The Livestock Industry

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1. Introduction

The livestock industry has played an important role in the success of not only the United States, but that also of the agricultural industry. In this production, we will discuss the advancements of the livestock industry and the development of its marketing practices. We will additionally cover the marketing of meat and meat products, as well as career development and entrepreneurship opportunities. Discovering the changes and how the livestock industry came about will provide a fresh new insight and increase awareness of how the meat we eat gets to our plate.

2. The Evolution of Livestock

The evolution of livestock-- the first livestock animals, such as sheep, horses, and cattle, were brought over to America in 1493, during Christopher Columbus's second journey to the New World. Once these livestock animals were brought over to the New World, herds of animals-- predominantly cattle-- were allowed to roam and graze freely. Since they were unprotected, they were more susceptible to predator attacks.

The early human civilizations were required and dependent upon hunting the animals and using wild plants with the animals' hides for food and clothing. They then realized that if they maintained the animals in a confined area, they would be able to have a stable supply of food and clothing. With a steady supply of food, there would also be an increase in the human population. Some historians have argued that without the domestication of these animals, we would have never become civilized.

3. Origins of Livestock

The cattle we are familiar with today are descendants from the Bos taurus and the Bos indicus. Bos taurus cattle came from either the aurochs, which is from Europe, or the Celtic short horn, which came from the British Isles. Bos indicus cattle, which are more commonly known for their hump, are found in the tropical countries, and are more resistant to some diseases, parasites, and heat than the Bos taurus cattle.

TEXT ON SCREEN - [Time Line of Stone Age: Paleolithic or Old Stone Age, 2.5 Million Years – Mesolithic or Middle Stone Age, 15000 years ago – Neolithic or New Stone Age, 11000 years ago]

Cattle were first tamed early in the Neolithic Age, also known as the New Stone Age, and were used for meat, milk, and draft. Draft is where the animals are used for pulling loads. During this age, the wealth of a person was measured by the number of cattle they had, meaning the more cattle they had, the wealthier they were. As the years progressed onward, selection and cross-breeding began to occur in order to improve the cattle and started the introduction of different breeds.

TEXT ON SCREEN - [Dell Allen – VP Technical Services & Food Safety, Cargill Meat Solutions, Retired]

Breeding now is taught through the old-- they call them gene jockeys, but actually looking down at the molecular level of genes and studying that, and so it's dramatically different than what it was back in the 1950s as far as animal breeding. And it's allowed us, and will continue to allow us to make some major advances in animal production by allowing us to look inside the gene pool, identify traits that are affected by certain genes, and in particular, make improvement in our animals through those types of technologies. And we're just beginning in that. We're not even close to scratching the surface yet of what can be done in the future on those things.

With the population moving westward, so did the cattle herds. The states in the Great Plains were the most successful because of the enormous amount of grazing land available to the settlers. Additionally, the number of

dairy cattle in the United States kept increasing till the mid 1940s, and milk production now occurs in all 50 states. Also, with the population going west, so did the men and their cattle. Many men began hiring other men to drive their livestock to the market to save on expenses, while those men who could afford it would haul their cattle using the railroads.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

I think if you look at the history of the meat industry, one of the most fascinating things about it are the evolutions that have occurred in transportation. If you look at the way that it was originally provisioned, we used to drive animals to the market place. Historically, you typically saw cattle drives, and they were the most famous, but they would also draft pigs, and sheep, and even turkeys and poultry to markets.

So we would actually transport the livestock to the processing facility for harvest. And then what we started to see is that it was actually easier to harvest the animals in the areas where they were actually fed because it became expensive to transport grain products to the facilities. So we started to see the use of the rail car, and the rail car was used more commonly to transport livestock to and from market facilities.

Rail cars soon developed into a refrigerated rail car, which then evolved into the refrigerated trucks used to ship meat in modern society.

Swine. Swine did surprisingly well during the beginning of the New World. As omnivores, and being known to eat practically anything, they would scavenge around the land trying to find food. The American breeds we are familiar with came from two wild ancestors, the European wild boar, Sus scrofa, and the East Indian pig, Sus vittatus.

The use of swine for meat did not occur till the New Stone Age. Pork and lard were used for export trade in return for other goods. The main concentration and expansion of swine production occurred in the Corn Belt

states, because the feed for finishing the hogs was largely produced in this area.

Sheep. Sheep were the only animals that required constant care and were maintained by a shepherd to keep predators away, as well as help keep them herded together. They were the first livestock animal to be tamed by humans because of their timid and defenseless characteristics.

There are over 200 breeds of sheep in the world today. The present day sheep came from wild sheep called moufflons and the Asiatic Uria, as well as the wild big horn sheep of Asia. The only sheep native to North America includes the big horn or Rocky Mountain sheep. The present day sheep came from imports from the beginning settlers. Sheep were generally used for their wool production by the settlers, and were predominantly found in the northeastern part of the United States.

Goats. Goats were imported from Switzerland and were mainly used for their mohair and milk. They are descendants from the pasang or Grecian Ibex found in Asia Minor, Persia, and other countries.

The main differences between goats and sheep are that goats have a less stocky body with shorter tails. Sheep tails always go down, whereas goat tails always go up. Additionally, the horns on goats grow upward, backward, and outward, versus a spiral twist of horns on sheep. Furthermore, male goats have a beard and give off a strong odor during breeding season.

The main difference between the two is that goats are more intelligent and can fend for themselves while sheep cannot. If goats were to be wild again, they would be able to survive, whereas we could not say the same about sheep. Most goats are found in the western part of the United States, and Texas possesses the largest number of goats in the United States.

Horses. Horses are native to North America, but they disappeared before Europeans came to the New World. Therefore, Christopher Columbus

reintroduced the New World with horses during his second journey over to the United States in 1493.

Horses evolved from a foot-tall swamp-dwelling four-toed drawn horse, Eohippus. Since oxen were more commonly used as draft animals, horses were mostly used as pack animals and for riding. Now, horses are primarily used for racing and riding.

Poultry. Poultry and eggs were used for food for quite some time, but it is only recently that the poultry industry has become a major commercial entity. The chicken originated from the Gallus-gallus, which was found in India.

Chickens were brought to the New World by the early colonists and explorers. In the 1850s, poultry shows began to exhibit and recognize the different breeds. The poultry industry is prominent in the southern United States, and small flocks are virtually non-existent. This vertically-integrated industry is trying to keep up with the high demand from the consumers. Chicken consumption is the only one set to increase over the next 10 years.

4. Livestock Industry: Then and Now

Livestock industry-- then and now. During the Civil War, the livestock industry began to see changes. Instead of slaughtering animals on an as-needed basis, animals began to be slaughtered in excess during the winter months. They did this because they would not be able to maintain them due to harsh winters, and they would preserve the meat into jerky.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Meat has always been used as a morale builder among army units because it's a perishable item, and so it's not readily available. And so if you were going to provision troops with meat, it was a rare occurrence, and it was actually a unique opportunity for them that helped build morale.

And so there was a packer by the name of Sam Wilson, and he actually provisioned troops by sending over meat packed in barrels. And they stamped on the outside of the barrels "US." And so when the troops saw the barrels packed and marked with "US," they knew that they were getting a care package from Uncle Sam Wilson. And so Uncle Sam actually became a spokesperson for the United States because of that. Additionally, technological advancements such as barbed wire helped shape the livestock industry to what it is today. These new inventions helped improve the efficiency of their herds by keeping them contained in certain areas, protecting them from predators, and making the best of the lands they are grazing on.

Furthermore, science advancements, such as artificial insemination, helped farmers and ranchers increase their herd size, which would increase their production and income for the years to come. Also, with the use of artificial insemination, the process of breeding animals can help prevent injuries from the bull, boar, or ram mounting the cow, sow, or ewe.

There are also cases where there is a surrogate female used to give birth to the animal after an embryo transplant has occurred to protect the health or stability of the female who provided the egg. This procedure is also known as embryo transfer. Another scientific advancement that has helped the livestock industry is an ear implant.

TEXT ON SCREEN - [Gary Smith, Ph.D – Monfort Endowed Chair in Meat Science, Colorado State University]

Well, usually if you hear someone in the industry talking about growth promotants, they talk about growth hormones. And of course, we don't ever use growth hormones. We don't administer those to cattle. We do administer some hormones that are growth promotants, but they're not growth hormone because that happens to be bovine somatotropin, which only the animal produces and only the animal can really use.

So what you're talking about is we're using estrogen or testosterone or progesterone in different forms to cause the animal to do a tiny bit faster

growing process and to increase the amount of bone and muscle as opposed to fat deposition as they're growing.

Now, the livestock industry ranges anywhere from small ranches, which are characterized to consist of animals ranging from five to 100 head, to concentrated animal feeding operations, CAFOs. CAFOs are largely operated facilities that raise animals in a confined area and provide management over the animals, such as feeding them, cleaning their environment, as well as taking care of the animals' health by providing vaccinations and disposing of the dead animals.

The animals being raised in CAFOs get their food brought to them rather than them grazing and roaming to find food. Also, CAFOs provide a high number of animals produced to assist in meeting the demands and needs of society for food.

TEXT ON SCREEN - [Gary Smith, Ph.D – Monfort Endowed Chair in Meat Science, Colorado State University]

Concentrated animal feeding operations are simply any place where you assemble a large number of animals so that the workers' inputs can be directed toward more animals in any given period of time. And again, it's one of those things that we try to do to increase production efficiency and also to provide a place for those animals to do whatever they're supposed to do-- lay eggs, produce meat, produce offspring-- in as effective means as we can, protecting them from the effects of the environment.

The livestock industry faces criticism on their practices, such as treating their animals with antibiotics and hormones to increase their animal production and receive a larger sum of money for their animals. These practices are done as part of animal welfare and are used to prevent and treat diseases or infections from occurring throughout their stock.

With ranchers vaccinating their animals to prevent future diseases, they are promoting their stock's health by proactively taking action and not allowing

the disease to become an epidemic outbreak and potentially harming every animal.

With the animals being managed closely by the operators, the quality of the animal's health will improve since there is always someone monitoring their activity. This, in turn, solidifies the fact that the animals are being well managed and safe to be processed to meat for consumption.

5. Marketing Livestock

Whether it was taking their animals around behind the house to slaughter or driving them thousands of miles to the market, many ranchers found a way to get their product used or sold. Cowboys came about because many ranchers hired these men to take their herds to market instead of paying the rather pricey cost of using the railroads. With the idea of Manifest Destiny, settlers began moving west. Over the years, the methods in which livestock were marketed have changed.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

The industry became to be more commercialized. We actually saw that it was very centralized. And it was very centralized around the major markets, one of those being Chicago. If you look at Cincinnati, it was actually nicknamed Porkopolis, because so many pigs were actually marketed and harvested in Cincinnati. So those markets were very centralized. And that's why the cattle and the pigs had to be taken to those markets for harvest.

But as the population began to grow around those areas, space became a precious commodity. And so most of the processing plants were built up. And it was not uncommon during that time for plants to harvest multiple species. And they would actually segregate those carcasses by putting them on different floors of multistore processing plants, just because space was a commodity. But as the industry evolved and we began to decentralize the industry, the processing industry moved away from those centralized areas and established itself in areas where cattle were more

predominant, where pigs were more predominant, where feed sources were more predominant, so we saw a decentralization of the area. And that's when we started to see larger processing plants, and that's when we also started to see plants focused on one single species in their harvest facility, because they basically wanted to specialize so that they could do one thing and do it well.

With the population increasing, the demands for food also began to increase. The producers had to keep up with this newfound demand. And ranchers began cooperative markets, where they would join forces with fellow ranchers to split costs and hopefully achieve a larger profit. Fairs and shows began to allow producers to sell and show off their animals. Now, these fairs and shows have changed to exhibit these animals for their superiority compared to the others in the show. The winners are now auctioned off to the highest bidder, receiving the slaughtered animal for their consumption.

Also, with a different goal in mind, there are auctions where the animals are sold to breeders and people interested in improving their stock. Breeders take their new animals back to their ranches and use them to increase the number of animals, as well as the productivity of that animal. In addition to selling and harvesting animals, there are initiatives present that provide funding for research and promotion for every product sold.

There actually are incentive programs that are in place that are used in the industry. The most common are the Checkoff programs. And the way these are designed is that $1 of the sale of an animal actually goes into a fund that is regulated by USDA that is used to support the promotion and research, development, and marketing of meat products. And so those monies are actually regulated by industry boards, also known as National Cattlemens Beef Association and the National Pork Board, and also administered through the Cattlemens Beef Board, where monies are actually allocated for the promotion, as well as the research, to ensure the safety and quality of meat products so that we have a viable industry that

continues to move forward and is technologically advanced and on cutting edge to provide a safe and satisfying product to consumers.

Marketing meat and meat products. Once the animals are fed out for the proper amount of time for production, they are hauled to the market, sold, and then sent to the processing plants.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Animals can be sold to packers in two ways-- on a live weight basis and on a carcass grid basis. Live weight basis is simply marketing cattle based on their live weight, where a price is paid per pound. When you market carcasses on a grid, you're actually marketing or selling the animal based on its carcass characteristics. So typically, animals are harvested and then presented for grading, at which time USDA grades are assigned. And then the value of that animal is determined based on its weight, as well as its quality grade and yield grade using a predetermined grid or pricing structure that was agreed to between the producer and the packer prior to harvest.

Quality and yield grading play an important role in the marketing of meat products.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Meat grading is actually used to market meat products. And so the way the grading is implemented in the industry is, it's used to sort carcasses from a very diverse or heterogeneous group into smaller, more homogeneous groups, so that they can be direct marketed to specific markets. And so basically, the way it works is, in a processing facility, a lot of animals are brought in and they're harvested. And then those carcasses are sorted by USDA grader into smaller, more homogeneous groups, so that then those smaller groups can be taken into fabrication and broken down into smaller pieces for marketing of meat products. So the grading system, in essence,

is basically set up to market animals. And that's why it's administered by the USDA agricultural marketing service.

Yield grades are heavily utilized to determine carcass value among all species of red meat animals.

TEXT ON SCREEN - [Dale Woerner, Ph.D – Assistant Professor – Colorado State University]

We talk about grading systems for each of the individual red meat species. Of course, for beef carcasses, we'd have both quality and yield grading to indicate the value of the overall carcass. The pork industry, we're primarily concerned with the fragments of that animal, but also the amount or percentage of lean that's produced from an individual animal. And then in similar fashion, the lamb industry utilizes yield grades or relies on those very heavily to determine the value of the carcass and does use quality grade to some extent as well. Traditionally, or in the past, but also currently, red meat carcasses are evaluated using human subjective judgments.

We are starting to see instrumentation, or the use of instruments, becoming more common in our industry in order to really equalize the playing field or remove some of that subjectivity or human decision from that process. The most common instrumentation that we see is the use of video image analysis, both for beef carcasses, as well as lamb carcasses, and then also some other mechanical measures for the pork industry, including what we call the Fat O'Meter, which actually penetrates the carcass in order to assess or determine the thickness of fat, as well as the muscling of that animal.

Breeding procedures vary from species to species. Whether the process involves several factors or just a handful of different calculations, the process creates a common similarity amongst the thousands of different carcasses. Beef.

TEXT ON SCREEN - [Beef]

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Beef carcasses are segregated into two grades-- quality grades and yield grades. Beef quality grades estimate palatability which is the tenderness, juiciness, and flavor of a cooked meat product. Beef palatability or beef quality grades are determined by measuring the physiological maturity of the carcass and matching that with a marbling score, which is the amount of intramuscular fat deposited in the ribeye at the 12th and 13th rib location. Beef yield grades are estimates of cutability and cutability is also defined as yield. Because muscling and trimness are the two biggest drivers of yield, those are the characteristics that are typically measured on a carcass. We measure the fat opposite the ribeye at the 12th rib location. We also measure the weight of the carcass. We estimate the amount of internal fat on the carcass. And then we estimate the size of the ribeye area. And those are then put into a formula to calculate yield grade.

Pork.

Typically, pork carcasses are not graded in a commercial processing facility. There are USDA grades for pork carcasses and they are based on cutability and quality.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

However, quality is slightly different. Whereas most other quality grading systems are hierarchical nature, where they have a graded series of quality, pork is what we call a bipartite or dichotomous system, where it's either determined to be acceptable or unacceptable. But typically, yield grades are sorted out on a scale of one to four, with one being the most desirable and four being the least desirable. And it is based on a general muscling score and back fat measured at three locations.

Lamb.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Lamb carcass grades are divided into two general categories-- yield grades and quality grades. Yield grades are determined based on the external fat cover opposite the ribeye at the 12th rib. So trimming or trimness is the only quality or the only yield indicating characteristic that's currently used to segregate lamb carcasses based on cutability, which is their expected cut out or yield. Quality grades are estimates of palatability, so they are based on quality indicating characteristics of the lean.

One of the largest indicators or one of the largest factors that affects quality is age. And so the joints on a lamb carcass are actually used to determine the physiological age of the carcass, as well as the size and the shape and the condition of the ribs in the thoracic cavity. In addition to that, flank streakings or fat streakings in the flank muscles are also used as indicators of quality. And those are then combined with the conformation or the overall shape of the carcass to determine quality grade.

Packaging.

A lot has occurred in meat packaging in the last 100 years. In fact, we actually did not have meat packaging 100 years ago. Prior to packaging, most products were either further processed with smoke or cured agents or they were actually sold in carcass form under cold conditions before they perished. But the very first form of packaging that occurred was actually wooden barrels. And so meat was packed as tightly as it could be into a wooden barrel. And that's actually how we get the term meat packing industry.

Advancements in technology led to advancements in meat packaging.

The most common form of packaging was paper wrap. And we actually had wax-lined paper. And it's still often referred to as butcher wrap or paper wrap today and you still see it used in some custom butcher shops. But the

meat product was actually wrapped in that package and then the seams were actually taped together and it was marketed in that way. Then we had wax-lined boxes. And boxes were actually coated on the inside with a wax coating to help retard some of the elements, but to actually keep pieces of meat products or subprimals intact until they were shipped to their destination. And then what followed was vacuum packaging. It was much more sustainable. It was much easier to use. It resulted in a longer shelf life. And so subprimals were vacuum packaged and then placed in boxes and shipped across the country. And that's pretty much the method that's still used today.

Fueled by product safety, packaging has evolved over the years. However, product safety is not the only purpose for packaging.

The purpose of a meat package is to protect the product, but it also has other functions as well. And packaging is often used as a marketing agent or a merchandising agent as well. And so because of that, we see a lot of different types of packages that are used at retail. But most of the package types are matched to the product itself. Vacuum packaging is a form of packaging. We typically package meat products for preservation and to protect the products during shipping or retail display.

Vacuum packaging involves the use of a plastic film or pouch in which meat products are placed inside and then the air is removed or vacuumed out of the bag and the bag is sealed before the environment is allowed back into the chamber. So it's basically a vacuum protection or plastic film that is vacuumed around a meat product and sealed and then shipped. It creates an anaerobic environment, which is an environment that is devoid of air around the meat products. And it drastically improves the shelf life of most beef products.

Animal byproducts. Livestock does not only serve the purpose of providing meat to the world. It also provides fiber and skins for the production of clothing. The livestock industry provides conservation to the soil that they are grazing on, as well as fertilizing the land as they go. In many cases, the manure from the animals is collected and then processed to create

extremely nutrient-rich fertilizer. Animal byproducts are valuable to society and can also be used to make perfumes, candles, lanolin, and glycerin.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

Byproducts can actually be divided into two categories-- edible and inedible. The edible and inedible ratings are actually based on whether or not they are edible and inedible for human consumption. There are some inedible byproducts that actually could be fed to some species, even though that's highly regulated by the industry. But among edible byproducts, we typically break those down into variety meats, which are edible organs and glands, as well as other products that are typically sold for cooking agents, such as fats and oils.

The most common animal byproducts of probably the most value is a hide. Most of the skins or the hides are removed from animals during the harvest process. And they're used for a variety of purposes and probably the most diverse use. We also get-- a number one byproduct of the harvest industry is also fats, tallows, and oils. They can be used as lubrication. They can be used for cooking agents. And then they actually can be broken down into more simple components and used for everything from explosives to leather conditioners.

Additionally, the rendered meat can be made into a stew and used to make tinned dog and cat foods. For the inedible products, the fat is then dried and ground to create meat and bone meal. Paint brushes that artists use are made from the hairs found in the animal's ears. Additionally, the animal's bones, horns, and hooves are used to produce glue, buttons, sandpaper, dice, piano keys, and toothbrushes. Plants that render meat are marked with an offensive odor and are often far away from homes and towns where people would be subjected to the smell.

Furthermore, many medicines used by humans have been made from animal byproducts. Insulin, which is used by diabetics, is taken from the pancreas of animals. Cortisone that is used to treat rheumatoid arthritis,

adrenal insufficiency, some allergies, diseases of the connective tissue, and gout is taken from the adrenal glands of animals. Thrombin is from the blood of animals and is used during surgeries to help make blood clot, as well as in skin graft operations and the treatment of ulcers.

Rennet comes from the stomachs of cattle and is used to make cheese, as well as assist babies in digesting milk. Epinephrine comes from the adrenal glands as well and is used to treat some allergies and relieve the symptoms of hay fever and asthma. Heparin comes from the lungs of animals and is used to prevent blood clotting during operations and helps prevent heart attacks. Corticotropin comes from the pituitary glands of the brain and is used to treat breathing problems, allergies, mononucleosis, and leukemia.

TEXT ON SCREEN - [Jayden Montgomery, Ph.D – Senior Project Director - Targacept]

In the US, new chemical entities are regulated, especially for livestock and the animal industry, through the Food and Drug Administration.

Once the livestock animals have been harvested, they are now a part of the food industry. The livestock and food industry work hand-in-hand with one another to create a quality and safe product.

TEXT ON SCREEN - [Mindy Brashears, Ph.D – Professor, Food Microbiology and Food Safety – Texas Tech University]

The livestock industry and the food industry are very much related to each other. Livestock, whether it be cattle or poultry or dairy animals, actually provide much of the food that we eat. So the livestock industry and the food industry have to work together to make sure we have the highest quality and the safest food supply that we can possibly have.

The livestock and food industry have faced and overcome challenges over the years, whether the concerns were with food safety or with the correct

sanitary procedures from the processing plants. The two industries continue to pave the way for a better, safer food supply for the public.

Some of the major events that have affected about the food and the livestock industry are things like foodborne pathogen outbreaks. Whenever we have an outbreak-- a large outbreak of a foodborne pathogen-- it will negatively affect cattle prices if it's related to beef or the price of eggs if they're associated with eggs. So these things are very important. Another thing that comes to mind is the relationship between the livestock industry and antibiotic resistance. Now, we have no data that say that feeding antibiotics in cattle at low levels actually impacts the amount of resistance in humans. But there is a perception that that could happen. So we have to be very careful about what we do in the livestock industry and make sure that it doesn't have an impact on the food and ultimately on our human food supply.

Even with interventions and efforts made to keep outbreaks to a minimum, unfortunately, mistakes still happen.

In 1993, we had a major foodborne outbreak with E. Coli 0157:H7. And this was linked back to undercooked hamburgers. And this completely changed the face of the food industry, because we implemented more regulations at the food industry level to prevent pathogens from getting into the food supply. And this includes implementation of HACCP and also testing programs. Also, processors took extra care to make sure their product was safe and started processing under different conditions where they could track and trace the product and have an easier recall to make sure that the consumers were protected from another outbreak, so that it wouldn't happen.

The livestock and food industry are constantly striving to improve the quality and wholesomeness of their products. With advancements in technology and new standards being created, the livestock industry can take preventative measures themselves, reducing the risks for future problems.

TEXT ON SCREEN - [Mindy Brashears, Ph.D – Professor, Food Microbiology and Food Safety – Texas Tech University]

The livestock industry can be proactive, because we know that there are things that can be done in the live animal, and this is referred to as pre-harvest food safety. And some of the things that are available are vaccinations for cattle for a coli or feeding of direct fed microbials. And both of these options can actually reduce the number of E. Coli in the animal before they go to slaughter or harvest. And there's also vaccinations in poultry for Salmonella. So implementation of these types of interventions or using best practices, which are just guidelines to keep your farm clean, the housing clean, the bedding, those types of things, those can also go a long way in improving food safety.

6. Career Development and Entrepreneurship Opportunities
The livestock industry is a broad and important industry with several different career opportunities as well. Whether you are interested in science or business and have a passion for the livestock industry, there is an opportunity to develop a career and potentially your own business.

TEXT ON SCREEN - [Dale Woerner, Ph.D. – Assistant Professor – Colorado State University]

There is a lot of careers that are developing in our livestock industry that revolves around the use of technology and information sharing. I see a lot of jobs in computer design, software design. Those would be non-traditional jobs.

But in the food industry, we'll still have to have the traditional jobs. We'll always have the need for agricultural producers, whether they're farmers or ranchers or feedlot operators. We'll always have the need for those types of jobs. But certainly those people entering those jobs will have to have a great deal of background in technology management and have a great understanding of computer systems specifically.

Potential careers can include, but are not limited to, positions as a public relations specialist, geneticists, agribusiness manager, college professor, veterinarian, animal economist, and government administrator. In most cases, careers in the livestock industry require a minimum of a bachelors degree. And in certain careers, it is required to have furthered your education to receive a doctorate or law degree.

TEXT ON SCREEN - [Hugo Irizarry – Director of Value-Added Products, Category Manager of Swift & Co. – Greely, CO.]

When I first got to Excel Corporation, or Cargill, I was a little frustrated because having a Master of Science I was on the same level as some of the supervisors that had come up through the ranks. But quickly, I learned that there is a lot more to learn when you get out in the real industry besides what you learned in college.

TEXT ON SCREEN - [Brad Johnson, Ph.D. – Gordon W. Davis, Regent's Chair in Meat & Muscle Biology – Texas Tech University]

The best part of my job-- and I've been in academics my whole professional career-- I really enjoy the students, and not just graduate students, but also undergraduate students. I currently advise and teach undergraduate classes as well as advise many graduate students and teach graduate level classes.

But you know, one of the best things that I like about my job-- and I have many students come through my door and asked me for a reference letter, for example. And they kind of do it a little bit sheepishly like, well, Dr. Johnson, I really need this letter, but I know it's a lot of work for you.

And I have the same message to an undergraduate student that's applying for a scholarship or one of my doctoral students that's trying to get an academic position at another university. That is the part of my job that I enjoy the most because that's why I went into academics is to educate young people. And the capstone of that is being able to put those thoughts on paper about young men and women and how well they did.

As you can see, the livestock industry is an integral part of agriculture and is as complex and diverse as the people and animals involved in it. The livestock industry has come a long way from letting animals roam and graze freely to concentrated animal feeding operations. Additionally, the uses of the animals have also changed, and now the byproducts are helping humans medically as well as meeting their wants for items such as makeup, candles, and clothing.

Methods of how we get these animals to market have also changed, along with the high demands of meat from the consumers today. This industry will continue to grow and change with the constant advancements in technology and new innovations developed daily.

The livestock industry has been a successful industry, withstanding countless obstacles. Questions have arisen concerning whether or not the agricultural industry will continue to be maintained and supported by environmental resources and human labor.

TEXT ON SCREEN - [Chance Brooks, Ph.D. – Associate Professor, Meat Science – Texas Tech University]

One of the issues that we have to deal with, that's often asked, is the agriculture industry sustainable? We typically define that in simple terms as this-- are we going to be able to produce enough meat in a safe and efficient way to be able to feed the increasing population? And so one of the things that we have to contend with is are we a sustainable industry? We don't want to be able to produce meat products at a detriment to the environment or to society.

And I'm proud to report that in agriculture, we are a very sustainable industry. What we find is that we have the ability to utilize technologies that have been developed so that we can efficiently raise animals for meat production to feed not only our country but other third world countries. And so one of the things that we really have to focus on is that we have to be environmentally friendly and conscious.

A lot of people often think that that means going back to the old ways. But if you actually look at what technology enables us to do, we can actually produce much more beef now using technology than we could 20 and 30 years ago. And it comes at a saving in grain. It comes at a saving in water because animals are actually more efficient, and they actually produce more pounds. So that means that we get more pounds of beef per animal marketed than we could 30 years ago. And that is the only way that we are going to be able to sustain this industry for future growth in population.