AUBURN UNIVERSITY

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

extension

ALABAMA A&M & AUBURN UNIVERSITIES

The Feasibility, Marketing, and Economic Impact of New Beef Cattle Processing in Alabama

Adam N. Rabinowitz, Ph.D.

Wendiam Sawadgo, Ph.D.

Dennis Brothers

Ken Kelley

Max Runge

December 20, 2021

Partial funding support for this project provided by the Alabama State Beef Checkoff.

202 Comer Hall, Auburn AL 36849

Corresponding Author: adam.rabinowitz@auburn.edu

TABLE OF CONTENTS

Executive Summary 4
Introduction 6
Alabama Cattle Producers 7
    Current Processing Perceptions 7
    Current Marketing Practices 8
    Potential for Cooperative Marketing Strategies 9
    Barriers to Finishing Cattle 9
    Knowledge and Ability to Finish Cattle 10
Barriers to Finishing Beef Cattle in Alabama 13
Regulatory and Food Safety Concerns 15
    Custom Exempt Facilities 15
    Inspected Facility – ADAI State Inspection Only 16
    Inspected Facility – USDA-FSIS or Talmage-Aiken Federal Inspection 17
    Special Rules for Mixed Inspection Facilities 18
    Special Rules for Combination Domestic Livestock and Wildlife Processing Facilities 18
    Processing Cull Cows or Bulls 18
    Food Safety Concerns: Retail Sale of Processed Products 19
    Farmer's Market Sales of Processed Meat Products 19
    Processing Facility Wastewater Concerns 19
    Offal/Hide/Waste Product Disposal Concerns 20
    Business Licensing and Building Permits 21
    Quality and Yield Grading of Freezer Beef 22
    Regulatory and Food Safety Concerns Specific to Marketing or Purchasing "Freezer Beef" 22
    Sites to Visit for Further Information 23
    Beef Processor Inspection Decision 25
Alabama Processing and Cattle 26
    Two Historical Case Studies 26
    Existing Processing and Cattle Inventory 27
    Potential Processing Expansion 28
    Expected Future Expansion 29
Distribution and Marketing: National Trends 30
    Meat Consumption and Trends 30
    Beef Markets 31
    COVID-19 Impact on the Beef Market 32
    Packing Plant Slaughter Capacity and Supplies 35
Distribution and Marketing: Local Demand 36
    Freezer Beef Terminology 37
    Dedicated Freezer Space 38

Beef Purchase Location and Product Characteristics 38
Barriers to Purchasing Freezer Beef 41
Potential Margins for Beef Slaughtering and Processing 43
Financial Analysis 47
Base Assumptions 47
Facility Construction and Equipment 48
Financing the Capital Investment 49
Annual Operating Costs Including Labor 49
Profitability Analysis 50
Breakeven and Sensitivity Analysis 51
Summary and Conclusions 53
Economic Impact Analysis 55
Assumptions 55
Economic Impact Analysis of a New Slaughter and Processing Operation 56
Key Findings and Conclusions 57
References 58

Executive Summary

- Recent supply chain disruptions in the beef market have created interest in expanding local processing throughout the United States, including Alabama.
- The United States Department of Agriculture (USDA) is developing multiple initiatives to address supply chain issues through grants, loans, technical assistance, rulemaking, and enhanced transparency in markets.
- Fifty-seven percent of Alabama cattlemen expressed interest in additional processing in the state for use by their operation.
- While only 31% of cow-calf operators are currently finishing cattle, 85% indicated they might be willing to finish, creating opportunities for additional processing in Alabama.
- Expanding cooperative marketing has been identified by the USDA as a potential risk management strategy to benefit cattle producers. A majority of Alabama producers expressed a willingness to either purchase shares in a cooperative processing plant or cooperatively market fat cattle.
- The lack of facilities to finish cattle is the number one barrier identified by producers, however, there are also other issues that are of concern, including the need to direct market to consumers, and the financial needs for finishing.
- While most producers have the necessary knowledge to finish, the areas of greatest need for education is in marketing and regulations for selling freezer beef.
- Numerous federal and state regulations govern the processing and sale of livestock and are important considerations in establishing a new processing facility.
- There are at least 29 processing facilities in Alabama that handle meat, and not all process beef. Only 4 state inspected and 4 federally inspected facilities exist in the state.
- Considering the location of existing facilities and cattle inventories, there are notable geographic gaps in processing in Alabama.
- National trends for meat consumptions show competition for beef from other meats and plant-based alternatives.
- Retail prices of beef have also increased over time, with recent a spike due to COVID-19 supply chain disruptions. Wholesale prices also spiked as a result of COVID-19, but the farm value decreased.
- Freezer beef is a niche market term that is illustrated by the wide variety of words that Alabama consumers associate with the term. Some of the words the general population associates with freezer beef exhibit less favorable opinions of this market and a need for education and marketing.
- Deep freeze space is abundant in Alabama with 59% of residents in the state having this appliance in their home.
- The three most important attributes that Alabama consumers look for in beef are price, USDA grade, and taste.

- Alabama consumers that purchase freezer beef do so because of lower prices and better value. They are less likely to do so out of just a preference for buying from local producers.
- Some of the most significant consumer barriers for purchasing freezer beef are concerns about quality and lack of familiarity with the product.
- Alabama producers indicated a willingness to provide finished cattle at an average premium of $1.91/lb (processed weight) when compared to selling feeder cattle.
- Alabama consumers indicated a willingness to purchase freezer beef at an average premium of $2.21/lb when compared to ground beef purchased at a supermarket and $3.53/lb when compared to boneless sirloin steak purchased at a supermarket.
- Potential margins for slaughtering, processing, distribution, and marketing range from $0.30/lb for value beef consumers to $1.62/lb for premium beef consumers. This represents a simple average of $0.96/lb.
- A financial analysis was performed on a 35-head per week beef cattle operation. Total construction costs ranged from $525,000 to $640,000 plus $145,000 in equipment cost for a capital investment of $670,000 to $785,000. With an annual expense estimated at just over $700,000, there are opportunities for profit (before income tax) under the right operating conditions.
- The availability of skilled labor, in particular butchers and meat cutters, is a concern for the industry.
- A sensitivity analysis illustrates the necessity to produce at or near capacity at the lower end of the evaluated price points. At 75% of capacity, it will be necessary to carefully control costs or rely on higher prices that may not be sustainable.
- Consideration should be given to diversification of processing to include hogs, deer, and potentially small ruminants. Additionally, value-added opportunities such as bacon and sausage production or producing cooked meats can help increase profitability and minimize risk of insufficient supply of cattle to produce at capacity.
- An economic impact analysis shows that developing a new beef slaughter and processing facility that employees six employees can have additional impacts on the State of Alabama economy. Increased economic activity occurs from the plants production, purchase of inputs, and wages that are spent in the community on household spending for goods and services. Depending on the price point, the total economic impact of a new slaughter and processing facility is between 12.5 and 15.2 new jobs and $1.5 - $2.2 million of economic activity.

INTRODUCTION

Beef production in the U.S. is predominantly based on a logistical structure that involves producers across the entire country shipping their cattle to the Midwest for finishing and processing. As a result, a few major packers currently dominate the market, raising concern during times of supply chain disruptions. The Tyson beef packing plant fire in 2019, followed by the COVID-19 pandemic created significant impacts on all aspects of the global beef supply chain. Alabama producers faced lower farm-gate prices and Alabama consumers, with limited supply, faced higher retail prices.

In response to concerns about the beef supply chain, the United States Department of Agriculture (USDA) Agricultural Marketing Service (AMS) investigated the market impact of recent supply chain disruptions on cattle producers (USDA AMS 2020). One of the proposed solutions from this investigation is to consider small processor and cooperative opportunities. Additionally, there have been renewed conversations among policy makers and industry experts about the need for a more flexible supply chain that includes expanding the geographic capacity of beef cattle processing to insure the national food supply. The USDA has already begun some Initiatives to help address these issues through a commitment of $500 million in grants, loans, and technical assistance, allocation of $55 million for a Meat and Poultry Inspection Readiness Grant program, a $100 million dedication to reduce inspection fees, rulemaking to clarify sections of the Packers and Stockyards Act, and a plan to enhance farmers market access and returns (USDA 2021a).

This report is designed to provide a multi-faceted feasibility, marketing, and economic impact study of new beef cattle processing in Alabama. We provide stakeholders, including potential investors and policymakers, with the information necessary to make informed decisions about investment and economic development opportunities in beef cattle processing in Alabama. We analyze different aspects of the beef supply chain, first focusing on the supply side with cattle producers and the potential for providing finished cattle for processing in Alabama. We discuss regulatory and food safety concerns for beef processing, including information about different types of processing facilities and a decision tree to help interested parties determine the best structure for their operation. We also present an overview of existing processing and cattle inventory to identify potential locations for new processing.

On the demand side, we examine national trends of distribution and marketing, including the COVID-19 impact on food consumption. From a local perspective, we consider unique aspects of the distribution and marketing to Alabama consumers for locally processed beef. With consideration of supply and demand factors, we estimate potential margins for beef processing in Alabama and then put these in perspective with respect to a financial analysis of the capital investment and annual operating costs of a processing plant. Finally, we present an economic impact analysis of the employment and economic activity generated from development of new processing in the state.

ALABAMA CATTLE PRODUCERS

One of the critical needs for the success of a beef slaughter and processing facility is the local availability of finished cattle. The supply of cattle for this market has been historically limited in Alabama. To evaluate the potential expansion of supply of finished cattle, a producer survey was conducted. The survey asked questions focused on Alabama cattle producers' current endeavors and challenges finishing cattle, willingness to finish cattle, and potential limitations to expanded finished beef products. The survey was distributed with the assistance of the Alabama Cattlemen's Association through their listserv. A total of 301 participants responded to the producer survey.

The sampled population was fairly representative of Alabama cattle producers. About 53% of the respondents had less than one hundred head of cattle, which is consistent with the 2017 USDA Census of Agriculture, in which 47% reported less than one hundred head. Respondents relied on other sources of income other than farming, with almost 90% of respondents reporting less than half of their household income as coming from on-farm sources. This is consistent with the large number of small producers in the state that have a part-time cattle production.

CURRENT PROCESSING PERCEPTIONS

Respondents expressed a lot of interest in expanding beef cattle processing in Alabama. Fifty-seven percent of respondents stated that they are interested in additional processing for their own operation while another 27% or respondents mentioned a need for increased processing for other operations. Twice as many respondents preferred a finished beef processing facility over a cull cow processing facility.

While 31% of cow-calf operators indicated they are currently producing finished beef, we found an overwhelming majority (85% of respondents) indicating they *might* be willing to finish. Three-quarters of the cow-calf operators who currently finish cattle do so at a weight of 1,000 to 1,400 lb. However, 92% of the cow-calf operators in the survey are currently marketing at less than 800 lb, indicating that finishing cattle would require a change in current production and marketing practices and could significantly affect cash-flow for those operations.

Producers desired having processing facilities closer to their operations, as shown in Figure 1. While producers are on average willing to increase their travel distance for processing by a few more miles, more than half would prefer processing capabilities between 25 and 75 miles. Those who are currently finishing cattle expressed an even greater preference for closer processing facilities, with half of respondents preferring facilities within 50 miles. Conversely, only 37% of producers who are willing to finish but do not currently finish cattle had a desired travel distance of 50 miles or less.

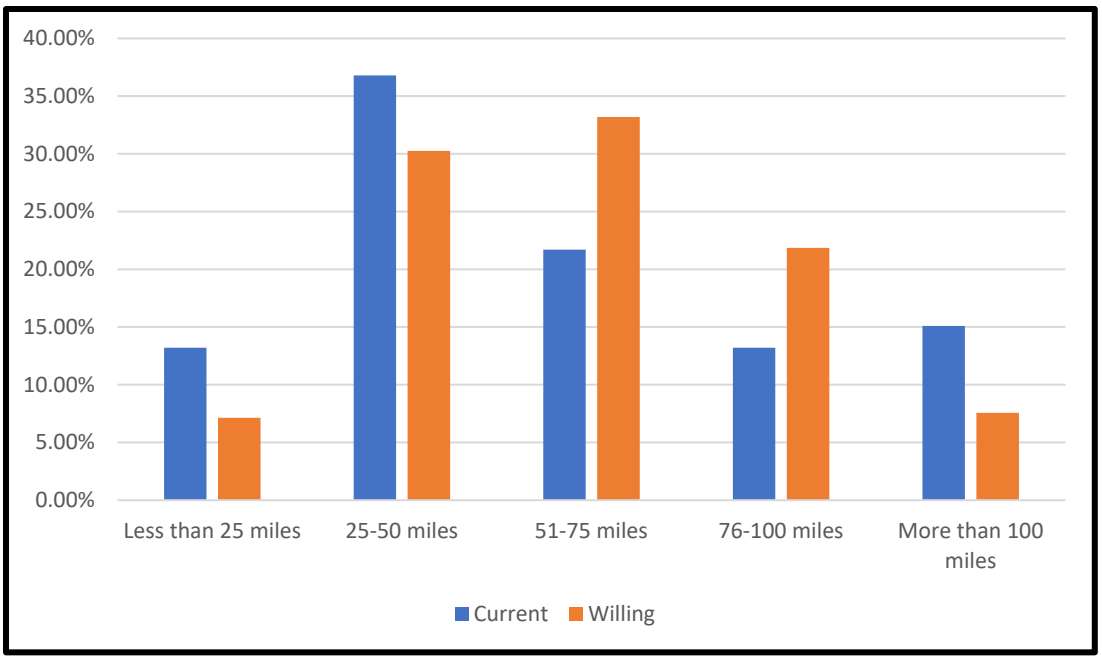


Figure 1. Travel Distance for Processing Cattle

CURRENT MARKETING PRACTICES

About 25% of the cow-calf operators that responded to the survey sell direct to consumer, in addition to using other marketing practices. Figure 2 shows the marketing practices used by Alabama cow-calf producers. Most cow-calf producers (84%) sell feeder cattle to the stockyard, and thirty-eight percent sell via private treaty off the farm. Only 7% of cow-calf producers currently sell to feedlots.

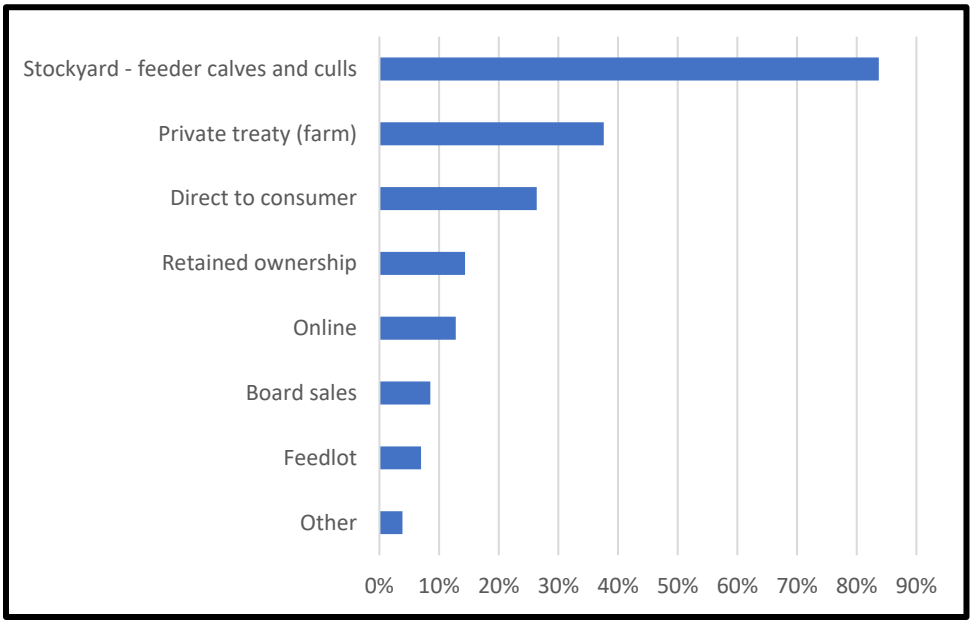


Figure 2. Marketing Practices Used by AL Cow-Calf Producers

POTENTIAL FOR COOPERATIVE MARKETING STRATEGIES

Due to the limited size of Alabama cattle operations, marketing structures that involve groups of producers marketing their cattle cooperatively could increase prospects for finished beef. In fact, cooperative marketing opportunities is one of the risk management strategies identified by the USDA AMS (2020) in their cattle price spread investigation report. Following this recommendation, we asked in our survey whether (1) producers would be willing to purchase shares in a cooperative processing plant and (2) whether producers would be willing to cooperatively market their fed cattle.

Both a cooperative processing plant and cooperative marketing of fat cattle appealed to cow-calf producers. As shown in Figure 3, more than half of the respondents stated being willing to work cooperatively, while most of the others would be open to exploring the idea. Only 7% of the respondents indicated they would not be willing to participate in some type of cooperative relationship.

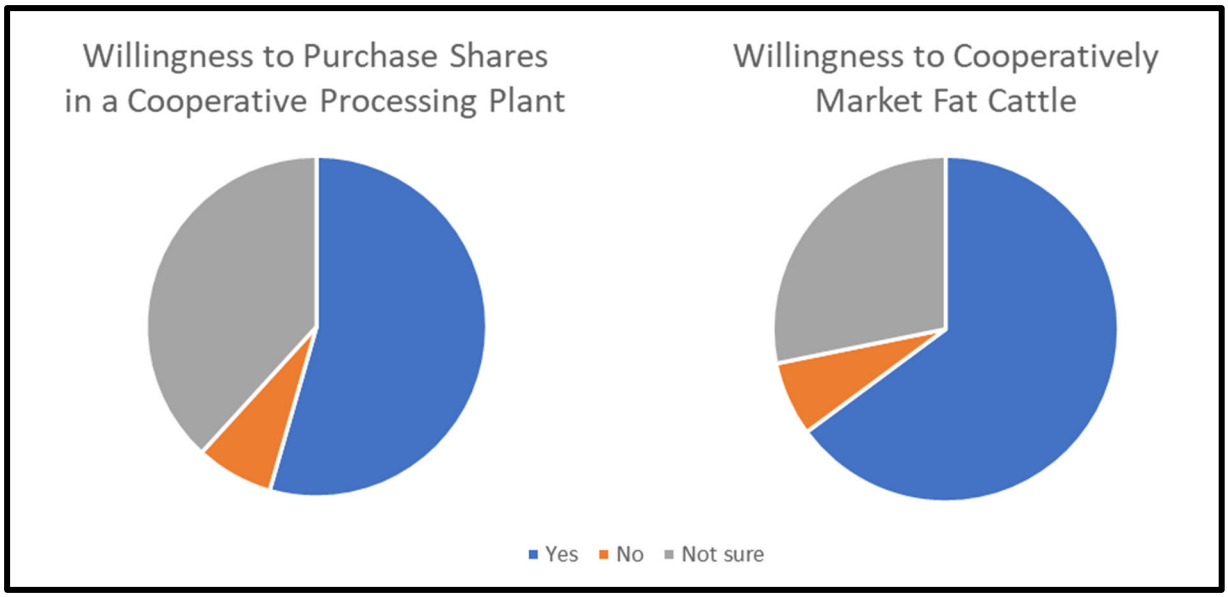


Figure 3. Cooperative Processing and Cooperative Marketing Potential

BARRIERS TO FINISHING CATTLE

We presented participants with a discrete-choice experiment in which respondents were given multiple price scenarios and options to sell beef through different marketing channels. The purpose of this section was to understand how many producers would potentially be willing to finish cattle and evaluate the price points at which producers would be willing to finish cattle on their operations.

The available marketing channels included in the survey were (1) selling feeder cattle through their current marketing channel versus (2) selling finished cattle as freezer beef. In all scenarios,

respondents could select neither choice as an option. An example of the experiment is presented in section on Potential Margins for Beef Slaughtering and Processing in this report.

Among producers who were not willing to finish cattle in at least one of the hypothetical scenarios, the leading reason was the lack of the facilities needed to finish cattle, with 45% stating that was the main cause. This is shown in Figure 4. Twenty-eight percent stated that they were not interested in direct marketing to consumers. Twenty-seven percent mentioned that it was not financially feasible for them to finish cattle, suggesting delays in cash flow could pose an issue.

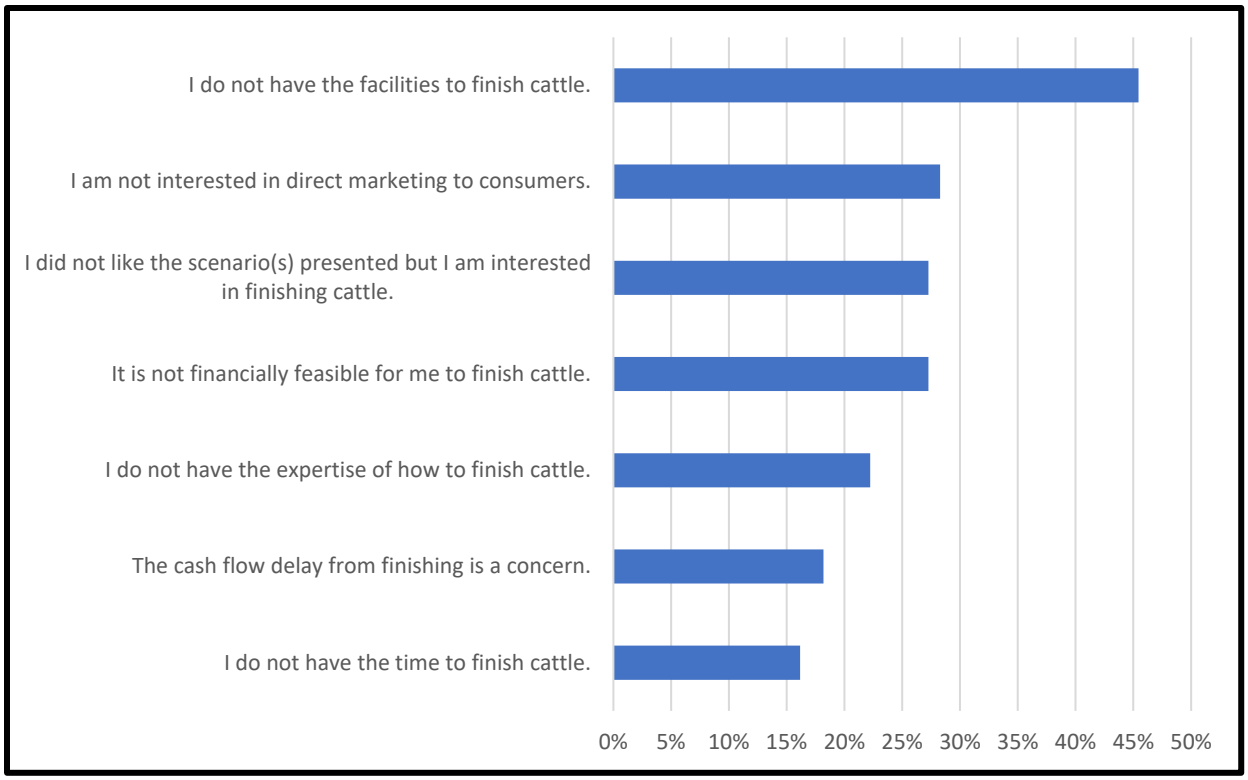


Figure 4. Reasons for Not Choosing to Finish Cattle in Hypothetical Scenarios

KNOWLEDGE AND ABILITY TO FINISH CATTLE

While a willingness to finish cattle is necessary, so is the knowledge and ability of the producer. We asked producers about their knowledge on a variety of topics related to finishing cattle. We also asked them about their access to appropriate facilities. Figure 5 shows the average knowledge level of cow-calf producers in the survey. Respondents reported being more than moderately knowledgeable about topics related to finishing cattle, especially on the production side. Producers were most confident about their knowledge on nutrition management of beef calves after weaning, reporting an average knowledge level of 66 out of 100. Producers also expressed confidence in knowledge on diet after weaning; how to produce high-quality forage

for grass-finished beef; expected meat yield from finished cattle; the effects of breed and sex on meat yield, marbling, and meat quality; business and tax considerations; and the finishing diet needed to achieve sufficient marbling. Producers were less confident on the marketing considerations of beef, having an average knowledge level of 46 out of 100. Respondents were the least confident on the laws and requirements for selling freezer beef as either whole carcasses or as individual cuts, having an average reported knowledge level of 43 out of 100.

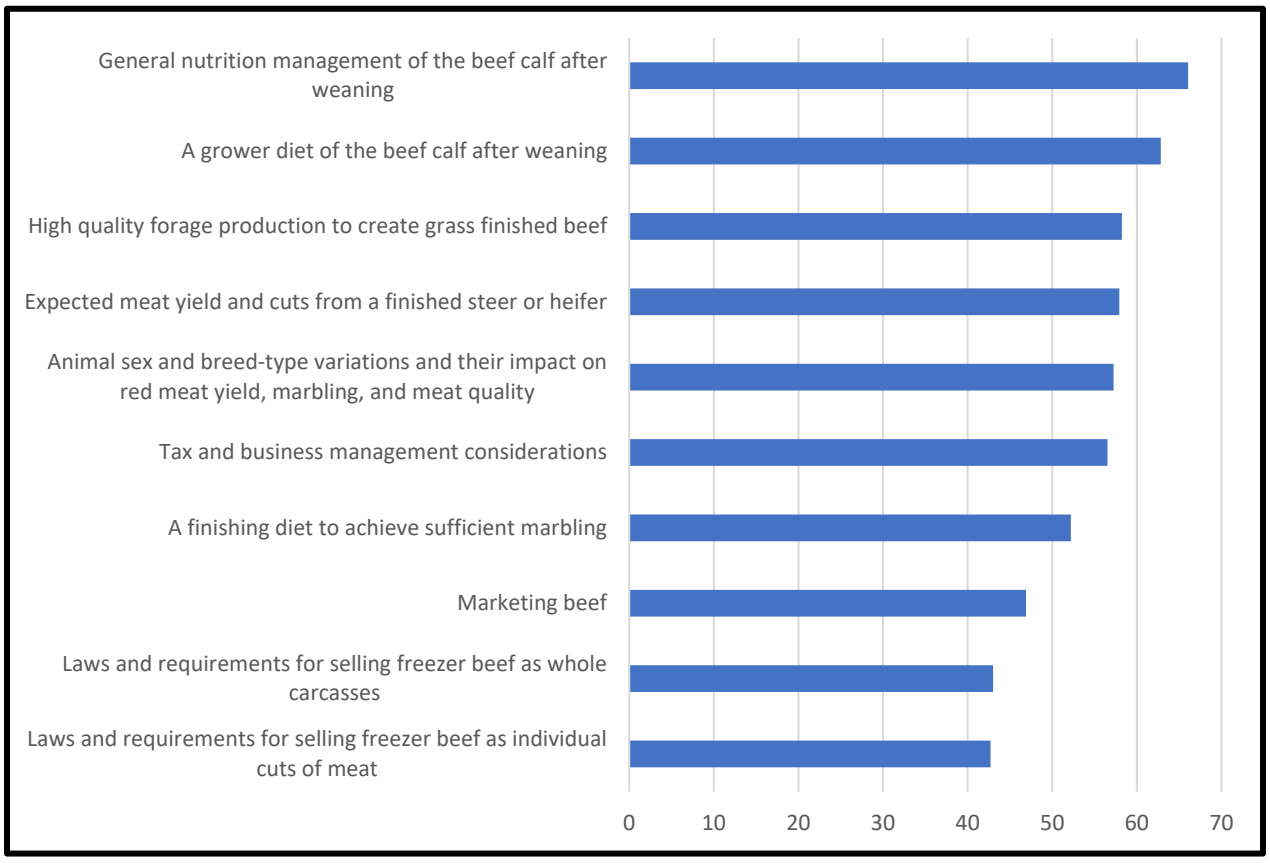


Figure 5. Average Knowledge Level (Scale is 0-100 from Not Knowledgeable to Extremely Knowledgeable)

Meanwhile, Figure 6 shows how access to facilities used for finishing cattle are uneven between those that currently finish and those who do not. Producers who currently finish were more likely than those who do not currently finish to report having access to facilities for production of annual grasses or forages, confined animal feeding, handling feedstuff for finishing calves on-farm, and the ability to measure calves' live weights to inform management decisions during the feeding phase. The one exception was facilities for vaccination, deworming, and other health treatments, with 93% of those who do not currently finishing reporting adequate facilities, but only 89% of those currently finishing reporting adequate facilities.

The greatest potential obstacle for those not currently finishing was the measuring of calves' live weight to assist with management decisions, with only 38% stating they had the ability to do so, compared to 57% for those who currently finish cattle. While these gaps in existing facilities may limit the ability of producers to finish cattle without additional capital investments, there are still many producers who have sufficient access if they choose to finish cattle.

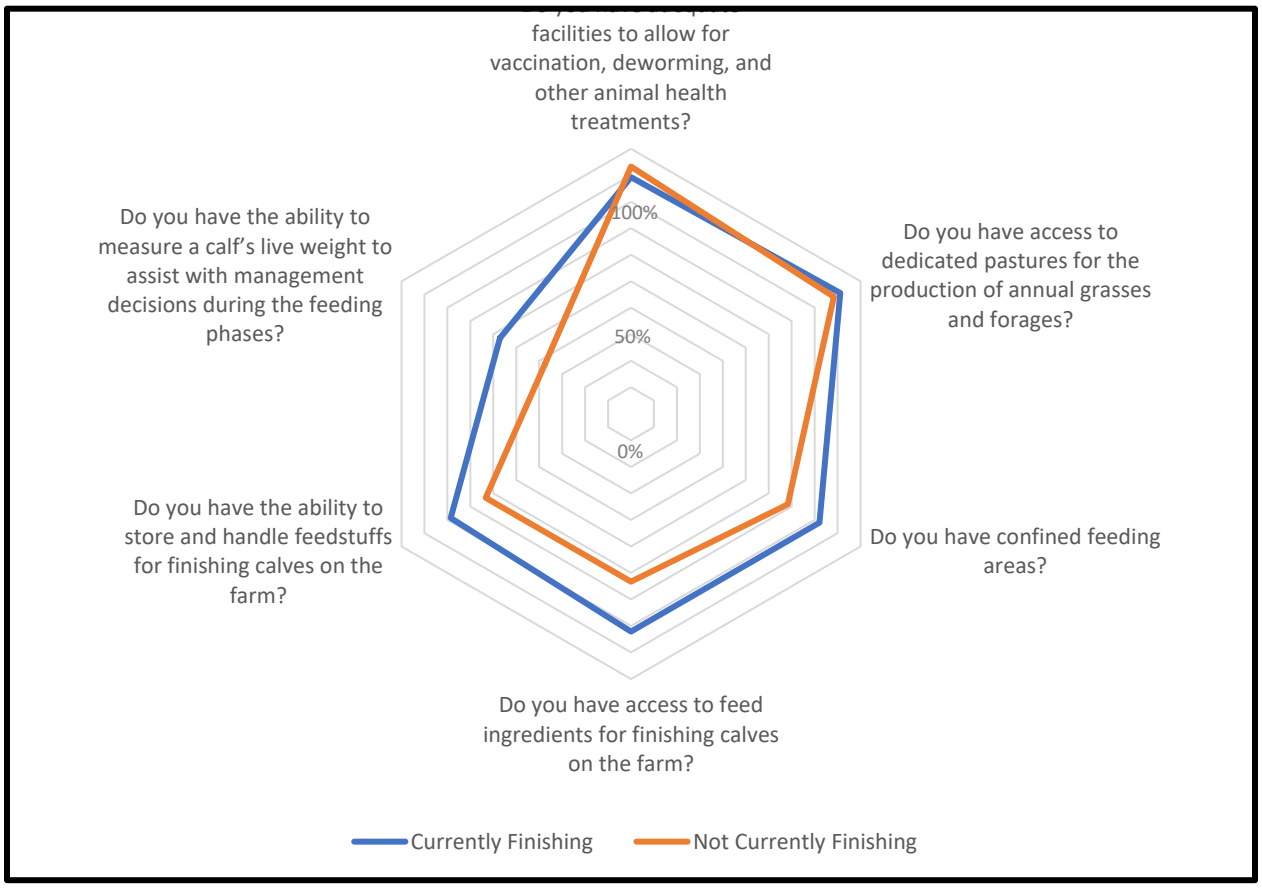


Figure 6. Access to Facilities for Finishing Cattle

BARRIERS TO FINISHING BEEF CATTLE IN ALABAMA

Traditional large scale beef feeder calf finishing has historically been focused in the Western and Mid-Western states. There are multiple reasons for this, and each of these reasons can be considered barriers for large scale cattle feeding in Alabama. The major factors to be considered would be (1) feed, (2) climate, (3) facilities and (4) cash.

Feed costs are the largest portion of finishing costs, excluding feeder calf prices. Corn is the predominant driver of feeder calf prices, and the majority of domestic production occurs in the mid-western states driven by soil dynamics and typical weather patterns. Corn production in the southeast tends to be of lower yield and often lower quality due to the heat and humidity associated with Alabama summers. Data obtained from USDA NASS (2021a) estimates harvested acres of corn in Alabama of 340,000 acres, as opposed to 11,000,000 in Illinois and 12,560,000 in Iowa. The USDA also estimates per acre production of 165 bushels in Alabama, 214 bushels in Illinois, and 196 bushels in Iowa. This means that larger feeding operations in the Southeastern U.S. must either contract a limited supply of local corn or pay a substantially higher price than midwestern feedlots due to transportation and handling costs. Corn prices are also about 75% higher in late 2021 than the 5-year average, resulting in a higher cost of production for finishing cattle.

USDA NASS (2021b) Cattle on Feed reports show the three largest cattle feeding states (inventory) as Texas, Kansas, and Nebraska in 2021. Average rainfall [3] for Alabama is 56 “, as opposed to 35” in Texas, 32” in Kansas, and 27” in Nebraska (it should be considered that data for Texas includes all of the state, while the majority of feedlots are located in the much drier panhandle region) (World Media Group 2021). Rainfall and humidity in the southeast presents as multiple issues for cattle feeders, including both physical (mud) and health (respiratory, foot rot).

Facility issues for southeastern feeders are directly tied to climate. Western and Mid-Western feeders have the opportunity to utilize open feeding areas for cattle. Rainfall in southeastern states make this difficult for cattle feeders, often requiring semi-enclosed feeding facilities to ensure adequate conditions for animal well-being and optimum production. These facilities present larger startup costs, larger depreciation costs, and larger maintenance and management costs.

Cash flow issues must be considered when analyzing feeding opportunities in the southeastern states. Figure 7 displays an enterprise budget for grain fished slaughter cattle in Alabama. These estimated costs and returns use Alabama Cooperative Extension System recommended management practices, thus individual producer costs may differ. This provides an example of the costs necessary for a farmer to provide additional finished cattle in Alabama. While there are farmer feeders in Western and Mid-Western states finishing cattle, the majority of U.S. cattle are finished in larger feedlots owned by entities with proven financial stability. These do not exist

in Alabama. The majority of these feedlots have relationships with large processing plants that are also financially stable and have proven to be sustainable.

NOTE: Changes can be made ONLY in the HIGHLIGHTED cells.

5 HEAD: GRAIN FINISHED SLAUGHTER CATTLE BUDGET ALABAMA, 2021
ESTIMATED COSTS AND RETURNS; USING RECOMMENDED MANAGEMENT PRACTICES;

750 LBS. BEG. WT.;
3.00 LBS. ADG.; **180** TOTAL DAYS FEEDING PERIOD; **116** COMMERCIAL FINISHED C
1125 LBS.STOCKED/AC; **30** DAYS OF TRANSITION TO FULL FEED **35** MARGIN %
1.50 HD. STOCKED/AC; **150** DAYS OF FULL FEED
1.50 % DEATH LOSS; **1238** LBS. ENDING WEIGHT W/ 4 % SHRINK

ITEM	HEAD	UNIT	QUANTITY	PRICE OR COST/UNIT	TOTAL VALUE/COST	$/HEAD SOLD	% OF TOTAL
1. GROSS RECEIPTS							
SLAUGHTER CATTLE	5.00	CWT.	12.38	**156.60**	$9,694	$1,939	100.0%
2. VARIABLE COST							
FEEDER CALVES	5.00	CWT.	7.50	**122.00**	$4,575	$915	50.0%
SALT & MIN.		CWT.	1.69	26.00	$44	$9	0.5%
HAY		TON	1.88	90.00	$169	$34	1.8%
VET & MED		HD.	5.00	17.50	$88	$18	1.0%
FEED		TON	10.44	300.00	$3,133	$627	34.2%
LABOR		HR.	25.00	12.00	$300	$60	3.3%
LAND RENTAL		ACRE	3.33	25.00	$83	$17	0.9%
MARKETING EXPENSES		HD.	5.00	50.00	$250	$50	2.7%
BEEF PROMOTION FEE		HD.	5.00	2.00	$10	$2	0.1%
EQUIPMENT		DOL.	1.00	60	$60	$12	0.7%
INTEREST ON OP. CAP.		DOL.	965.55	**0.0550**	$53	$11	0.6%
TOTAL VARIABLE COSTS					$8,764	$1,753	95.7%
3. INCOME ABOVE VARIABLE COST					$929	$186	

Figure 7. Enterprise Budget for Finished Slaughter Cattle, 2021

REGULATORY AND FOOD SAFETY CONCERNS

According to the National Agricultural Law Center (Rumley and Wilkerson 2021), "The processing of livestock- which includes animals such as cattle, sheep, swine, and goats- is governed on a national level by the Federal Meat Inspection Act and implemented through United States Department of Agriculture (USDA) regulations. Similarly, the processing of poultry, including chickens, turkeys, ducks, geese, ratites, and squab is governed by the Poultry Products Inspection Act and implementing regulations. In those laws, USDA Food Safety Inspection Service (FSIS) is given primary authority for oversight of meat products that will be offered for sale. One of the main components of that oversight is the requirement that the slaughter of livestock and processing of meat products be subject to continuous inspection by government inspectors. Additionally, there are various labeling, sanitation and building requirements. Further, for plants slaughtering and processing livestock, there are further requirements based on the Humane Slaughter Act."

For beef processors in Alabama, this simply means they are required by law to conform to the regulatory guidelines set forth by the USDA-FSIS and every processing plant in the state is required to be inspected by either the Alabama Department of Agriculture and Industries (ADAI) or the USDA. Under these guidelines, there are two types of facility classifications:

1. Custom Exempt Facility
2. Inspected Facility

The type of facility classification a processor falls under depends on how they choose to operate and if the product from the services they provide are available for sale to third party purchasers, and if those products will be sold inside Alabama only or across state lines. While all facilities are inspected, there are different guidelines for Custom Exempt and Inspected Facilities. Both Custom Exempt and Inspected Facilities are required to apply for permitting through the ADAI and/or the USDA.

A Custom Exempt facility is a single category with inspection handled exclusively by ADAI personnel. Inspected Facilities fall under one of two categories: a. ADAI State Inspected Facility or b. USDA-FSIS Federally Inspected Facility.

CUSTOM EXEMPT FACILITIES

Custom Exempt status is the lowest level of inspection required for any processor providing public slaughter/processing services in Alabama. To be classified as Custom Exempt, the processor provides a service for a fee to the owners of the livestock being processed. These owners must also be the end users of the product. If the producer is not the end-user, the animal must have been sold to the end-user alive, or "on the hoof" prior to slaughter. Animals may be sold by the individual live animal or by live weight. Sale of animals by dressed weight requires processing in a state inspected or USDA-FSIS inspected facility. Under the Custom Exempt

classification, purchase of whole or divided portions of a live animal (halves or quarters for example) by multiple purchasers is allowed, but such purchases must be made and documented prior to slaughter. Every animal is required to have the date of purchase, name and address of owner at delivery, license tag of delivery vehicle, description of the animal and age of the live animal at time of slaughter all documented and provided to the plant.

A producer can include processing as a service included in the animal's purchase price, but the processing must be separate in the sales contract. Hauling services to the processor and return hauling of processed product can also be included as a service by the producer to the purchaser but must also be a separate part of the contract. In the case of a producer hauling processed product back to the animal owner, they must obtain a permission slip signed by the animal owner for the service and this should be retained as part of the animal sales contract. All processed, packaged products are to be the property of the animal owner at time of slaughter and cannot be resold to a third party. All packaging must be clearly labeled as "Not for Resale".

Custom Exempt facilities are still under the authority of the USDA and are inspected by ADAI personnel. However, the inspection consists mainly of general sanitation issues, pest control and record auditing. Inspectors are not on site for every aspect of slaughter or processing, but facilities are subject to quarterly on-site inspection, or on an "as-needed" basis with 30-day follow-ups to any issues being found. No livestock may be slaughtered that result in food unfit for human consumption. ADAI also responds to any complaints against Custom Exempt processors.

INSPECTED FACILITY – ADAI STATE INSPECTION ONLY

Products that are to be sold to a third party, and not simply the result of a processing service to the owner of the live animal, must be inspected under more stringent USDA-FSIS guidelines. In such cases, the USDA-FSIS inspection authority may be designated to a state agency in those states that chose to apply for such authority, if the state requirements are "at least equal to" those enforced by USDA-FSIS. State inspection programs operate under a cooperative agreement with FSIS, and facilities in states with state inspection can choose between FSIS or state inspection. The difference between the two approaches is that state inspection programs only allow for meat processed in these facilities to be sold within the state- "intrastate"- while direct FSIS inspected facilities can export meat to other states, or "interstate."[1]

Under ADAI State Inspection only, processors or producers may engage in <u>intrastate</u> (within Alabama) sell of processed products by the individual cut, or otherwise post-slaughter, to third party purchasers as long the product is not sold across state lines. Retail or wholesale intrastate marketing is allowed under ADAI State Inspection.

Upon approval of application for inspection, state inspection is provided at no charge to the facility. However, there are requirements that every facility is responsible to meet. Inspection

personnel must be onsite during all slaughter procedures to oversee all aspects of slaughter. Typically, facilities will have specified days they slaughter, and process inspected animals. To facilitate this, an inspection office space must be provided on-site for the inspector.

An approved Sanitation Standard Operation Procedure program must be in place. An approved Hazzard Analysis Critical Control Point (HACCP) program must also be in place. Guidelines for these can be found under USDA-FSIS regulations CFR 416 and 417 (USDA 2018, USDA FSIS 2021). Approved labeling must be in place for all products. Only packaged, frozen and labeled products can be sold, whether retail or wholesale. If produce will be stored at the processing facility, storage units will be inspected. If product is transported and stored at a different location – at a producer's location for example – transportation must be below 45F, and the storage facility must be registered with the compliance department of the inspection service and meet similar standards of sanitation, temperature, and inspection. If products are to be sold by the processing facility in a retail space or to wholesale distributors, the US Food and Drug Administration requires a retail exempt permit to be issued. Guidance and training for all these procedures is available through ADAI.

INSPECTED FACILITY: USDA-FSIS OR TALMAGE-AIKEN FEDERAL INSPECTION

For a facility to process product eligible for sale post-slaughter and across state lines, the facility must be a USDA-FSIS inspected facility. This level of inspection can be administered directly by the FSIS or through a USDA-State cooperative agreement.

According to the National Association of State Departments of Agriculture (2021), "Twenty-seven states have their own meat and/or poultry inspection programs covering nearly 1,900 small or very small establishments. These programs were authorized by the passage of the Federal Meat Inspection Act of 1967 (FMIA) and the Poultry Products Inspection Act of 1968 (PPIA). The states run the programs cooperatively with FSIS, which provides up to 50% of the funds for operating them, comprising about $65 million of the total FSIS budget annually. A state program operating under a cooperative agreement with FSIS must demonstrate that its system is equivalent to federal inspection; however, state-only-inspected meat and poultry products are limited to intrastate commerce only."

This agreement is commonly known as the Talmage-Aiken act, such plants are often designated T-A inspected facilities. State inspection under T-A agreement qualifies as federally inspected product in Alabama, as ADAI inspection meets or exceeds all USDA-FSIS requirements for inspection. But this does not mean that a plant already under ADAI state-only inspection automatically qualifies for T-A status or is considered a FSIS Inspected facility for interstate sale of product.

If a facility is already under state-only inspection, they must file an application with USDA-FSIS for federal labeling. USDA-FSIS then decides if they will be inspected by the state under the T-A

agreement or if USDA-FSIS will retain inspection for the facility directly. Typically, state-only inspected facilities in Alabama will fall under the T-A agreement and will qualify for USDA-FSIS labeling after application approval. If the procedures or products changed with the new USDA-FSIS application, it is possible the USDA-FSIS will start directly inspecting.

If a facility does not currently fall under state inspection and wishes to be inspected for interstate sales, an application for inspection must be filed with the USDA-FSIS first, at which time the USDA-FSIS will direct the inspection to fall under the T-A agreement with the state or they may choose to have the facility USDA-FSIS inspected directly.

After inspection of the livestock at slaughter in a T-A or FSIS facility, the carcass can then be sold by the whole, half or quarter under CE rules with the product stamped “Not for Resale” or may be sold by the individual cut or other post-slaughter method.

SPECIAL RULES FOR MIXED INSPECTION FACILITIES

Carcasses and products processed under Custom Exempt guidelines must be kept separate from ADAI State or T-A / FSIS inspected carcasses and products. All species of domestic livestock must be kept separate from each other regardless of inspection type.

SPECIAL RULES FOR COMBINATION DOMESTIC LIVESTOCK AND WILDLIFE PROCESSING FACILITIES

Many Custom Exempt facilities, as well as some Inspected facilities, also process deer or wild swine during certain times of the year. At no time during the processing is any wildlife species to “touch” other meats. All wildlife must be kept separate and apart from all other species being processed from start to finish, including carcass hanging. Often this means wildlife is processed on days when no livestock is being slaughtered or processed. Processed, packaged and frozen product can be stored in mixed freezer space.

PROCESSING CULL COWS OR BULLS

Processing of cull cows or bulls (over 30 months of age) is allowed at any processing plant at all levels of inspection but only under specific guidelines. First, the animal must be able to enter the slaughter floor under their own power. Because of concerns of transmission of Bovine Spongiform Encephalopathy (mad cow disease), the head and vertebral column must be removed on the slaughter floor and not further be in contact with the carcass, processed or otherwise, of the slaughtered animal or other animals. The brain and vertebral column must be separated and disposed of before the animal leaves the slaughter floor and the slaughter area must be cleaned prior to other animals being slaughtered. To accommodate these requirements, these animals should be processed on a separate day or at the end of a slaughter day.

FOOD SAFETY CONCERNS: RETAIL SALE OF PROCESSED PRODUCTS

All food safety issues are addressed by the Alabama Department of Public Health (ADPH), ADAI and USDA-FSIS where applicable. Additional local or county rules may apply. Processors or producers who wish to sell retail product (packaged state or USDA inspected cuts) must be permitted as a "Priority Category 1" establishment by the county health department, as per the Alabama Department of Public Health for Food Establishment Sanitation regulations (ADPH 2020). "Priority categories" are a tiered structuring of food establishments based on the public health risk for foodborne illness inherent in the establishment due to the menu, operations, or consumers, used for purposes of permitting and inspection scheduling. "Priority Category 1 establishment" means those food establishments that sell or market only prepackaged time/temperature control for safety food items. This type of establishment may also be called a "Limited Retail Food Store Establishment."

According to ADPH rules, Priority Category 1 establishments shall be inspected once per year under the following specific guidelines:

1. General - A Priority Category 1 establishment shall comply with the requirements of these rules except as otherwise provided. The application for a permit and the permit shall specify that only prepackaged food items shall be sold or handled.
2. Facilities -
    a. Equipment and utensil cleaning facilities shall not be required in Priority Category 1 establishments which market only prepackaged food items.
    b. At least one handwashing sink shall be provided and supplied with water, hand cleanser, and provisions for hand drying.
    c. A Priority Category 1 establishment shall have the garbage and refuse cleaning facilities specified in 420-3-22-.05 or demonstrate other effective means for keeping the containers clean.
        i. Floors, walls, and ceilings of the Priority Category 1 establishment shall be maintained in good repair and shall be kept clean.
    d. Facilities selling retail cuts must also register with the Alabama Department of Ag and Industries annual food safety permit –
        i. $50 permit fee
        ii. This requires a quarterly inspection by ADAI inspection staff
        iii. Proper temperature and cleanliness of storage/display areas will be a focus of inspection

FARMER'S MARKET SALES OF PROCESSED MEAT PRODUCTS

Sale through local farmer's markets is regulated through the ADAI (2021) Direct Market Guidelines. Under these guidelines, only raw meats, including fish and seafood, that are processed, packaged, and labeled at an inspected facility or are otherwise exempted from

inspection may be sold at a farmer's market (exempted meats: rabbit, quail and bison). All processed meat sold in the state of Alabama must be processed by an Inspected Facility (State Inspected, FSIS or T-A Facility) and labeled accordingly. Meat products, other than fish and shellfish, must be brought to the market in frozen condition and kept frozen until sold. Selling packaged meat at the farmers market requires sanitary handling and temperature control. A mechanical unit capable of maintaining the meat and poultry products in the frozen state is recommended to be used.

PROCESSING FACILITY WASTEWATER CONCERNS

Wastewater is a serious concern for meat processing plants. Beef processing water usage, primarily from carcass washing and processing cleanup, has been reported at 355 gallons per 1000 lbs of body weight for commercial plants (Ziara 2015). Using the above average, a 30 head per week processing plant would use approximately 43,000 gals of water a month. By comparison, a typical 3-person household uses 5,400 gals per month. Sufficient water access is therefore a consideration when building or expanding a processing plant. Since most plants will be located with access to municipal water, appropriately sized meters and plumbing is a concern as well as the cost of water. If the plant uses well water, a well and pump capable of delivering the desired flow are required.

Since much of the water usage is in cleaning, a sewer connection or other wastewater system must be installed to handle wastewater effluence. Local health departments typically do not approve septic systems for slaughter plants. Alabama Department of Public Health (ADPH) requires plants must go through Alabama Department of Environmental Management (ADEM) for permitting to attach to a sewer system or other approved on-site wastewater system (OSS) (ADPH 2017, ADEM 2021). This often means a large-capacity septic system designed to handle projected water usage. An ADEM permit for an OSS requires a Professionally Engineered / Stamped design be submitted for approval through the ADEM permit process. These plans can cost $5k - $10k each, depending on complexity and size. Plants then must register online for a $1500 registration fee, file an electronic Notice of Intent, and submit their engineered plan for approval. Approval is typically granted without modification, but systems are subject to ADEM inspection prior to operation.

OFFAL/HIDE/WASTE PRODUCT DISPOSAL CONCERNS

Offal / hide and other waste product disposal can also be a serious problem to overcome for beef processing plants. ADAI publishes four options for processing facilities to dispose of waste products (ADAI 2010).

"Cattle Slaughter and Processing Facilities waste products policy:

1. *Option 1.* If you currently use a renderer for the disposal of the non-edible byproducts from your operation and your renderer certifies to you (in writing) that they do not process the byproducts into any animal feed, no changes to your operation are required.
2. *Option 2.* If you currently use a renderer for the disposal of the non-edible byproducts from your operation and your renderer has refused to accept any byproducts from your facility in the future, your options are disposal in a permitted landfill, incineration, or composting.
3. *Option 3.* If you currently use a renderer for the disposal of the non-edible byproducts from your operation and your renderer is willing to accept the non-restricted byproducts, then you must separate the restricted byproducts of the slaughtered cattle (brain and spinal cord) from the other offal. There are certification requirements on the slaughter facility and the renderer included in the new rules that must be followed. The restricted byproducts may be disposed in a permitted landfill, incinerated, or composted. If the owner of the slaughtered cow also owns a farm, the restricted byproducts may be transferred back to him for on-farm disposal.
4. *Option 4*. If you slaughter cattle that are less than 30 months of age only and the renderer agrees to accept the non-edible byproducts from your operation based on this fact. It is important to understand that all the non-edible byproducts of cattle slaughtering, and processing can be taken by a renderer and used for other purposes. The new FDA rule restricts the rendering of Cattle Materials Prohibited in Animal Food or Feed (CMPAF) including brains and spinal cords of cattle older than 30 months into all animal feed."

In the past, there were opportunities to receive some compensation for some waste products through selling them to rendering or "Hide and Tallow" businesses. Now there is only one such business operating at scale in Alabama, and facilities are charged a monthly fee based on disposal amounts for drop-off privileges to the rendering plant. This has caused some processing plants to dispose of offal/hides in landfills for a fee. ADAI requires a letter from the landfill authorizing disposal of waste products. Edible offal products can be sold to customer/owner if they are from an inspected carcass (not Custom Exempt). Brain and spinal cord products are always excluded from sale.

BUSINESS LICENSING AND BUILDING PERMITS

Business licensing is handled through the local city/county building authorities or planning commissions. For producers planning to sell individual cuts to third parties from an Inspected Facility, it is recommended that they contact the local business development center for guidance on appropriate business licensing. The same recommendation applies to someone building a new processing facility. Local building ordinances and permits will govern much of the requirements for a new building and the site surrounding it. However, it is recommended that someone considering building or expanding a processing facility share their plant design with inspection personnel prior to finalizing any plans. Your local Small Business Development Center or Chamber

of Commerce can be of great assistance in helping someone navigate through the local business licensing and permitting areas. As with any business plan, contacting a certified public accountant skilled in small business accounting is highly recommended. A concise business plan will also be needed to secure any business loans.

QUALITY AND YIELD GRADING OF FREEZER BEEF

Most purchasers of retail cuts of beef are familiar with the USDA quality grading system and have seen the grade stamps of USDA Prime, Choice or Select on packages of steaks at the meat counter. There are also the lesser-known grades (decreasing in order of quality) of Commercial, Utility, Cutter and Canner. These latter grades do not typically show up in retail meat shelves but are for animals that, because of age or condition, are judged not to be desirable for individual cuts like steaks or roasts and are usually relegated to ground product or other further processing only. The three primary "steak" grades of Prime, Choice and Select are based on a combination of factors including age, finish, and intramuscular fat content, or "marbling" at the ribeye. The USDA – Agricultural Marketing Service establishes the criteria and oversees the labeling of these quality grades. USDA-AMS also oversees Yield Grading, which is an estimation of the final boneless yield of a carcass prior to processing. Quality and yield grading is voluntary for processors and is done for a contract fee through USDA-AMS as a way to assign value to a carcass prior to processing for products typically being sold to wholesale or export markets (Webb 2014). Custom Exempt Facilities would have no reason to pay for quality grading, as they are only providing a service for the animal owner and the quality grade of yield of the animal has no bearing on their business. USDA or State Inspected facilities could possibly have reason to have products quality graded if they were selling the products through on-site retail, or wholesale product to distributors, as their customers may be willing to pay more for quality graded product. Quality grading services must be requested and it is the USDA's decision as to whether the service will be provided or not. At this time, there is no small processor in Alabama approved by the USDA for quality grading services. Given the significant expense and the training of skilled labor required, it is highly unlikely for a small processor to be able to economically support grading services. For further information on USDA quality and yield grades, see https://meat.tamu.edu/beefgrading/ or contact USDA-AMS directly at: https://www.ams.usda.gov/services/grading . A processor can also request grading services directly from the USDA-AMS website.

REGULATORY AND FOOD SAFETY CONCERNS SPECIFIC TO MARKETING OR PURCHASING "FREEZER BEEF"

The term "freezer beef" has been defined as beef that is purchased as a whole, half or quarter of a live animal, then processed and delivered in the same portion to the live animal owner, who is the end-user. The term can also be used to describe cuts of beef that are sold through non-

traditional markets. Unlike retail grocery stores or butcher shops, freezer beef is often purchased directly from the beef producer or processor. The regulatory and safety concerns vary slightly with these two freezer beef scenarios.

With the first scenario, freezer beef must be purchased and delivered to the customer/end-user under the regulations governing Custom Exempt Facility processing as outlined earlier in this report. Safe handling and storage of the beef is the responsibility of the processor while in their possession. As stated above, if the processor is being paid for delivery, safe handling during that time is the processor's responsibility also. The specific live animal, or portions of a live animal belonging to a customer should be kept separate from products of other customers throughout the processing stages. All the products delivered to the customer; steaks, roasts, ground meat, etc., should all come from the same purchased animal. No mixing of cuts from different animals should happen since the customer purchased a specific animal and the products resulting from its slaughter. Once the beef is delivered, safe food storage and handling becomes the sole responsibility of the purchaser, as with any food item in their home. Again, the products must all be labeled "Not for Resale" when delivered to the end user. Individual cuts or portions cannot be resold to a third party in any form under Custom Exempt inspection rules.

The only way freezer beef may be sold or purchased by the individual cuts, or resold to a third party, is when it was processed and labeled under the regulations outlined for an Inspected Facility. State only inspection restricts the wholesale marketing of individual cuts to within state lines. Any inspected product (State Only or USDA/T-A) can be sold to the end-user or shipped across state lines via internet sales or otherwise to the end-user. This includes cuts of beef purchased through a local farmer's market or small home or farm-based retail stand. However, only USDA/T-A inspected product can be sold wholesale for retail resale across state lines. Individual cuts of beef sold through retail sales areas at processor facilities must also meet these same inspection regulations. Sanitation, food handling and storage in a retail case or freezer is regulated by ADPH food safety permits and guidelines. Only pre-packaged, frozen cuts of beef should be purchased from such entities.

If a beef producer desires to sell a finished beef animal directly to consumers by the whole, half or other partial portion of the live animal, then a Custom Exempt facility is sufficient to do the processing. Processing can be a service provided by the producer to the end-user via an arrangement with a processor. Transportation of live animal and finished product can also be provided. However, if a producer wishes to sell packaged individual cuts and not live animals, a state or USDA inspected facility must be used to process the beef, whether the sale is at a retail facility, farmer's market, or an on-farm sales outlet.

SITES TO VISIT FOR FURTHER INFORMATION

- ADAI Inspection: http://agi.alabama.gov/divisions/animal-industries#resources

- ADAI Food Safety Permit: http://agi.alabama.gov/docs/default-source/Food-Safety/food-safety/2021-2022-food-safety-application.pdf?sfvrsn=4
- USDA-FSIS – General Inspection Information: https://www.fsis.usda.gov/inspection
- USDA-FSIS- Small Plant Information (HACCP and Sanitation SOP guidance can be found here): https://www.fsis.usda.gov/inspection/compliance-guidance/small-very-small-plant-guidance
- USDA-FSIS Grant of Inspection Information: https://www.fsis.usda.gov/inspection/apply-grant-inspection
- USDA-FSIS Application for Federal Inspection Form: https://www.fsis.usda.gov/sites/default/files/2020-08/Form_5200-2.pdf
- Alabama Small Business Development Center: http://asbdc.org/
- "Meat Processing 101": https://www.nichemeatprocessing.org/wp-content/uploads/2016/08/CrashCourseTwo.Final_revised_10.1.pdf
- Texas A&M- Department of Animal Science: https://animalscience.tamu.edu/2020/07/06/so-you-want-to-build-a-slaughter-plant/
- Extension- Alabama A&M and Auburn Universities: https://www.aces.edu/blog/topics/testing-labeling/getting-a-food-processing-permit-in-alabama/?cn-reloaded=1

BEEF PROCESSOR INSPECTION DECISION

Choosing between only offering processing service to animal owners or being able to process and sell individual products, or process for customers who then want to sell to third parties is the first major decision for a processor to consider. This choice will dictate how they proceed with structural considerations as well as facility management. The decision tree in Figure 8 can help work through that decision process.

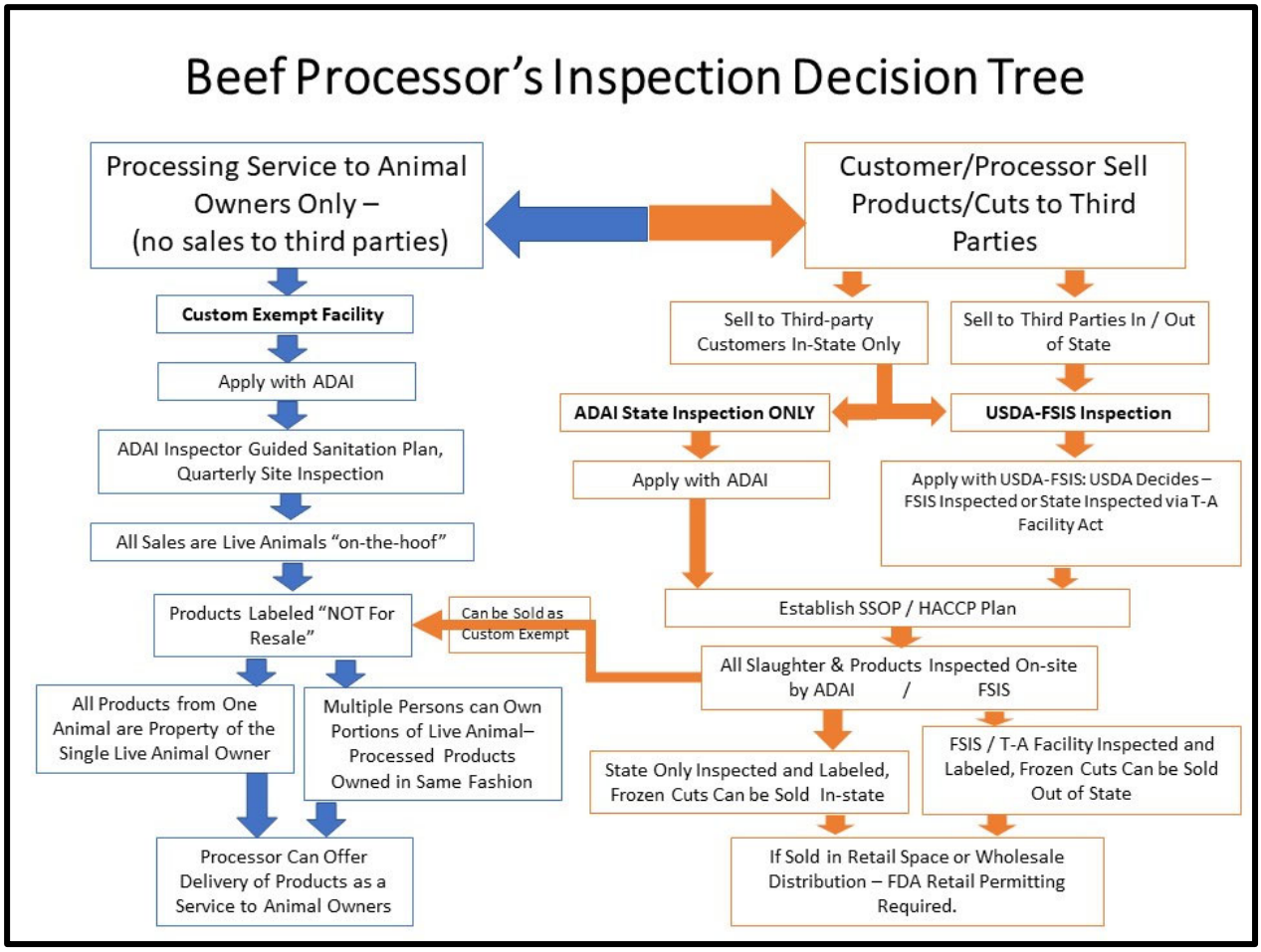


Figure 8. Beef Processor's Inspection Decision Tree

ALABAMA PROCESSING AND CATTLE

TWO HISTORICAL CASE STUDIES

There have been numerous livestock packing and processing facilities operated in the State of Alabama, with the majority of plants of small to medium size. It is often assumed that Alabama has not had any larger processing facilities, but that would be incorrect. There have been multiple operations owned and operated at larger capacity than expected with ownership interests from national and international corporations. None of these were successful.

Andalusia Packing Company was built in 1916 and slaughtered beef and pork, producing both primal and finished products. The plant was purchased by Swift & Company packing facilities in 1917. The June 1917 edition of Ice and Refrigeration Illustrated included the following excerpt:

"*Swift and Company Packers is reported to have purchased the stock of the Andalusia Packing Co. Andalusia AL which is equipped with a 60-ton refrigeration machine, and will be enlarged to improve the plant."*

Swift and company invested in the plant, sending money and leadership from Chicago. Former Andalusia resident Edy Bell Taylor reported to the Andalusia Star News (Wilson 2018):

"*Our home was one of about four houses built by the Swift executives who owned the packing company that Stella Beasley later bought. (That property eventually become Alatex Property). The houses were all similar (Sears-Roebuck homes which packages were shipped to Andalusia by train) and are still standing including the Howard Ward house on South Three Notch."*

Andalusia Packing as a subsidiary of Swift is mentioned in 1919 as part of hearings before the committee on agriculture and forestry of the United States Senate (US Senate 1919). The hearings were part of a larger discussion of collusion and monopoly of the packing system nationally and internationally that discussed multiple bills that were being presented to congress to address the issues.

The business was purchased and moved by Stella Beasley. Beasley packing operated a large beef and pork processing plant that produced and delivered both primal and refined products. Beasley packing operated until 1970 when default was made on loans driven by higher wage demands amid unionization efforts of employees (US. v. George H. Proctor, 1974).

John Morrell operated a plant in Montgomery Alabama slaughtering beef until 1991 (Meat & Poultry 2005). The plant was then purchased and operated by Con Agra and SSI (officially S&C Beef Processors) and ran as slaughter and processing plant, and eventually (after 1999) just a processor. The plant specialized in the processing of ground beef patties. The plant employed 365 people at the time of closing in 2005 (Alabama Public Radio 2015). The company endured several amputation citations (Smith 2003), but was shuttered for financial and not regulatory issues. Company executives cited tax issues, production problems, increased costs, and renovation needs as the reasons for closure of the plant.

The Andalusia plant operated as a mainly feeder kill facility and the Montgomery plant eventually operated as a mainly cull facility.

EXISTING PROCESSING AND CATTLE INVENTORY

Alabama has at least twenty-nine processing facilities that handle slaughter meat (ADAI 2020). These facilities are shown on the map in Figure 9. Most of these facilities only preform custom-exempt services, with only four facilities being state inspected and four federally inspected. It is important to note that some of these facilities only handle deer processing and are not equipped for finished beef slaughter and processing.

There are also some notable geographical gaps in processing coverage. Figure 9 also shows the density of cattle throughout the state. There are no state or federally inspected facilities in west, southwest, or central Alabama, despite a large number of cattle inventories in the region: Montgomery is the third-leading county in number of cattle (USDA Cattle Inventory Report, 2021). The nearest state or federal exempt facility is the Auburn University Meat Lab.

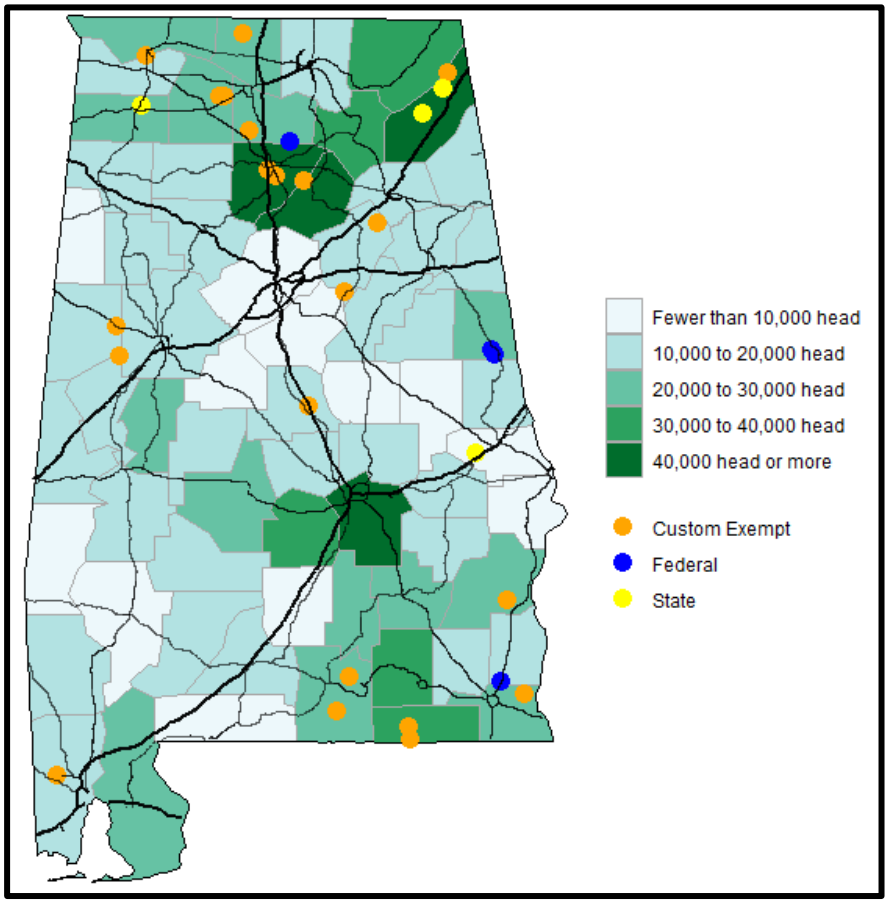


Figure 9. Processing Plants and Head of Cattle by County in Alabama

POTENTIAL PROCESSING EXPANSION

Due to the demand for more processing facilities and limited capacity, expansion may be warranted. When looking at potential locations for new processing plants, it is important to consider where the cattle and producers are located as well as where the consumer base is, especially when considering processors that would sell retail beef to consumers.

The largest population center in the state is the Birmingham Metropolitan Statistical Area, which has 1.1 million people. Huntsville and Mobile follow, with 480 thousand and 430 thousand, respectively (see Table 1).

Table 1. Major Cities in Alabama by Metro Area Population; Data from 2020 Census

City	Metropolitan Statistical Area Population
Birmingham	1,091,921
Huntsville	481,681
Mobile	428,692
Montgomery	372,583
Phenix City – Columbus, GA	328,883

The top five counties in terms of number of cattle, shown in Table 2, are Dekalb (61,000), Cullman (57,000), Montgomery (46,000), Blount (45,000), and Lowndes (39,000). Most of the counties with high cattle inventories are in the northern part of the state where there are current custom exempt and state or federally inspected facilities. However, there are few processors in the central part of the state near Montgomery and Lowndes counties or throughout the Blackbelt.

Table 2. Potential Processing Plant Locations in Alabama by Population, Cattle Inventory, and distance to major Metropolitan Areas

Potential Location	Cattle in AL Counties within 50 miles	Population within 50 miles	Distance to Major Metropolitan Areas (miles)			
			Birmingham	Huntsville	Mobile	Montgomery
Anniston	216,700	825,555	64	102	279	110
Atmore	58,300	809,381	210	310	52	121
Demopolis	132,100	144,318	111	210	141	102
Evergreen	110,200	148,912	166	266	92	78
Greenville	234,700	415,975	133	233	126	46
Lowndesboro	221,700	529,435	111	211	162	23
Montgomery	242,400	597,833	90	189	168	0
Selma	247,700	547,014	87	186	175	50
Tuscaloosa	123,600	1,240,188	58	156	195	103

Note: Population Source: https://www.statsamerica.org/radius/big.aspx; Data from 2020 Census and 2021 USDA Cattle Inventory Report; Distance data from Google Maps.

Several potential locations for expanded processing are evaluated in Table 2. The potential locations selected are all located near interstates or major highways and in areas with gaps in existing processor coverage. To evaluate cattle availability, the table estimates the number of cattle in Alabama counties within 50 miles of the potential processing plant location, population within 50 miles of the potential processing plant location, and distances to four major cities (Birmingham, Huntsville, Mobile, and Montgomery) from the potential location.

There are tradeoffs between size of the potential consumer base and number of cattle nearby for each of the considered locations. For example, a processing plant near Tuscaloosa would have the largest potential consumer base (1.2 million people) of those evaluated but would only have 124,000 cattle in the Alabama counties within 50 miles. It would also be just around 58 miles from Birmingham, the largest population center of the state. Conversely, a processing plant in Selma would have the largest number of cattle (247,700) but would have a lower population (547,014) nearby. A Selma plant would be around 50 miles from Montgomery and 87 miles from Birmingham.

A middle ground location would be Anniston, which 64 miles from Birmingham and has a population of 825,555 within 50 miles. Anniston is also in close proximity to Blount and Marshall counties, two of the top ten Alabama counties in cattle inventories and has an estimated 216,700 head of cattle within 50 miles.

EXPECTED FUTURE EXPANSION

The USDA recently awarded Meat and Poultry Inspection Readiness Grants to existing Alabama facilities to expand processing and become Federally Inspected. The following were awarded grants in Alabama.

- Renegade's Meat Processing LLC
- Southeast Alabama Meat Processing LLC
- Slasham Valley Farms, LLC
- Curbside Provisions, LLC
- D&S Quality Beef, LLC

These facilities will secure new equipment for expanded capacity, enhanced distribution, and become USDA Federally inspected (USDA 2021b).

DISTRIBUTION AND MARKETING: NATIONAL TRENDS

MEAT CONSUMPTION AND TRENDS

There have been major shifts in meat consumption over the past few decades. Poultry overtook beef and pork as the most-consumed meat per capita in the early 1990s. Beef consumption fell from sixty-four pounds (boneless retail weight) per person to fifty-six pounds, between 1990 and 2020. On the other hand, poultry consumption increased from fifty-seven pounds to eighty-one pounds per capita, over the same period. Pork consumption per capita remained stable, slightly increasing from forty-seven to forty-nine pounds from 1990 to 2020. Overall, total red meat and poultry consumption increased by about twenty-five pounds from 1990 to 2020, to a total of 225 pounds (retail weight) per capita annually.

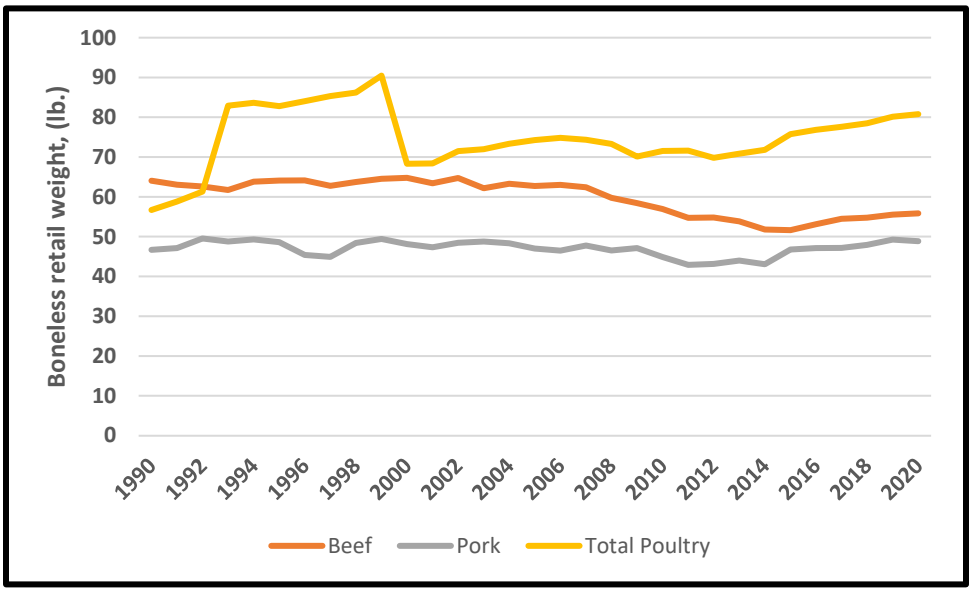
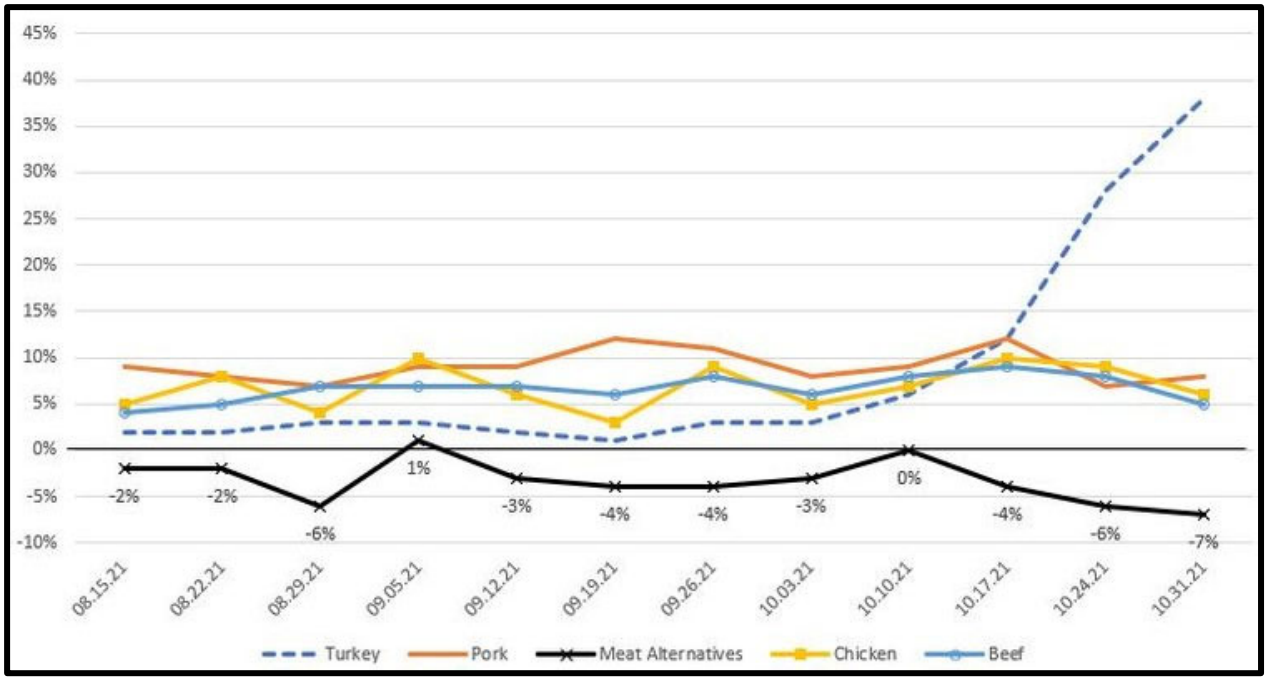


Figure 10. Meat consumption per capita by year, US

In addition to shifting to other meat sources, another challenge to beef markets could be consumer shifts to non-meat protein sources. There has been a lot of discussion regarding the growth of plant-based meat products, but not a lot of data on the potential size of this market and the extent to which it has grown recently. One source of data is a Gallup poll from 2019, which suggested that 41% of Americans had tried plant-based meats, and 60% of those that tried them were very likely or somewhat likely to continue consuming them in the future (McCarthy and Dekoster 2020). There were regional differences in consumption, with only 36% of those in the South noting that they had tried plant-based meat, the lowest of any region. Coming from a higher income household, living in the suburbs, and being younger were all associated with higher rates of having tried plant-based meats. However, the extent to which increased plant-based meat consumption will eat into meat consumption is unknown. For instance, if plant-based meat consumers rarely eat the product, the impact on the beef industry could be rather limited; whereas, if a large proportion of consumers completely shift away from meat consumption, there could be a larger impact on the meat industry.



#

Figure 11. Change in Weekly Meat and Meat Alternative Sales in 2021 Compared to 2020 Source: http://jaysonlusk.com/; Data source: IRI

More recently, demand for plant-based meat products declined in the latter half of 2021, compared to 2020. For example, the week ending October 31, 2021 saw sales 7% lower than the same week in 2020, shown in Figure 11. Questions remain as to whether the early enthusiasm about plant-based meat has begun to disappear or if the drop in 2021 simply reflects a temporary disruption to the market.

BEEF MARKETS

Beef prices have increased over the past two decades, above the rate of inflation. Steaks have the highest price at $9.67 per pound as of July 2021. Beef roasts and beef for stew are close behind at around $6.70 per pound. Ground beef lands at around $4.80 per pound. Prices of other cuts are near $6.40 per pound and have increased relative to the prices of steak, roasts, stew beef, and ground beef. Figure 12 shows beef prices by retail cut since 1998.

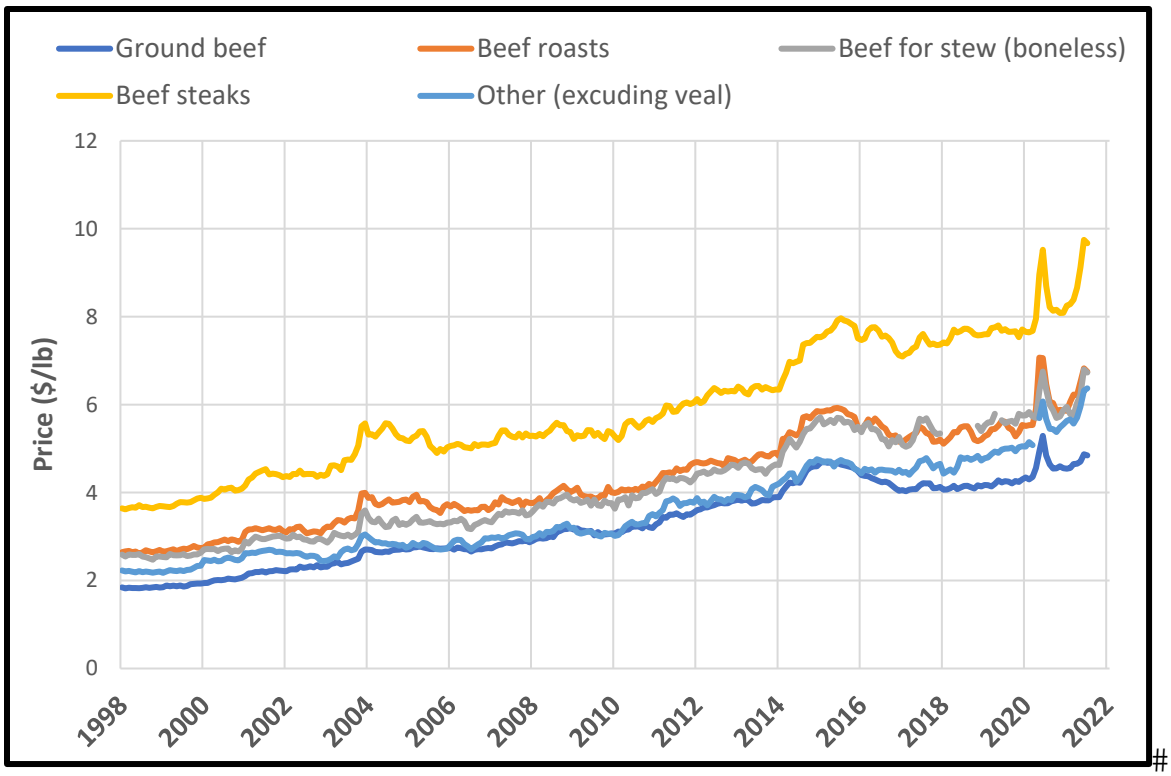


Figure 12. Beef prices, by retail cut

COVID-19 IMPACT ON THE BEEF MARKET

The COVID-19 pandemic saw large shifts in food consumption behavior. In April of 2020, there was a sizable drop in food sales, as shown in Figure 13. April of 2021 also saw expenditures on food at home (e.g. purchases at grocery stores and supermarkets) begin to exceed food away from home (e.g. restaurants). That pattern remained until May of 2021, in which the pre-pandemic behavior re-emerged, and food-away-from-home expenditures overtook food-at-home

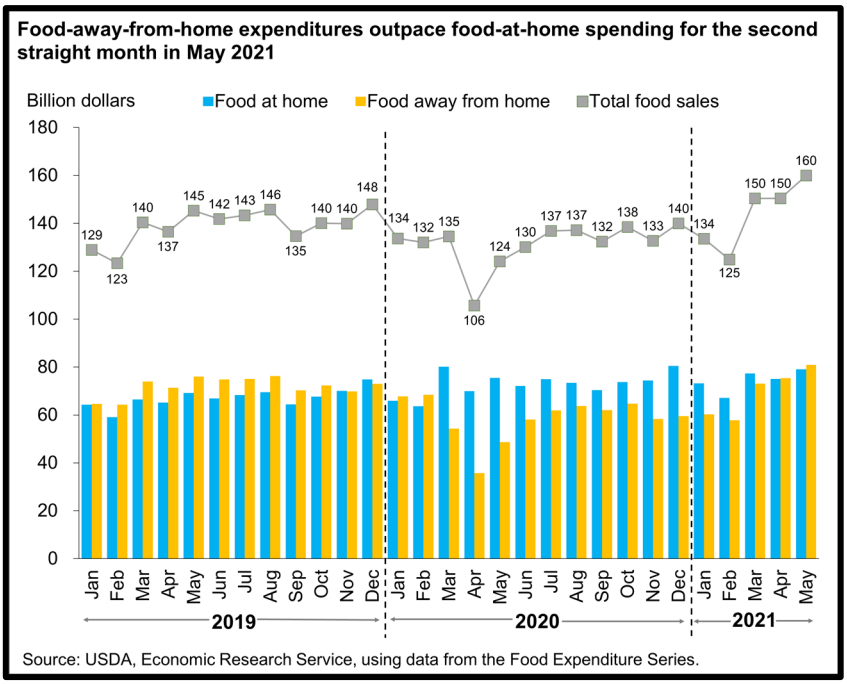


Figure 13. Food-away-from-home and food-at-home

expenditures. The abrupt change to food consumption caused by the pandemic led to differential impacts across products; for example, there were increased sales of shelf-stable products such as canned and frozen produce items and shifts to cheaper protein sources such as peanut butter.

Beef markets also observed a shift to more food-at-home consumption. Figure 14 illustrates how retail beef consumption increased in 2020 relative to 2019, whereas foodservice consumption declined. In 2018 and 2019, retail sources represented 38.5% of beef consumption, but in 2020 that figure rose to 45.3%. Overall beef sales decreased by 730 million pounds in 2020, demonstrating the importance of foodservice consumption for the beef industry.

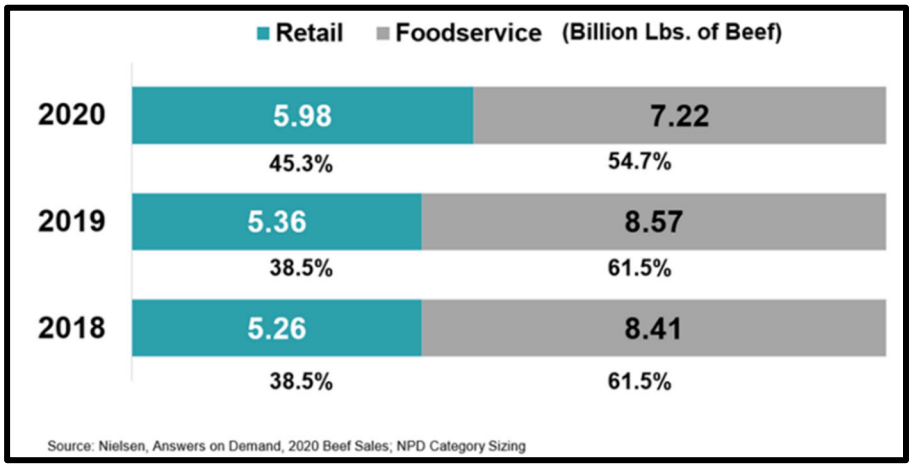


Figure 14. Beef sales shifting to food-at-home

Another major impact of the pandemic occurred on the supply side, as packing plant closures caused major supply-chain disruptions. The demand for fed cattle for slaughter fell due to the closures, which then reduced feedlot demand for feeder cattle across the US. These factors, combined with increased demand at retail outlets, resulted in a spike in both the price received for retail cuts of beef and prices received at the wholesale level. However, these price increases did not trickle down the supply chain to prices received by producers. Figure 15 shows the wholesale and retail spike in 2020, while the net farm value drops slightly.

An alternative way to look at the impact on producers during COVID-19 is through the farm to wholesale price spread, shown in Figure 16. The beef price spread between the value received by the farmer and that by the wholesaler had typically been between $0.25 to $0.50 per pound from 1995 to 2015. However, the price spread began to increase around 2016 toward $1.00 per pound, meaning producers were obtaining a lower share of beef prices. At the beginning of the COVID-19 pandemic, farm-to-wholesale price spreads increased to unprecedented levels, approaching $4.00 per pound in June and July of 2020. Despite some declines over the past year, price spreads remain well above their levels from four years ago.

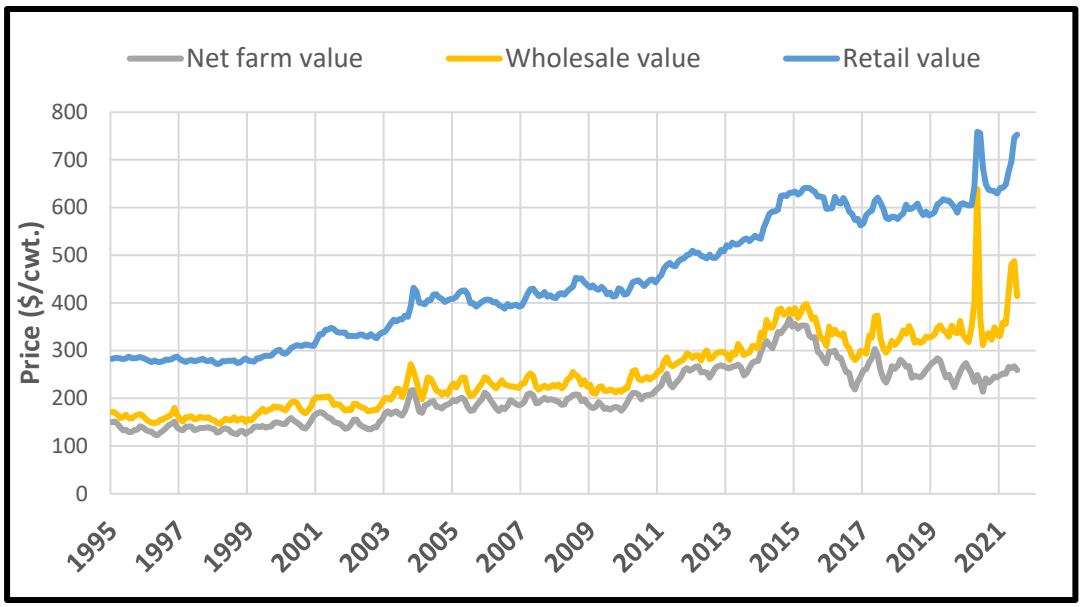


Figure 15. Beef prices at farm, wholesale, and retail levels

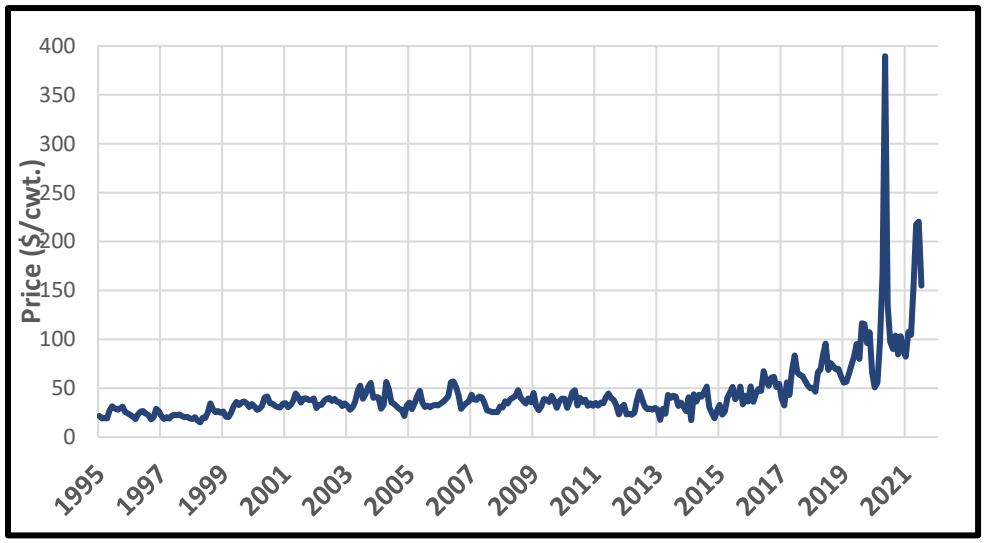


Figure 16. Farm to wholesale price spread, by year

PACKING PLANT SLAUGHTER CAPACITY AND SUPPLIES

Another factor driving the increasing farm-to-wholesale price spreads is the supply and demand situation of the meat packing plants. Over the past five years, slaughter capacity has been below the supply of animals ready for slaughter. While weekly slaughter capacity has increased since 2015 (see Figure 17), it has remained constraint, which has contributed to the increased slaughter prices. The high supply of animals ready for slaughter relative to demand has contributed to increased price share absorbed by processors.

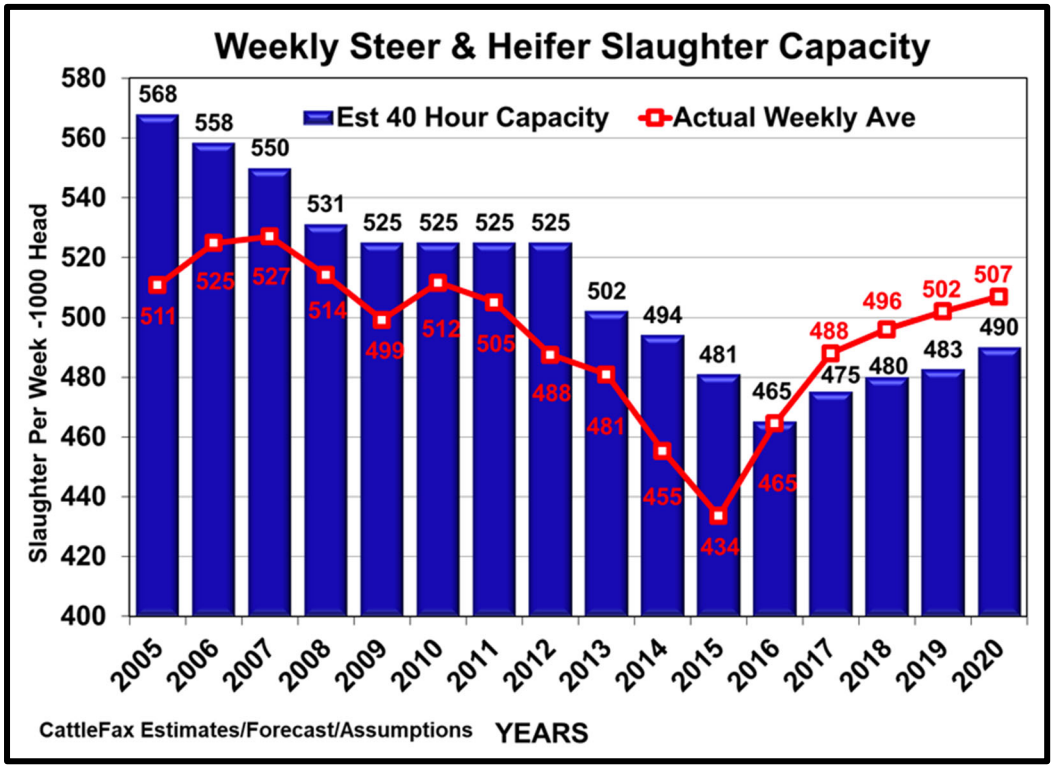


Figure 17. Weekly Steer & Heifer Slaughter Capacity

DISTRIBUTION AND MARKETING: LOCAL DEMAND

While we have explored national market trends for beef purchasing in the U.S., it is important to consider local factors that may distinguish Alabama consumers from national averages. We are also interested in some of the other aspects of local purchasing of beef, which go beyond the typical local food studies that focus have been done in the past. In particular, the type of local food purchasing of interest for this study is that of direct from producer to consumer. To evaluate the local market, we surveyed 1,001 Alabama residents through a Qualtrics survey panel. Survey questions focused on awareness of freezer beef, purchasing characteristics, storage space, and interest in purchasing direct from the producer.

The sampled population was fairly representative of the Alabama population, as shown in Table 3. We intentionally oversampled females as they are the primary food shoppers in the household. In fact, 93% of respondents indicated that they are the primary food shopper for the household either by themselves or shared evenly with another adult in the household. While the majority of the respondents were between 25 and 54 years old, all participants were at least 18 years of age as required by the Institutional Review Board (IRB) at Auburn University.

Table 3. Consumer Survey Demographics

Demographic		Percent of Respondents
Gender	Male	38.3%
	Female	61.2%
	Non-binary / third gender / other	0.5%
Age	18 - 24 yrs	9.9%
	25 - 54 yrs	58.0%
	55+	32.1%
Geographic area	Rural	39.3%
	Suburban	38.9%
	Urban	21.9%
HHI	0-50K	54.1%
	50K-100K	33.1%
	100K+	12.8%
Education	Less than High School	4.2%
	High School/GED	26.3%
	Some College	28.2%
	2-Year College Degree (Associates)	11.8%
	4-Year College Degree (BA, BS)	19.6%

	Master's Degree	8.5%
	Professional Degree (Ph.D., J.D., M.D., etc.)	1.5%
Race	White	70.9%
	Black	23.4%
	Other	5.7%
Hispanic, Latino, or Spanish origin	Yes	3.1%
	No	96.9%

FREEZER BEEF TERMINOLOGY

One of the questions we were interested in was understanding is how consumers viewed the term "freezer beef". This term is often used by industry stakeholders to refer to purchasing beef in bulk quantity directly from a cattle producer, usually as a whole, half, or quarter of an animal. As seen in the word cloud in Figure 18, the most common words associated with "freezer beef" are frozen, beef, meat, hamburger, ground and freezer. We see little association with terms that stakeholders would more commonly think of, such as local, home grown, and fresh farm raised. More significantly, we see terms such as fake, nasty, old, burnt, and yuck.

Figure 18. Consumer view of the term "freezer beef".

Further illustrating this point, we asked consumers to correctly identify the term "freezer beef" from pre-defined answer choices. Only 26% of respondents correctly identified the term as "purchasing beef in bulk quantity directly from a cattle producers, usually as a whole, half, or quarter of the animal". The majority (58.8%) of the respondents believed it is just purchasing beef from the freezer section of the supermarket, while 10% believed it meant purchasing frozen beef from a mail order beef company. The remaining 5% believed the term was best defined as some other definition not listed. This misunderstanding of the term "freezer beef" can present a significant barrier to marketing without consumer education.

DEDICATED FREEZER SPACE

One requirement of purchasing freezer beef is the need for dedicated deep freezer space. We asked Alabama residents whether they owned a deep freezer, further defining it for them as a chest freezer or upright freezer that does not have an attached refrigerator. A total of 59% of respondents indicated they have a dedicated freezer. This is likely a result of significant increases in purchasing of freezers since the pandemic shifted consumers to food at home purchasing. Major national retailers, such as Best Buy, Home Depot, and Lowes, quickly sold out of dedicated freezers in the initial weeks of the pandemic spreading throughout the U.S., creating months of backordered sales (Tyko 2020).

BEEF PURCHASE LOCATION AND PRODUCT CHARACTERISTICS

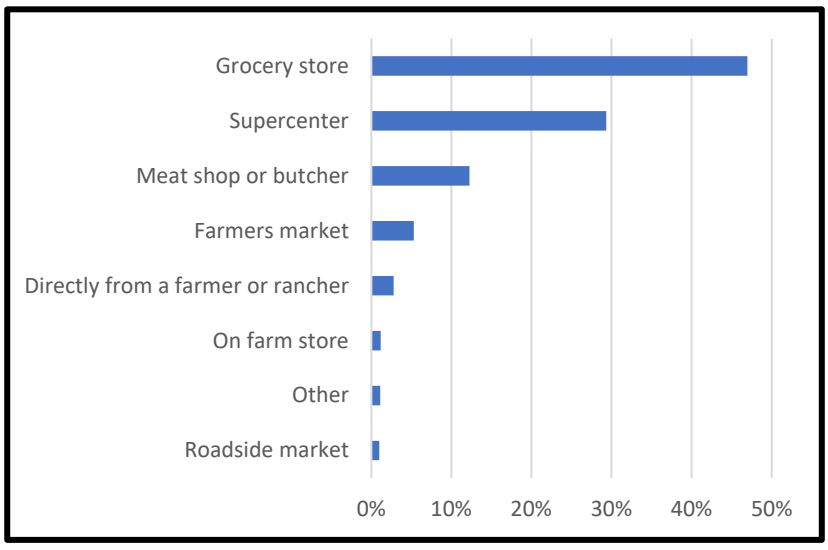


Figure 19. Beef Purchasing Locations

Beef purchase locations are primarily at grocery stores and supermarkets, as shown in Figure 19. About 5% or less of Alabama consumers purchase beef from a farmer's market or other direct outlet. Meat shops or butchers serve a little more than 12% of the Alabama populatin as a beef purchasing location. When asked to further define their *primary* beef purchasing location, meat shops and butchers dropped to 6.8% while direct market venues including farmer's markets dropped to less than 2% of the responses.

Spending on beef purchases is presented in Figure 20. During the 12-month period of September 2020 through August 2021, beef purchases averaged $40.86 for consumers that spent less than $196 per shopping trip. Meanwhile 4% of consumers spent more than $196 on beef during a typical shopping trip. The segment of consumers that are spending more on beef during a typical shopping trip are more likely to have the available funds necessary to purchase larger quantities of beef direct from producers.

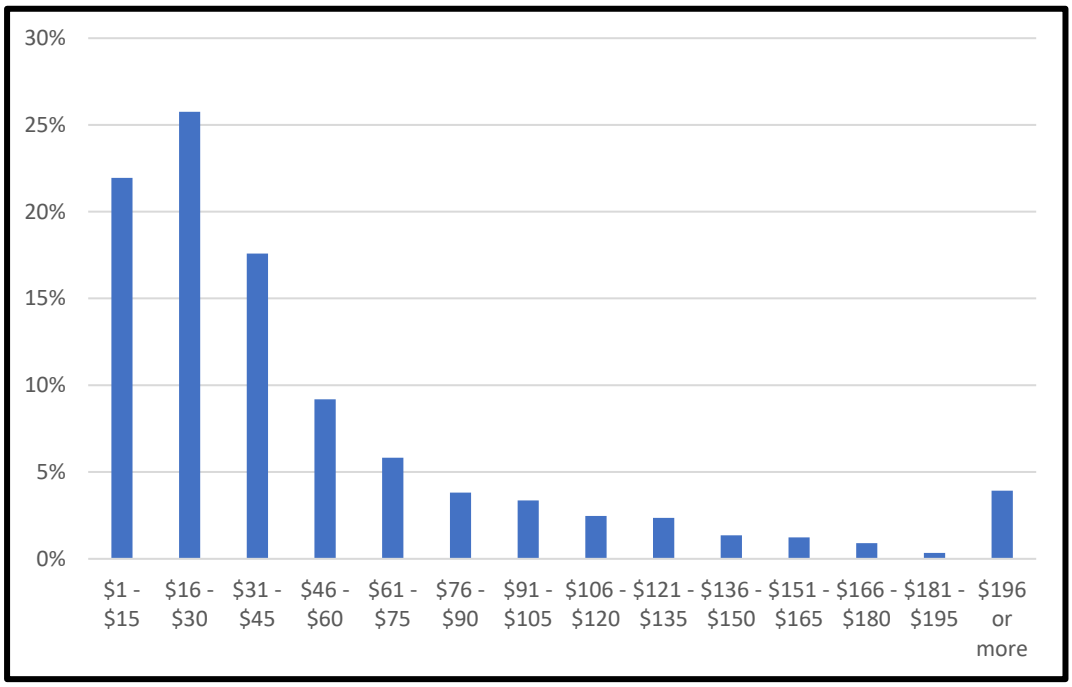


Figure 20. Average Spending on Beef During a Typical Shopping Trip

We also asked consumers of beef about certain characteristics, including the purchase of USDA Grades and the most important attribute when purchasing beef. Not all consumers are aware of the whether the beef they purchase is USDA grade or not. In fact, about one-quarter of respondents do not know the grade (USDA/non-USDA), while roughly 5% indicated they purchase a non-USDA grade. Figure 21 shows the relative importance of the primary attribute considered when buying beef. Price, USDA Grade, and taste were the top three characteristics of beef consumers, representing 63% of respondents. Meanwhile, indicators of local purchasing, such as local (born, raised, and processed in Alabama) and farm-to-table, were identified by a much smaller percentage of respondents. It is worth noting, however, that a little more than half (52%) of respondents have either seen or are aware of the Sweet Grown Alabama logo indicating value to that marketing opportunity when choosing to appeal to local consumers.

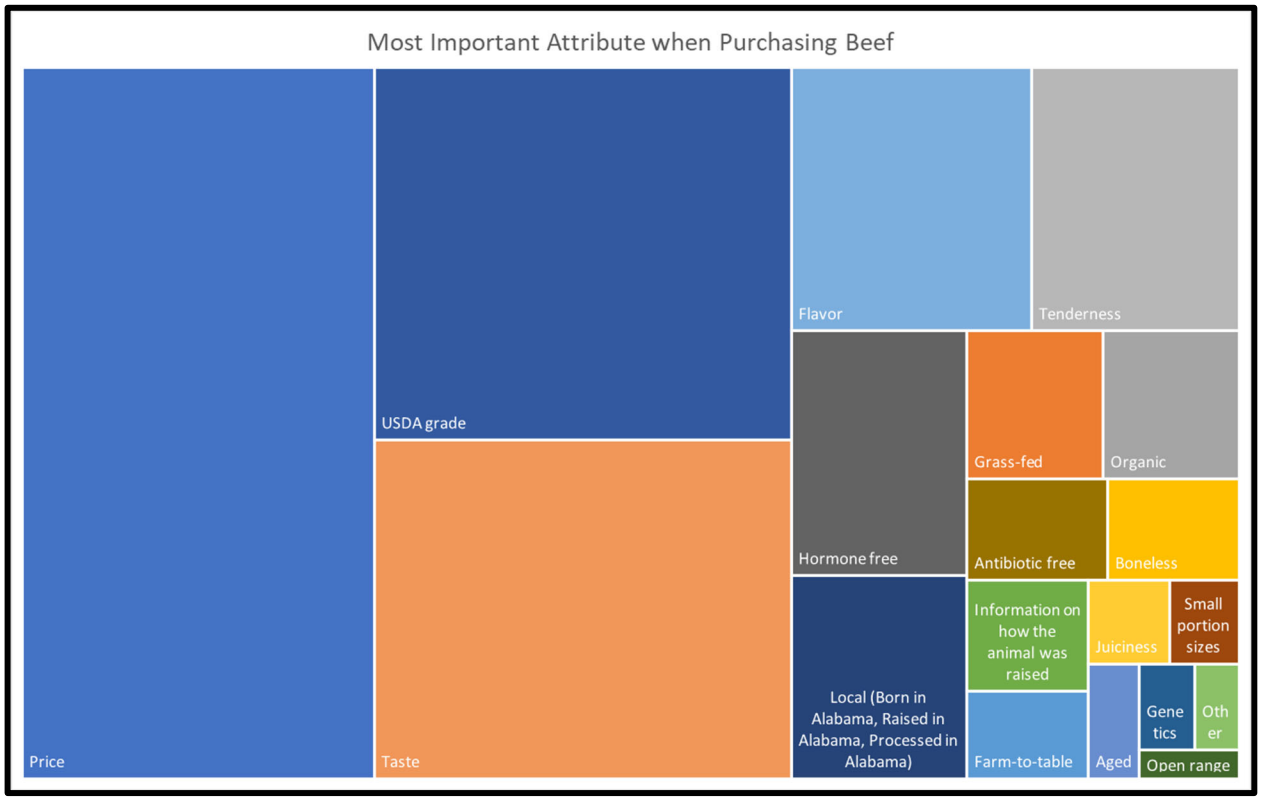


Figure 21. Most Important Attribute when Purchasing Beef

Buying from a local producer is not the most common reason for purchasing freezer beef. We found that Alabama consumers that are knowledgeable about freezer beef and purchased it in the past are primarily focused on price and value. Figure 22 shows that over half of the this population purchased freezer beef because of a lower price or better value. Quality and taste

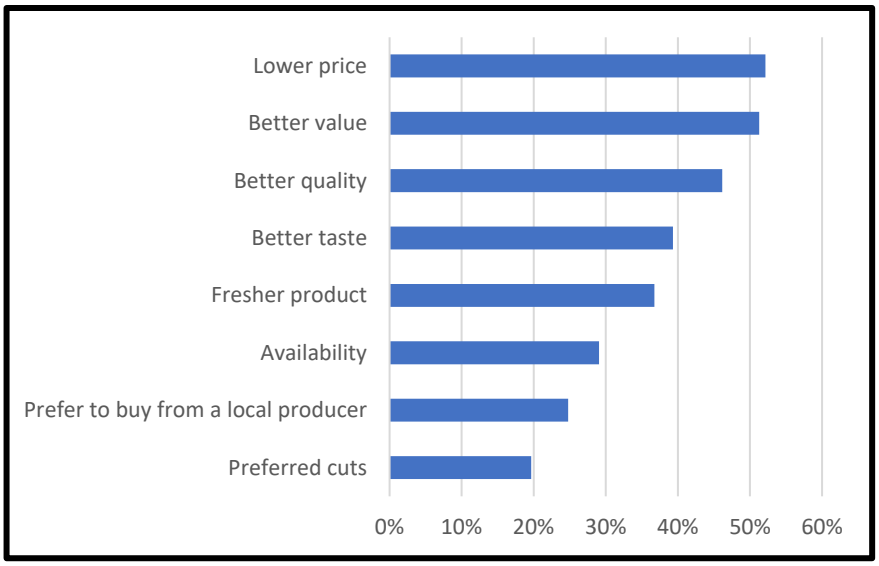


Figure 22. Reasons Consumers Purchase Freezer Beef

followed, but just the idea of buying from a local producer lagged behind at 25%. The least popular reason is that they are able to get the cuts of beef they prefer.

While Alabama consumers do not predominantly choose to buy freezer beef because of its local origin, they do associate locally grown food with helping the local community, better taste, and decreased miles to transport (see Figure 23). Meanwhile, some consumers have the wrong beliefs that local means non-gmo, organic, and lack of pesticides.

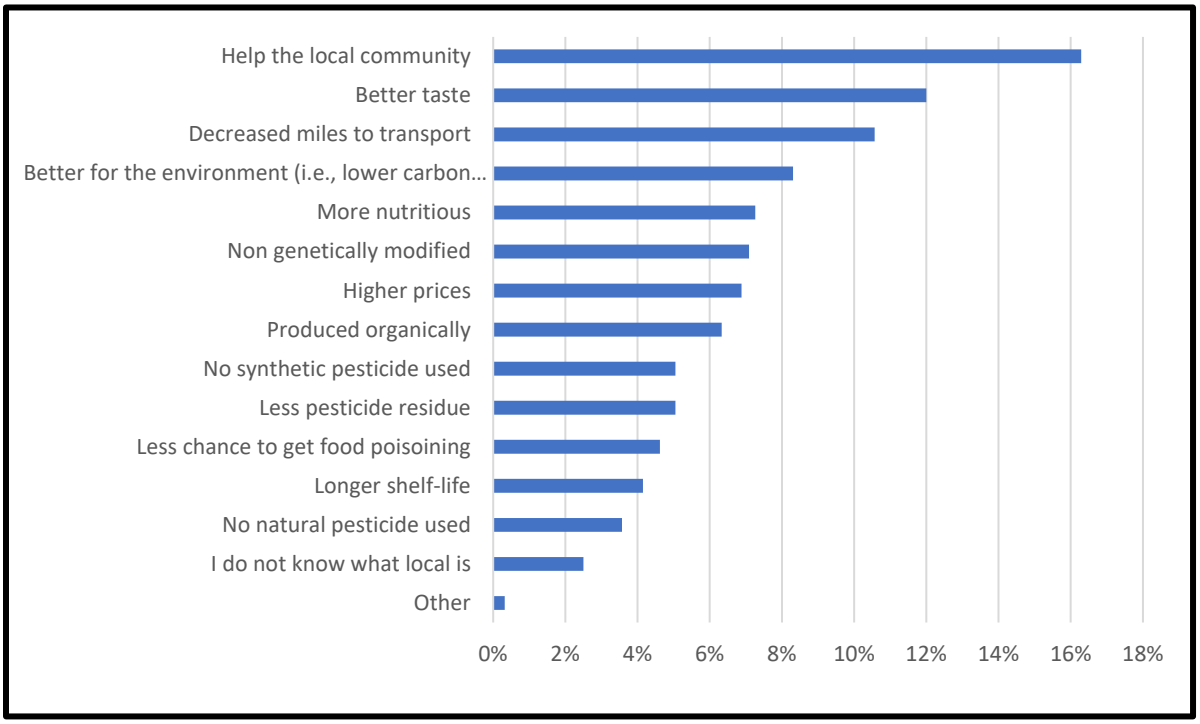


Figure 23. Characteristics Associated with Locally Grown Food

BARRIERS TO PURCHASING FREEZER BEEF

We presented participants with a discrete-choice experiment in which respondents were given multiple price scenarios and options to purchase beef through different marketing channels. The purpose of this section was to understand how many consumers would potentially switch from one marketing channel to another for their beef purchase. Furthermore, we are able to evaluate the price points at which consumers are willing switch when that occurs.

The available marketing channels included in the survey were (1) purchasing beef the supermarket versus (2) purchasing freezer beef directly from a producer. In all scenarios, respondents could select neither choice as an option. An example of the experiment is presented in section on Potential Margins for Beef Slaughtering and Processing in this report.

Most consumers that did not choose freezer beef in the experiment did so because they are not interested or are not familiar with the product, as shown in Figure 24. Also, within the top five reasons for not choosing the freezer beef option was concern about the quality and lack of trust for that purchasing option. This is likely a result of uncertainty about purchasing direct from a producer.

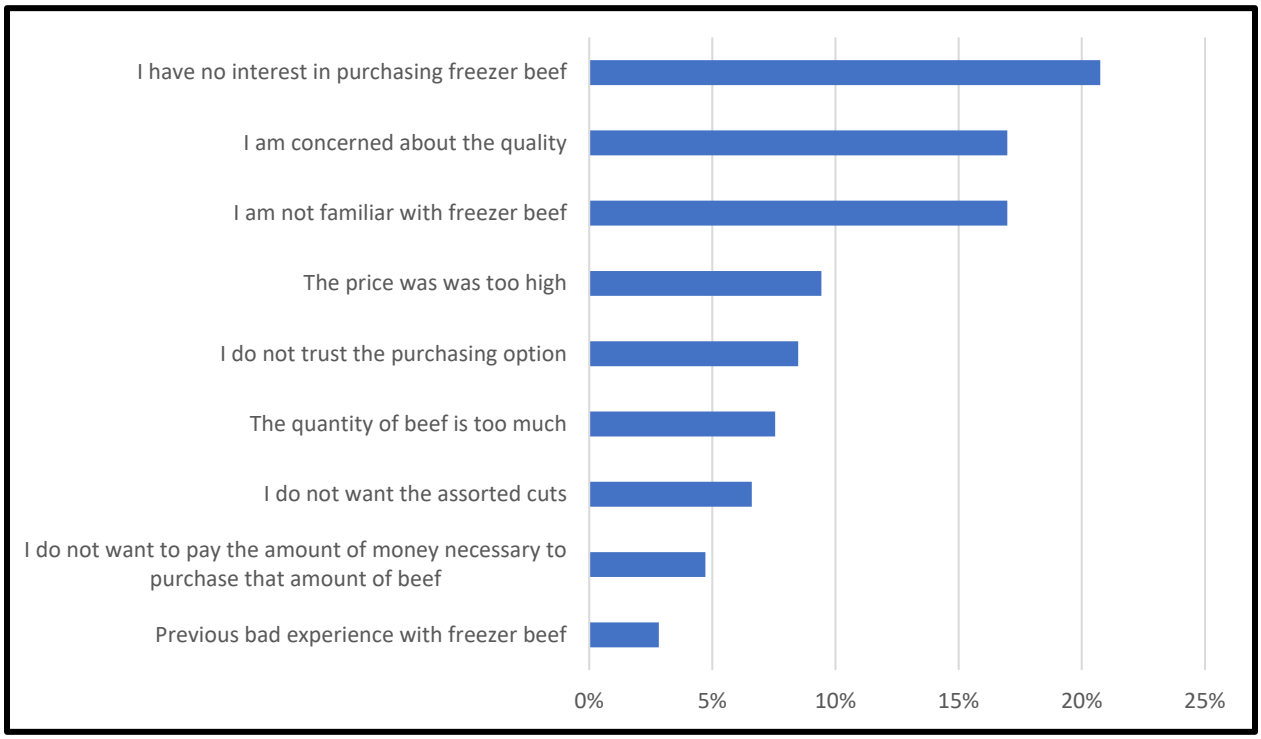


Figure 24. Reasons for Not Choosing Freezer Beef

POTENTIAL MARGINS FOR BEEF SLAUGHTERING AND PROCESSING

To evaluate the potential margins for beef slaughtering and processing in Alabama, it is necessary to look at the supply and demand factors that determine price. This includes the producers willingness to provide products to the marketing and the consumers willingness to purchase those products. Furthermore, one must consider the necessary steps within the supply chain between producer and consumer.

While an ideal situation would be to have actual price and sales data, we consider a next-best alternative which is the use of a discrete-choice experiment in which participants are given multiple price scenarios and options to either sell or purchase a product. We vary the marketing channel where that transaction will occur as well as providing different price points. This allows us to determine the premium that at which producers would sell to and consumers would purchase from the desired market. In all cases we provide a neither choice option, recognizing that some produces and consumers may choose to opt out of the market entirely rather than make a choice between the two options provided.

Figures 25 and 26 display an example of the information and questions presented to Alabama cattlemen who responded to the survey. We first defined the scenario as feeder beef and finished cattle for freezer beef so that all participants would have the same reference point for the experiment. We then provide cost information that forms a basis for the price options presented. This includes a base price plus finishing cost. The example assumes a 750 lb feeder steer, that would then require additional expenses to finish at a weight of 1,250 lbs. We varied the scenario for different initial weights less than 700 lbs based on a producers earlier survey response of their typical marketing weight. In those scenarios we also indicated the need for additional expenses to reach the 750 lbs necessary before entering the finishing phase of production.

Based on the responses to the producer experiment we calculated the Alabama cattlemen's willingness-to-accept (WTA) finished cattle slaughtered and processed in Alabama compared to feeder cattle typically shipped to the Midwest. The average premium producers are WTA was $1.91/lb (processed weight) when compared to selling feeder cattle.

We presented Alabama consumers with a similar experiment to assess their willingness to purchase freezer beef compared to the typical supermarket beef product. In this scenario, with an example shown in Figure 27, we defined two different supermarket products, ground beef and a boneless sirloin steak. Consumers were told they can purchase any volume they chose in 1-3 lb packages. The alternative option was to purchase assorted cuts of freezer beef as part of 1/4 of the animal.

In the following scenarios you will be presented with options to sell beef through different channels. These options include:

1. **Feeder cattle**: Sell feeder calves (through one of various marketing outlets) that will eventually end up at feedlots in the Midwest for feeding of corn-based diets to attain the growth and finish desirable to consumers.
2. **Finished cattle for freezer beef**: Retain ownership of your feeder calves on your farm and feed them to the point of slaughter readiness where you will sell them as freezer beef (e.g. whole, half, quarter).

Figure 25. Information Provided to Producers about Scenarios

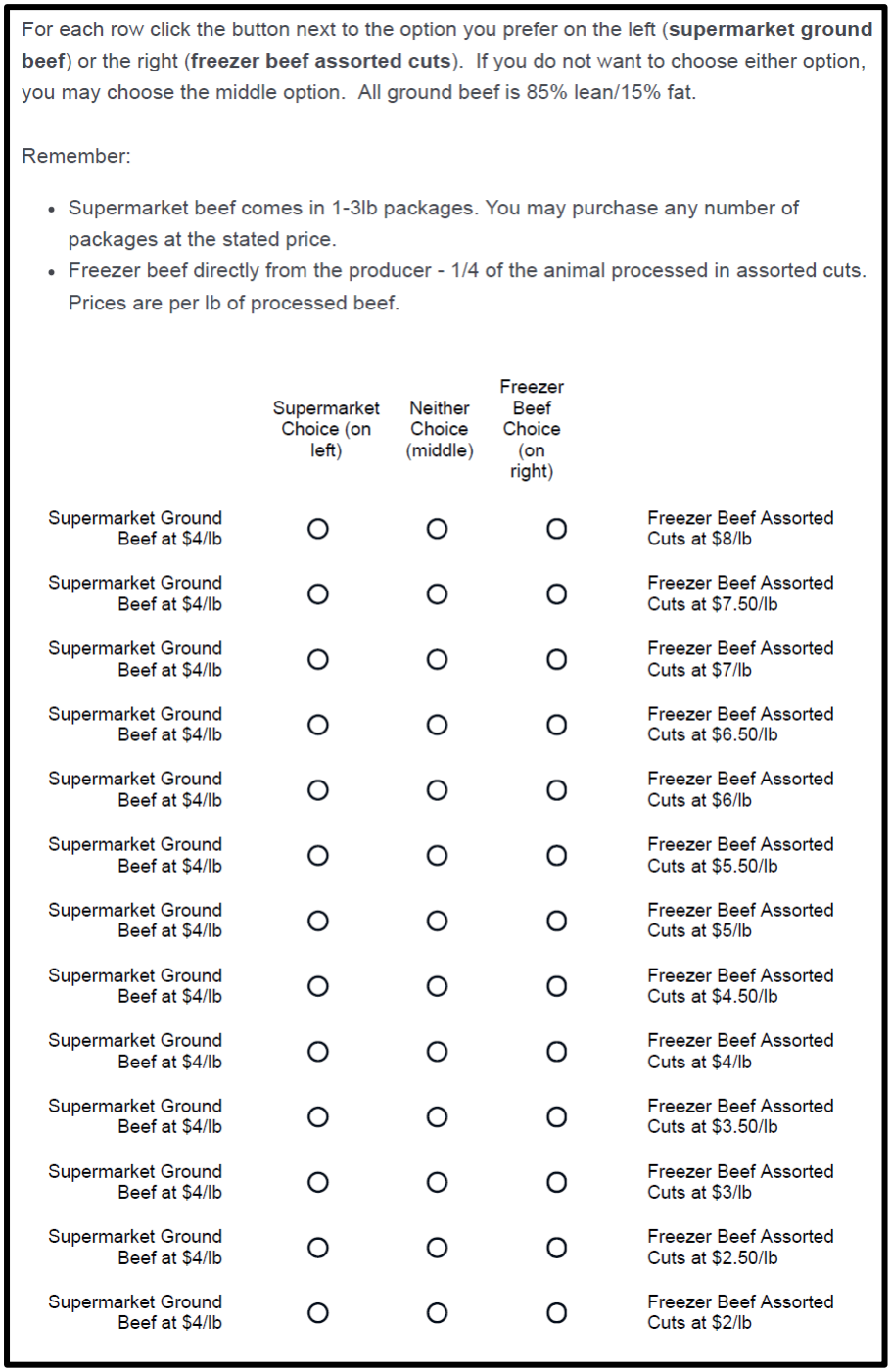
For each row click the button next to the option you prefer on the left (**feeder cattle**) or the right (**finished cattle for freezer beef**). If you do not want to choose either option, you may choose the middle option.

Remember:

- You indicated that you typically market cattle at a weight of 700 lb or more. In this scenario, suppose you have the option to sell 750-lb feeder steers. The 5-year average for 700-800 lb feeder steers is $118.32/cwt, or $887 for a 750-lb feeder steer.
- To finish cattle at a weight of 1,250 lb per head from a starting weight of 750 lb per head, budgets by the Alabama Cooperative Extension System estimate a cost of $850 per head and a 180-day feeding period.
- When comparing finished cattle to feeder cattle, you need to account for both the $850 additional expense presented above, as well as the cash flow delay of around 6 months.
- Keep in mind that the costs presented may be different for your operation.

	Feeder cattle Choice (on left)	Neither Choice (middle)	Finished cattle for freezer beef Choice (on right)	
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $147/cwt ($1,838/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $148/cwt ($1,850/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $149/cwt ($1,863/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $150/cwt ($1,875/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $151/cwt ($1,888/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $152/cwt ($1,900/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $153/cwt ($1,913/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $154/cwt ($1,925/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $155/cwt ($1,938/head)
Feeder cattle at $118.32/cwt ($887/head)	○	○	○	Finished cattle for freezer beef at $156/cwt ($1,950/head)

Figure 26. Example of Producer Experiment Choice Options



For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember:

- Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.
- Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Figure 27. Example of Consumer Experiment Choice Options

The consumer survey yielded an Alabama consumer's willingness-to-pay (WTP) for assorted cuts of freezer beef compared to either ground beef or boneless sirloin steak at a supermarket. The average premium consumers are WTP ranged between $2.21/lb when compared to ground beef purchased at a supermarket and $3.53/lb when compared to boneless sirloin steak purchased at

a supermarket. The ground beef premium can be considered a proxy for a beef consumer that prefers value cuts, whereas the steak premium can be considered a proxy for a beef consumer that prefers premium cuts.

One should consider these premiums when determining the potential margin available for the value-added process between finishing cattle and the consumer purchasing processed beef. For beef purchased at a supermarket, the value-added includes slaughtering, processing, distribution, and retailing. For freezer beef, the value-added includes a different means of distribution and marketing that does not have the same retail costs as a supermarket.

Taking the difference between the WTP premium for each type of beef product and the WTA premium for finished processed beef, the estimated average available margin ranges from $0.30/lb for value beef consumers to $1.62/lb for premium beef consumers. A simple average of these two margins yields an average $0.96/lb that is available for freezer beef slaughtering, processing, distribution, and marketing.

FINANCIAL ANALYSIS

The parameters and cost estimates for the financial analysis are based on multiple meetings and conversations with stakeholders in Alabama, an extensive review of the literature, and local and inflationary adjustments. This included representatives from the Alabama Department of Agriculture and Industries, Alabama Cattlemen's Association, Auburn University Lambert-Powell Meats Lab, Alabama Cooperative Extension System, and existing slaughter and processing operations. References are included for multiple papers that were evaluated for this study, including Matson Consulting (2020), Hughes, Wright, Griffith, and Pepper (2017), Holcomb (2011), Food and Livestock Planning (2011), and Shepstone Management Company (2000). Cost and inflation indexes were consulted from the Bureau of Labor Statistics (2021), Construction Analytics (2021), Turner Building Cost Index (2021), and St. Louis Federal Reserve Economic Data (2021).

There are many assumptions that are necessary to perform a financial analysis. We approach these assumptions with the goal to provide a reasonable, yet conservative estimate of developing beef cattle processing in Alabama. Throughout the section we identify individual decisions, such as the use of new and used equipment, labor needs, and pricing structures, that may alter this analysis from a financial analysis for any one particular operation. This analysis like others in this literature is, therefore, a general guide and not a business plan for a specific operation.

The financial analysis includes discussions of facility construction requirements including equipment costs, financing the capital investment, annual operating costs including labor, and a profitability analysis. Finally, we provide a breakeven and sensitivity analysis to consider further variation in annual expenses and expected revenue, both of which can fluctuate depending on continued inflationary pressure and cattle market supply and demand.

BASE ASSUMPTIONS

The existing structure of the beef cattle market in Alabama is such that cattle are primarily shipped to the Midwest for finishing and processing. The general lack of finished cattle in the state provides a substantial limitation to the size of any new facility that might be established. Thus, it was determined that the facility most appropriate in Alabama would be a state inspected facility or federally inspected through the T-A agreement. Capacity should be limited to 35 head of beef cattle per week. A small-scale facility, such as this, generally requires a building of between 3,000 and 5,000 square feet that is best suited on roughly three acres of land. We also assume that the facility will be operating 50 weeks per year, allowing time for closures for holidays and cleaning. Table 4 includes a summary of the base assumptions for this analysis.

Table 4. Summary of Base Assumptions	
Facility capacity	35 head of beef cattle per week
Operating weeks	50 weeks per year
Building size	3,000 - 5,000 sq ft
Land area	About 3 acres

FACILITY CONSTRUCTION AND EQUIPMENT

The basic construction requirements for a beef cattle processing facility include acquisition and preparation of land, a shell exterior building typically made of steel, a holding pen with a livestock unloading area, and interior construction that includes appropriate refrigeration. The estimated costs in this section are for a basic design and overall capital investment. A detailed process for designing and determining the appropriate layout has been developed by Iowa State University Extension in a comprehensive "Guide to Designing a Small Red Meat Plant" (Thiboumery, 2009).

The site acquisition and land preparation are estimated at a cost of $145,000. This includes the purchase of 3-acres of land with the appropriate grading and other dirt work, roadways, and permitting. We assume that the site has access to sewer and city water. A holding pen and livestock unloading area needs to be constructed on the land at an estimated cost of $27,000.

The size of the exterior footprint of the building is estimated to range between 3,000 and 5,000 square feet. This will allow for sufficient space for slaughtering, processing, refrigeration, office space, locker room and showering facilities, and restrooms. We consider a range in the size to allow for consideration of value-added opportunities or future expansion. The cost of the shell building is estimated between $150,000 and $210,000. Interior construction of coolers, doors, and other interior work is estimated to range between $80,000 and $135,000 with refrigeration adding an additional $123,000 to the cost.

Equipment requirements were determined using an overhead rail system that begins with bleeding and continues through all remaining harvesting and dressing procedures with the carcass suspended and moving along the rail (Heinz, 2008). The overall equipment costs are estimated at $145,000. It is noted that these costs can vary if used equipment are secured rather than new installation, although consideration should be given to potential higher maintenance costs in that scenario.

Table 5. Summary of Facility Construction and Equipment Costs	
Land and Site Prep	$145,000
Building	$150,000 - $210,000
Refrigeration	$123,000
Interior construction	$80,000 - $135,000
Holding pens and Livestock unloading area	$27,000
Total Construction Cost	$525,000 - $640,000
Equipment Cost	$145,000
Total Capital Investment	$670,000 - $785,000

Table 5 outlines each individual cost category discussed and the overall construction and equipment cost of $670,000 to $785,000 that depends on the building size chosen for the operation.

FINANCING THE CAPITAL INVESTMENT

The total capital investment necessary to build and purchase equipment for a new beef slaughter and processing facility is estimated between $670,000 and $785,000. A typical financing loan for this type of facility can cover up to 80% of the cost to be paid back over a ten-year period. Therefore, the estimated required financing for this project is between $536,000 and $628,000. Details of the financing assumptions and annual payment calculation are presented in Table 6.

Table 6. Summary of Financing Assumptions and Annual Payment	
Loan period	10 years
Interest rate	5% - 7%
Percent financed	80%
Total capital needed	$670,000 - $785,000
Capital financed	$536,000 - $628,000
Annual Loan Payment	$69,414 - $81,329

Loan interest rates are currently near all-time lows, and thus we estimate interest payments based on a lower estimate of 5.0%. However, interest rates do vary based on timing of the project and credit worthiness. Furthermore, it is expected that interest rates may begin to rise in 2022. To account for this potential variation, we also estimate interest payments based on an upper estimate of 7.0%.

Amortizing the loan over a ten-year period, the interest and principal payment will range between $69,414 to $81,329 per year. This range considers variation in the total project costs and interest rates as previously discussed.

ANNUAL OPERATING COSTS INCLUDING LABOR

A breakdown of the major annual operating cost categories are shown in Table 7. Utilities makes up the single biggest expense category after labor, estimated at $144,500. Utilities include electricity, gas, water, sewer, internet, and phone, of which the electricity costs make up a large proportion due to the refrigeration needs of the facility. Regular services are needed for laundry, legal, accounting, laboratory testing fees, and disposal of inedible byproducts and solid waste. The service costs are estimated at $28,250. Insurance and taxes are estimated at $20,850. Equipment maintenance, office supplies and cleaning supplies are estimated at $20,550.

Table 7. Summary of Annual Operating Costs Including Labor	
Utilities (including electric, gas, sewer, water, internet, and phone)	$144,500
Services (including laundry, legal, accounting, and laboratory, solid waste and inedible removals)	$28,250
Insurance and Taxes	$20,850
Maintenance and Supplies	$20,550
Packaging Materials	$100,000
Total Operating Costs	$314,150

In addition to the operating costs outlined above, packaging materials are needed on a per head basis. This cost is the single largest item operating cost and is estimated at $100,000 for a 1,750 head per year operation. At just over $57/head, this cost may increase with additional value-added processing that may alter packaging needs.

Labor needs are based on a full staff requirement that does not assume owner-operator or family labor. A plant of the proposed size would typically employ six workers, including a plant manager, butcher, three workers dedicated to packaging and cutting, and clerical assistance, as shown in Table 8. Total labor expenses are estimated at $235,522 for wages and $82,433 for payroll taxes and benefits.

Table 8. Summary of Labor Costs	
Plant Manager	$71,262
Butcher	$37,935
Packaging/Cutting (3)	$99,130
Clerical	$27,194
Taxes and Benefits (35%)	$82,433
Total Labor Costs	$317,954

The plant manager is the highest paid employee, responsible for the daily operation of the plant, regulatory compliance, and should have the expertise to fill in for other personnel as needed, including the butcher. The salary for a plant manager is estimated at $71,262. Just as important as a competent plant manager, a skilled butcher is essential for the success of the operation. In particular, this was a point of concern for most stakeholders. There is a very limited supply of workers available with the necessary skills and/or desire to engage in the profession. Discussion of training for butchers and meat cutters has been ongoing in the state in collaboration with the Alabama Community College System Innovation Center and a meat processing course training course is under development. A wage of $37,935 was estimated for a butcher. In addition, three packers/cutters would be needed at a wage of $33,043 per employee.

The final employee covers office responsibilities, including sales, marketing, and clerical assistance. This position would be essential for recruiting and coordinating with farmers to provide a continuous flow of livestock for processing. The wage for this position is estimated at $27,194. Payroll taxes and benefits are estimated at 35% of the total labor expense.

PROFITABILITY ANALYSIS

Profitability is determined from an estimate of expected revenue minus expected expenses. To determine annual revenue, we assume a hanging weight per head of 700 pounds. The fee structure that is most common is a base kill fee per head plus a processing fee per pound. We assume a base fee of $50 per head and a processing fee ranging from 50 cents to 80 cents per pound. The base fee of $50 represents a conservative estimate, while the per pound processing range is high due to the long-term variation in beef prices that can potentially restrict processing margins. It is also possible to charge a higher fee than 80 cents per pound for special processing, but for the sake of being a conservative analysis we do not consider these special cases.

Table 9 shows the expected annual revenue given these assumptions. Depending on the per pound processing fee, revenue is estimated between $400 and $610 per head. If 100% capacity is achieved, a total of 1,750 head would be slaughtered and processed per year for an annual revenue of $700,000 to $1,067,500. Total annual expenses are also shown in Table 6. Given operating costs, labor costs, and loan payments, total expenses range from $701,518 to $713,433. The range in profits, before income tax, is thus estimated between a $13,433 loss and a $365,982 profit. This profit also does not consider a return on invested capital (or opportunity cost thereof) and a return to unpaid management or additional family labor.

Table 9. Summary of Profitability Analysis	
Annual Revenue	
Hanging weight per head	700 lb
Base fee per head	$50
Processing fee per pound	$0.50 - $0.80
Revenue per head	$400 - $610
Number of cattle processed	1,750
Total Annual Revenue	$700,000 - $1,067,500
Annual Expenses	
Loan Payment	$69,414 - $81,329
Operating Costs	$314,150
Labor Costs	$317,954
Total Annual Expenses	$701,518 - $713,433
Profitability Analysis	
Total Annual Revenue	$700,000 - $1,067,500
Total Annual Expenses	$701,518 - $713,433
Total Profit (Before Income Tax)	$(13,433) - $365,982

BREAKEVEN AND SENSITIVITY ANALYSIS

To assess the potential for profitability, it is useful to consider the breakeven price given expected expenses and the breakeven yield given expected prices, as shown in Table 10. Given estimated annual expenses of $701,518 to $713,433 we calculate a breakeven price of $400.87 to $407.68. This price is only for slaughtering and processing, which does not include the cost of the live animal. Alternatively, we calculate the number of beef cattle necessary to cover estimate expenses at the $50 per head base fee plus the 50 cent or 80 cent per pound processing fee. At the higher expense level and lower fee, where we have established a slight loss, we estimate a breakeven number of head of 1,784 per year. This is above our assumed 1,750 head per year capacity. At the other end of the range, with a lower expense level and higher processing fee, it would take 1,151 head per year to achieve a breakeven profit. Given those parameters, breakeven profit occurs at 66% of capacity.

Table 10. Summary of Breakeven Analysis	
Breakeven Price per Head Assumed 1,750 head processed per year.	$400.87 - $407.68
Breakeven Number of Cattle Assumed $713,433 in annual expenses and $50 base fee plus 50 cents per pound processing fee	1,784
Breakeven Number of Cattle Assumed $701,518 in annual expenses and revenue at $50 base fee plus 80 cents per pound processing fee.	1,151

To further illustrate how profitability can vary with changes in prices and expenses we perform a sensitivity analysis. This analysis expands the range of expenses to cover 10% below the lower estimate and 10% above the upper estimate. We also depict profits at each 10-cent interval from 50 cents per pound to 80 cents per pound, maintaining the original $50 base fee. We perform this sensitivity analysis at 100% capacity and 75% capacity, as shown in Table 11.

At 100% capacity, we estimate negative profits occur at the 50-cent per pound processing fee at our lower bound annual cost estimates. In all cases of higher prices, a positive profit is achieved. If the 50-cent per pound price point is targeted then one must consider means to reduce annual operating, labor, or loan expenses. Current market prices are higher than this level and thus it is reasonably achievable to achieve positive profits in this market, which is also supported by our consumer and producer survey results that indicate $0.96 margin available for slaughtering, processing, distribution, and marketing of freezer beef to Alabama consumers.

Table 11. Summary of Sensitivity Analysis at 100% Capacity				
Assumptions	Lower Estimate Minus 10%	Lower Estimate	Upper Estimate	Upper Estimate Plus 10%
Annual Expense	$631,366.54	$701,518.38	$713,433.38	$784,776.71
Total Profit (Before Income Tax) based on Assumed Processing Fee				
$0.50/lb	$68,633.46	$(1,518.38)	$(13,433.38)	$(84,776.71)
$0.60/lb	$191,133.46	$120,981.62	$109,066.62	$37,723.29
$0.70/lb	$313,633.46	$243,481.62	$231,566.62	$160,223.29
$0.80/lb	$436,133.46	$365,981.62	$354,066.62	$282,723.29

One concern that is illustrated in this sensitivity analysis is the necessity to produce at or near capacity. Table 12 depicts the estimated profit at 75% capacity. In this case, one must have expenses at the lower cost estimate or below and be at the 70-cent per pound processing fee in order to make a profit. Higher prices would allow for higher costs, although profits are quite minimal at the upper estimate plus 10% even at an 80-cent per pound price. This variability, especially during the first ten years of operation when loan payments are being made should be

considered. In particular, will lower beef prices result in an inability to maintain these levels of production or processing fees?

Table 12. Summary of Sensitivity Analysis at 75% Capacity				
Assumptions	Lower Estimate Minus 10%	Lower Estimate	Upper Estimate	Upper Estimate Plus 10%
Annual Expense	$631,366.54	$701,518.38	$713,433.38	$784,776.71
Total Profit (Before Income Tax) based on Assumed Processing Fee				
$0.50/lb	$(106,366.54)	$(176,518.38)	$(188,433.38)	$(259,776.71)
$0.60/lb	$(14,491.54)	$(84,643.38)	$(96,558.38)	$(167,901.71)
$0.70/lb	$77,383.46	$7,231.62	$(4,683.38)	$(76,026.71)
$0.80/lb	$169,258.46	$99,106.62	$87,191.62	$15,848.29

SUMMARY AND CONCLUSIONS

The financial analysis presented provides an estimate of the capital investment necessary for building a new beef slaughter and processing facility in Alabama. We include site acquisition and all building costs plus annual operating and labor expenses. We further consider that 80% of the capital necessary to start such a plant is obtained through financing. There are many assumptions that go into this analysis that can affect the obtained results. This includes the number of beef cattle processed, purchase of new or used equipment, chosen price point, owner/family labor, and chosen price points.

On the low end of the price distribution, combined with the high end of the annual expenses, an annual loss occurs of $13,433. This, however, is quickly mitigated through an increased price per pound that is expected to exist in the market. While 100% capacity is the main consideration in this analysis, we do also present a sensitivity analysis that considers 75% capacity. At this level, there is greater concern for profitability at price points below 70 cents per pound, depending on annual cost estimates. Thus, potential processors must consider the likelihood of either maintaining a high capacity during the first ten-year loan payback period or find ways to minimize costs or increase prices. At current levels of processing in Alabama there is a high likelihood of maintaining a near 100% level of capacity in the near-term. The longer-term horizon is more complicated as processing changes may occur at the national level as the USDA and current presidential administration seeks to address concerns about concentration and competitiveness of the beef packing sector. Furthermore, state and federal funds have become available in various localities that are providing for expansion of existing facilities and potentially development of new facilities. This may further saturate the market and dilute the potential to maintain near-capacity levels of processing activity.

In addition to price, there are other considerations that can affect profitability that have not be considered in this analysis. Many plants of this nature diversify their operation as multi-species slaughter and processing facilities. Processing hogs, deer, and potentially small ruminants in place of some of the beef cattle capacity can help provide a more consistent flow of livestock through the facility and maintain capacity levels closer to 100%. This diversification can help manage profitability and address concerns about long-term viability. In addition, there are value-added opportunities such as bacon and sausage production or adding a smokehouse to produce cooked meats. Finding value-added opportunities can help appeal to a broader customer base and offer supplemental revenue for increased profitability.

ECONOMIC IMPACT ANALYSIS

Policymakers and industry representatives often look to understand the total economic impact of a change in the local economy. Changes to employment and output of one sector ultimately affect other sectors in the economy through direct, indirect, and induced effects. This interaction between sectors of a local economy can be measured through an input-output model. IMPLAN is a software that can help estimate these impacts.

Through the use of multipliers, we can determine changes in employment, income, value added, and output.

- Direct effects are first established, which are the initial changes to the industry being studied.
- Indirect effects are then changes that occur in other sectors that supply the sector being studied. Essentially, indirect effects measure the increase in demand for inputs to the production being studied.
- Induced effects focus on changes in income affect local spending. Additional income is generated as more employees are hired in the sector being studied or in an input sector that is facing increased demand. This additional income is then spent on additional economic activities throughout the local economy.

In this study, the sector being examined is beef slaughtering and processing. We specify the economy of interest to be the State of Alabama, thus we estimate the economic impact on the state economy rather than a specific local community. A set of assumptions are then necessary to evaluate this new operation in the beef slaughtering and processing sector.

ASSUMPTIONS

We assume the new operation generates $700,000 of output which for this economic impact analysis is a highly conservative figure that represents a lower bound on the potential impact. This is computed assuming figures from the financial analysis, i.e. 1,750 beef cattle processed per year at the $50 base fee plus 50-cent per pound processing fee. We also assume that six new employees are hired at a combined total income (including taxes and benefits) of $317,954. Finally, we assume that linkages within the backwards supply chain remain the same as existing assumptions provided by IMPLAN. These base assumptions make for our initial economic impact analysis as shown in Table 13.

We recognize the likelihood that the output generated from this new operation will be greater than $700,000. Thus, we also present a second economic impact analysis in Table 14 where we assume an 80-cent per pound processing fee resulting in $1,067,500 in output. All other assumptions remain the same.

Given the above assumptions, we compute the direct, indirect, and induced effects at the 50-cent per pound processing fee. We are particularly interested in the indirect and induced effects, as they represent the additional economic activity in Alabama that occurs as a result of the newly generated output and employment, shown in Table 13. An additional 6.53 jobs are created, generating over $300,000 in additional income for those employees. Additional output is generated in the state through backward linkages to input suppliers, adding $437,645 to the states economic impact. Induced effects also create additional output through household spending on healthcare, food, and all other personal needs. The total economic impact of a new processing facility given this price scenario is 12.5 jobs and $1.5 million of economic activity in the state of Alabama.

Table 13. Economic Impact Analysis Assuming $0.50/lb Processing Fee

Impact	Employment	Labor Income	Value Added	Output
Direct	6	$ 319,712	$ 327,395	$ 700,000
Indirect	4.05	$ 216,269	$ 262,642	$ 437,645
Induced	2.48	$ 105,928	$ 200,600	$ 362,317
Totals	12.53	$ 641,909	$ 790,637	$ 1,499,962

Based on IMPLAN data and user defined direct impacts for employment, labor income, and output.

Table 14. shows changes to the economic impact analysis due to an increase in the processing fee to 80-cents per pound. This adds about $300,000 to the direct output and $376,000 to the indirect and induced effects. The total economic impact of a new processing facility given this price scenario is 15.19 jobs and $2.2 million of economic activity in the state of Alabama.

Table 14. Economic Impact Analysis Assuming $0.80/lb Processing Fee

Impact	Employment	Labor Income	Value Added	Output
Direct	6	$ 320,636	$ 332,351	$ 1,067,500
Indirect	6.17	$ 329,810	$ 400,530	$ 667,409
Induced	3.02	$ 128,985	$ 244,226	$ 441,113
Totals	15.19	$ 779,431	$ 997,106	$ 2,176,022

Based on IMPLAN data and user defined direct impacts for employment, labor income, and output.

KEY FINDINGS AND CONCLUSION

This report provides essential information necessary to determine the feasibility of a new beef cattle processing facility in Alabama. We evaluate aspects of supply and demand, a financial analysis, and economic impact of opening a new plant. Some of the major takeaways from this report include:

- Alabama cattle producers see opportunities for additional processing, express interest in finishing cattle, but may lack some of the infrastructure needed for finishing. They also expressed less knowledge of marketing and regulatory requirements for selling freezer beef.
- There are notable geographic areas of the state where cattle inventories exist, but processing is lacking.
- Alabama beef consumers are primarily focused on price, USDA grade, and taste, although for the market for freezer beef to expand there needs to be education as the term is often associated with less favorable opinions and is thus not well understood.
- The financial analysis shows opportunities for profit at the right price point, but also the necessity to ensure maintaining high levels of production at or near capacity.
- A new slaughter and processing facility will provide between 12.5 and 15.2 new jobs and $1.5 - $2.2 million of economic activity in the State of Alabama.

There are some limitations to the current study that are recognized and should be considered in evaluating a new operation. A more precise cost estimate is necessary for any formal business plan that considers individual plant characteristics, including the potential for multi-species slaughtering and processing and value-added operations. Availability of skilled labor is also a major concern for the industry and while being addressed may take time to develop into available workers. The choice of geographic location needs to also be carefully selected to ensure an adequate and continuous supply of livestock and consumer demand. It is recommended that a potential operator also establish relationships with potential suppliers as part of a specific evaluation of their operation to address concerns about long-term supply and continued viability of a new operation. With generally high levels of interest in cooperative models, this can be an area for further exploration. Finally, expansion of existing facilities and concurrent new development may impact market potential and should be considered as market dynamics continue to change.

REFERENCES

Alabama Department of Agriculture and Industries. 2010. Livestock Disposal Policy. Available at: http://agi.alabama.gov/divisions/animal-industries#forms

Alabama Department of Agriculture and Industries. 2021. "Direct Market Guidelines." Available at: http://www.fma.alabama.gov/pdfs/Brochure-DirectMarketGuidelines_v3.pdf

Alabama Department of Environmental Management. 2021. Water Division Water Quality Program Volume 1, Admin Code R. 335-6. February 15. Available at: http://www.adem.alabama.gov/alEnviroReglaws/files/Division6Vol1.pdf

Alabama Department of Public Health. 2017.RULES OF STATE BOARD OF HEALTH BUREAU OF ENVIRONMENTAL SERVICES, DIVISION OF COMMUNITY ENVIRONMENTAL PROTECTION CHAPTER 420-3-1, ONSITE SEWAGE TREATMENT AND DISPOSAL. March 6. Available at: https://www.alabamapublichealth.gov/onsite/assets/onsitesewagedisposalrules.pdf

Alabama Department of Public Health. 2020. RULES OF ALABAMA STATE BOARD OF HEALTH BUREAU OF ENVIRONMENTAL SERVICES, CHAPTER 420-3-22, FOR FOOD ESTABLISHMENT SANITATION. Available at: https://www.alabamapublichealth.gov/environmental/assets/foodrules2020.pdf

Alabama Public Radio. 2015. ConAgra To Close Montgomery Plant. Available at : https://www.apr.org/2005-03-25/conagra-to-close-montgomery-plant

Food & Livestock Planning. 2011. "Business Plan for a New Small USDA Inspected Meat Processing Plant to Serve Local Livestock Producers." Report to United States Department of Agriculture Rural Development. May.

Heinz, G. 2008. "Abattoir Development: Options and Designs for Hygienic Basic and Medium-Sized Abattoirs. "Animal Production and Health Commission for Asia and the Pacific Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific. RAP Publication 2008/1 Bangkok.

Holcomb, R.B., K. Flynn, P. Kenkel. 2011. "Feasibility Template for a Small Multi-Species Meat Processing Plant." Accessed August 2021.

Hughes, D.W., H. Wright, A. Griffith, H. Pepper. 2017. "Feasibility of a Federal Inspected Custom Livestock Processing Facility in Tennessee." Center for Profitable Agriculture, University of Tennessee.

Ice and Refrigeration Illustrated. 1917. Packing House Notes. p. 110.

Matson Consulting 2020. "A Study of Small-Volume Red Meat Processing in Virginia."

McCarthy, J. and S. Dekoster. 2020. "Four in 10 Americans Have Eaten Plant-Based Meats." Gallup. January 28.

Meat & Poultry. 2005. ConAgra closing Alabama beef patty plant. April. Available at: https://www.nxtbook.com/sosland/mp/2005_04_01/index.php?startid=4#/p/4

National Association of State Departments of Agriculture. 2021. "Interstate Meat Sales Background." Available at: https://www.nasda.org/policy/issues/food-safety/interstate-meat-inspection/interstate-meat-sales-background

Rumley, E., Wilkerson, J. 2021. "National Ag Law Center" Available at: https://nationalaglawcenter.org/state-compilations/meatprocessing/

Shepstone Management Company. 2000. "Meat Processing Facility Feasibility Study."

Smith, S. 2003. Double Amputation at Meat Plant Leads to OSHA Fines. EHS Today. Available at: https://www.ehstoday.com/archive/article/21913890/double-amputation-at-meat-plant-leads-to-osha-fines.

Thiboumery, A. 2010. "Product Cost/Pricing for Meat Processors and Marketers." Niche Meat Processor Assistance Network. October 21, Webinar.

Tyko, K. 2020. "Looking for a freezer to store your coronavirus stockpile? You're not alone in being frozen out." USA Today. April 4.

United States v. George H. Proctor, 504 F.2d 954 (5th Cir. 1974)

US Senate. 1919. Stimulation of Live-stock Products: Hearings Before the Committee on Agriculture and Forestry, United States Senate, Sixty-sixth Congress, First Session

USDA AMS (Agricultural Marketing Service). 2020. "Boxed Beef & Fed Cattle Price Spread Investigation Report." July 22.

USDA. 2021a. "USDA Announces $500 Million for Expanded Meat & Poultry Processing Capacity as Part of Efforts to Increase Competition, Level the Playing Field for Family Farmers and Ranchers, and Build a Better Food System." Press Release No. 0154.21, July 9.

USDA. 2021b. "Transportation and Marketing, Meat and Poultry Inspection Readiness Grant, Fiscal Year 2021 Description of Funded Projects." Available at: https://www.ams.usda.gov/sites/default/files/media/FY21MPIRGDescriptionofFundedProjects.pdf.

USDA FSIS (Food Safety Inspection Service). 2018. Meat and Poultry Hazards and Control Guide. Available at: https://www.fsis.usda.gov/sites/default/files/import/Meat_and_Poultry_Hazards_Controls_Guide_10042005.pdf

USDA FSIS (Food Safety Inspection Service). 2021. Sanitation SOP Guide. Available at : https://www.fsis.usda.gov/sites/default/files/media_file/2021-03/Sanitation-SOP-Guide.pdf

USDA NASS. 2021a. Crop Production. August 12. Available at: https://downloads.usda.library.cornell.edu/usda-esmis/files/tm70mv177/ks65j987z/s1785k223/crop0821.pdf

USDA NASS. 2021b. Cattle on Feed. November 19. Available at https://downloads.usda.library.cornell.edu/usda-esmis/files/m326m174z/2b88rf030/dj52x580x/cofd1121.pdf

Webb, Megan J., et. al. 2014. "AN OVERVIEW OF BEEF MARKETING AND CLASSIFICATION STANDARDS AMONG THE INDUSTRIES OF THE UNITED STATES, CANADA, URUGUAY, AND AUSTRALIA" Available at: https://digicomst.ie/wp-content/uploads/2020/05/2014_01_05.pdf

Wilson, S. 2018. "Remembering when: Growing up in the '30s, '40s." Andalusia Star News. August 4.

World Media Group. 2021. "U.S. Average Precipitation State Rank". Available at: http://www.usa.com/rank/us--average-precipitation--state-rank.htm

Ziara, R. 2015. "Water and Energy Use and Wastewater Production in a Beef Packing Plant." Available at : https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1084&context=civilengdiss