

Argentina: Bringing Beef to the Modern Age

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Précis

As one of the world's major producers of beef and cattle products, Argentina will soon become a more important player in the global marketplace. Decades of political and social turmoil have prevented Argentina from developing its economy to its fullest potential. This report aims to synthesize historical information, current policy and practices, and future trends to develop a recommendation for the direction that those involved with the beef industry should take to augment beef production in Argentina. Many factors must be considered when analyzing an industry, including management practices, disease and public health concerns, environmental impacts, economic policy and markets, and cultural perceptions. All these areas are discussed in this paper, then synthesized and analyzed to determine the best strategies available to Argentine beef producers to improve their competitiveness and profits in the future.

Table of Contents

| | |
|--|----|
| Table of Contents | 3 |
| List of Figures and Tables | 4 |
| Introduction | 5 |
| The Development of Cattle Ranching in Argentina | 5 |
| Politics and Economic Depression Affect the Beef Industry..... | 11 |
| Current State of Beef Production | 18 |
| Thesis Activity | 21 |
| Methods | 22 |
| Results and Discussion | 22 |
| Modernization of Technologies | 22 |
| <i>Pasture Resource Management</i> | 22 |
| <i>Herd Improvements</i> | 24 |
| <i>Feed Efficiency</i> | 27 |
| Disease Control | 29 |
| <i>Foot and Mouth Disease</i> | 32 |
| <i>Other Diseases and Control Programs</i> | 35 |
| <i>Monitoring and Traceability</i> | 41 |
| Environmental Sustainability | 42 |
| Economic Reforms..... | 48 |
| Export Marketing..... | 51 |
| Cultural Considerations..... | 54 |
| Conclusion | 57 |
| References Cited | 62 |
| Appendix | 66 |
| Appendix I: Glossary | 66 |
| Appendix II: Abridged Timeline of Argentine History | 68 |

List of Figures and Tables

| | |
|--|-----|
| Figure 1: Regions of Argentina..... | 18 |
| Figure 2: Grazing Regions in Argentina and their Main Functioning Controls. | 19 |
| Figure 3: Disease Timelines in Argentina..... | 319 |
| Figure 4: FMD Status | 32 |
| Table 1: Agri-Environmental Indicators for Argentina..... | 32 |
| Figure 5: Evolution of No-Till Adoption in Argentina for Major Crops | 46 |
| Figure 6: Emissions by Agricultural Sector in Argentina, Average 2011-2012 | 48 |
| Table 2: Export Tax Rates..... | 489 |

Introduction

There is an old joke in Argentina: “After God created Earth, he discovered that the Southern Cone had received all the riches– fertile prairies, oil deposits, majestic mountains, attractive hills and lakes, rich river basins, and varied climates. Then, for the sake of balance, He populated the region with Argentines.” From their colonial beginnings to the present day, Argentina has struggled to take full advantages of the wealth of resources available to it. With some of the most fertile land in the world, Argentina developed her two “mother industries,” cattle ranching and farming, which have supported the country through some of the most extreme economic downturns of any nation. This paper discusses how the beef industry in Argentina can be improved to provide both for the Argentine citizens and for the export market that Argentina so desperately needs to support its economy. Information from the introduction was taken from (Brown, 2003) and (Lewis, 2015) unless otherwise noted. The reader should note that a glossary of terms is included in Appendix I. Often Spanish words will be used in the written text and the term will be explained or developed in the Glossary.

The Development of Cattle Ranching in Argentina

In 1537, the Spanish conquistador Juan de Garay unknowingly created the basis for ranching in Argentina when his expedition abandoned several species of domesticated animals, including horses and cows, near what would become Buenos Aires. Before this introduction of species, there were no large herbivores or carnivorous predators in most of Argentina. The grasslands were the ideal niche for these new species, and huge herds grew which wandered freely across the country (Garbulsky and Deregibus, 2006).

They changed the soil and land structure as they grazed and modified the landscape as high tussock canopies changed to nutritious and softer forages and the topsoil's fertility increased (Garbulsky and Deregibus, 2006). Wild cattle, or *cimarones* would form the basis of cattle ranching as the Argentine nation developed.

As settlers arrived in the newly formed town of Buenos Aires, cattle ranching provided the draw that would become the city's first industry. There was trouble initially turning the free ranging herds into profitable commodities. Few laborers were available to produce hides, tallow, and other products as the Native American population was reduced by European diseases. *Rodeos*, or round-ups, were difficult to organize with frequency, and there was little market for these goods in the Spanish Colonial economy as locations where there was demand were isolated from Buenos Aires. However, the industry continued to grow as new markets and royal promotions increased the demand for cattle products. Settlers came into increasing conflict with Native American tribes of the Pampas as ranching expanded. *Vaquerías*, or expeditions to gather cattle, moved further into the country's interior as the decades of *rodeos* and slaughter had diminished herds around the city. Due to this antagonism, life on the Pampas was meager and the population small. The people who made their living on the Pampas were referred to as *vagos*, but from these humble beginnings arose the *gauchos*, now idolized in Argentina culture.

The slave trade in the 1700 and 1800's grew Buenos Aires into a large port. Along with increased traffic through the port, demand for salted beef produced by *saladeros* grew as an inexpensive food source for slaves in other parts of the world. The Bourbon Reforms in the late 1700's allowed cattle ranching, which had become the

main export industry of colony, to expand by legalizing trade with foreign nations. Exports of hides went from 100,000 annually in the mid-1700's to over 700,000 after 1776. The industry underwent a transformation as foreign investors began to invest in the cattle industry. They obtained rights to cattle in areas of the countryside and hired a permanent workforce. This set the stage for the rise of the *estancias*.

International revolutions in the 1800's disrupted global trade and led to trade restrictions. A shortage of legal merchant ships arriving in Buenos Aires from Spain caused the authorities to demand that imperial trade restrictions be lifted. Eventually, the failure of Spain to meet the needs of its colony resulted in the collapse of the colonial system and Argentina's independence. Those who rose to power following the fall of Spanish rule were often *estancia* owners themselves. For an overview of general Argentine history during this and future time periods, please see Appendix II. Political turmoil rocked Buenos Aires and Juan Manuel de Rosas emerged as the dictatorial ruler of the region. Rosas rewarded his supporters with land and cattle, among them Justo José Urquiza. However, various trade restrictions, both internally and abroad made life difficult for ranchers, including Urquiza. In 1851, Urquiza challenged Rosas during the election of the governor of Buenos Aires, which quickly escalated to military conflict. Thus began a long history of military imposition in government.

Urquiza became the President of the new Argentine Confederation and attempted to garner the allegiance of the province of Buenos Aires in the new Confederation. However, the province refused to align itself with Urquiza. With such an important port city outside the Confederation's control, the Confederation could not lure British investment. Trade and ranching expanded, but merchants favored Buenos Aires

and growth was small due to lack of financing. Hostility grew, and after a series of military strikes against him, Urquiza resigned. After substantial revision to the Constitution of 1853, a period of instability saw Bartolomé Mitre rise to President of the new Argentine Republic in 1862. His strategy of economic change, including negotiations with British investors, would grow Argentina's "mother industries," making Buenos Aires the economic center of the country, and provide the base for Argentina to become one of the wealthiest countries at the turn of the 20th century.

At the beginning of the 20th century, observers predicted that Argentina would "one day challenge the U.S. for hemispheric supremacy," in large part due to the remarkable expansion and modernization of ranching and farming. Sadly, a century of political conflict, corruption, and social injustices would lead to the collapse of the once great economy. In 1851, the development of steam powered ships revolutionized industry, bringing investors, immigrants, and new trade relations. To take advantage of this new opportunity, transportation over land needed to be improved. Major rail lines began to weave their way across the nation by the 1860's despite international conflict and political turmoil within the country limiting railroad construction. From 1880 to 1910, rail lines expanded from 1,570 miles to 17,350 miles. Since the colonial era, ranching had grown as available land expanded, and the government leased, sold, and gave land to ranchers. Some criticize land policies, saying they allowed a privileged few to take control of the majority of the land, giving a small powerful group the ability to use their economic influence to control Argentine politics across generations. Nonetheless, during the 19th century rapid turnover of land and dispersal amongst children as owners died caused properties to be subdivided as the years passed.

During the mid-1800's, sheep ranching dominated the livestock industry in Argentina. While wild cattle had roamed freely, sheep ranchers wanted better control of their flocks. In 1844, barbed wire fencing was introduced, revolutionizing the way in which livestock were raised. In the 1880's, expansion of cattle-breeding and cattle-fattening operations as well as grain farming pushed sheep herding to the margins of the Pampas. Nevertheless, sheep *estancias* were responsible for the first essential steps of international trade and land management.

In 1879, the Conquest of the Wilderness Campaign eliminated the population of Native Americans from the Pampas. This opened up the Pampas to agricultural activity, and cattle ranchers began to aggressively seek new markets via the *Sociedad Rural Argentina* founded in 1866. Salted beef was not popular in the European market, so Argentine ranchers sought new avenues to capitalize on their cattle. Argentine exports were impeded by two problems: inferior stock in comparison to European cattle, and how to transport Argentine beef overseas. The *Sociedad Rural Argentina* created an ambitious campaign to improve the quality of Argentine beef and its international reputation. The *Sociedad* dispersed magazines monthly offering advice and innovations to ranchers. It also pressed for exchange of local cattle with improved breeds from Europe familiar to European consumers that yielded higher quality beef. Slowly, the Argentine stock underwent a shift from lanky longhorns to stockier, fatter shorthorns perceived to produce higher quality meat. The shift created a sense of community within the industry. The *Sociedad* began sponsoring local and national cattle expositions, held contests, and praised ranchers who went furthest towards perfecting beef production.

With the arrival of meat extract in the 1860's, Argentine beef entered the world market. The Liebig Company, using local cattle and mutton, produced a canned paste that was easily shipped and stored, high in protein, and accepted worldwide. However, tinned beef produced small profits and could not compete with other, more attractive beef products. Shipments of live cattle were disappointing as the animals that survived were in bad condition and there were fears of imported diseases such as Foot and Mouth Disease, hurting the reputation of Argentine beef. With the development of refrigeration, ranchers saw a window of opportunity. In Buenos Aires in 1882, the first packing plant, or *frigorífico*, to produce frozen beef opened. Production of frozen beef and mutton jumped from an average of 34,016 metric tons annually between 1821 and 1889 to 266,491 metric tons between 1905 and 1909. This significantly increased profits to ranchers, but frozen beef was considered of inferior quality and sold at lower tiers in European markets as it was discolored. In 1908, new technology provided the opportunity to ship chilled beef, which was comparable to local beef in international markets. This allowed Argentine beef to capture a large share of the markets, and within 20 years exports averaged 400,000 metric tons a year.

Modernization expanded beef export in international markets, but some ranchers were still far removed from production plants. This caused a shift in the structure of cattle ranching. *Estancias* far removed from ports began to specialize in breeding and raising calves while those closer bought stock from breeders to fatten on improved pastures. These animals were then sold for slaughter upon reaching the preferred age and weight. Ranchers celebrated increased profits, allowing them to direct money into other industries. By the close of the 19th century, the *gaucho* class that had made their

living roaming the plains, taking work when they wanted, were forced to become settled workers. The advent of barbed wire fences and new ranching techniques made cattle roundups a thing of the past. While some reveled in the fall of the *gaucho*, it has not stopped the Argentine culture from glorifying the legendary *gauchos* as the symbol of rural tradition in Argentina.

As the cattle industry grew from 1880 to 1900, so too did grain farming, due in part to the needs of ranchers of the Pampas. To break the land, ranchers employed farmers who would lease the land for two to four years, sharing a portion of their grain profits with the rancher. After plowing, sowing, and harvesting their chosen crop, farmers would then plant alfalfa and move on to a new parcel. This new improved alfalfa pasture was ideal for fattening cattle. In the 1890's, grain export accounted for more than half of export revenue.

Politics and Economic Depression Affect the Beef Industry

Argentina's "Golden Age" from about 1870 to 1910 saw huge expansion of the economy, but underneath the glossy exterior there were signs of trouble. After 1880, the *Partido Autonomista Nacional* (PAN) rose to power. Often nicknamed the "Cattle Party" due to the dominance of ranchers within the party, the PAN brought Julio Argentino Roca into power after his success in the "Conquest of the Wilderness" which had evicted the Native American population from the Pampas. The government abandoned the gold standard in 1885, printing more pesos to increase the money supply and causing an economic crisis. In 1889 a British investment firm called the Baring Brothers offered investment shares to improve public works projects in Buenos Aires. The

corrupted officials quickly misappropriated the loan to fund the ongoing war against Brazil, and subsequent government officers failed to even pay the interest. In what would become known as the “Baring Crisis,” investors’ concerns over the financial conditions in Argentina caused a shortage of funds creating a panic in the market and discouraging foreign investments. The peso collapsed, causing export values to fall and imports to become more expensive. By 1890, Argentina had entered a recession which led to a series of rebellions and governmental instability.

New electoral reform legislation, the *Ley Saenz Peña*, passed Congress and took effect in 1912. The hope of the new government was to create a more democratic system and halt the corruption and violence rampant in Argentine politics. Unfortunately, a new economic crisis stemming in part from successful rural industries pushing up land values again destabilized the country. Argentina entered a depression at the cusp of World War I as weather and locusts caused a nearly complete failure of the grain harvest. While World War I worsened the depression for the majority of Argentina’s industries, the ranching sector prospered. Nations at war sought meat products as rations for their troops. This caused a rise in demand for tinned and frozen beef and mutton. However, grain shipments plunged as grain was not seen as a necessary commodity, and wartime trading partners could not risk sending ships for goods other than those critical to war efforts, such as meat.

Following World War I, civilians and the government clashed over labor rights and the poor economic conditions as the Great Depression rocked the world. The Argentine government made protecting its market share a priority as other countries vied for trading rights. The Ottawa Pact of 1932 between Great Britain and its colonies

would have put Argentina at a disadvantage relative to Canada and Australia in international trade. To prevent this, Argentina sent negotiators to Great Britain and the Roca-Runciman Treaty was signed to ensure a continued British market for Argentina beef via establishment of minimum base imports. The treaty also approved the expansion of Argentine-owned meat packing plants to reduce the control of foreign companies over the beef trade. Over the next years, the Justo government continued to negotiate trade agreements with other Latin American and European countries in hopes of alleviating its economic problems. Even the beef export industry was a victim of government corruption. British *frigoríficos* came under investigation after pressure from landowners over decreased profits in the 1930's. The government investigations revealed British-owned *frigoríficos* had falsified accounting to evade taxes while the government turned a blind eye. The Minister of Agriculture, himself an *estancia* owner, had cut a deal with the British owners to receive a price 10 times higher than paid to other cattlemen for his steers at market.

Economic conditions continued to decline, and in 1933 a new economic team created the *Plan de Acción Económica* to halt falling commodity prices and deal with the collapse of the peso by creating the *Banco Central* to control fiscal policy. While the policy seemed to prove successful as the economy recovered, none of the underlying issues were addressed, and Argentina's "mother industries" continued to operate without reform. The weakness of the program was revealed in 1938 as a new economic crisis took shape. The Argentine government then began to take action, hoping to grow their industries to make the country more self-sufficient. This was in part due to competition with the United States during the 1940's and 1950's for international market

shares of agricultural goods. Tariffs and subsidies blocked Argentine exports of beef and grain to the United States, and therefore Argentina could not maintain a balanced trade relationship with the continued importation of manufactured goods from the United States.

To fund the process of expanding the country's other industries, the government took control of Argentina's "mother industries" to generate revenues for new programs. In 1946, the *Instituto Argentino de Promoción del Intercambio* (IAPI) assumed control of Argentina's export industries and became the exclusive purchaser of rural exports. The IAPI set base prices of grains, meat, wool, and other exports below what was paid abroad to generate a surplus revenue for the government. Between 1946 and 1956, this practice generated over 8 billion pesos.

The Marshall Plan created by the United States in 1948 would indirectly cause a shift in agricultural practices in Argentina. The Marshall Plan caused record grain production and beef from the United States and Canada to be channeled into European markets, driving down international prices and shutting Argentine products out of European markets. Falling market shares and stable prices caused increasing resentment towards the policies of the IAPI as producers were well aware of actual prices being paid for goods abroad. Many farmers began to shift to crops not under government control such as oats, harvested and sold as feed not under the auspices of the IAPI, or alfalfa pastures for cattle. In addition, growing urban populations caused an increasing percentage of agricultural products to remain within the country

During World War II, beef was the main export from Argentina. However, domestic consumption was on the rise without an increase in output, decreasing

exports. This proved problematic for the export economy, as meat provided a buffer when grain production fell to help balance foreign trade accounts. Increased national consumption, shifts in production, and bad weather threatened the government's source of revenue and caused yet another economic crisis in 1952. The production of foodstuffs declined to such a degree that in the 1950's the government went as far as to ban meat sales on certain days, this in a country with the highest per capita beef consumption of any nation. The government collapsed as reduced export revenue made it impossible to maintain social and economic programs, and inflation reached 30% annually in 1952. Raul Prebisch took power and his administration lifted much of the government's control over exports. The IAPI was disbanded, trade regulations were lifted, and currency devaluations increased exports. The Argentine economy enjoyed several years of growth before reductions in cattle and grain production in 1958 once again led to trade deficits and decreased tax revenues. Argentina began to modernize its rural industries in order to ensure that export-led economic growth could continue.

Argentina lacked domestic sources of agricultural implements, chemicals, fertilizers, and other inputs needed for technological improvements that would allow the rural industries to compete with world markets. These inputs needed to be imported, but currency and trade imbalances made obtaining the necessary tools difficult. For years, capital had poured out of the countryside to fund urban programs, and large urban populations now consumed much of the rural agricultural products. Conditions within Argentina and abroad made it difficult to realize the goals of agricultural modernization.

Finally, in 1963, trade conditions, a recession, and government loans and programs encouraging investment created an opportunity for farmers to fund the

importation of goods. Production became more efficient with the introduction of new technologies, and favorable exchange rates gave ranch and farm products from Argentina a competitive edge abroad. Farm exports increased nearly 50% between 1963 and 1966, and exports once again allowed Argentina to maintain its balance of payments. It was not enough, though, and government deficits again began to increase as industry stagnated. Once again, taxes on exports were introduced to increase government revenues. Currency devaluations and high tax rates began to take their toll as the cost of imported machinery and goods again began to rise.

From 1975 to 1981 more rebellion ensued. The new government of 1983 under Raul Alfonsín began to attempt the painful process of economic and political recovery. Ranchers and farmers had hoped that the new regime would cut taxes and create a coherent trade policy, but this was not the case. They threatened to reduce outputs, which would have cut exports and tax revenues. Faced with pressures from industrialists, exporters, and agriculturalists, the government attempted to restructure Argentina's economic policies. The results of their efforts would further destabilize the economy. With little support and economic failure, the administration transferred leadership to the new president Carlos Menem ahead of schedule in 1989. This marked the first time since 1916 that a rival party had peacefully handed off control of the government.

To the surprise of many, Menem embarked on a radical program which stabilized the Argentine economy within two years. Part of Menem's strategy was to seek closer trade relations with neighboring countries. In 1991, the presidents of Argentina, Brazil, Paraguay, and Uruguay met to create the *Mercado Común del Sur*, also known as the

Mercosur. Chile and Bolivia would later join the *Mercosur* as associate members. This economic trade agreement eliminated tariffs on trade between member nations and established common trade standards. This gave Argentine grain and beef producers access to more than 215 million consumers. The bold move by the Argentine government paid off, and the 1990's saw a period of strong and consistent economic growth not seen since the 1940's. However, the reprieve was short-lived, and at the end of the 1990's as the dollar gained value worldwide, the peso strengthened and began to deflate. While Argentine prices were high and Argentine exports became expensive abroad, imports of foreign goods became more affordable domestically. Exports declined and imports grew, hurting Argentine agriculture and industry and increasing the trade deficit. The economy again began to contract in 1999.

In the early 2000's, relations between the government and farming organizations were strained as the government had implemented price ceilings and export limits due to the rise in cost of food domestically. In 2003, nearly half of Argentines lived at or below poverty level. In 2007, new taxes on soybean and sunflower seeds designed to generate government revenue further angered farmers. Led by the *Federación Agraria Argentina* and the *Sociedad Rural Argentina*, farmers threatened a strike. The government had little leverage as export taxes were still the most important revenue stream, but President Fernandez de Kirchner implemented an executive decree to increase taxes and cap profits that farmers could earn from exports. Farmers went on strike across the Pampas, driving tractors and trucks off fields to block transit routes. Work stoppages affected grain supply, and beef production fell producing urban shortages. For months the standoff continued, and by June the government had no

other option but to negotiate and pursue Congressional approval of an export tax decrease. The initiative failed to pass the Senate, and changing markets along with the farmers' strike and a drought in 2008 decreased export revenues.

While Argentina has some of the best agricultural resources in the world, and ranchers and farmers consistently react rapidly to new innovations, opportunities, and markets, the Argentine beef industry still struggles to overcome failed government policies that weaken the entire country's economy.

Current State of Beef Production

Today, beef production has increasingly been pushed out of historical ranchland to the periphery of the Pampas (Figure 1) as the crop farming industry grows. The segmentation of the industry born in the late 1800's continues.

The Campos and East Chaco (Figure 1, Figure 2) house approximately 8 million cattle, primarily from cow-calf operations with

low stocking densities as the winter forage is poor and conditions are not suitable for growing supplementary forage. Weaner calves weighing 160 kg to 180 kg are



Figure 1: Regions of Argentina
http://2012books.lardbucket.org/books/regional-geography-of-the-world-globalization-people-and-places/section_09/a5d89947c59877f46cf91b35c240c05c.jpg



- Flooding Pampa grasslands
- Cropland Pampas
- Chaco Forests
- Campos and Espinal forests
- Rainforest
- Temperate Forest
- Patagonian low shrub steppes
- Monte and Caldenal Shrublands
- Puna and High Andes Grass steppes

Figure 2 Grazing Regions in Argentina and their Main Functioning Controls.
<http://www.fao.org/ag/agp/agpc/doc/Counprof/Argentina/grazfig>

transported via truck to the Pampas. One of the major struggles of producers in these areas is a regional phosphorus deficiency, causing available forages to be low in phosphorus. This low calving rates, averaging only 40 percent to 60 percent in a season (Garbulsky and Deregibus, 2006). Phosphorus deficiencies have been associated with reduced rebreeding efficiency, irregular estrus, infertility, and anestrus (Anonymous A, 1999). Secondary productivity averages 30 to 40 kg/ha/year, although top producers can see outputs of 100 to 120 kg/ha/year (Garbulsky and Deregibus, 2006).

On the Pampas, home to 62 percent of the national cattle stock in 2006, the major

cattle industry is grazing of weaned and yearling calves, mainly steers, for slaughter. These cattle are grazed on pastures of oats, fescue, clover, and Lucerne or fattened in feedlot yards. Over the years, the original grasslands have made way for rainfed croplands. Soybeans, maize, wheat, or sun-flower are often planted for 4 to 5 years, then sown with pasture grasses such as Lucerne or clover and grazed for 4 to 5 years. The cycle is repeated to maintain pasture fertility. Fertilized pastures can produce up to

500 kg/ha/year in beef, but most pasture is not fertilized and production decreases after 1 to 2 years as the soil is depleted and plants die (Garbulsky and Deregibus, 2006). While cattle grazing in the past contributed to maintenance of land fertility, modern non-tillage practices and genetically modified soybeans have decreased the need for this rotation and increasingly pushed cattle out of the Pampas due to growing cash crop prices that generate higher profits.

The semi-arid grasslands and dry forests of the Monte shrubland and Calden forest have seen an influx of cattle production from displacement by cropping. In the early 1900's, livestock introduced to these regions overgrazed the area, preventing fires and changing the ecosystem from sparse forests to shrublands. Today, the areas support grazing and suckler operations (where calves weaned at 6 month at a weight of 140 kg are reared), and meat production ranges from 4 to 20 kg/ha/year. A major problem in the area is access to water, as aquifers are deep and the water is of low quality (Garbulsky and Deregibus, 2006). Some suggest that by incorporating new technologies this region could see a huge expansion in productivity.

Some of the areas that may see the largest growth in the coming years are a semi-arid region bordering the Pampas and the Andes. While 5 million cattle grazed here in 2006, with proper improvements some believe this region could support 8 to 10 million head. The northern parts of Chaco and the Pampas also have the ability to greatly increase stocking density with proper management and incorporation of new breeds. These improvements will be discussed below in the *Results and Discussion* section.

While large *estancias* dominate the discussion of Argentine beef production, one cannot forget that for much of Argentina's history small producers vastly outnumbered large *estancias*. This began to change in the mid-1990's as operations smaller than 20,000 ha became infeasible. Costs rose and small producers could not weather the economic instability. Today, larger corporations increasingly dominate the cattle market (Garbulsky and Deregibus, 2006). That said, the large production operations have the capital to employ new technology to improve efficiency and quality of the beef they are producing.

It is estimated that a population as large as 35 million head will be displaced by cropping and a major redistribution in cattle production will take place. To compete both domestically and abroad, Argentine beef producers will need to take steps to increase efficiency of production and find new markets both within Argentina and internationally. To do this, several constraints must be overcome. Economic turmoil in Argentina has limited investments in Argentina and created a volatile export market. In addition, while the ban of exported Argentine beef in the United States due to fear of Foot and Mouth Disease was recently lifted, Argentina must maintain their reputation for safe and healthy products. Domestically, Argentine cattlemen must invest their time in new technologies to halt soil degradation, find new areas to raise their stock, and maximize production. In the following pages, some suggestions are offered to Argentine beef producers to help maintain and elevate Argentine beef to the high standards it is capable of reaching to benefit producers, consumers, and Argentina as a whole.

Thesis Activity

Argentina has the resources and technology available to vastly increase beef production and grow their domestic and export markets via the strategies suggested in this paper.

Methods

Aspects of the beef industry will be explored individually, with a summary of the current status of the topic of discussion along with commentary on the future direction that should be taken. Six facets of the beef industry are explored, as they were deemed the most significant factors affecting Argentina's beef industry today. The areas discussed are as follows: modernization of technologies, disease control, environmental sustainability, economic reform, export marketing, and cultural considerations.

Results and Discussion

Modernization of Technologies

The most important barriers to production in the semi-arid rangelands are water resource development, nutritional value of feeds, fire management, stock distribution, cattle breeds, and grazing management along with improved pastures. In the humid regions, major obstructions that must be overcome include heat stress, lack of adequate fertilization of feedstuffs, slow establishment of new forages and grazing practices, and lack of nutritional supplementation (Garbulsky and Deregibus, 2006).

Pasture Resource Management

Many cow-calf producers continue to use rangeland as a major source of forage for their cattle. Traditionally, cattlemen have employed high stocking densities and continuous grazing practices which damages the productivity of the rangeland. Producers must begin to transition to a more conservative grazing strategy, decreasing stocking rates and resting the land between grazing rotations. One study suggested that a transition to a more conservative grazing strategy led to a doubling of herd size as well as forage production (Quiroga, et al., 2009). This study compared stocking densities of 75 percent with no rest of the rangeland to stocking densities of 50 percent with each paddock rested for one growing season every three years. However, many producers have not adopted this system of grazing due to perceived economic losses associated with an initial reduction in herd size that would allow rangelands to recover. Nevertheless, by keeping their best producing animals, producers may even realize superior gains in the future through genetic improvement of their herds. This bias must be overcome if ranchers are to switch to this new method of pasture and range management. Stocking rate has major impacts on long-term economic returns in cow-calf production systems, with moderate stocking rates yielding the best results in environments such as the semi-arid regions of Argentina (Quiroga, et al., 2009).

Another option to improve the use of pastures is to supplement grazing practices with hay. For producers that graze their cattle year-round, they are at the mercy of weather patterns and their effects on forage availability, especially during the winter. Having access to supplemental feeds during the winter for cows would improve body condition, reproductive success, and ultimately increase the calf crop the next year. Producers can choose to purchase hay, or produce their own. Well managed hay

production more completely utilizes the productivity of land, allowing producers to conserve resources that are abundant during spring and summer but are lost during the winter (Romera, et al., 2005).

Many producers already utilize improved pasture resources, but many more can benefit by incorporating pasture improvement into their management systems. While the species of pasture forage will have to be tailored to the region, proper fertilization, irrigation, and grazing management are a necessity for all systems (Garbulsky and Deregibus, 2006). Improved pastures also decrease the impact of drought years, especially when proper irrigation techniques are used. Nitrogen and phosphorus content of forages are particularly important and have a major impact on weaning percentage. Protein content of many available forages is low due to dry winters. Nitrogen supplementation beyond superior forages may be needed in some regions. Phosphorus deficiencies can be overcome by adequately fertilizing pastures or by direct supplementation. Improved pastures will also increase energy density of pastures which will directly affect productivity of herds (Garbulsky and Deregibus, 2006).

Better management of pastures would prevent the need to burn areas to reduce the accumulation of biomass before the following growing system. Non-authorized fires may contribute to land degradation as they can reduce the species variability (Garbulsky and Deregibus, 2006).

Herd Improvements

The projected forecast for beef production in 2016 is only at 2.68 million metric tons carcass weight equivalent (cwe). This is the lowest that production levels have been in the past four years. While this number seems to signal a downward decline for

beef producers, it may actually indicate the opposite. Low production is expected due to retention of heifers for breeding as there are expectations that the cattle sector will improve in the coming years (Joseph, 2015). The beef market changes relatively slowly due to changes in demand, as the time between when cow-calf producers decide to expand their cow herd and when animals reach slaughter weight is long (Womach, 2005). The total cattle inventory of the country is expected to jump to 53.2 million head in 2016, the highest since 2008, after a period of severe drought and low returns. However, potential has been limited by floods in central parts of the Buenos Aires province causing reduced calf crops (Joseph, 2015). Producers can utilize several technologies to improve the productivity of their animals as cattle herds expand.

Artificial insemination (AI) is an important technology that has made rapid genetic progress available to individual producers. While AI may have previously had limitations in beef herds due to the difficulty in detecting estrus in large, pastured herds, new ovulation synchronization programs have made AI much more feasible for beef producers. In 2013, about 3,000,000 head of cattle were artificially inseminated in Argentina. Artificial Insemination is easy to perform, inexpensive, and allows for incorporation of genetics safely from outside the herd. To fully realize the benefits of AI, producers must manage their herds well and maintain their herds on a good plane of nutrition (Bó, et al., 2014). Several ovulation synchronization protocols are available, and producers must weigh the costs and benefits of each protocol before implementing it in their herd. Producers in Argentina seeking to quickly better the genetics of their herd should consider AI as an alternative to natural breeding.

While embryo transfer (ET) technology may not benefit every producer, ET may become an important tool as well as a revenue stream to some Argentine beef producers. Currently, the South American cattle industry accounts for approximately 13 to 15 percent of ET technology worldwide; 70 percent of ET work done in Argentina is in beef cattle (Anonymous B, 2009). ET allows producers to capitalize on exceptional animals, increasing the number of offspring they can produce over their lifetime. Thus ET has an immediate effect in that productivity is improved with an increase in producing ability of the offspring. Genetic merit of a herd is also increased with maximization of superior genetics in the herd. Embryos can be sold, bought, and exported, giving producers a way to infuse improved genetic variation into their herd as well as create another source of revenue.

Current improved breeding programs are based on statistical analysis of pedigree information and performance. The estimated breeding value (EBV) based on traits that are economically significant are determined. Most prevalent traits include characteristics associated with growth and reproduction. At a minimum, producers should be tracking this data to determine the productivity of their animals and make informed breeding and culling decisions. Several breed societies exist in Argentina to track and evaluate purebred production cattle and potential sires. New technologies, such as genomic selection, could allow producers to more rapidly improve genetics in their herd. Evaluation of genetic merit of an individual can often lag by two years as assessment is done by progeny evaluation. Genomic selection can reduce the time needed to determine breeding values. With genomic analysis an animal's genetic merit is estimated through the individual's chromosomal analysis. Thus the breeds values are

estimated for young cattle within the first weeks of life. This technology can be used when selecting calves to keep as future breeding bulls and when selecting replacement heifers. The technology may be too expensive now for many small scale producers to utilize to a great degree. Yet, as the technology advances and becomes less expensive and more reliable, it may develop into an important tool when making herd decisions in the future (Montaldo, et al., 2012).

The majority of cattle raised in Argentina are *Bos taurus* breeds including Angus and Hereford cattle (Montaldo, et al., 2012). While these breeds market well, producers should consider other breeds or crosses, especially depending on the environment in which they are raising cattle. New breeds have become increasingly popular as cattle production is relocated to more marginal grazing areas, such as the Criollo Argentina and Braford (5/8 Hereford, 3/8 Brahman). These breeds are more hardy and adapted to the tropical and subtropical climates of these marginal lands. In general, Bradford steers have higher marbling, higher fat, and more tender meat than that produced by Criollo Argentina steers (Orellana, et al., 2009). Transitioning to these breeds will serve producers as they try to maximize productivity on new grazing land, but they must be careful to select for animals that also produce beef that meets the quality standards expected by consumers.

Feed Efficiency

Over the last decade, the industry has seen a switch to grain finished cattle fattened for longer periods. Cattle are sent to market slightly heavier and feedlots are taking feeder cattle that have been grown out longer over their smaller counterparts. Cow-calf producers are growing out younger calves to create larger framed animals

finished to heavier weights. Feeder cattle entering the feedlots now average between 200 kg and 240 kg live weight. Cattle are marketed for slaughter between 320 kg and 380 kg live weight. A select number of producers are finishing cattle to 450 kg live weight to be slaughtered for the European market. Nevertheless, Argentines still demand cuts from young cattle, particularly heifers, slaughtered around 350 kg live weight (Joseph, 2015).

The ability of producers to adopt feedlot systems is in part due to the relationship between farmers producing grains used as feed and the cattle producers. Farmers producing sorghum and corn far from ports used for export sell their grain for feed or buy feeder cattle to add value and avoid the high cost of shipping (Joseph, 2015). New legislation (discussed below) may cause the total number of cattle fed grain to drop slightly as domestic grain prices rise due to increased exports. Small, less efficient operations may have to substantially reduce the amount of corn fed. This will allow larger, more efficient operations capitalize on the less competitive market, growing their business even with higher domestic grain prices. With less restriction on beef exports, it is likely that feedlots will increasingly grow their stock out longer, producing bigger animals not preferred by the Argentine market (Joseph, 2016). That said, this change may allow smaller producers to fill the gap left as large scale production moves towards heavier animals. Many of the current systems focus on producing lightweight pasture and range raised animals familiar to the Argentine consumer but not as popular in the rest of the world. It may be that feedlots production will rise to fill the increasing demand for exports while smaller operations continue to provide for the domestic market. The two systems currently utilized may find they can operate synergistically to maintain

domestic beef supplies while also capitalizing on the increased opportunity in the export market.

Argentina faces added challenges due to rapidly shifting agricultural regulations. The profitability of feeding in confinement operations is directly linked to the price of feed. Many feedlots struggle to maintain a steady supply of high energy feedstuffs at a price that maintains profits. In addition, feeding systems vary between feedlots, with many not employing optimal ration formulation, mixing, and feeding strategies. Feedlots also rarely utilize byproducts, such as those commonly utilized by U.S. feedlots, so they compete directly with food crops sold for the human market when buying feedstuffs. Feedlots could lower costs and ensure a more stable supply of feedstuffs by formulating rations utilizing byproduct feeds (Arelovich, et al., 2011). Other strategies to maximize feed efficiency include providing adequate mineral and vitamin supplementation, using feed additives such as ionophores that improve efficiency, employing hormonal implants to increase rate of gain and efficiency, and monitoring feed bunks to reduce waste and ensure proper mixing (Loy, 2015). Selection for more feed efficient animals may also help to improve overall productivity, but selecting for improved efficiency has been negatively correlated with several growth traits (Grion, et al., 2014).

The country's average weaning ratio remains stationary as cow-calf operations move to the central parts of the nation away from grain producing regions. Cattle production in northeast and northwest parts of Argentina continues to grow, but breeding productivity has decreased (Joseph, 2015). As stated above, nutritional deficiencies play a large role in decreased reproductive performance. Meeting cattle's energy requirements via the suggestions outlined in the *Pasture Management* section

along with grain supplementation will improve conception and calving rates, thereby increasing productivity. Mineral requirements must also be met. There are many supplements available that producers can utilize to improve reproductive performance.

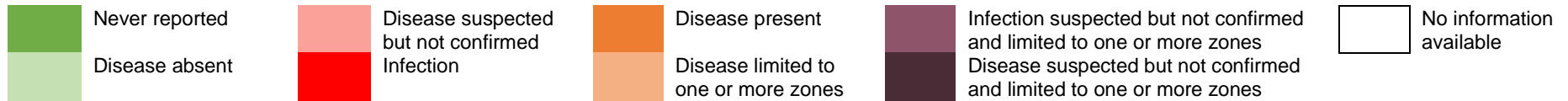
Disease Control

Disease monitoring, reporting, and prevalence is important both for continued livestock production and trade relations. This section will discuss several diseases of note that either impact production, public health, or global trade for beef producers in Argentina. Figure 3 should be referenced for an overview of diseases discussed as well as their current status in Argentina. Diseases with large effects on export opportunities include Foot and Mouth Disease and Bovine Spongiform Encephalopathy. These are discussed in depth to give the reader perspective into how they affect the growth of the beef export industry. Diseases important to public health, including Bovine Tuberculosis and Q fever were selected to showcase the different strategies employed by the government to control certain diseases. In addition, bluetongue, bovine viral diarrhea, and *Brucella abortus* are discussed as management of these diseases must be improved to ensure the health of cattle and maximize production. Vesicular stomatitis was noted in the discussion as it can be mistaken for Foot and Mouth Disease and should therefore be monitored to ensure cases of Foot and Mouth Disease are not missed. Argentina's monitoring and traceability systems, under the direction of the *Servicio Nacional de Sanidad y Calidad Agroalimentaria*, are discussed to provide a context for how the health of Argentine livestock is overseen and reported to outside

agencies. A functioning veterinary infrastructure such as this is necessary to any country exporting livestock products to other nations.

Disease Timelines in Argentina

| | 2005 | | 2006 | | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | |
|-----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec | Jan-Jun | Jul-Dec |
| Bluetongue | | | | | | | | | | | | | | | | | | | | |
| BSE | | | | | | | | | | | | | | | | | | | | |
| Bovine tuberculosis | | | | | | | | | | | | | | | | | | | | |
| BVD | | | | | | | | | | | | | | | | | | | | |
| Brucella abortus | | | | | | | | | | | | | | | | | | | | |
| Foot and Mouth | | | | | | | | | | | | | | | | | | | | |
| Q Fever | | | | | | | | | | | | | | | | | | | | |
| Vesicular stomatitis | | | | | | | | | | | | | | | | | | | | |



When different animal health statuses between domestic and wild animal population are provided the box is split in two:

- The upper part indicates the situation in domestic animals
- The lower part indicates the situation in wild animals

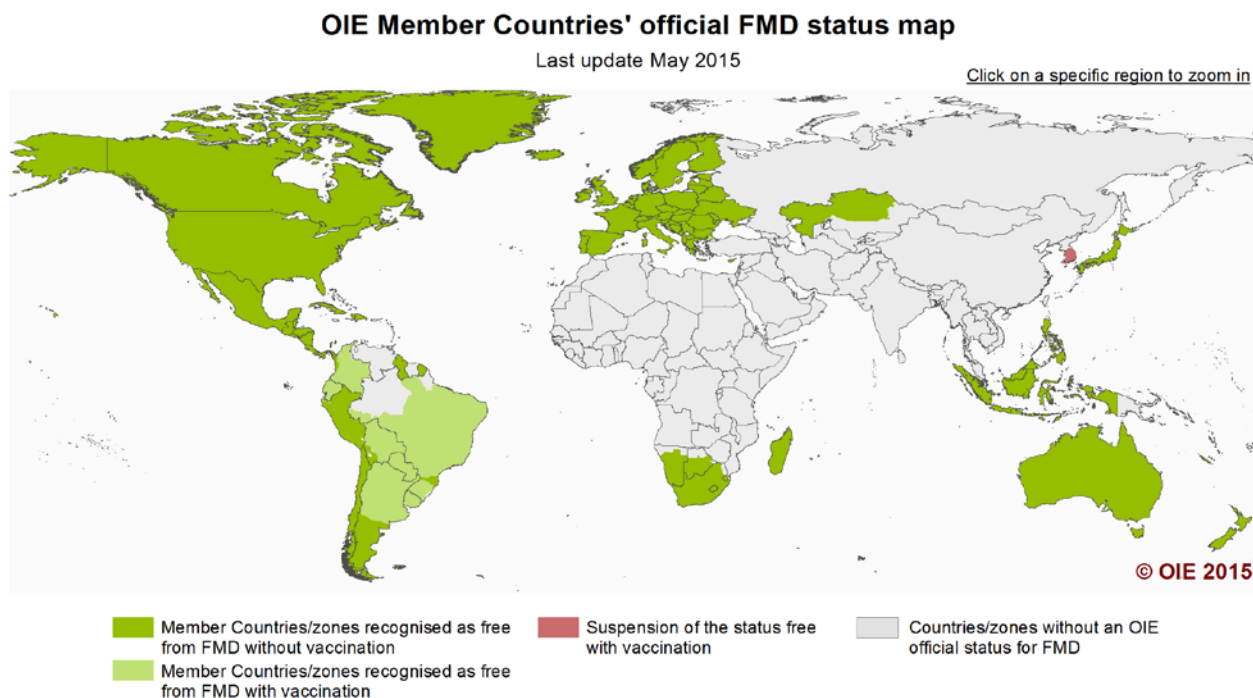
Figure 3 Disease Timelines in Argentina, adapted from (Anonymous L, 2013)

Foot and Mouth Disease

The threat of Foot and Mouth Disease (FMD) has global implications and retaining its FMD Free status under the World Organization for Animal Health (OIE) remains a top priority for Argentine producers. FMD is a highly contagious viral disease affecting cloven-hoofed animals with differing degrees of severity. Vesicular lesions of the feet, oral mucosa, and mammary glands in females are hallmarks of the disease. While occasionally fatal, the disease's largest impact comes from lost production due to the effects of the lesions and eradication programs (León, et al., 2014). Loss of production affects not only the Argentine economy, but also food security for smaller communities. Control and management of FMD incurs large costs, shouldered by the producer and the government. In addition, countries with endemic FMD are generally barred from international trade as the threat of introduction to FMD free countries is too great. Outbreaks in FMD free areas lead to staggering amounts of resources consumed to curb the outbreak and regain FMD free status (Knight-Jones, Rushton, 2013), .

Argentina experienced an outbreak of FMD in 2006. Rapid response to cull affected animals and vaccinate those around the epicenter of the outbreak led to containment with eventual return to FMD Free with Vaccination status under the OIE. The *Servicio Nacional de Sanidad y Calidad Agroalimentaria* (SENASA), the national animal health service of Argentina, continues to implement vaccination and surveillance programs (León, et al., 2014). While expensive, the vaccination program remains necessary. Many countries in South America continue to experience outbreaks of FMD, including Argentina's close neighbor Paraguay in 2012. The threat of FMD crossing the border into Argentina, either from imported animal products or free ranging livestock

makes the vaccination programs in northern Argentina essential. Ultimately, the goal of these vaccination programs is to increase herd immunity to a level which protects against the accidental introduction of FMD or prevents spread within susceptible populations. The southern Patagonia region of Argentina is recognized by the OIE as



Free of FMD Without Vaccination (León, et al., 2014) (see Figure 4 for FMD status in the region).

Figure 4: FMD Status, adapted from <http://www.oie.int/en/animal-health-in-the-world/official-disease-status/fmd/en-fmd-carte/>

SENASA currently implements a mandatory vaccination program using a tetravalent vaccine for A24/Cruzeiro, A/Argentina/2001, O1/Campos, and CS/Indaial strains. There are seven separate serotypes of the FMD virus, and immunity to one serotype is not cross-protective for other serotypes. Vaccination campaigns occur twice

a year and vaccines are administered to all cattle independent of age during the first campaign and to cattle under two years during the second. SENASA oversees testing for safety and potency of all vaccinations (León, et al., 2014).

Effectiveness of vaccination campaigns depend on several factors, as defined by the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*. Vaccines must be adequately potent and safe, contain strains of the FMD virus that match those found in the field, and subscribe to modern quality assurance systems. The vaccines must be stored and distributed under proper handling conditions, maintaining the cold chain, and should not be used once the shelf life of the vaccine has been exceeded. The temporal administration of vaccinations should coincide with appropriate patterns of natural and artificial immunity, and thus must be tailored to each production situation. Failure at any one of these points can contribute to persistence of FMD in a region (León, et al., 2014).

While changes have been made to administration of vaccines and monitoring for both immunity and FMD, there are still areas of improvement that will further limit the threat of another FMD outbreak. Clusters of highly susceptible animals still exist in more remote locations. Unfortunately, clusters of highly susceptible animals are much more dangerous than the same number of highly susceptible animals dispersed throughout the population (León, et al., 2014). With many susceptible animals in close contact, the disease can spread quickly to other animals, increasing the likelihood of FMD virus spreading to another group of animals. SENASA must make strides to include these remote locations in their vaccination campaigns. In addition, young cattle, the most susceptible age group, are often under-covered under the current program. In regions

where seasonal calving occurs during a three to four month period, vaccinations generally take place only once just prior or just following calving season. This results in many calves still having high titers of colostral antibodies, and passive immunity interferes with the calves' response to the vaccine. In addition, young calves are often moved after weaning without a second booster and intermingled with other young calves of unknown origin. This greatly increases the likelihood of transmission of FMD virus between calves (León, et al., 2014). To combat this, SENASA should tailor their vaccination programs to each production scenario, perhaps vaccinating multiple times in a given herd, and ensure calves are revaccinated prior to transport.

Tailoring vaccination strategies to individual production systems and reaching remote locations will increase resources required by the vaccination program significantly. That said, the threat of another outbreak closing export markets to Argentina is of much greater importance to the national economy and the expenditure of resources to prevent this is warranted. In addition, SENASA must continue to monitor seroprevalence of immunity in Argentina's herds to ensure efficacy of the program as well as the implementation of the vaccination itself. Errors in adherence to protocol can be just as dangerous as not vaccinating. If the vaccines are administered or stored improperly, they will not confer immunity. Resources will be wasted and the cattle population will be unknowingly at risk.

Other Diseases and Control Programs

Several other diseases important to Argentina's livestock industry will be briefly discussed as well as management and control protocols currently implemented. A brief outline of the recent prevalence of these diseases can be found in Figure 3.

Bluetongue is a virus transmitted by *Culicoides* midges between susceptible ruminants. The disease does not cause a persistent infection, but mortality can range from 30 to 70 percent in affected sheep. Cattle are less susceptible, with mortality for serotype 8 in Europe only estimated at 1 percent. Cattle generally do not exhibit clinical signs, while sheep display fever, nasal discharge, ulceration and hyperemia of the oral mucous membranes, and abortion and congenital malformations. The Bluetongue virus requires a biological vector, which means that the distribution of the disease is correlated with the vector host's range. Vaccines for Bluetongue are available, but are serotype specific. There is no effective treatment, and vector control is the preferred method to prevent disease. For cattle, Argentina currently reports incidents of Bluetongue and monitors the borders and domestic populations for incidence of the disease. Vaccination is not required (Anonymous C, 2013).

Bovine Spongiform Encephalopathy (BSE) is a progressive, fatal disease affecting the nervous system of cattle induced by prion proteins. BSE is one of several diseases classified as transmissible spongiform encephalopathies. The disease is transmitted by ruminant consumption of ruminant source proteins containing the prion causing the disease. Of particular importance to global health, tissue from affected cattle can produce forms of spongiform encephalopathies in other species, including humans, if consumed. Clinical signs include gait abnormalities, tremors, behavioral changes, and other neurologic signs. There is a long incubation period (averaging four to five years), and no vaccine or treatment is available (Anonymous D, 2012). Argentina has been given a "Negligible BSE risk" status by the OIE and the EU. Since 1995, Argentina has implemented an effective ruminant feed ban, which was extended in

2004 to prohibit feeding of all animal proteins to ruminants. This ban is realized by requiring manufactured animal feeds using raw ingredients to only have ingredients sourced from suppliers registered and approved by SENASA, producing ruminant feed on production lines only used for ruminant feed, auditing of slaughter houses by official veterinary inspectors to prevent BSE suspect animals from entering the human or animal food chain, monitoring of movement of ruminant meat and bone meal, and testing of animal feeds for contamination with ruminant protein (Anonymous E, 2015). BSE is a notifiable disease and samples are collected for diagnosis from any suspect animal.

Bovine tuberculosis is a chronic infection caused by *Mycobacterium bovis*. Diagnosis is often difficult as clinical signs vary and may not be present. Often the first indication is response to testing or granulomatous lesions in the thorax found at slaughter (Anonymous F). While bovine tuberculosis is most prevalent in the dairy industry in Argentina, it still represents an economic loss and a public health problem for beef producers. This chronic disease may spread slowly with a mean infection rate of 2.2 cattle per year for every one animal infected in semi-extensive operations, but due to the persistence of the disease it still causes production losses, carcass condemnation at slaughter, and the potential for zoonotic transmission. Argentina began a test and cull program in 1999 that has been revised as it has progressed, but bovine tuberculosis is still endemic to the region. However, there is no compensation offered for culled animals which may be jeopardizing the program. Ante-mortem testing is often sporadic in beef herds and not always interpreted correctly, adding to the persistence of bovine tuberculosis. Pasteurization of milk and slaughterhouse inspections have effectively

eliminated food borne transmission of *M. bovis* to humans. Nevertheless, slaughterhouse workers and rural workers are still at risk of aerosol transmission (de Kantor, Ritacco, 2006). The only effective way to eliminate the zoonotic threat of bovine tuberculosis is eradication. The Argentine government must impose stricter testing methods and cull programs to successfully eliminate the disease.

Bovine Viral Diarrhea Virus (BVDV) is a viral disease which affects ruminants. Clinical signs are highly variable and depend on the stage of life when the animal is infected. BVDV can cause reproductive and respiratory problems and is responsible for large production losses, both via loss of calves and via health effects on older animals. Vaccines are currently available and should be utilized according to the manufacturer's and veterinarian's recommendations. Producers stand to gain significantly through vaccination of their herds against this important disease. Preventing BVDV infection can also be accomplished through testing of semen used for artificial insemination and testing and culling of persistently infected calves infected in utero that will continue to shed the virus for the duration of their life. Proper colostrum management will also ensure calves receive maternal antibodies against BVDV when vaccination protocols are followed (Anonymous G, 2007).

Bovine brucellosis, caused by infection with the bacterium *Brucella abortus*, is a leading cause of abortion in cattle and has zoonotic potential. Infected cows can become chronically infected and act as a source of infection for other cattle as well as humans. Naïve herds can experience abortion storms when exposed to *Brucella abortus*, causing abortion rates of 30 to 80 percent, an economically important loss for cattle producers. Humans can contract an infection by coming in contact with infected

animals or tissues, and by ingesting unpasteurized dairy products from infected cattle. In humans, *Brucella abortus* causes variable clinical signs, including flu-like signs (Anonymous H, 2009). The Argentine National Control and Eradication Program for bovine brucellosis was initiated in 1999. The program includes measures such as identification of vaccinated animals and mandatory vaccination for all three to eight month old female cattle, negative serological tests before animals can be moved for reproductive reasons, and categorizing farms based on their brucellosis status. Programs are tailored to the region where they are implemented by local SENASA officials. Monitoring is also conducted via surveillance of milk. While vaccination is the best way to prevent and control disease, eradication can only be completed through test and slaughter, prevention measures, and controlling movement of animals. The disease is currently better controlled in dairy herds due to incentives including higher milk prices for *B. abortus* free herds. However, the disease continues to be a problem in beef herds as no compensation is offered for *B. abortus* free beef producers. During the FMD outbreak, the eradication program fell by the wayside. After FMD was controlled, the program was reestablished. The vaccination campaign reaches the majority of animals, but the SENASA system for recording needs improvement to properly track vaccinated animals. A survey of seroprevalence in 2004 showed 12.4 percent of beef farms had at least one animal seropositive for *B. abortus*. Another study conducted in 2010 found positive serological results in 15.53 percent of beef herds in San Luis and 25.7 percent of farms in La Pampa. The vaccine is not thought to interfere with serological tests in vaccinated cattle over 18 months of age. To move forward with bovine brucellosis eradication in beef herds, there must be some form of compensation provided for farms

that become brucellosis free. SENASA must also play a larger role in monitoring its own actions. While the regulations under the eradication program are clearly laid out, they are not always realized at a local level. More controls must be put in place to regulate animal movement, vaccination practices, record keeping, and surveillance for the disease (Aznar, et al., 2014).

Q Fever is a disease caused by the bacterium *Coxiella burnetii*. The bacterium can be transmitted via tick vectors or contact with infected tissues and bodily fluids. While often asymptomatic in non-pregnant ruminant hosts, it has zoonotic potential and causes flu-like symptoms and hepatosplenomegaly in humans. Humans can contract the disease from aerosolized bacteria, infected bodily fluids, and unpasteurized dairy products. Q Fever can cause abortion in pregnant ruminants and should be considered during cases of higher than average abortion rates (Anonymous I, 2014). Currently, Argentina does not test herds routinely for Q Fever unless there is cause for epidemiological investigation. SENASA handles outbreaks on a case by case basis, but has in the past employed a modified stamping out policy, culling infected animals in affected herds to prevent spread of the disease. Vaccination is prohibited and not available in Argentina (Anonymous J). More public education is required for the disease, as human cases are often misdiagnosed. People in rural areas routinely consume unpasteurized dairy products and there is increased animal-human contact. This puts the public at risk, and they must be made aware of the threat of contracting Q fever.

Vesicular stomatitis is a viral disease transmitted by direct contact of infected animals as well as by insect vectors such as sandflies, mosquitoes, and black flies. While morbidity can be high, up to 90% of a herd, mortality is low. Vesicular stomatitis is

seen in horses, ruminants, and can cause a minor zoonotic infection in humans. This disease is of importance because it can mimic the clinical lesions of FMD (mucosal ulcerations), and the two may be confused upon preliminary diagnosis. The disease has only been seen historically in Argentina sporadically, and has not been reported in the last ten years. There is no treatment or vaccine commercially available for vesicular stomatitis, and the best prevention is quarantine of infected animals, disinfection of fomites, and vector control (Anonymous K, 2013).

Monitoring and Traceability

SENASA has a large network of employees and facilities designed to monitor and protect the health of Argentina's agricultural industries. The network consists of 15 regional centers and over 350 local offices around the country (Anonymous E, 2015). Slaughterhouses licensed at either the municipal or national level have permanent SENASA government veterinarians and their employees present to evaluate every animal and carcass passing through the plant. All cattle operations are also routinely audited by SENASA veterinarians or accredited veterinarians to monitor adherence to regulations regarding registration and identification of animals, feeds, use of veterinary products, and management of data (Anonymous E, 2015).

Argentina has an established system of traceability, the *Sistema Integrado de Gestión de la Salud Animal* (Sigsa), to allow them to fully investigate any disease or food incident. All food businesses in Argentina must have a system for food recall, and simulations are conducted frequently by slaughtering facilities to trace the origin of animal products as part of standard operating procedures. Labeling on beef products allows them to be traced to the slaughter establishment of origin, the group of animals

the product came from, and the farm the cattle were raised on (Anonymous E, 2015). Documentation is required to control the movement of animals and trace them back to their farm of origin, and individual identification of animals is required by all producers.

Overall, Argentina has a robust monitoring system in place to ensure the safety of animal products and provide excellent pathways for disease investigation. To continue to provide the Argentine public and international consumers with safe products, SENASA must continue to maintain a presence in the beef industry and audit producers to ensure compliance with regulations regarding treatment, feeding, and traceability. The comprehensive degree of oversight should serve to increase export trade as foreign countries can be assured that Argentine products hold up to food security standards of other nations. The traceability of animals will allow Argentina to quickly address any disease incidents or outbreaks as long as personnel are well trained and the system is utilized to its fullest potential.

Environmental Sustainability

In today's society, environmental sustainability has taken a prominent role in national and global policy. However, in recent years, the government and producers of Argentina have concentrated heavily on market and economic growth rather than environmental impacts of the beef industry (Rótolo, et. al., 2007). In 2000 agricultural activities accounted for 35 percent of Argentina's greenhouse gas emissions. Of this, beef production created 61.9 percent of the methane emissions, and 96.8 percent of the nitrous oxide emissions were the result of livestock production. This does not take into account much of the cropping pollution involved in producing feed. Crop cultivation

utilizes 75 percent of the country's extracted water, yet due to antiquated irrigation practices is less than 40 percent efficient (Anonymous M, 2009). With beef production outputs projected to steadily increase up to 6 percent per year, environmental management must become a driving factor in the livestock industry to reduce overall pollution and emissions in Argentina (Anonymous N, 2012).

Argentina currently has an extensive agricultural system, as discussed previously, with little technology being utilized to minimize environmental emissions and impacts. Of particular note are soil degradation and water use. Soil degradation continues to be a major problem in many regions of Argentina. Table 1 shows that in 1990 land degradation was found to have greatly reduced productivity and major intervention was needed to reclaim the land. Unfortunately, few steps have been taken to improve the state of farmland. Additionally, in 2000 only 1.12 percent of agricultural land was irrigated, but this accounted for approximately 66 percent of total water use in Argentina (Anonymous O, 2014). Methods of soil and water conservation must be taken to ensure the continued productivity of the land. The most pressing issues include biomass carbon loss and habitat destruction largely due to deforestation as well as depletion of phosphorus levels in the soil. However, in the past two decades, the rate of pollution and soil erosion have been on the decline. This can be attributed to less aggressive pesticide use as newer pesticides and methods of pest control are employed and a switch to no-till practices for crop production. The increasingly inefficient water use seen throughout the agricultural sector is cause for concern, and producers must invest in more efficient irrigation technologies (Viglizzo, et al., 2011). Droughts are a major problem and have affected cattle production severely throughout history. Argentina

must take steps to improve water efficiency and expand reservoirs to mitigate the effects of drought. Further study is also needed to determine groundwater levels and use in many regions to better track water utilization (Anonymous P, 2009).

| Domain | Sub-domain | Indicator | Argentina Value (Year) |
|--------|---------------------------|--|------------------------|
| Soil | Land degradation – GLASOD | Average land degradation expressed in GLASOD erosion degree** | 2.60 (1990) |
| Water | Water use in agriculture | Water withdrawal for agricultural use as a % of total water withdrawal | 66.07 (2000) |

Table 1: Agri-Environmental Indicators for Argentina, adapted from (Anonymous O, 2014)

Argentina finds itself in a unique position due to the availability of resources and arable land in the country. Compared to many developed nations, Argentina consumes less energy, produces more energy domestically, and has lower soil erosion rates with better nitrogen and phosphorus balance. The low-input, low-output system that has served Argentina well has also limited environmental impacts (Viglizzo, et al., 2011). In the coming years, though, Argentina’s crop production systems will continue to modernize and become more intensive. If crop producers can implement conservation methods during this transition, they will be in a much better position environmentally in the future.

The no-till practices (also called Conservation Agriculture) currently employed in much of Argentina can be mutually advantageous to both crop and livestock producers while maintaining producers’ commitment to environmental sustainability. Figure 5 shows the increase in no-till practices in millions of hectares of agricultural land from 1997 to 2011. The arrow in Figure 5 indicates the year when the Argentina No Till Farmers Association (AAPRESID) was formed. AAPRESID aims to promote and develop models of farming that improve productivity and increase profit while ensuring

the future direction of agriculture in Argentina is geared towards sustainability (Peiretti and Dumanski, 2014). No-till practices, in addition to being environmentally beneficial, are also economically advantageous due to low input costs. This method of crop production sequesters carbon and conserves topsoil in addition to improving infiltration of rainfall and moisture storage, decreasing water demands (Kassam, et al., 2014). Incorporation of grazing rotations with no-till systems has been shown to enhance the productivity of the land via nutrient cycling. Proper management of livestock may help maintain nutrient levels in soil while decreasing the need for commercial fertilizers, thereby further decreasing pollution and runoff (Costa, et al., 2014).

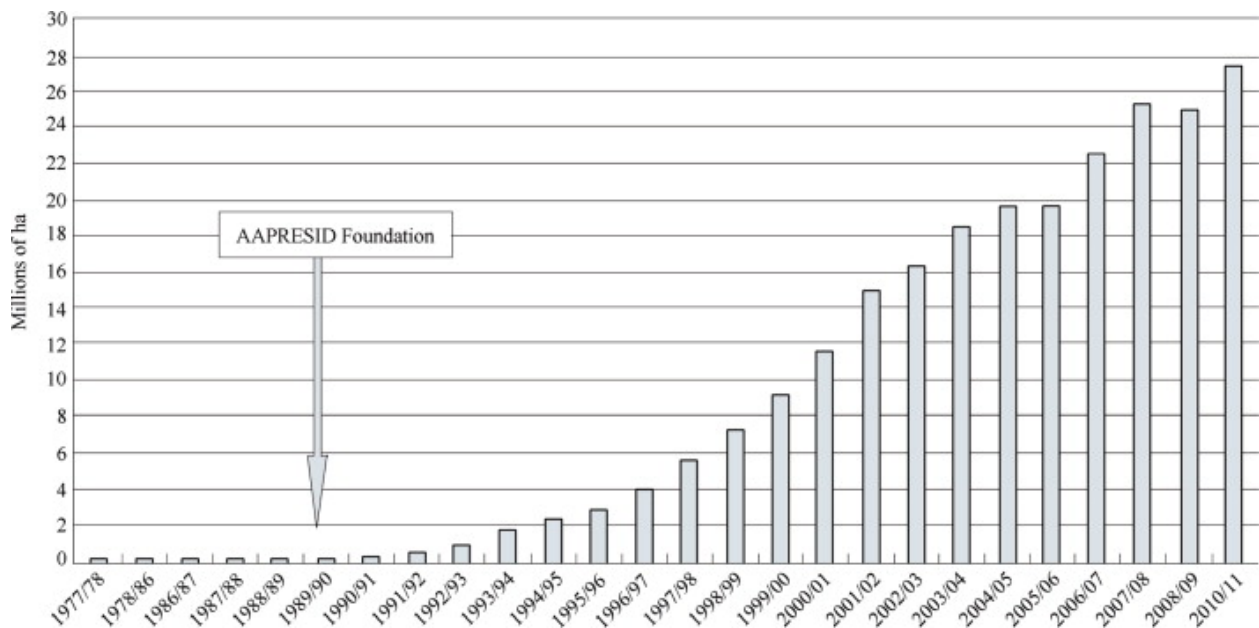


Figure 5: Evolution of No-till Adoption in Argentina (millions of ha using no till practices vs. year) for Major Crops, adapted from (Peiretti and Dumanski, 2014)

One of the areas of most concern globally is the effect of greenhouse gas emissions, most notably emission of nitrous oxide, methane, and carbon dioxide. Figure 6 represents a breakdown of the proportion of emissions (CO₂ equivalents) from agriculture that each agricultural sector generates. Manure and enteric fermentation

account for over 80 percent of total agricultural emissions (Anonymous Q). Recommendations for decreasing emissions from livestock production are complex. Decreasing livestock numbers will not solve the emission problems and producers will not be willing to reduce herds as markets grow. In addition, this recommendation may not even impact overall emissions. With emerging economies and increasing consumption of livestock products, markets will continue to spur livestock production. In addition, by decreasing livestock numbers, production of plant crops may increase to compensate. Ruminants are able to utilize feedstuffs and poor quality pasture that humans and monogastrics cannot derive nutrients from. Especially given Argentina's pasture based systems of cattle production, decreasing livestock numbers may not successfully reduce emissions. The increase in food crop production needed to compensate for lack of ruminant products would generate greenhouse gases during production that could equal those previously produced by livestock production (Garnett, 2009). Instead, producers must focus on maximizing the efficiency of their animals. Crop producers will have a role as well, as they transmission to more sustainable methods of crop production.

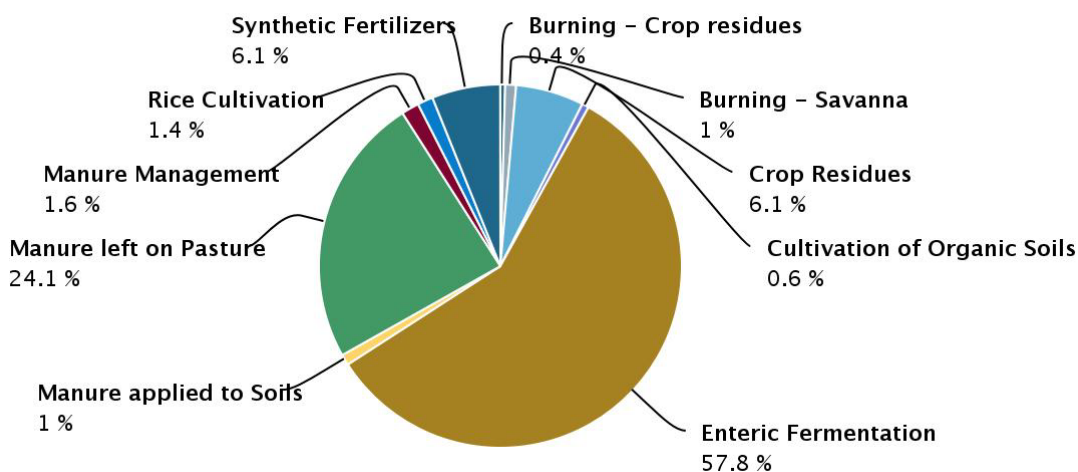


Figure 6: Emissions by Agricultural Sector in Argentina, Average 2011-2012, adapted from http://faostat3.fao.org/browse/G1/*/E

The three primary methods of reducing enteric fermentation emissions, most notably methane, are improved feeding practices, dietary additives, and changes in breeding practices. Methane production increases when ruminants are fed high forage diets. Therefore, by switching to concentrate based diets, methane emissions are reduced. Studies note that concentrate diets may increase daily methane emission, but per kilogram of feed and per kilogram of product, methane production is almost always reduced. Confounding variables include the number of animals, age of slaughter, and transport of concentrates which can all affect the overall emissions produced. For cattle fed forages, improving pasture quality will improve animal productivity, reducing energy lost in the form of methane as well as reducing nitrogen excretion and nitrous oxide emissions by optimizing the animal's protein utilization. Certain feed additives such as ionophores, antibiotics, and halogenated compounds that inhibit methanogenic bacteria have been suggested as methods to reduce methane production, but their effects are generally short lived and their use is banned in several countries which may affect Argentina's beef exports. The use of bovine somatotropin and hormonal growth implants can indirectly reduce methane production by increasing feed efficiency, but again their use is banned or not tolerated by consumers in several markets. Selectively breeding for animals with high feed efficiency and bettering management practices overall can lead to decreased methane per kilogram of product produced (Smith, et al., 2008).

A large portion of emissions come from degradation of manure. Manure releases nitrous oxide and methane as it degrades, but manure management techniques have a

significant impact on the amount of emissions released and can be constructed to allow the emissions to be redirected to produce energy. If manure is stored in lagoons or tanks, as is often the case in feedlots, emissions can be decreased by covering and cooling of the manure, or the methane can be captured and stored. Anaerobic storage methods, such as anaerobic digesters, can maximize methane production and allow its retrieval to be used as a fuel source. Manure stored in liquid form, such as in lagoons and tanks, reduces nitrous oxide formation (Smith, et al., 2008). Concentrated feeding operations must implement manure management systems as they continue to expand in Argentina to both reduce emissions and capitalize on methane production as a fuel source. Nonetheless, cow-calf operations are generally still pasture based and manure is deposited in fields where it is unavailable for collection and storage. This presents a challenge to reducing emissions from this avenue. Tailoring the vegetation to best utilize manure nutrients and reduce nitrous oxide emission has been suggested, but is hard to implement practically. At this point, improving pasture quality and feed efficiency of animals on pasture may be the best opportunity to reduce enteric emissions on pasture (Smith, et al., 2008).

Economic Reforms

To grow the Argentine beef industry, producers must look both domestically and abroad. Government regulations have historically been focused on using heavy taxes on agricultural exports, such as beef and soybeans, to fund sectors other than agricultural industries and rural programs. Much of the revenue generated by these taxes have gone to public works projects in cities, community programs, and other

policies that have not benefited the rural communities were the profits were generated. Cattlemen need to gain a bigger presence on the political stage to ensure the success of the industry.

Previous policy from 2005 to 2015 sought to maintain a supply of inexpensive beef domestically for Argentine consumers. These policies lowered exports and overall production. From 2005 to 2014, Argentina fell from the world's 3rd largest beef exporter to the 10th, with export levels falling from 762,000 tons cwe to just 197,000 tons cwe (Joseph, 2016).

In December of 2015, a newly elected government took power. There was uncertainty in where this new group of elected officials would take their economic reforms regarding the agricultural sectors (Joseph, 2015). Many hoped different policies implemented in the following months would increase Argentina's export competitiveness by revision of export limitations and taxes (previously at 15 percent of beef export value (Joseph, 2015)) and by stabilizing the value of the peso. On December 17th, 2015, legislation was passed to remove the multiple exchange rate system, eliminate export currency controls, reduce export taxes, and do away with export permit requirements (Sandoval, Joseph, 2015). Decree 133/2015 stated that the export tax on soybeans and soybean byproducts would be reduced by 5 percent, and most other commodities would see a complete elimination of export taxes. Export taxes on soybeans and their products still remain high, between 27 and 30 percent (Sandoval, Joseph, 2015) (see Table 2).

| | Export Tax Rate | |
|------------------|-------------------------------------|----------------------------------|
| Commodity | Prior to Decree 133/2015 (%) | After Decree 133/2015 (%) |
| | | |

| | | |
|--------------|----|----|
| Beef | 15 | 0 |
| Corn | 20 | 0 |
| Wheat | 23 | 0 |
| Soybeans | 35 | 30 |
| Soybean Oil | 32 | 27 |
| Soybean Meal | 32 | 27 |
| Barley | 20 | 0 |

Table 2: Export Tax Rates. Adapted from (Sandoval and Joseph, 2015)

The removal of government regulations on currency controls allows Argentine businesses to buy U.S. dollars without being taxed and without authorization by the government. Market flux now determines the value of the peso, although the Central Bank still reserves the right to intervene. Devaluation of the peso due to these reforms will improve Argentina’s competitiveness in foreign markets for agricultural exports. In the short term, producers must be careful as this policy is implemented to avoid flooding markets too quickly. Many producers have held on to inventories, awaiting policy changes in favor of increased profits. In subsequent growing seasons, corn and wheat production is predicted to increase as soybean production decreases. These new regulations create incentives to cultivate alternative crops other than soybeans (Sandoval, Joseph, 2015).

While the government has kept its promise to pass trade reforms, the national economy remains under pressure and the government may, as in the past, continue to attempt to generate revenue through regulation of agricultural enterprises (Joseph, 2014). Argentina may see a shift in crop production under these new regulations, which would further impact government revenues as production switches from soybeans to

alternative crops. It is likely that in the future the government will once again impose tight export regulations. Producers in the agricultural industry must continue to lobby for less strict government oversight of export trade if they are to remain competitive in the growing global market place. Since many nations might emerge as competitors that offer similar products at lower prices, Argentina has now taken steps to increase their economic shares. The question is: will the government be able to maintain these new regulations, or will they resort to old methods of revenue generation and revert to high taxes on exports once again? In the past this has not borne fruit for the overall economic stability of the country. To combat this, a compromise must be sought that will benefit both parties. Some export taxes are needed to fund the government that provides the oversight for trade. However, in the past the government has overstepped their bounds, raising export taxes to extraordinary levels to benefit other sectors. The government must find a balance between export taxation and allowing agricultural producers to seize the opportunities offered by a global market.

Export Marketing

Argentine beef producers are in a unique position in today's marketplace. New markets are opening, government export regulations are being repealed, and the industry is transitioning to new methods of production.

There are currently a breadth of international markets open to beef exports from Argentina, many of which the country is not taking full advantage. Of the country's 600 slaughter plants, roughly 100 are eligible for export. However, it is estimated that 50 of the 200 most important slaughter plants for the industry are closed. Of these 50, 30 are

medium to large export plants (Joseph, 2015). Argentina is not fully utilizing these resources, even with markets available. A large fall in beef exports beginning in the mid-2000's dropped profits, leading to a years-long slump in exports, and thus, overall production (Joseph, 2015). Recently, Argentina has been presented with several opportunities to claim their share of new markets and expand existing ones.

For the first half of 2015, beef exports to China and Hong Kong increased 61 percent. Last May, the first slaughter plant owned by a Chinese company in Argentina (acquired in late 2014) sent its first shipment of Argentine beef to China (Joseph, 2015). While there has been some economic change in China, many believe the Chinese market will hold strong and continue to grow. The European Union (EU) is one of Argentina's most important markets. The EU offers several quotas to Argentine exporters. A reduced-tariff TRQ quota, called the Hilton Quota, continues to not be met. Of the 29,500 tons product weight offered, in 2014-15 only 22,900 tons were utilized (Joseph, 2015). The 481 quota provides a duty-free quota for grain-fed beef from young cattle. Argentina hopes to fulfill a bigger percentage of this quota, up to 8 to 10 percent in the coming year. In addition, Argentina hopes to export 10,000 to 14,000 tons of chilled beef outside these quotas (Joseph, 2015).

While Chile, in the past, has offered Argentina a strong market, recently they have lost market shares to other competitors such as Paraguay. Paraguay recently began recovering its market share after an outbreak of Foot and Mouth Disease, and prices for Paraguayan imports in Chile are lower than those of Argentina. Brazil also continues to compete for the Chilean market, especially with its recent currency

devaluation (Joseph, 2015). Argentina's market in Israel is also coming under strain by competitors, and Argentina must fight to preserve its share of the market.

In response to the OIE's listing of Argentina as Free of Foot and Mouth Disease With Vaccination and with negligible risk of BSE, the United States Department of Agriculture's (USDA) Animal and Plant Inspection Service (APHIS) passed an amendment to allow the import of fresh beef from northern Argentina (the Patagonia region was previously allowed to export to the U.S.). Producers hope to begin exporting in early 2016 (Joseph, 2016). While the first few years may be slow with the export of less valuable cuts, it will be imperative that Argentine producers begin to grow the market for premium cuts and sell their brand to consumers in the U.S. Currently, exports to China, Chile, the EU, and Israel make up greater than 80 percent of beef exports (Joseph, 2015). This opens yet another market to Argentina. The establishment of trade with the U.S. will impart confidence in Argentine exports. Argentina must now focus its efforts on gaining approval of other large markets, such as Mexico and Canada.

While the current trend in Argentina is towards grain-fed beef, with 70 to 80 percent of slaughtered cattle now finished on grain in confinement operations, Argentina still stands to profit from its grass-fed cattle which were the roots of their initial industry (Joseph, 2015). Grass-fed beef is an emerging market, a product which Argentina has been producing for centuries. While many countries have transitioned their beef industry to more intensive practices, Argentina has just recently undergone this change and has the opportunity to capitalize on Argentina's rich grazing land to fill this niche market. With an increasing focus on sustainable production and environmental responsibility

globally, if producers in Argentina can create a plan to sustainably manage their rangelands, their products may in turn generate large profits from consumers abroad.

Producers must now focus their attention on reestablishing relations with former clients and develop new clients as export markets open. To do this, producers must market their products both commercially and to specific niche markets. Producers must ensure the health and sanitation of their products. In the EU and the U.S. a major focus of consumers has been the wholesomeness of the food substance at a reasonable price. Countries with large disposable incomes may be receptive to a market of high value cuts that will generate larger profits than lower value cuts. The lower value cuts and trimmings currently are the majority of exports from Argentina to the EU (Joseph, 2016).

Exports are expected to increase as high as 280,000 tons cwe, or perhaps higher depending on changes in governmental policies (Joseph, 2015). If producers continue to gain export shares as government regulations decrease and export markets open, they must tread the fine line between domestic and international supply and demand. Domestically, Argentines are expected to consume 2.4 million tons cwe of beef, the lowest amount since 2011 with per capita consumption dropping from 59 kg to 56 kg annually. This projection is based on the estimates for increased exports shrinking domestic beef supplies and a jump in retail beef prices (Joseph, 2015). If producers turn to the export market to generate profits without increasing production in turn to supply domestic demand, the government may step back in as it has in the past to further limit exports. It is imperative that producers take the steps outlined previously to ensure a growing supply of beef to meet the needs of both the national and export markets.

Cultural Considerations

More than just an avenue for government revenue or a product sitting on supermarket shelves, beef is at the core of Argentine culture. From the colonial days of Argentina to the rise of the *estancias* in the 1800's to the export driven economy of the Golden Age, beef has been at the center of the country's progress. In the early days of the beef industry, *gauchos* roamed the countryside tending cattle. Later, the *gaucho* would develop into a symbol of Argentine rural values and traditions after Argentina's independence from Spain. The *gaucho*, a rugged independent persona, symbolized the Argentine's ability to survive and reap from the land (Haines, 2010). The *gauchos* provided a steady supply of beef for other Argentines and popularized cooking methods using all parts of the cow, cooked over an open fire on a low grill outdoors. Today, this can still be seen in the traditional *asado*, similar to a United States' barbecue, but using a special grill or *parilla*. Different parts of meat unique to Argentine butchering are used in addition to more familiar cuts and organs. In many regions, the *asado* is a weekly hours-long event, creating a social environment for friends and family. Popular belief in Argentine culture is healthy adults are those that eat meat on a daily basis (Haines, 2010). Over the years, Argentines have maintained their beef-eating identity, consistently having one of the highest per capita beef consumptions of any nation, 59 kg per person annually in 2015 (Joseph, 2015). This is exemplified by the economic collapse in 2001. Beef prices rose dramatically compared with income, and deaths were attributed to malnutrition and hunger. Particularly in the province of Tucumán, these deaths were curious as a large variety of foodstuffs were produced and available.

According to one local newspaper, the *La Gaceta*, people were so devoted to beef that they refused to replace it with other food when it was no longer available (Haines, 2010). While this theory is unconfirmed, it still illustrates the grand love affair Argentines have with beef.

Argentines, of course, are not immune to the effects of a diet high in red meat, which is a risk factor for high blood pressure, hypertension, and heart disease. Obesity is a growing problem in Latin American countries, in part due to poor nutrition. While there are numerous contributing factors, animal-source foods and fats are a part of the rise in obesity (Anonymous R). The cultural norm of beef consumption imbedded in Argentina's population for centuries will make a shift towards healthier eating habits difficult. Better nutritional education programs are needed, especially for children and youth, to inform the public of the potential outcomes of their lifestyle choices. The beef-centric culture of Argentina can coexist with dietary changes if people are willing to compromise.

While *gaucho* ideals glorified the rural vision of cattle round-ups on open plains, today 70 percent to 80 percent of all cattle slaughtered in Argentina are from grain-based production systems. Curiously, while beef produced now has a different flavor from the beef of grass-fed production systems of the past, Argentine consumers have not appeared to find this undesirable. Beef produced in Argentina by concentrated feeding operations is considered by the consumer more consistent and of better quality (Joseph, 2015). This bodes well for current and suggested changes in the industry, as what seems to matter more to the Argentine consumer is the availability of high quality beef, not the manner in which it was produced. While there will always be niche

markets, the switch to a more intensive system of raising cattle will not damage the domestic market for beef.

The availability of cuts from young, light, small heifers and steers slaughtered around 350 kg live weight is of more importance to the domestic consumer (Joseph, 2015). This method proves less efficient as animals are slaughtered at lower weights, but producers oblige because of the current market conditions and export limitations. Beef is also still largely sold through butchers, accounting for about 70 percent to 75 percent of the domestic market (Joseph, 2015). Supermarket food sales have increased in recent years, but consumers still prefer to buy meats from local stores with personal interactions. Butchers obtain their beef from either beef distributors, meat packers, or if they are large in scale, purchase cattle and utilize plants for slaughter services. On the other hand, larger supermarket chains are vertically integrated in the industry and are involved from fattening to slaughter and distribution. Smaller supermarkets employ in-house butchers and purchase carcasses similarly to butcher shops (Joseph, 2015). The current method of beef sales leaves the industry somewhat unregulated, threatening food safety for consumers.

Conclusions

Argentina is a country with a turbulent history but a bright future, and at the center of Argentine commerce and culture is beef. The beef industry has incredible potential, and by employing the strategies outlined above, producers, the government, and Argentina as a whole stand to benefit from the industry's success.

As beef production transitions from an extensive grazing system to a more modernized and commercial business, producers can utilize new technologies to maximize returns. By employing new techniques in management of grazing operations, such as better methods of grazing management, nutritional supplementation, and improved pastures, reproductive performance and weaning weights will increase. These practices will also help to mitigate the threat of drought that has too often caused debilitating damage to producers. In addition to improving nutrition, especially nitrogen and phosphorus availability in the diet, cattle producers must improve the genetics of their herds. Natural breeding must take a back seat to artificial insemination in order to facilitate rapid genetic improvements. New technologies such as embryo transfer and genomic selection should be employed by seed stock and high end producers to create superior lines of animals which will then positively affect the entire industry. New environments may affect producers' breed considerations as cattle production is increasingly pushed onto marginal lands. To improve performance, ranchers may need to convert their herds to heartier animals, such as cross breeds and local breeds to improve returns. Feedlot production is also gaining ground in Argentina's beef industry. With excellent access to a variety of feedstuffs, this switch to concentrated feeding systems, if managed properly, will improve feed efficiency and returns. Feedlot owners can realize greater profits by feeding out to heavier weights. However, while this may be feasible for the export market, the domestic market still prefers lower weight cattle. Employing marketing strategies to change public perception may be needed if producers are to begin producing heavier weight cattle. Feedlots must also seek alternative feed sources to minimize the impacts of market fluctuation for cash crops.

Byproduct feeds are an excellent option that should be pursued. Many feedlots remain somewhat small, and thus their management is not ideal. To capitalize on investments, feedlot producers need to improve ration formulation, mixing strategies, and feed bunk management. Producers should also incorporate other methods of improving growth rates, such as use of ionophores and hormonal implants.

After several disease outbreaks, producers and government officials have come together to construct a variety of control and eradication measures. After the FMD outbreak in 2006, Argentina has employed an excellent control program, vaccinating herds and instituting better monitoring and tracking systems. Nevertheless, there is still room for improvement by ensuring that all, even the most remote producers, are reached and vaccines are handled and administered properly. Vaccination programs should also be better tailored to each producer's herd schedule to ensure maximal protection of all animals. Several other important livestock diseases are endemic to Argentina, including Bluetongue, bovine tuberculosis, BVDV, bovine brucellosis, and Q fever. There are still food safety and public health concerns surrounding several of these diseases. Eradication programs for bovine tuberculosis were set back by the FMD outbreak, but now must be monitored and employed more consistently if Argentina is to truly eradicate the disease. Public education should remain at the forefront of control measures, especially regarding the dangers of consuming raw dairy products and meat. SENASA has instituted an identification and monitoring system for livestock that will allow them to rapidly address disease outbreaks in the future. This system should also serve to help expand their export market as consumers can be assured of the safety of Argentine beef products.

While Argentina continues to modernize its beef industry, environmental impacts must not be written off. Recently, focus has been on expansion of export markets and employment of new technologies. However, livestock remain a major contributor to soil degradation, water use, and greenhouse gas emissions. Improved irrigation practices that maximize efficiency and rotational grazing methods coordinated with crop growth will reduce the impact of livestock production. Many of these methods will benefit producer productivity as well, but startup costs and the amount of education needed may be high. Education of local producers by cattle associations, educational bodies, and government officials is needed. On feedlot operations, improving feed efficiency will reduce resource needs as well as reducing greenhouse gas outputs. Another major challenge for feedlots is management of manure. Unfortunately, the methods that reduce the environmental impacts of manure production the most, such as anaerobic digesters, can be expensive to implement and may only be feasible for large producers. Investment in research and improvements in Argentina is needed to implement environmental sustainability programs.

Newly lifted government regulations will have a positive impact on beef export in Argentina. This said, producers must maintain a lobbying presence as, evidenced by Argentina's tumultuous history, policy can change quickly. Producers must continue to educate the government of the mutual benefits of a thriving export market. Government officials may once again see export markets as a quick source of capital for other programs as they continue to grow and impose high taxes, or attempt to reduce domestic prices by capping exports. A mutually beneficial compromise must be sought

with a low export tax rate that funds governmental programs related to agricultural industries, but that does not impede trade by producers.

Recently several new markets have opened for Argentine beef, including China and the U.S. There is a great opportunity for producers to generate increased profits through the sale of higher value cuts and establishment of niche markets as beef exports gain traction in these markets. In addition, Argentina needs to maintain its presence in historical markets such as Europe and Israel. With newly lifted export restriction, Argentine beef producers can send more beef internationally to capitalize on trade quotas that are currently underutilized. With the support of large markets like the U.S. and China, it is likely that Argentina can negotiate new trade agreement with other large consumer nations such as Canada and Mexico. To maintain these markets, producers must increase production via steps outlined in other sections as well as maintain their health status for several diseases with the OIE, most notably their FMD free with vaccination/ FMD free without vaccination status.

Through all of the ups and downs of the beef industry, cattle production remains a cultural icon to the Argentine people. Consumption of beef brings communities together and celebrates traditional rural values for many. With one of the highest per capita beef consumption rates of any nation, the domestic market remains a strong driver for beef production practices, namely slaughter weights and available cuts. However, for health reasons, some aspects of beef consumption in Argentina may need to change. While larger slaughterhouses and production facilities are well regulated, many local butchers are not. This represents a threat to public health, especially if the general public is not educated on the risk of zoonotic diseases. In addition, high levels

of red meat consumption have been linked to several human health concerns. While beef consumption may not be the sole reason for the deterioration in the average health of Argentines, the high levels of beef in the diet must be addressed when educating people of dietary changes.

Argentina is set to become one of the top contenders in the world beef market. If government stability is realized and producers implement techniques to increase production, reduce disease, and improve environmental health, cattle production will drive Argentina's economic growth in the coming years. The world has asked for beef, and Argentina will deliver.

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Appendix I - Glossary

Asado – social barbeque event popular in Argentina and Uruguay

Banco Central – Regulatory body created in 1934 to control fiscal policy and prevent renewed economic crisis

The Bourbon Reforms – political and economic legislation enacted by the Spanish Crown under the House of Bourbon in the 18th century. Aims of the legislation included reestablishing Spanish rule by limiting the power of Creoles, restructuring the administration in colonies, and promoting economic development

Cimarones – wild cattle roaming the Argentine grasslands prior to the industrialization of cattle ranching

Estancia – term for cattle ranch in South America

Federación Agraria Argentina – private institution founded in 1912 to serve as a business organization for small and medium sized agricultural producers

Frigorífico – packing plant producing chilled and frozen meat

Gaicho – cowboy of the South American Pampas

Instituto Argentino de Promoción del Intercambio (IAPI) – government body created to centralize trade exports and transfer resources between different economic sectors

Ley Saenz Peña – electoral reform legislation of 1912 establishing universal, secret, and compulsory voting for all adult males in Argentina

The Marshall Plan – U.S. initiative following World War II to help fund the rebuilding of Western European economies

Mercado Común del Sur (Mercosur) – economic and political agreement between Argentina, Brazil, Paraguay, Uruguay, and Venezuela. Associate countries include Bolivia, Chile, Peru, Colombia, and Suriname. Designed to promote free trade of goods and services between member countries.

The Ottawa Pact – economic pact of 1932 giving British colonies and previous colonies preferential trading rights with the United Kingdom

Parilla – pit filled with charcoal and covered with a heavy metal grate

Partido Autonomista Nacional (PAN) – conservative political party during late 1800's and early 1900's in Argentina

Plan de Acción Económica – policies proposed in 1933 to curb falling commodity prices and the collapse of the peso

The Roca-Runciman Treaty – trade agreement of 1933 between Argentina and the United Kingdom designed to curtail the trade impacts of the Ottawa Pact on Argentine beef exports

Rodeo – roundup of free ranging cattle

Saladero – business which produced salted beef

Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA) – Argentine government agency in charge of auditing and certifying animal and agricultural products and byproducts including disease surveillance, prevention, and eradication

Sistema Integrado de Gestión de la Salud Animal (Sigsa) – system created by SENASA to track movement and health of animals

Sociedad Rural Argentina – civil association created in 1866 to promote agriculture and rural communities

Vagos – people living in the countryside of Buenos Aires in the 16th century

Vaquería – expedition to gather free ranging cattle

Appendix II – Abridged Timeline of Argentine History

Adapted from (Brown, 2003) and (Lewis, 2015)

| | |
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| 1825 | Great Britain recognizes United Provinces of Río de la Plata |
| 1829 | Military conflict breaks up United Provinces of Río de la plata; Juan Manuel de Rosas takes governorship of province of Buenos Aires |
| 1835 | Rosas appointed governor for second time of Buenos Aires, given dictatorial powers |
| 1838 | France blockades port of Buenos Aires |
| 1844 | British born Richard Newton introduces barbed wire; spread of barbed wire allows modernization of sheep and cattle ranches |
| 1845 | Great Britain blockades port of Buenos Aires (three years) |
| 1852 | Rosas defeated at Battle of Caseros, deposed by Justo José de Urquiza; San Nicolás Agreement forms Argentine Confederation on May 31 |
| 1853 | Republic of Argentina established with formation of Constitution |
| 1859 | Confederation wins Battle of Cepeda, defeated Buenos Aires joins Confederation |
| 1861 | Urquiza loses battle of Pavón, resigns |
| 1862 | Adoption of new constitution; railway building increases under President Bartolomé Mitre |
| 1865 | Five Year War begins between Paraguay and Argentina |
| 1876 | Indigenous war parties commit last great raid |
| 1877 | First shipment of frozen beef from Argentina to Europe |
| 1878 | Shipments of wheat from port of Rosario to Great Britain begin |
| 1879 | Conquest of the Wilderness by General Julio A. Roca ends resistance of indigenous peoples, southern Patagonia and Pampas opens for settlement |
| 1880 | Roca takes presidency, the City of Buenos Aires becomes federalized |
| 1890 | Revolt by opponents of the Generation of Eighty; Baring Crisis leads to financial panic and recession |
| 1891 | Establishment of Banco de la Nación Argentina |

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| 1893 | Financial crisis causes farmers to revolt, President Miguel Juárez Celman resigns |
| 1902 | First general strike by workers in Buenos Aires; law passed to expel foreign-born “troublemakers” |
| 1905 | Radicals revolt |
| 1912 | Tenants of farms in Entre Ríos strike, reformation of electoral laws |
| 1916 | Hipólito Yrigoyen wins presidential election, power peacefully transferred from Radical to Conservative party |
| 1922 | Marcelo T. de Alvear takes presidency; army suppresses strikes in Patagonia; YPF (state oil company) founded, Unión Ferroviaria founded for railroad workers |
| 1928 | Yrigoyen wins presidential election for second time |
| 1930 | Export prices plunge, military coup replaces Yrigoyen with General José F. Uriburu |
| 1932 | General Agustín Justo elected president, election experiences voting irregularities and Radicals prevented from participating |
| 1933 | <i>Plan de Acción Económica</i> implemented |
| 1934 | Roca-Runciman Treaty enacted, preserves Argentina’s export interests in British markets |
| 1938 | Conservative member Roberto M. Ortiz wins presidential election under shadow of widespread election fraud |
| 1943 | Nationalist army officers commit coup d’etat, Labor Department taken over by Juan Domingo Perón |
| 1945 | Demonstrations against Perón’s pro-labor policies; workers protest on October 17 to free Perón from arrest |
| 1946 | Perón wins presidential election |
| 1948 | Nationalization of railway system as Perón purchases British companies |
| 1952 | Perón reelected; recession and drought result in 80 percent inflation; workers protest against austerity policies |
| 1955 | Military coup of the Revolución Libertadora; military takes power and Perón exiled (18 years) |
| 1956 | General Pedro E. Arambura and military junta begins process of “de-Peronization”; workers resist |

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| 1958 | Arturo Frondizi wins presidential election, Peronists prevented from participating |
| 1961 | Ernesto "Che" Guevara makes secret visit to Buenos Aires |
| 1962 | Frondizi removed from power by military |
| 1963 | Arturo Illia wins presidential election, Peronists again excluded |
| 1966 | General Juan Carlos Onganía replaces Illia in military coup |
| 1969 | Cordobazo strike by students and workers; Aramburu executed by Montonero guerrillas |
| 1973 | Presidential election won by Peronists, Perón returns from exile to take presidency |
| 1974 | Perón dies, Isabel Perón (his wife) assumes presidency; Montoneros declare war against government; Argentine Anticommunist Alliance (Triple A) initiates anti-terrorist activities |
| 1976 | Inflation rises to 600 percent; Isabel deposed by military coup; <i>patota</i> squads start elimination of leftist "suspects" |
| 1977 | Protests begin against military terror by Mother of the Plaza de Mayo |
| 1979 | General strike by workers protesting military government |
| 1982 | Under president Leopoldo Galtieri, Argentina invades British controlled Falkland Islands, British forces defeat; Galtieri resigns; General Reynaldo Bignone assumes presidency |
| 1983 | Inflation rises to 343 percent; debt reaches \$45 billion; Radical Paúl Alfonsín wins presidential election |
| 1984 | Military officers prosecuted for abuse of human rights |
| 1986 | Inflation reduced to 80 percent by Plan Austral |
| 1987 | First rebellion by Carapintada commando troops |
| 1989 | Inflation rises to 3,000 percent; IMF riots; Peronist Carlos Saúl Menem wins presidential election; privatization begins |
| 1990 | Convertibility Plan attaches peso to dollar |
| 1991 | Mercosur formed by Argentina and three neighboring countries |
| 1995 | Inflation falls to 3 percent, Menem reelected |
| 1997 | Unemployment rates reach 17 percent, workers hold protest march |

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| 1999 | Economic recession begins; Radical Fernando de la Rúa elected president |
| 2001 | Recession enters third year, debt reaches \$132 billion; second IMF riots; de la Rúa resigns; three interim presidents enter and leave office in two weeks; Peronist Eduardo Duhalde becomes interim president |
| 2002 | Eduardo Duhalde elected president; peso severed from dollar; peso falls 40 percent; Argentina defaults on loans |
| 2003 | Nestor Kirchner takes presidency after opponent Carlos Menem drops out; World Bank repayments negotiated, relations with IMF ameliorated |
| 2005 | Renegotiation of debt service plan; full payments on debts made to IMF |
| 2007 | Cristina Fernández de Kirchner wins presidential election |
| 2008 | Confrontation between farm organization and government over proposed tax increases and caps on profits of farm export; farmer strike threatens economy |
| 2011 | Fernández de Kirchner reelected |
| 2014 | Rising inflation and devaluation of peso due to decreased export revenues, economic instability, and increased government spending; Argentina defaults on debt |