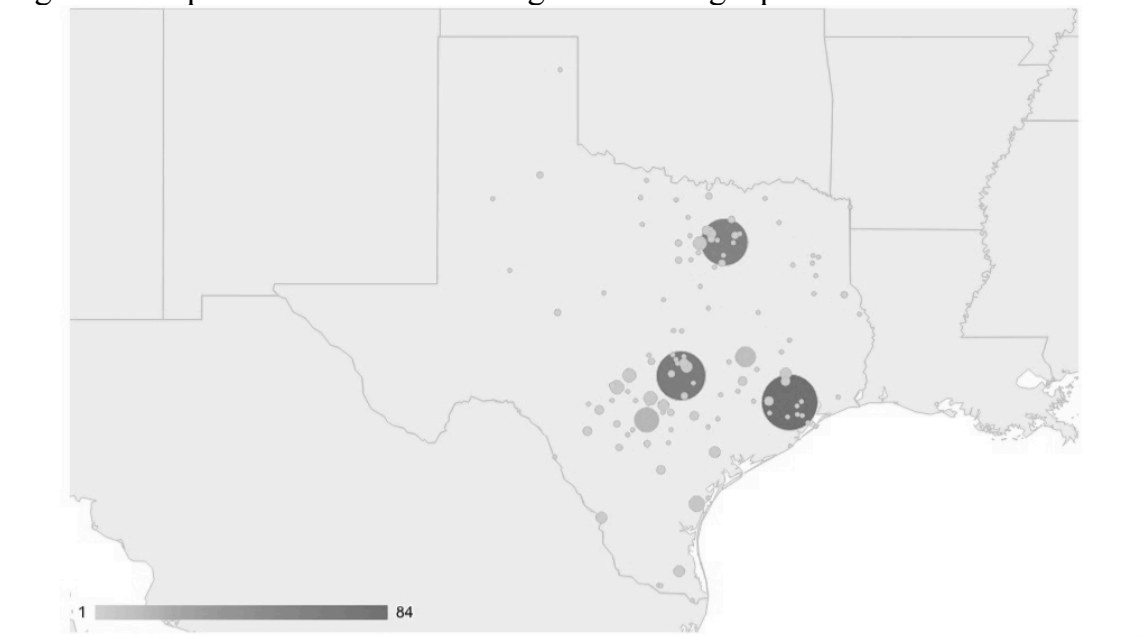
proprietary income, other property income, and indirect business taxes. (Minnesota IMPLAN Group Inc., 2000) Employee compensation refers to wages and salaries as well as other employee benefits. Other benefits include health insurance, life insurance, retirement benefits, and other non-monetary benefits. Proprietor income is simply income received by people who are self-employed. Other property income can be described as rent, interest made, or profits. Indirect business taxes are defined as the taxes individuals pay to businesses for their goods or services.

CHAPTER IV

RESULTS

Figure 1. shows a map of the location of the deer breeding and hunting operations that were surveyed. Operations were spread across the state of Texas, with 18.41% coming from the Houston area, 15.4% coming from the Austin area, 13.17% coming from the Dallas area, and 5.08% coming from the College Station area.

Figure 1: Map of Texas Deer Breeding and Hunting Operations



Of the 46 survey respondents, 14 were breeding only operations, 30 were breeding and hunting, and only 2 were self-described as hunting only operations. On average, breeding operations began in 2004 and hunting operations began in 1998 (Table 1). As expected, operations dedicated to solely hunting used the most land. On average hunting operations run on an average of 7,920 acres for hunting only operations and breeding and hunting operations used around 1,627 acres. For deer breeding, operations that specialize in breeding only use about 21 acres and breeding and hunting operations dedicate an average of 30 acres to breeding. The number of pens on the property is typically determined by the size of the herd. Deer are split up based on age and there are typically about 20 does per pen per buck. Breeding and hunting operations had more pens on the property. This is because these ranches typically used the breeding operation to stock the hunting operation. Breeding and hunting operations have an average of 15 pens over 20 acres of land. Those operations that are dedicated to breeding only averaged 9 pens over 10 acres. Of these breeding operations, 75% reported having whitetail deer and 9% reported other species. These other species include elk, fallow, axis, and eight other unidentified species of exotic cervids.

Herd size and composition vary greatly across different breeding operations. Table 1 describes the structure of the average herd on a deer breeding operation. The survey showed the average breeding operations have 129 breeder deer. In addition, herds averaged 51 breeder bucks, 31 stocker bucks, 56 does, and 40 fawns. Breeding only

operations reported an average annual mortality rate of 10%. This mortality rate refers to the death percentage of deer over 12 months of age.

Table 1: The Herd Structure of Deer Breeding Operations

	Breeding	Breeding & Hunting
Operation		
Year Started	2004	2004
Area of breeding operation (acres)	21	30
Area of hunting operation (acres)	N/A	1,627
Number of pens	9	15
Area of pens (acres)	10	20
Herd Inventory		
Total number of breeder deer	129	168
Breeder bucks (no.)	51	59
Stocker bucks (no.)	33	48
Does (no.)	56	78
Fawn (no.)	40	57
Mortality rate (%)	10%	6%

Breeding and hunting operations tend to run with a slightly larger herd.

Operations average 168 breeder deer, 59 breeder bucks, 48 stocker bucks, 78 does, and 57 fawns (Table 1). Breeding and hunting operations reported an average annual mortality rate of 6%.

Operational Costs

When assessing operational costs for deer breeding and hunting operations, the survey first asked about the costs associated with obtaining a herd. Table 2 outlines purchases of breeding stock in 2015. Breeding only operations purchased an average of

2 breeder bucks with an average total cost of \$18,500. Breeding only operations purchased an average of 1 open doe and 2 bred does. The average annual cost of open does totaled \$7,000 and the cost of bred does averaged \$27,833. Breeding operations also purchased an average of 2 fawns for an average cost of \$5,438 and 7 semen straws with an average total of \$16,125 in 2015. The costs related to building deer inventory for breeding and hunting operations was similar. Breeding and hunting operations purchased an average of 2 breeder bucks with an average total cost of \$18,300. Breeding and hunting operations purchased an average of 14 stocker bucks. The total average cost of 14 stocker bucks for breeding and hunting operations was \$67,000. These operations also purchased an average of 5 open does and 6 bred does. Annual average costs for the 5 open does totaled \$18,625 and the 6 bred does totaled \$38,750. Breeding and hunting operations purchased an average of 2 fawns and 9 semen straws. The total annual cost of fawns averaged \$18,590 and \$25,937 for semen straws. In total, breeding stock purchases for breeding only operations averaged \$74,896. Breeding and hunting operations spent an average total of \$187,202 on breeding stock in 2015.

Table 2: Average Breeding Stock Purchases in 2015

	Breeding	Breeding & Hunting
Number Purchased		
Breeder bucks (no.)	2	2
Total cost of breeder bucks (\$)	18,500	18,300
Stocker bucks (no.)	0	14
Total cost of stocker bucks (\$)	0	67,000
Open does (no.)	1	5
Total cost of open does (\$)	7,000	18,625
Bred does (no.)	2	6
Total cost of bred does (\$)	27,833	38,750
Fawns (no.)	2	2
Total cost of fawns (\$)	5,438	18,590
Semen (no.)	7	9
Total cost of semen straws (\$)	16,125	25,937
Total number purchased	13	38
Total cash cost for breeding and hunting stock	74,896	187,202

To analyze production expenditures for hunting operations, data were collected about the number of hunters and non-hunters that use the facility. In 2015 the average breeding and hunting operation had 37 hunters and 63 non-hunters. Breeding and hunting operations release an average of 22 stocker deer and 15 exotic deer. Breeding and hunting operations reported the annual average cost of releasing stocker deer as \$58,531 and the cost of releasing exotic deer averaged \$22,000. These operations also reported an average of 49 deer and 16 exotics harvested each year. Breeding and hunting operations sometimes release deer onto the hunting operation as a herd management strategy. Breeding operations release older and smaller deer onto the hunting operation to keep the quality of their breeder deer as high as possible. Of the total number of harvested animals on breeding and hunting farms, 54% are sent to a taxidermist. There are three popular types of mounts for deer. The animal can be mounted at the shoulder,

the animal can be a full body mount, or simply a skull mount. Breeding and hunting operations reported an average taxidermy cost of \$615 per animal. Another cost incurred when harvesting animals is a meat processing cost. Breeding and hunting operations spent an average of \$227 per animal for meat processing.

Table 3 provides a summary of total operational expenditures on an annual average basis. The table is broken down into cost categories. First, the table shows an outline of the size and structure of each type of operation. The first cost category refers to capital expenditures. A capital expenditure is the cost to acquire a fixed asset. One of the most significant fixed assets in the deer breeding industry is land. The total average land value for breeding only operations is \$489,238. The land value of hunting only operations totaled at \$13,500,000 and the total land value of breeding and hunting operations is \$3,505,167. When determining the average cost of land per acre, the survey for hunting operations broke this value down into land purchased and land inherited. Of the respondents with hunting operations, 50% stated they purchased the land, whereas 50% inherited a portion of their land. The value per acre of purchased land for hunting only operations averages \$16,667 and inherited land averages \$2,381 per acre. Breeding and hunting operations average \$37,382 per acre of purchased land. Similar to hunting only operations, the value of inherited land is significantly less. Inherited land for breeding and hunting operations averages \$3,254 per acre. The breeding operation survey does not include an area for land inherited. Therefore, for the purpose of this study, the land for breeding operations is categorized as purchased land, averaging

\$22,122 per acre. Other capital expenditures include fencing, shelters, improvements, and buildings. Other facility costs include handling facilities as well as lodging and other guest facilities. Handling facilities ease tasks associated with herd management. Of breeding only operations, 50% chose to invest in a handling facility. These facilities averaged \$82,857 for breeding only operations. Seventy-seven percent of breeding and hunting operations had handling facilities. The average cost of a handling facility for breeding and hunting operations is \$84,689. The final cost in this category is lodging and guest facilities. These facilities cost breeding and hunting operations an average of \$600,541 and hunting only operations an average of \$112,500. The significant difference in the two can be attributed to the fact that there are only two operations that categorized themselves as hunting only. These operations may be on the lower end of the cost spectrum in this category.

Equipment is one of the most costly capital expenditures. It includes large equipment such as tractors or bobcats, ranch vehicles, ATVs, trailer and transport crates, as well as feeding equipment. Equipment for this category also includes camera/video equipment, sedation equipment, hunting blinds, freezers or coolers, and a category labeled other equipment. These items provide the bulk of the total capital expenditure. Breeding operations spent an average total of \$409,487. Breeding and hunting operations averaged \$419,109 and hunting only operations averaged \$110,750.

Table 3: Average Annual Operational Costs

	Breeding	Breeding & Hunting	Hunting
Operation			
Year Started	2004	2004	1998
Area of breeding operation (acres)	21	30	N/A
Area of hunting operation (acres)	N/A	1,627	7,920
Number of pens	9	15	N/A
Area of pens (acres)	10	20	N/A
Capital Expenditures			
<u>Fixed Expenses</u>			
Land inherited (acres)	N/A	917	840
Inherited land value (\$/acre)	N/A	3,254	2,381
Land purchased (acres)	21	546	1,500
Purchased land value (\$/acre)	22,122	37,392	16,667
Total land value (\$)	489,238	3,505,167	13,500,000
Fencing (\$)	95,171	139,236	N/A
Shelters (\$)	58,070	48,852	N/A
Improvements (\$)	25,174	120,334	25,000
Buildings (\$)	125,804	118,795	30,000
Cost of handling facility (\$)	82,857	84,689	N/A
Lodging and guest facilities (\$)	N/A	600,541	112,500
Total fixed expenses (\$)	876,313	4,617,615	13,667,500
<u>Equipment</u>			
Large equipment (\$)	128,466	130,298	25,000
Farm implements (\$)	124,360	28,837	7,000
ATVs (\$)	17,242	25,505	17,500
Ranch vehicles (\$)	57,060	60,993	0
Trailers/Transport crates (\$)	29,610	20,410	3,000
Feeding bins/feeding and watering equipment (\$)	41,968	35,063	0
Camera/Video equipment (\$)	3,311	4,252	3,750
Sedation equipment (\$)	3,969	5,053	0
Hunting blinds (\$)	N/A	41,606	41,500
Freezer/Cooler (\$)	3,500	7,262	3,000
Other equipment (\$)	N/A	59,826	10,000
Total cost of equipment (\$)	409,487	419,103	110,750
Annual Operating Expenses			
<u>Veterinary & Animal Supplies</u>			
Medical supplies (\$)	4,136	5,116	N/A
Veterinary expenses (\$)	4,534	6,282	N/A
Sedations (\$)	6,153	5,848	N/A
Artificial insemination (\$)	7,677	14,275	N/A
CWD testing (\$)	1,127	2,560	N/A
DNA testing (\$)	3,012	4,494	N/A
I.D. tags/RFID tags/microchips (\$)	273	529	N/A
Total cost of veterinary & animal supplies (\$)	26,910	39,104	N/A

Table 3: Continued

	Breeding	Breeding & Hunting	Hunting
<u>Labor</u>			
Number of salaried employees	2	2	0
Number of hourly employees	1	2	0
Number of part-time employees	7	3	0
Total salary wages paid (\$)	53,186	76,713	0
Annual salary per employee (\$)	22,794	38,170	0
Total hourly wages paid (\$)	29,893	21,508	0
Annual hourly wages per employee (\$)	29,893	11,908	0
Total part-time wages paid (\$)	5,000	11,958	0
Annual part-time wages per employee (\$)	690	4,279	0
Outsources services (\$)	3,277	11,004	1,500
Total labor expense (\$)	91,356	121,183	1,500
<u>Utilities</u>			
Utilities (\$)	5,841	7,733	3,000
Fuel (\$)	4,137	6,079	10,150
Total cost of utilities (\$)	9,977	13,812	13,150
<u>Miscellaneous</u>			
Feed and hay (\$)	84,072	175,355	50,500
Food and beverages for guests (\$)	N/A	8,449	20,000
Maintenance and repairs (\$)	22,936	36,352	12,300
Rental equipment (\$)	1,725	4,259	0
Operating supplies (\$)	7,157	10,286	0
Lodge supplies (\$)	N/A	11,295	50,000
Insurance (\$)	5,236	8,788	10,000
Advertising/Marketing (\$)	7,406	7,559	0
Taxidermy (\$)	1,709	6,216	10,000
Travel/Meeting attendance (\$)	5,184	4,842	0
Property taxes (\$)	5,171	10,411	28,000
Permit/Licenses (\$)	514	538	750
Hunting lease (\$)	N/A	16,417	200,000
Seed and fertilizer (\$)	N/A	4,539	1,200
Other expenses (\$)	14,231	15,866	0
Total cost of miscellaneous expenses (\$)	155,341	321,170	382,750

The next category of costs contains information related to annual operating expenses. The first section is veterinary and animal supplies. This includes the cost of medical supplies, veterinary services, sedations, the cost of artificially inseminating, DNA testing, CWD testing, and the cost of I.D. tags. The total cost to breeding only operations averages \$26,910 annually and breeding and hunting operations average \$39,104 each year. The newest cost category is the cost of CWD testing. In August of

2016, new management rules went into place to reduce the spread of CWD. These rules establish a minimum level of post-mortem tests that must be submitted. Testing for CWD costs for breeding only operations averaged \$1,127 each year and breeding and hunting operations averaged \$2,560 per year.

Labor makes up a large percentage of total operating expenses. The average breeding only operation employs a total of 10 employees and the average breeding and hunting operation has 7 employees. Of the survey respondents, breeding only operations reported 2 salaried employees with an average total wages expense of \$53,186 per year. Breeding and hunting operations employed an average of 2 salaried employees for an annual expense of \$76,713. Breeding only operations averaged 1 employee for \$22,794 annually. Breeding and hunting operations averaged 2 hourly employees for a total of \$38,170 annually. Part-time employees averaged 7 for breeding only operations and 3 for breeding and hunting operations. Breeding only operations paid an average of \$5,000 per part-time employee and breeding and hunting operations paid \$11,958 per employee per year.

All three types of operations outsourced certain services. Breeding only operations paid about \$3,277 annually, while breeding and hunting operations paid an average of \$11,004 annually, and hunting only operations spent about \$1,500 for outsourced services.

Another expense incurred by breeding and hunting operations is utilities. Breeding only operations paid an annual average of \$5,841 for utilities and \$4,137 for

fuel. Breeding and hunting operations spent an average of \$7,733 for utilities and \$6,079 for fuel. Hunting only operations express utility expenses as \$3,000 for utilities and \$10,150 for fuel.

The final operating expense category is described as miscellaneous expenses. The largest cost in this category is feed and hay. Supplemental feed can allow genetically superior animals to realize their full potential. For breeding only operations, the total cost of feed includes the cost of feed and hay, protein feed for penned animals, textured/treated feed for penned animals, alfalfa hay for penned animals, and the cost of feeding fawns. The total cost of feed for fawns includes milk replacers and fawn supplement feed. Combining the feed costs allows a better understanding of the size of the feed expenditure. Of the operations described as breeding only 93% stated that fawn were bottle-fed. All of the breeding and hunting operations stated that fawns were bottle-fed. Breeding only operations had an average annual total feed cost of \$84,072. The majority of that expenditure comes from feed and hay, representing 46% of the total cost. Protein feed accounts for 40%, textured and treated feed is 8%, alfalfa hay represents only 6%, and the cost of bottle-feeding fawn represents 1% of the total cost.

The total feeding cost for hunting only operations is comprised of the cost of protein feed for pasture animals and the cost of corn/bait food. The annual average cost of feed and hay for hunting only operations was \$50,500 for hunting only operations. Of the total expenditure, 61% came from protein feed and 39% came from corn and bait. Hunting only operations also expressed having food plots. The average hunting only

operation has a total of 6 acres dedicated to food plots. The annual average cost to maintain these plots was \$300 and the annual average cost of seed and fertilizer was \$1,200.

The total feeding cost for breeding and hunting farms combines the cost of feed and hay, protein feed for breeding animals, textured/treated feed, alfalfa hay, the total cost of fawn feed, as well as protein feed for pasture animals, and corn/bait food for pasture animals. Total feeding costs for breeding and hunting operations averaged \$175,355 annually. Protein feed makes up the majority, representing 44% of the total cost. Feed and hay is about 35%, textured and treated feed is about 10%, and 2% of the total cost is alfalfa hay. The remaining 10% of the total cost is described as corn and bait, which accounts for 4%, and fawn feeding, which accounts for 6%. Breeding and hunting operations also indicated food plots were on the property. The average operation has 265 acres of food plots. The main costs associated with food plots are the cost of seeds and fertilizer and the cost to maintain them. Breeding and hunting operation's annual average expenditure for seed and fertilizer is \$4,539. Maintaining these food plots costs these operations about \$4,310 annually. While the costs of food plots are small in comparison, the advantages are quite significant. Food plots lure the animals for viewing and photographing while increasing the amount of nutritious available foliage.

This section also includes the cost of lodging supplies and food and beverages for guests. While breeding only operations do not incur this cost, hunting and breeding and hunting operations have a significant expenditure. The total cost of food and beverages

for guests for hunting only operations averaged about \$8,449 each year. Breeding and hunting operations averaged \$20,000 each year for guests' food and beverages. Other expenses included the cost of maintenance and repairs and rental equipment. Breeding only operations average \$22,936 annually on maintenance and repairs, while breeding and hunting operations average \$36,352, and hunting only operations average \$12,300 annually. Other miscellaneous costs include the cost of operating supplies, lodge supplies, insurance, advertising/marketing, and taxidermy. Operating supplies and lodging supplies are significant costs to deer operations. Operating supplies cost breeding only operations \$7,157 and breeding and hunting operations \$10,286 per year.

Hunting operations incur significant costs associated with lodge supplies. Hunting and breeding operations average \$11,295 and hunting only operations average \$50,000 annually. Other miscellaneous expenses include insurance, advertising and marketing, taxidermy, travel and meeting expenses, and property taxes. On average, breeding operations paid a total of \$5,236 on insurance. The average insurance cost to breeding and hunting operations was far more significant, with insurance costs averaging \$8,788. Hunting only operations averaged \$10,000 annually for insurance. Advertising and marketing expenses for breeding only and breeding and hunting operations both averaged around \$7,500. Of the hunting only operations that were surveyed, advertising and marketing expenses were not reported. Other miscellaneous expenses include the cost of leasing hunting land, and other miscellaneous expenses. On average, the cost of leasing hunting land for breeding and hunting operations was \$16,417. Leased land for

hunting only operations averaged \$200,000 in 2015. All other miscellaneous expenses for breeding only farms averaged \$14,231. Breeding only operations described these expenses as the cost of cell phones, seeds, LLC corporation fees, and other association fees. Miscellaneous fees for breeding and hunting operations average \$15,866 annually. Breeding and hunting operations described these fees as equipment maintenance, any necessary chemicals or pesticides, road maintenance and dozer work, and other association fees. Hunting only operations did not state any uncategorized expenses were incurred.

Figure 2 illustrates a breakdown of the annual costs of typical deer breeding only operation. Operational expenses cover supplies, labor, utilities, insurance, maintenance, travel, etc. Operational expenses averaged \$218,468 for breeding operations. This category accounts for 61% of total costs. Feed includes the cost of feed and hay, supplemental feed, and fawn feeding supplies. Feeding expenditures account for 23% of total costs. Breeding operations spent an average of \$84,072 of feed. General expenses describes the cost of veterinary expenses, CWD testing, DNA testing, taxes, permits, taxidermy, etc. Finally, general expenses consume only about 16% of total operation costs. Breeding operations spent about \$55,941 on these expenses.

Figure 2: Annual Operation Expenditures for Breeding Only Operations

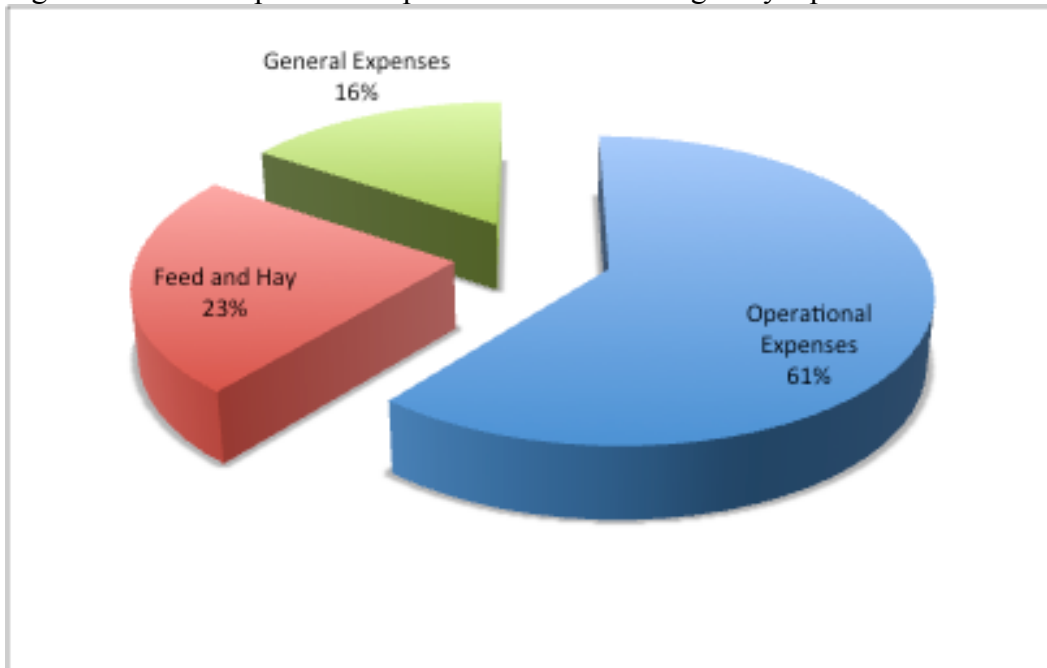
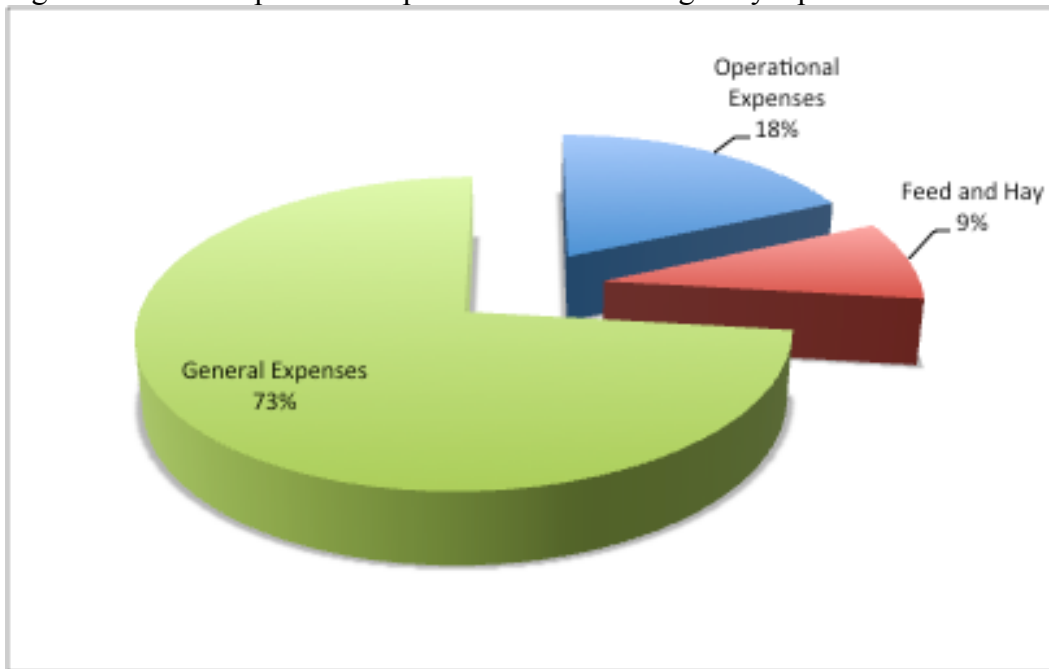


Figure 3 breaks down the similar operation cost structure of hunting only operations. Operational expenses is similar in that it includes all of the same labor, supplies, utilities, etc. expenses, with the addition of taxidermy costs. Total operational costs for hunting only operations averaged \$108,150. Operational costs represents only about 18% of total costs. Feeding expenses for this category only includes the cost of feed and hay and supplemental feeding. Hunting operations do not bottle feed fawn, therefore no fawn supplemental feed or supplies are purchased. Total average feed costs for 2015 were about \$50,500. Feed accounts for 9% of costs. General expenses cover food plots and any addition related expenses. All general costs totaled an average of \$431,500 and 73% of total expenses. While breeding only operations incur significant

operational costs, the average annual cost of operating a hunting only operation is around \$108,150.

Figure 3: Annual Operation Expenditures for Hunting Only Operations



Income

Income associated with deer breeding and hunting operations comes from a variety of areas. Table 4 describes the income associated with these different operations. Income derived from a breeding operation comes from annual sales. The survey was

used to collect data on the sales of breeder bucks, stocker bucks, open does, bred does, fawns, and semen straws.

Table 4: Annual Income From Breeding Stock

	Breeding	Breeding & Hunting
Breeder bucks sold (no.)	5	3
Income from breeder bucks (\$)	38,400	41,120
Stocker bucks sold (no.)	14	18
Income from stocker bucks (\$)	54,550	91,400
Open does sold (no.)	0	9
Income from open does (\$)	0	17,760
Bred does sold (no.)	14	15
Income from bred does (\$)	40,700	55,689
Fawns sold (no.)	4	6
Income from fawns (\$)	1,600	47,743
Semen straws sold (no.)	10	18
Income from semen straws (\$)	5,000	32,800
Total number sold	47	69
Total income earned	140,250	286,511

Breeding only operations sold an average of 5 breeder bucks and 14 stocker bucks. Income for breeder bucks averaged \$38,400 and stocker buck income averaged \$54,550. Sales of open does, bred does, fawns, and semen straws totaled an average of \$47,300. In total, the average income derived from a deer breeding operation in 2015 was \$140,250.

Income for breeding and hunting operations is shown divided into two parts. Income from the breeding operation comes from animal sales. These breeding and hunting operations sold an average of 3 breeder bucks for a total income of \$41,120.

Income from selling 18 stocker bucks totaled \$91,400. Breeding and hunting operations sold an average of 9 open does and 15 bred does. Income from open does averaged \$17,760. Income from bred does average \$55,689. For breeding and hunting operations, income from sales of fawns and semen straw was very significant. On average 6 fawns were sold for a total of \$47,743. In 2015, breeding and hunting operations sold an average of 18 semen straws for a total income of \$32,800.

Income from the hunting operations comes from the deer hunters, non-hunters, exotic hunters, other game on the property, and outdoor enthusiasts'. The average breeding and hunting operation hosted 37 hunters and 63 non-hunters. Of these hunters, deer hunters provided an average of \$143,568 in income and exotic hunters provided \$25,685. Income from non-hunters averaged a \$36,500. Several operations stated other animals were hunted on the property. Of the operations that responded, 40% stated game such as dove, turkey, duck, and other birds were hunted. Average income from other game averaged \$9,786. Some operations also reported income from other activities that take place on the property. These activities included bike races, ATV riding, fishing, leasing to outdoor writers, and camping. The total income associated with these other activities averaged \$27,140. In 2015, the average total income from operations association with the breeding and hunting of deer was \$244,679.

The average hunting only operation hosted 41 hunters and 25 non-hunters. Deer hunters provided an average of \$175,000 in income and non-hunter income averaged about \$30,00. Of the hunting only operations surveyed, none reported any exotic hunters

or income from other activities on the property. All hunting only operations reported other game was hunted on the property however, species were not specified. Income from other game totaled \$20,000. As a whole, income for hunting only operations averaged \$225,000 in 2015.

CHAPTER V

ECONOMIC IMPACT

To understand the economic impact of the deer breeding and hunting industries an input-output model was used. IMPLAN (Impact Analysis for Planning) is a software system for regional economic analysis. The model uses national and state level business survey data to understand the interrelationships of different industries. The direct effects are the basis of the economic activity that the industry creates. That activity then ripples through the economy creating indirect and induced effects. Indirect effects are the changes in purchases from other industries needed to support the initial effect on the economy. As this initial impact moves through the economy, finally an induced effect is observed. The induced effect is seen resulting from the change in household spending stemming from the change in income from the direct and indirect impacts. The total effect is calculated by combining the direct, indirect, and induced effects.

To determine the economic impact of the Texas deer breeding industry, total expenditures were calculated for each category to calculate the total value of final goods and services for each industry. Total expenditures were calculated on an annual basis. Costs such as large equipment, shelters, handling facilities, misting systems, handling facilities, and other ranch vehicles and trailers were assumed to have a 10 year life. Other equipment such as feeding and watering equipment, feed bins, cameras, foggers,

and dart guns were assumed to have a 3 year life. The annual cash expense for equipment is 10% of large equipment value and 33% of other equipment value.

Annual operation expenditures were calculated separately for breeding only operations, breeding and hunting operations, and then hunting only operations. Breeding only annual expenditures totaled \$3,452,384 for the 14 respondents. The 2 hunting only operations totaled \$610,033 in annual expenses and the 30 breeding and hunting operations spent \$22,777,971 annually. To calculate total industry costs, two different methods were used.

For the first method, total annual expenses were divided by the number of deer farms for each type of operation. Of the 46 respondents, 14 described their operation as breeding only, so annual expenditures totaled \$246,599 per operation. The number of breeding only respondents was then divided by the total number of survey respondents to provide an estimate of the percent of breeding only operations. Of the surveys received, 30.04% described themselves as breeding only. The estimated percent of breeding only operations was multiplied by the total number of surveys distributed. This gives the total estimated number of breeding operations in Texas. Using this method it is estimated that there are 396 breeding only operations across the state. Finally, the total number of breeding only operations is multiplied by the total annual expenses per operation to calculate the total annual expenses for all breeding only operations in Texas. The total annual expense for all breeding only operations is estimated to be \$97,567,393. This series of calculations was repeated for the other two types of operations to calculate a

total annual expenditure for each type of operation. The estimated annual expenditures for all Texas breeding and hunting operations is \$643,725,278 and the annual expenditures for all Texas hunting only operations is estimated at \$17,240,056. These totals were then added together to calculate the total annual expenditure for the Texas deer breeding and hunting industry. The entire Texas deer breeding and hunting industry averages \$758,532,727 in annual expenditures.

The second method involves calculating the total annual expenditures in the same way. Annual costs for each type of operation were added together to calculate a total annual cost of each type of operations. The results are the same as above. These totals were divided by the survey response rate to estimate the total annual expenses by type of operation. The total annual expenditure for 14 breeding only operation survey respondents (\$3,452,385) was then divided by the 3.6% response rate. This gives an estimated total annual expense of \$95,899,575 for all Texas deer breeding only operations. This method was used to calculate total annual expenditures for the other two types of operations. The estimated total annual expenditures for all Texas breeding and hunting operations totaled \$632,721,427. The estimated total annual expenditures for all hunting only operations in Texas totaled \$16,945,354. These three totals were then summed to give the total annual expenditure for the entire Texas deer breeding and hunting industry. In 2015, the Texas deer breeding and hunting industries' estimated annual expenses totaled \$745,566,356.

Due to the natures of the sample size, both calculation methods were used to calculate total annual industry expenditures. The totals from each method were averaged to give a more accurate depiction of the true nature of the industry. After averaging the two numbers, the total estimated annual expenditure for the entire Texas deer breeding industry is \$752,049,542. This annual expenditure was then used in the IMPLAN model. Table 5 provides a summary of the total economic impact of the Texas deer breeding and hunting industry.

Table 5: Total Economic Impact of the Texas Deer Breeding and Hunting Industry

	Direct Effects	Indirect Effects	Induced Effects	Total Effects	Employment
	(millions of dollars)				(no.)
Texas Deer Breeding and Hunting Industry	752	113.4	225.9	1091.4	14,351

The entire Texas deer breeding industry generates an estimated \$752 million in direct economic impacts. The industry is responsible for a total of \$113.4 million in indirect impacts and \$225.9 in induced impacts. This totals to an estimated \$1.09 billion in total economic impacts. This economic activity provides an estimated 14,351 jobs across the state of Texas.

The economic contributions for deer breeding vs. deer hunting are calculated by analyzing the annual expenses from the deer breeding survey separate from the hunting survey. All breeding and hunting operations filled out both a breeding expenses and

hunting expenses survey. To calculate the total annual expenditures for all breeding operations, the annual expenditures from the breeding survey were calculated. Total expenses for breeding surveys were divided by the number of breeding operations to calculate total annual costs per operation. The number of breeding surveys was expanded based on the sample size population of respondents filling out this survey form. It is estimated that 1,243 Texas deer operations have separate expenses for breeding. This number was then multiplied by the total annual expenditure per operation to estimate total expenses for breeding operations in Texas of \$412,981,687. A similar calculation was made to estimate a total annual expense for hunting only operations in Texas of \$339,067,855.

Breeding Operations

Table 6 outlines the impact of all Texas deer breeding operations. The average total annual expenditures and direct economic impacts for all breeding operations totals \$412 million. This value describes the total cost of goods and services purchased by the industry. For deer breeding operations, these direct expenditures cover everything from veterinary services to feed stores, fencing companies, utilities, etc. These direct expenditures are multiplied through the economy to create an indirect effect. The Texas deer breeding operations generate a total of \$62.3 million in indirect impacts. Indirect effects are additional purchases to stimulate the extra economic activity described in the direct impact. Table 6 also illustrates the induced effects the industry creates. Deer

breeders create \$124.1 million in induced effects. Induced effects can be described as the economic activity created by the additional spending of employees of the directly and indirectly affected industries. The Texas deer breeding industry also generates \$448.1 million in value added. Value added can be seen in the form of wages, other employee compensations, proprietor income, other forms of income, and business taxes. In total, the deer breeding industry generates \$599.3 million in economic activity across the state of Texas. The total economic activity supports about 7,881 jobs throughout the entire economy.

Table 6: Economic Impact of All Texas Deer Breeding Operations

	Direct Effects	Indirect Effects	Induced Effects	Total Effects	Value Added	Employment
	(millions of dollars)					(no.)
Breeding Operations	413	62.3	124.1	599.3	448.1	7,881

Hunting Operations

To determine the economic impact of the Texas deer hunting industry, total expenditures were calculated and used as inputs for the IMPLAN model (Table 7). The total final value of goods and services was multiplied across to calculate the total impact in each category.

Table 7: Economic Impact of All Texas Deer Hunting Operations

	Direct Effects	Indirect Effects	Induced Effects	Total Effects	Value Added	Employment
	(millions of dollars)					(no.)
Hunting Operations	339.1	51.1	101.9	492.1	390.2	6,470

The Texas deer hunting industry generates a total of \$339.1 million in direct economic impacts. These impacts can be described as direct expenditures of the industry. As the total expenditure is calculated through the model the indirect effects become apparent. The Texas deer hunting industry generates \$51.1 million in indirect effects. Induced effects from the hunting industry can be described as the increase economic activity due to the increase in income from industry-supported businesses. The Texas deer hunting industry generates \$101.9 million in these induced effects. Table 7 also illustrates the value added. The deer hunting industry supports \$390.2 million in value added in Texas. In total, Texas deer hunting generates \$492.1 million in economic impacts. This total activity provides the state of Texas with an additional 6,470 jobs across various industries.

CHAPTER VI

CONCLUSION

With the continual growth of deer hunting in the state of Texas, hunting operations have turned to deer breeding to stock their own land. The growth of deer breeding operations stems from its ability to maximize land profits for farmers. While most of these operations are located in rural communities, the Texas deer breeding industry continues to support local businesses while providing employment opportunities and stimulating consumer spending. Deer breeding operations generate an estimated \$599.3 million in economic impacts and supply 7,881 local jobs. Hunting operations' estimated total impacts average \$492.1 million and support 6,470 jobs.

In total, the Texas deer breeding and hunting industry generates an estimated \$1.09 billion in total economic impacts and provides Texans with 14,351 jobs. With the increasing number of deer breeding and hunting operations across the state of Texas, the deer breeding and hunting industry is becoming vital to the growth and stability of rural communities.

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APPENDIX

Texas Deer Industry Economic Impact Survey

Please indicate type of operation:

Breeding Only ___ Breeding and Hunting ___ Hunting Only ___

Whitetail Breeding ___ Non Whitetail Cervids ___ Specify _____

Instructions are provided at the end of the survey. For Hunting Only operations, please skip first two pages. Please use 2015 annualized figures where appropriate.

I. Operation

1. Year started _____ 2. Area of breeding operation: _____ (acres) 3. Land valuation _____

II. Herd Inventory (Final 2015 inventory)

- 1. Total number of breeder deer _____
2. a. Total # bucks _____ b. Number of stocker bucks _____ c. Number of does _____
3. a. Fawns in 2015 _____
4. Annual mortality rate (12 mo. and older) _____ %

Table with columns for Annual sales (2015 figures) and Annual Purchases (2015 figures). Rows include Breeder Bucks, Stocker Bucks, Open Does, Bred Does, Fawns, and Semen straws, with sub-rows for Income and Costs.

III. Facilities

- 1. Number of pens: _____ 2. Area of pens: _____ (acres)
3. Capital cost fencing: \$ _____ 4. Capital cost of shelters: \$ _____
5. Capital cost of other improvements like roads, water lines, etc.: \$ _____
6. Capital cost of buildings: \$ _____
7. Do you have a handling facility? Yes ___ No ___ 7a. If yes, capital cost of facility: \$ _____
8. Do you have a misting system? Yes ___ No ___ 8a. If yes, capital cost of system: \$ _____
9. Annual cost of maintenance and repairs: \$ _____

IV. Equipment

- 1. Purchase price of all large equipment, combined (i.e. tractor or bobcat): \$ _____
2. Purchase price of all ranch vehicle(s), combined: \$ _____
3. Purchase price of ATV(s), combined: \$ _____
4. Purchase price of all implements, combined: \$ _____
5. Purchase price of all trailer(s)/transport crate(s), combined: \$ _____
6. Purchase price of all bulk feed bin(s), combined: \$ _____
7. Purchase price of all feeding equipment, combined: \$ _____
8. Purchase price of all watering equipment, combined: \$ _____
9. Purchase price of all camera/video equipment, combined: \$ _____
10. Annual cost of all rental equipment: \$ _____
11. Purchaser cost of insect fogger/sprayer: \$ _____
12. Annual cost of dart/sedation equipment; \$ _____
13. Purchase price of dart gun: \$ _____

V. Veterinary & Animal Supplies

- 1. Annual cost of operating supplies: \$ _____
- 2. Annual cost of feed and hay: \$ _____
- 3. Annual cost of medical supplies: \$ _____
- 4. Annual veterinary expense: \$ _____
- 5. Annual number of sedations: _____
- 6. Annual cost of sedations: \$ _____
- 7. Annual number of does A.I.'d: _____
- 8. Annual cost for A.I.'ing: \$ _____
- 9. Annual number of CWD tests: _____
- 10. Annual CWD costs: \$ _____
- 11. Number of animals DNA tested: _____
- 12. Annual cost for DNA certifications: \$ _____
- 13. Annual costs for I.D. tags/RFID tags/microchips/other: \$ _____
- 14. Annual cost for semen storage: \$ _____
- 15. Annual insecticide costs: \$ _____
- 16. Annual miscellaneous costs: \$ _____

VI. Labor

- 1. Number of employees: Salaried _____ Hourly _____ Part-time _____
- 2. Total wages paid: Salaried _____ Hourly _____ Part-time _____
- 3. Annual expense for outsourced services: _____

VII. Utilities

- 1. Annual cost of utilities: \$ _____
- 2. Annual cost of fuel/diesel/etc.; \$ _____

VIII. Miscellaneous Expenses

- 1. Annual insurance expense; \$ _____
- 2. Annual advertising/marketing expense: \$ _____ (include booths/sponsorships/ads/web)
- 3. Annual taxidermy expense: \$ _____
- 4. Annual travel/meeting attendance expense: \$ _____
- 5. Annual property taxes: \$ _____
- 6. TPWD/TAHC permit costs: \$ _____
- 7. Other costs (specify): \$ _____

IX. Feeding

Fawns

- 1. Do you bottle feed? All ____ Some ____ No ____ (skip to d. below)
 - a. Annual cost of milk replacer: \$ _____
 - b. Annual cost of fawn supplement feed: \$ _____
 - c. Annual cost of fawn care products: \$ _____
 - d. Annual cost for outside fawn care services if No above: \$ _____
- 2. Annual cost of protein feed for breeder penned animals: \$ _____
- 3. Annual cost for textured/treat feed for breeder penned animals: \$ _____
- 4. Annual cost for alfalfa hay for breeder penned animals: \$ _____

X. Other Expenses

Please list and explain any other costs not previously covered for breeder animals:

Hunting

Instructions are provided at the end of this survey. For combination Breeding and Hunting operations, please separate hunting expenses from breeding expenses. Use annualized 2015 figures where appropriate.

What is the purpose of your hunting operation? ___ Personal use; ___ Corporate clients, no fee; ___ Paying clients

I. Operation

- 1. Year started: _____
- 2. Area of hunting operation: _____ (acres)
- 2. Land purchased: _____ (acres)
- 4. Land inherited: _____ (acres)
- 5. Total land valuation: \$ _____

II. Facilities

- 1. Capital cost of lodge(s) or guest facilities: \$ _____
- 2. Capital cost of peripheral fencing: \$ _____
- 3. Capital cost of habitat, roads, water improvements, guest conveniences (combined): \$ _____
- 4. Capital cost of other buildings: \$ _____
- 5. Annual cost of maintenance and repairs: \$ _____
- 6. Approximate area of food plots: _____ (acres)
- 7. Estimated cost of labor to maintain food plots: \$ _____
- 8. Annual cost of seed and fertilizer for food plots: \$ _____

III. Equipment (Note if equipment is shared between breeding and hunting operations, use proportioned \$\$)

- 1. Purchase price of all large equipment, combined (i.e. tractor or bobcat): \$ _____
- 2. Purchase price of all farm implements, combined: \$ _____
- 3. Purchase price of all ATV(s), combined: \$ _____
- 4. Purchase price of all ranch vehicle(s), combined: \$ _____
- 5. Purchase price of all trailer(s)/transport crate(s), combined: \$ _____
- 6. Purchase price of bulk feed bin(s)/all feeding and watering equipment: \$ _____
- 7. Purchase price of all video/game camcorder equipment, combined: \$ _____
- 8. Purchase price of all dart gun/darts/sedation equipment: \$ _____
- 9. Annual cost of all rental equipment: \$ _____
- 10. Purchase price of cooler/freezer equipment: \$ _____
- 11. Purchase price for all hunting blinds: \$ _____
- 12. Purchase price of all other equipment: \$ _____

IV. Supplies

- 1. Annual cost of operating supplies for guest accommodations: \$ _____
- 2. Annual cost of food and beverages for guest operations: \$ _____
- 3. Annual cost for protein feed for pasture animals: \$ _____
- 4. Annual cost for corn/bait food for pasture animals: \$ _____

V. Labor

- 1. Number of employees: Salaried _____ Hourly _____ Part-time _____
- 2. Total wages paid: Salaried _____ Hourly _____ Part-time _____
- 3. Annual expense for outsourced services: _____

VI. Utilities

- 1. Annual cost for utilities: \$ _____
- 2. Annual cost for fuel/diesel/etc.: \$ _____

VII. Miscellaneous Expenses

- 1. Annual insurance expense: \$ _____
- 2. Annual advertising/marketing expense (include booths/sponsorships/ads/web): \$ _____
- 3. Annual taxidermy expenses: \$ _____
- 4. Annual travel/meeting attendance expense: \$ _____
- 5. Annual property taxes: \$ _____
- 6. TPWD (DNR) licenses and permit costs: \$ _____
- 7. Hunting lease costs (for non-owned lands): \$ _____
- 8. Other costs (specify): \$ _____

VII. Other Expenses

Please list and explain any other costs not previously covered for hunting operations:

VIII. Hunters (Guests)

- 1. Annual number of hunters: _____
- 2. Annual number of non-hunters: _____
- 3. Annual deer hunter income: \$ _____
- 4. Annual exotic hunter income: \$ _____
- 5. Annual non-hunter income: \$ _____
- 6. Total number of deer harvested: _____
- 7. Total number of exotics harvested: _____
- 8. Annual number of stocker deer released into the hunting area(s): _____
- 9. Annual cost for stocker deer released for hunting: \$ _____
- 10. Annual number of exotic animals released into the hunting area(s): _____
- 11. Annual cost for exotic animals released for hunting: \$ _____
- 12. Approximate percentage of harvested animals sent to taxidermists: _____ %
- 13. Average taxidermy cost per animal: \$ _____
- 14. Average meat processing cost per animal: \$ _____
- 15. Are other game species harvested in your hunting property? ___Yes ___No
- 16. Annual income from other game species (if charged for separately): \$ _____
- 17. Other outdoor enthusiasts' income derived from hunting property: \$ _____
Specify _____