BEEF PRODUCTION IN BRAZIL:
A VALUE CHAIN APPROACH TO
REDUCING DEFORESTATION

By Amy Braunz, Carrie Gonnella, Louise Hill, Jana Holt
Advised by Dr. Dan Vermeer
ABSTRACT

Deforestation in the Brazilian Amazon is a persistent environmental problem due to its contributions to global climate change and biodiversity loss. The beef industry is a major contributor to this problem with an estimated 60-75% of deforestation caused by conversion of rainforest to pasture land. The World Wildlife Fund (WWF) and the Global Roundtable on Sustainable Beef (GRSB) are seeking advice on initiatives to pursue that will make significant contributions to the reduction of deforestation.

This masters project analyzes the drivers of deforestation related to the production of Brazilian beef and identifies initiatives that could help reduce deforestation. For each initiative considered, benefits, risks, and barriers are explored. In addition, an analysis of the Brazilian beef value chain is undertaken to determine which segments of the chain hold the most appealing leverage points for implementing initiatives to combat deforestation.

Based on the results of this analysis, this paper recommends that WWF and the GRSB pursue efforts to improve land use planning, diversification of farm income, and implement financial mechanisms, such as REDD+. This paper also lays out a timeline for undertaking these initiatives, specific roles that the GRSB can play in each of these initiatives, and key stakeholders that the GRSB must engage with to be successful at positively impacting the problem of deforestation in the Amazon.
# TABLE OF CONTENTS

EXECUTIVE SUMMARY .................................................................................................................. 1

DEFORESTATION IN THE BRAZILIAN AMAZON IS A GLOBAL PROBLEM............................. 3
  Historical trends in Amazonian deforestation ......................................................................... 3
  Reducing Deforestation by 2020 ................................................................................................. 4

THERE ARE MULTIPLE DRIVERS OF DEFORESTATION IN THE AMAZON ....................... 4
  Public policy around domestic land use ................................................................................... 4
  Economic incentives for conversion of land and speculation .................................................... 8
  Increasing demand for food, fuel, and fiber .............................................................................. 9

ACCESS TO INTERNATIONAL TRADE ......................................................................................... 10

OUR CLIENT: World Wildlife Fund US ........................................................................................ 13

WWF AND THE Global Roundtable for Sustainable Beef .......................................................... 14

RESEARCH QUESTIONS AND METHODOLOGY ..................................................................... 15

BEEF PRODUCTION IS A MAJOR DRIVER OF ECONOMIC DEVELOPMENT IN BRAZIL ......... 18
  Physical and demographic characteristics of Brazil ................................................................. 18
  Brazil’s beef production ............................................................................................................ 19
  From farms to feedlots ............................................................................................................ 22
  Food quality and safety .......................................................................................................... 23

TRENDS IN GLOBAL AGRICULTURE AND BEEF CONSUMPTION IMPACT LAND USE CHANGE IN BRAZIL ................................................................................................................ 25
  Rise in beef consumption ....................................................................................................... 25
  Agricultural trends .................................................................................................................. 29
  Impacts of global climate change on agriculture ..................................................................... 30

BEEF PRODUCTION IN BRAZIL HAS SIGNIFICANT SOCIAL, ECONOMIC, and ENVIRONMENTAL IMPACTS .................................................................................................................. 31
  Socioeconomic issues ............................................................................................................ 32
  Economic Impacts .................................................................................................................. 34
  Environmental Impacts .......................................................................................................... 34

UNDERSTANDING THE BRAZILIAN BEEF VALUE CHAIN ....................................................... 36
  Inputs and Raw Materials ........................................................................................................ 37
  Cattle Ranchers ....................................................................................................................... 38
  Slaughter and Processing ....................................................................................................... 38
  Sales to Retailers and Brand Manufacturers ......................................................................... 40
  Consumer beef outlets .......................................................................................................... 42
  Insights from the Brazilian beef value chain ............................................................................ 43

POSSIBLE SOLUTIONS TO THE PROBLEM OF CATTLE-RELATED DEFORESTATION IN THE AMAZON ................................................................................................................. 45
  I: Increased productivity through genetics or feed efficiency ................................................ 46
  Recommendation 1: Do not spend resources on feed and genetic efficiency at this time .... 48
  II: Diversification of farm income ......................................................................................... 49
  Recommendation 2: Promote diversification of farm income ............................................... 51
  III: Land-use planning: agroecological zoning ..................................................................... 53
  IV: Land-use planning: use of degraded land ....................................................................... 55
  V: Financing mechanisms: low interest loans ..................................................................... 57
EXECUTIVE SUMMARY

Deforestation in the Brazilian Amazon has severe, global environmental implications on biodiversity and climate change. As the largest rainforest in the world, the Amazon is critical habitat for countless species, and a significant carbon sink. Since the 1960s, Brazil has lost thousands of square miles of forest canopy as the government invested in infrastructure projects like roads and hydroelectric power that have linked the remote, Northwest regions of the country to the South and opened the Amazon for economic development. Every year, 19,500 km² of Amazon land is deforested, an area approximately the size of New Jersey. From land use change alone, this releases up to 1.4 Gt CO₂e into the atmosphere each year, equivalent to the annual emissions of almost 292 million passenger vehicles.

Today, deforestation continues as a result of several factors that put pressure on agricultural lands. As pasture and croplands become scarce, farmers move deeper into the rainforest in search of new land that can be cleared for production. There are four key factors driving deforestation in Brazil today. First, domestic land use policies have created conflict and tension within the Amazon. Second, government financial incentives have created conditions that lead to land speculation and conversion of rainforest to pasture. Third, increased demand for agricultural food, fuel and fiber products have put pressure on scarce land resources. Fourth, access to international trade has opened Brazil to growing global markets.

The cattle ranching industry has emerged as the single largest contributor to deforestation. Over 60 percent of newly deforested land is used for cattle grazing pasture, and land use change accounts for more than 35 percent of the greenhouse gas emissions associated with beef production in Brazil.

With a mission of stopping degradation of the natural environment and creating a future in which humans live in harmony with the natural environment, the World Wildlife Fund
(WWF) views the Brazilian beef industry as critical to the long-term preservation of the Amazon. WWF has convened stakeholders from across the beef value chain in the Global Roundtable for Sustainable Beef (GRSB) to engage in a dialogue about improving the sustainability of the industry.

This research seeks to utilize key insights from a value chain analysis of the Brazilian beef industry to recommend interventions that will reduce deforestation associated with beef production. Short-, medium- and long-term projects are recommended that will engage GRSB members and a broad range of stakeholder groups. Initiatives to be pursued are diversification of farm income, agroecological zoning and innovative financing mechanisms, mainly REDD.
DEFORESTATION IN THE BRAZILIAN AMAZON IS A GLOBAL PROBLEM

Historical trends in Amazonian deforestation

The Amazon is the largest rainforest in the world. Although it spans nine countries, 70 percent of the Amazon lies within Brazil, an area that makes up about 40 percent of the world’s remaining rainforest. Largely unpopulated, the 5 million km$^2$ Brazilian Legal Amazon covers 58 percent of Brazil’s land territory but houses only 11 percent of the country’s population. In 1900, 4 million km$^2$ of the Brazilian Amazon was forested, with the remaining area covered by natural *cerrado*, or grasslands. In 1958 and 1968, the Brazilian government broke ground on the Belem-Brasilia and Cuiaba-Porto Vehlo highways to connect the Amazon states with the rest of Brazil. These two paved roads have become the center of the *Arc of Deforestation*, the region’s most heavily deforested area.

The development of major roads through the Amazon was significant because it made the Amazon’s vast natural resources accessible and ripe for development. Incentives for economic growth targeted resource intensive industries including cattle ranching, timber production, mining, and hydroelectric power. These industries became critical to the Brazilian economy as their revenues financed foreign debt and economic development. By 1978, over two million people had settled along the Belem-Brasilia highway.

From 1996-2005, average deforestation rates in the Brazilian Amazon were 19,500 km$^2$ per year. As forests are cleared, carbon dioxide is released and natural carbon sinks are destroyed, so this deforestation has resulted in emissions of 0.7-1.4 GtCO$_2$e annually. Cultivating cleared lands oxidizes stored carbon from the organic material captured in soils. At its peak in the 1990s, tropical deforestation is estimated to be responsible for 25

---

2 Kirby et al., 444.
3 Kirby et al., 444.
percent of global CO$_2$e annually.\textsuperscript{5} In Brazil alone, emissions from conversion of forests to pasture land are estimated at about nine percent of global greenhouse gas emissions.\textsuperscript{6} Livestock grazing, which is the primary catalyst of most deforested lands, accounts for 18 percent of global CO$_2$e emissions.\textsuperscript{7} From 2006-2009, Brazil achieved reductions to 36 percent of the historical deforestation rate, and in 2008 set a target to reach 20 percent of historical levels by 2020.\textsuperscript{8}

**Reducing Deforestation by 2020**

With the goal of reducing deforestation to 20 percent of previous levels, Brazil expanded the area of land under protection in 2008 to 51 percent of forested area, broadening a 1996 law to apply land stewardship requirements to up to 80 percent of total land area on protected properties. The government also increased efforts to cancel credit and other incentives for illegal land holdings and deforestation. At the 2008 United Nations climate negotiations, Norway committed $1 billion towards financial assistance if Brazil continues progress towards its climate goals.\textsuperscript{9} REDD and other financial mechanisms are discussed later in this paper.

**THERE ARE MULTIPLE DRIVERS OF DEFORESTATION IN THE AMAZON**

Deforestation is driven by several agricultural, economic, and sociocultural trends. It is important to understand these factors in order to parse out the effects of cattle ranching from other drivers of deforestation.

**Public policy around domestic land use**

Brazil faces the challenge of leveraging its abundant natural resources for economic development, while preserving the delicate ecosystems and biodiversity that contribute to

\textsuperscript{5} Houghton, Chapter 1 of Moutinho, Schwartzman and Santilli, from EDF.org. “Tropical Deforestation and Climate Change” pg 13.


\textsuperscript{7} Steinfeld, et al, 112.

\textsuperscript{8} Nepstad et al, 1350.

\textsuperscript{9} Nepstad et al, 1351.
the health of the planet. Policy around land use has attempted to strike this balance, to generally limited success. USAID reports that insecure land tenure, unequal land distribution, and lack of access to land by the poor have contributed to forest destruction, land degradation, human rights abuses, and violence.10

Research by the World Bank points to the importance of strong, clear land rights to support economic development. A report put out by that body shows that across regions in fourteen countries, stronger land rights were associated with improved economic efficiency and equity. The report found that for landowners, having their rights protected was a necessary prerequisite for making the investments that would provide the most benefit to the regional economy. In addition, investors require clear land rights be in place in the projects they invest in, so access to capital is lessened when land rights are not considered strong in a region.11 Last, dependable land rights result in higher payments for land transfers.

Brazil has suffered a history of conflict over land, and many policies have been put into place to try to address this ongoing conflict. Figure 1 from Simmons (2004) shows the forces across geographic levels that have interacted to influence land conflict in Brazil. As Simmons explains, the Brazilian government promoted economic development through subsidies, loans, and infrastructure development, such as roads. These policies resulted in an expansion of large ranching and other agricultural operations. At the same time, the government promoted conservation policies and created reserves for indigenous populations. The combination of these efforts – economic development, preservation of natural lands, and protection of land for indigenous populations – led to an artificial land scarcity problem. In particular, the pool of land available to small farmers was constrained. Brazil has seen high competition over valuable land, but institutions supporting land

tenure are weak. Over the last several decades, occupation of un-owned land has been common.

Figure 1: Policy mechanisms leading to land use conflicts in Brazil

Violence over land conflict is disturbingly common in Brazil; over the last two decades, there have been 1,200 deaths attributed to land conflicts in the Amazon region. Murders have resulted from conflict between workers and from animosity towards environmental activists in the area. The Pastoral Land Commission reported that in 2010, there were 18 land-related killings in the state of Para, half of which were related to conflicts between

workers. In 2011, the married couple and environmental activists Ze Claudio Ribeiro and Maria do Espirito Santo were ambushed and murdered in Para.

A look at the last few years of current events around land policy in Brazil illustrates the ongoing competition between forces lobbying for strengthening the rights of agricultural developers and those pushing for stronger safeguards against environmental destruction. In June 2009, President Luiz Inacio Lula da Silva signed law HB 458, which granted 166 million acres of land in the Amazon rainforest to more than one million illegal settlers. This land was priced based on parcel size, with smaller plots priced at “symbolic cost,” and larger sold at market price or auctioned. The supporters of this law said it creates a system of land tenure and makes it easier to enforce environmental laws. Detractors worried that it legitimizes land grabbing in Brazil, and will result in increased forest clearing and ownership dispute-based violence.

In 2012, government bodies, agricultural developers, and conservation organizations engaged in heavy debate over controversial adjustments to the Forest Code. The original Forest Code was passed in 1965, with the aim of protecting Amazonian forestlands from over-development. The Forest Code dictated that portions of forestland be set aside by landowners; depending on parcel size, location, the type of commercial activity engaged in on the land, and size of herd for cattle ranchers, between 20 percent and 80 percent of forestland was required to be conserved by the law. The law established fines for landowners who violated the conservation requirements, however enforcement has been

---

14 Wallace. ”A Death Foretold.“
considered very poor; Public Radio International reports that 4.6 million agricultural producers have violated the law since it was passed.17

Backed by the farming lobby, congress passed a new version of the law in 2012 that would relax forest conservation requirements and give amnesty to those who had violated the law prior to 2008, provided those violators agree to reforest their land. Conservationists strongly urged President Dilma Rousseff to veto the entire bill, disputing all adjustments to the code. Ultimately, Rousseff vetoed twelve articles of the bill, restoring parts of the law that had been eroded as it went through the House and Senate, and strengthening the requirements on large agricultural producers.18

A remaining concern is whether Brazil can actually effectively enforce the Forest Code. Debate about amnesty for previous violations of the Forest Code of 1965 make clear that acatching and prosecuting landowners violating the conservation requirements of the Forest Code has not been easy for Brazil. In general, jurisdictional overlap between various government bodies makes policing land laws complicated and contributes to insecure land rights and inconsistent abidance of conservation policies; governance for land and conservation laws are between various state and federal bodies, resulting in disputes, inefficiencies, and oversight.

**Economic incentives for conversion of land and speculation**

Development of the Brazilian rainforest picked up pace during the 1960s-70s as the southern, urban areas of the country saw population growth and economic development. Seeking to encourage growth in the Northern states and Amazon region, economic incentives were put into place to encourage growth in a region with no history of formal land ownership or tenure. The long-term effect of these policies was to create a disincentive for protection of the rainforest, despite related forest code preservation

---


18 Barbassa. “Brazil's president line-vetos new forest code.”
requirements. Homestead laws allowed farmers and ranchers to claim legal ownership of land after ten years by undertaking qualifying “improvements,” which consisted heavily of conversion to pasture land.\textsuperscript{19} Simultaneously, tax policies allowed speculators to apply up to 50 percent of personal and corporate income tax liability towards the purchase of new property in the Amazon.\textsuperscript{20} Finally, low-interest financing mechanisms attracted even more speculators to the region. Government backed loans, often at negative real interest rates, were offered for conversation of undeveloped forestland for agricultural use.\textsuperscript{21} During Brazil’s economic crisis in the 1980s, land speculators bought up cheap land, which was viewed as a more stable investment than bank savings. Smallholders sold their frontier land at high rates, and were pushed further into the Amazon to clear new land for pasture.\textsuperscript{22} With cleared land worth five to ten times more than forested land, these government programs led to a perfect storm of incentives for deforestation.\textsuperscript{23}

**Increasing demand for food, fuel, and fiber**

Worldwide, there is increasing demand for food, fuel, and fiber. As incomes increase in developing countries, higher demand for food and animal feed increases demand for grain. In addition, high oil prices and policies promoting renewable energy increase demand for crop-based biofuels. Land is often cleared to address these food, fuel, and fiber demands.

In 2007, world production of ethanol and biodiesel reached 12.9 billion gallons and 2.3 billion gallons, respectively. Brazil and the United States lead the world’s production of ethanol, each with approximately 37 percent of global supply. The United States and the

\textsuperscript{19} Philip M. Fearnside, “Predominant Land Uses in Brazilian Amazonia,” *Alternatives to Deforestation*, 1990, http://www.academia.edu/1190143/Predominant_land_uses_in_the_Brazilian_Amazon.


\textsuperscript{22} Mertens, et al. “Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of Sao Felix do Xingu in South Para.”

\textsuperscript{23} Mertens et al. “Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of Sao Felix do Xingu in South Para.”
European Union are the largest producers of biodiesel with 22 and 76 percent of global supply, respectively. Domestically, Brazil uses less than 2 percent of its arable land to produce sugarcane for ethanol, and relies on ethanol for 40 percent of non-diesel fuel consumption. Production of ethanol is estimated to grow from 18 billion liters in 2006 to 40 billion liters by 2015. Internationally, Brazil has increased production of biofuels in order to meet a growing demand from the EU, as the EU member states have agreed to a binding renewable energy target of 20 percent by 2020. As demand has increased and yields have leveled off, prices of both fuel and agricultural commodities have increased. In 2008, the prices of fuel and food reached historical highs at $147 per barrel of oil and $4.10 - $4.50 per bushel of corn, respectively. The amount of corn that was used to produce ethanol globally increased from 10 percent in 2002 to 24 percent in 2008.

At the same time that demand is increasing, the growth in production of grains is decreasing as the yields per harvested area level off or decline. Decreased spending on agricultural research as well as the challenge of obtaining adequate amounts of water are both drivers of falling yield growth. As a consequence, more land will need to be converted to agricultural uses in the coming decades in order to keep up with growing demand.

Access to international trade
The main driver of Brazil’s rapid industrial growth has been growth in the export market. This has in turn driven ranchers to clear land for cattle grazing. In 2002, only 13 percent of beef produced in Brazil was exported, compared to 28 percent in 2007, and 31 percent

---

Over the course of the last 20 years, Brazil’s trade partners have shifted from Germany, Italy, and the Netherlands to the Middle East and Russia, Venezuela, and Iran. Brazil seeks trade partners outside the US and EU because both markets are saturated with high quality meats and imports have high identification tracking and health safety requirements. For example, US imports from Brazil are limited to cooked products due to disease concerns. Additionally, disease concerns increase as cattle are raised closer to the Amazon rainforest.

During the 1980s, Amazonian deforestation started to become more closely linked with international agricultural markets, particularly for cattle and soybeans. Today, deforestation rates continue to be driven by global economic forces. Hargrave and Kis-Katos (2011) note a pattern of deforestation rates that closely mirror fluctuations in beef and soybean prices. Their analysis reveals that primary determinants of deforestation rates in the 2000s are increases in prices for

South-to-South trade
South-South trade, trade between developing countries has grown at an average of 19% per year between 2001 and 2010 and now accounts for 23% of global trade. This type of trade is made up of a greater proportion of raw materials and less processed products than trade that involves developed countries. One consequence of South-South trade is the formation of trade agreements that have larger reductions in tariffs than agreements involving the developed world. In the Americas, excluding sugar and dairy, these tariff reductions can reach 90% for most products. These large tariff reductions will likely lead to more cross border agricultural trade between countries involved in South-South agreements.


---

30 Ky Pohler, University of Missouri, interview by Amy Braunz, Carrie Gonnella, Louise Hill, and Jana Holt, Cattle ranching in Brazil, November 1, 2012.
agricultural commodities\textsuperscript{32} and enforcement of environmental regulations. These two forces act in opposite directions, with commodity prices increasing the expected financial returns on deforestation activities, and enforcement of fines for noncompliance decreasing returns. The agricultural commodity link is driven primarily by soybean prices; poor data quality precludes definitive analysis of the impact of meat prices on deforestation, though results indicate that they are likely of a similar magnitude as soybean prices\textsuperscript{33}.

Results of the Hargrave & Kis-Katos analysis also indicate that there may be significant, positive correlations between the availability of cheap, agricultural credit and deforestation. When linked to real agricultural GDP per capita, credit density is positively linked to deforestation rates with an elasticity of 0.13-0.17 percent\textsuperscript{34}.

\textsuperscript{32} Hargrave & Kis-Katos. “Economic Causes of Deforestation in the Brazilian Amazon: A Panel Data Analysis for the 2000s.”
\textsuperscript{33} Hargrave & Kis-Katos. “Economic Causes of Deforestation in the Brazilian Amazon: A Panel Data Analysis for the 2000s.”
\textsuperscript{34} Hargrave & Kis-Katos. “Economic Causes of Deforestation in the Brazilian Amazon: A Panel Data Analysis for the 2000s.”
OUR CLIENT: World Wildlife Fund US
The World Wildlife Fund (WWF) is a global nonprofit organization that seeks to “stop the degradation of our planet’s natural environment, and build a future in which humans live in harmony with nature.” In doing so, WWF’s programs are aimed at protecting natural biodiversity via conservation efforts targeted at both priority geographic regions and species. In parallel, WWF also has programs aimed at reducing the negative impacts of human development and activities, minimizing humans’ ecological footprint.

Within this broad set of organizational goals, the Market Transformation team works with business and industry to reduce the negative environmental impacts associated with growth in global trade and economic development. With a focus on global commodities, Market Transformations realizes that the environmental challenges created by the production and extraction of vital products, “is not just linked to rising global demand for food, fiber and fuel, but also to where and how industries and their global supply chains ‘source’ commodities.” Priority commodities that WWF focuses on include marine fisheries, aquaculture, and agriculture. Through company partnerships, commodity investments and multi-stakeholder engagements, the Market Transformation team engages with the private sector to develop sustainable solutions to environmental degradation. See Appendix A for selected WWF staff biographies.

Beef is one of WWF’s priority commodities due to its intensive environmental impacts associated with Amazonian deforestation and land degradation. As discussed, beef production in South America is the leading cause of deforestation in the Amazon rainforest and is a leading source of greenhouse gas emissions associated with land use. WWF has identified sustainable supply chain management and international financial markets as key leverage points for reducing the environmental impacts of agricultural commodities.

---

37 “What does WWF do?”
The World Wildlife Fund has a long history of establishing and participating in multi-stakeholder initiatives to develop standards and certifications for sustainable production of agricultural commodities. By bringing together industry, nonprofits and other partners across the value chain, WWF engages diverse parties in the development of more sustainable supply chains that impact WWF’s priority regions. Existing initiatives include the Forest Stewardship Council (FSC), the Marine Stewardship Council (MSC), the Roundtable on Responsible Soy (RTRS), the Roundtable on Sustainable Palm Oil (RSPO), Bonsucro (formerly the Better Sugarcane Initiative), and the Aquaculture Stewardship Dialogues. The Global Roundtable on Sustainable Beef (GRSB) is the latest of these efforts and was initiated in 2010 by the Global Conference on Sustainable Beef and formally launched as an independent organization in 2012.

**WWF AND THE Global Roundtable for Sustainable Beef**
The Global Roundtable for Sustainable Beef (GRSB) is a multi-stakeholder initiative launched in November 2010 to create clarity and improve sustainability regarding the beef production system. The GRSB “envisions a world in which all aspects of the beef value chain are environmentally responsible, socially equitable and economically viable.”

Founding members include:

- AllFlex
- Allianca de Terra
- Cargill
- Elanco
- Grupo de Trabalho da Pecuaria Sustentavel (GTPS)
- JBS
- McDonald’s
- Merck Animal Health
- National Wildlife Federation
- Rainforest Alliance
- Roundtable for Sustainable Beef Australia
- Solidaridad
- The Nature Conservancy
- Walmart
- World Wildlife Fund

Together these companies and organizations seek to build on national and regional initiatives to promote sustainable beef practices with measurable outcomes.

---

Over the last two years, the GRSB has hosted a plethora of dialogues in key beef producing regions including the United States, Australia, and Brazil. Members continue to share best practices, engage strategic working groups and encourage new members to join the effort. During the 2012 Global Conference on Sustainable Beef the group drafted bylaws, set the agenda for future actions, and reiterated their commitment to establishing socially and environmentally sound beef supply chains.

As such, the following value chain analysis will provide the GRSB and the WWF Market Transformation team with a clear roadmap of the financial and material flows of the Brazilian beef production system. This information can then be used to inform the strategic work of GRSB.

**RESEARCH QUESTIONS AND METHODOLOGY**

In collaboration with WWF, we established the following research questions to guide our project:

*What are the leverage points in the Brazilian beef value chain that will help reduce deforestation and land use change in the Amazon?*

In addition to this overarching question, our particular focus on WWF's relationship with the GSRB encouraged us to consider the following questions that specifically get at how the GRSB can be involved in efforts to reduce cattle-based deforestation:

- What are the most effective solutions that WWF and the GRSB can play a role in to address deforestation?
- What role should the GRSB play in these solutions?
- What partnerships will be necessary for the GRSB to be successful in reducing deforestation?
To address these questions, our team conducted a thorough review of the academic literature relating to Brazilian beef, agriculture, and deforestation, among other topics. We used this literature review to understand how Brazilian beef production compares to production in other countries, the issues regarding beef production in Brazil and the Amazon region, and government policies relating to beef production. We also set out to create a comprehensive map of the value chain for Brazilian beef; outlining the value chain would allow us to better understand how the various players in the chain interact and to identify the best leverage points for the GRSB to exert influence in an effort to improve the sustainability of beef. Before we started to research and construct our value chain, we met with value chain experts at Duke University’s Center on Globalization, Governance and Competitiveness (CGGC) in order to better understand the elements that needed to be included in our value chain. Additionally, we reviewed several of their value chain assessments for products and commodities to examine how the value chain theory was translated into real world application. We investigated the components of the Brazilian beef value chain through publically available company information and data from various government and nonprofit outlets. In our discussions with our client during the data gathering process, we discovered that our initial focus on collecting specific data was not as relevant to their mission as the links between, the relative size of, and the concentration of the players of the value chain. To better understand the state of affairs in Brazil and current efforts to address deforestation and improve the beef supply chain, we also conducted interviews with the following researchers and practitioners in the fields of conservation and agriculture:

- **Lukas Brun**: Senior Research Analyst, Center on Globalization, Governance and Competitiveness, Duke University
- **Andrew Hutson**: Director of Global Value Chain Initiatives at Environmental Defense Fund
- **Gustavo Silva-Chavez**: Climate and Forests Specialist, REDD Project Manager at Environmental Defense Fund
- **Ky Pohler**: Doctoral Candidate in Animal Science at the University of Missouri
- **Sabrina Vigilante**: Director of Strategic Initiatives at Rainforest Alliance
- **Nathalie Walker**: Manager of Tropical Agriculture, Forests and Climate Project at National Wildlife Federation
These interviews gave us direction for our research, additional perspective on what is happening on the ground in Brazil, and qualitative information on the state of current initiatives to reduce deforestation in the Amazon.
BEEF PRODUCTION IS A MAJOR DRIVER OF ECONOMIC DEVELOPMENT IN BRAZIL

Physical and demographic characteristics of Brazil
Brazil is the fifth largest country in the world, both by land area and population. The country has a land area of 8.46 million square miles, and a total area 8.51 million square miles.39

Brazil’s total population has seen steady growth over the last fifty years, from under 73 million people in 1960 to almost 195 million in 2010 (Figure 2).40 The population has undergone rapid urbanization over this time period (Figure 3); in 1960, over half of Brazilians lived in rural areas, but by 2011, 85 percent lived in urban areas.41 Coinciding with this demographic change, the proportion of Brazilians working in the agriculture sector has decreased, while the percentage in the service sector has increased (Figure 4). The proportion of the population working in the industrial sector has stayed relatively constant over the last thirty years, ranging from 25 to 23

---

40 World Bank Data
41 World Bank Data
percent. Major industries include textiles, shoes, chemicals, cement, lumber, ore, metals, aircraft, motor vehicles and parts, and other machinery and equipment.

In 2003, almost 23 percent of the population (43M) worked within Brazilian agribusinesses, with beef production specifically accounting for 6.8 million direct or indirect hires. Agribusiness accounted for 31 percent of GNP, and 42 percent of exports in 2003. Major agricultural exports include beef, coffee, soybeans, wheat, rice, corn, sugarcane, cocoa, and citrus, and Brazil is the world’s biggest producer of several of these products, including soybeans (24 percent of world production), sugar cane (33 percent) orange juice (30 percent), and coffee (38 percent). Brazil is particularly suited for agribusiness because land and labor are relatively cheap and the country has a stable climate, with infrequent extreme weather events.

**Brazil’s beef production**

Brazil is the largest beef exporter in the world, the second largest producer of beef (behind the U.S), and is responsible for one third of beef trade worldwide. In 2008, Brazil

---

42 World Bank Data
45 “The World Factbook”
46 Bento et al. “Productions systems – An example from Brazil.”
47 Bento et al. “Productions systems – An example from Brazil.”
produced 9.7 million tons CWE\textsuperscript{48} and exported 2.2 million tons CWE, bringing in revenue of US $5.3 billion.\textsuperscript{49} For comparison, the US produced 12 million tons and the European Union produced 8.1 million tons. Brazil's beef production is lower cost than other areas; costs in Brazil are 60 percent lower than in Australia, and 50 percent lower than in the US.

The beef and dairy cattle population are estimated between 190 and 200 million head. Of that number, 150 million animals are raised for beef, while 40 million are for dairy or dual-purpose. Much of the cattle population is Zebu, a breed from India, and the grasses they graze on are tropical grasses from Africa that were introduced in Brazil in the late 1960s and early 1970s.\textsuperscript{50} The interactions between the Brazilian environment, these African grasses, and the Indian cattle have produced a very robust beef production system in Brazil.

Although beef production in Brazil dates back to colonial times, it was not until World War I that there was enough economic stimuli to drive Brazil’s export market. The demand for frozen and chilled beef prompted foreign firms to establish meatpacking facilities in Sao Paulo and led to the eventual consolidation of the Brazilian processed meat sector in the 1920s. Foreign investment continued to propel the industry until the 1970s and 1980s when the government sought to acquire export outlets for cattle, and provided loan subsidies and tax breaks to drive further growth in the beef industry.

From 1970 to 1985, the Brazilian government provided $700 M in incentives, including subsidies, to expand agricultural and cattle-producing land.\textsuperscript{51} As market demand intensified, ranchers began moving into the southern part of Mato Grosso, with its mild climate, water

\begin{enumerate}
\item Carcass Weight Equivalent (CWE) is the weight of meat and meat products, converted to an equivalent weight of a dressed (no hide) animal carcass. It includes bones, fat, tendons, ligaments, and inedible trimmings. Source: USDA, http://www.ers.usda.gov/data-products/food-availability-%28per-capita%29-data-system/glossary.aspx#CWE
\item Bento et al. "Productions systems – An example from Brazil."
\item Bento et al. "Productions systems – An example from Brazil."
\end{enumerate}
resources, and rolling grasslands. This movement contributed to already shifting trends in how Brazil’s arid grasslands, called the Cerrado, were utilized.

The Cerrado, covers more than 20 percent of Brazil’s land, and is the largest savannah in all of South America (Figure 5). Prior to 1960, the Cerrado was used by a relatively small number of farmers as a natural pastureland and for growing crops such as cassava and beans. As the government built infrastructure, such as roads and railways, and provided incentives for agricultural development, large-scale mechanized commercial operations replaced individual farms, production shifted to monocultures of cash crops and cultivated grasses, and deforestation occurred in the Cerrado in order to expand cattle lands.

Although the Cerrado is now responsible for most of the country’s beef production, these pasture-based systems are considered to have low efficiency compared to other production systems in the world, due to low soil fertility, poor soil management, over-exploitation of native grasses, and low genetic potential of the animals.

The Cerrado
The Cerrado, the largest savannah in South America, and is considered one of the world’s biological hotspots. It is home to over 10,000 species of plants and animals, almost half of which are found only in this region. WWF has identified the Cerrado as a Priority Place and has worked with the Round Table on Sustainable Soy to promote sustainable cultivation of soy in the Cerrado.

http://wwf.panda.org/what_we_do/where_we_work/cerrado/

Figure 5: Map of the Cerrado
From farms to feedlots
Prior to World War I, beef cattle were raised, slaughtered, and consumed locally. With the invention of modern cooling methods and improved cereal grain yields, the beef industry transitioned into an export driven market. The current feedlot system, introduced in the 1960s, drastically lowered shipping expenses and reduced the need for stockyards. Feedlots were originated to take advantage of favorable weather, inexpensive grain, and availability of land in rural areas. Today, urban encroachment and land value continue to place pressure on the existence and efficiency of feedlot systems. Worldwide backlash from animal rights activists and conscious consumers have created negative perceptions about the health and environmental effects of the feedlot system urging many to adopt organic production methods.\textsuperscript{52}

Feedlots transformed the beef industry from the transfer of live animals to shipment of processed meat on rail cars. Meatpacking moved from metropolitan areas closer to where the cattle were actually being raised. The 1960s also saw the introduction of vacuum-sealed boxed beef; this new method of shipping meat greatly lowered the need for skilled butchers and decreased final shipping costs by removing weight from bones. It also permitted specific cuts of beef to be requested and shipped to

\begin{quote}
Building better cattle
Throughout the latter half of the 20\textsuperscript{th} century, technological advances led to cross-breeding and increased populations. First, artificial insemination was used to grow quality cattle herds beginning in the 1940’s. Then in the 1970’s the Canadian government decided to import exotic beef cattle breeds of superior performance from Europe. However, the price to import cattle was extremely high and there were very strict guidelines and quarantines that had to be followed before any exotic cattle could enter Canada. High import prices led to the need for superovulation and embryo transfer. The introduction of nonsurgical embryo recovery (otherwise known as flushing) arrived in the mid-1970s and techniques for nonsurgical transfer arrived in the late 1970s. Recently, cloning has emerged as a means to produce cattle with immunity to life-threatening diseases and to revive cattle species that are heading toward extinction. The technology is also being used to harvest cattle for specific medicinal and nutritional products.\textsuperscript{1}

Brazilian ranchers are increasingly turning to cross-breeding to improve cow size, strength, and growth rates. Roughly 7-12\% of Brazilian cattle are now bred using artificial insemination compared to 5-10\% in the US. Since 2000, there has been a 40\% increase in the volume of bull semen in the Brazil market.
\end{quote}

\textsuperscript{52} Michael Galyean. “The future of feedlot beef production,” Department of Animal and Food Sciences, Texas Tech University, 2010.
distributers – allowing the industry to be more responsive to customers and to do so at a lower cost. Both feedlot systems and vacuum-sealed beef led to concentration at the slaughterhouse stage, putting small plants out of business and lowering meatpacking wages. Today, processing facilities are undergoing further concentration as the wholesale market is eliminated and the sector becomes vertically integrated. 53 Brazil is now home to about 750 beef processing plants and slaughterhouses.

Demand for Brazilian beef has put pressure on the length of time a cow requires before slaughter. The average slaughter age has fallen from 54 months to 38 months of age due to both genetic and production techniques. Today, 50 percent of cattle in Brazil receive some grain feeding which may serve as a supplement or an alternative to natural grass grazing. Between 2003 and 2010 feedlots increased by 50 percent although only 6 percent of cows are destined for them before slaughter. 54

**Food quality and safety**

Certain trade barriers regarding quality, sanitation, and food safety have played an important role in the evolution of the beef production process. In the 1980s the meat industry shifted focus to product quality and began adopting the Japanese ISO quality system standards. Examples include the standardization of raw materials and the use of slaughter byproducts. Food safety was an increasing

---


Concern in the 1990s. With hundreds or thousands of cattle being raised together, the opportunity for pathogens to spread from one animal to another drastically increased. Additionally, cattle that are transported to slaughter on trucks are often transported with animals from various farms providing additional opportunities for bacterial exchange. Additionally, cattle transport is stressful and can negatively impact the productivity of the animal. As stress levels rise hormones are released and can lead to E. coli contamination in meat after slaughter. Mad Cow disease (BSE) was detected in the UK and France in 1992, when 37,311 cases were identified.55

The BSE outbreak ultimately led to comprehensive traceability programs among major exporters, including Australia, Brazil, and Canada. For example, the EU’s Directorate-General for Health and Consumer Protection must certify individual countries as having a credible and controlled production chain to be eligible for import. To verify compliance, there must be strict animal health standards, hygiene controls, and a monitoring system.56 Under the EU’s Single European Act of 1986, animals destined for import must have ear tags, animal passports, and be included in databases that establish the link between ranches and processing facilities. Once the meat is processed it is required to be labeled according to animal or group of animals. The label must also show the registration number of the slaughterhouse and all facilities where further operation occurs.57

Traditionally, Brazilian ranchers rely on a resource-intensive grass-fed production model, which has positive impacts on health safety especially concerning BSE.58 However, foot and mouth disease has plagued certain states and is a crucial determinant of Brazil’s access to higher-value export markets. Importers of Brazilian beef often require traceability

58 Carlos Steiger, ”Modern Beef Production in Brazil and Argentina.” Choices Magazine 21 no. 2 (2006).
programs to prevent such diseases from entering their country. The Brazilian system only extends between the farm and the slaughterhouse, unlike more in depth programs in the EU, Japan, and Australia. Nevertheless, it is equally precise as it allows for individual animal identification. In 2001, the Brazilian Beef Processors and Exporters Association (ABIEC) began an aggressive marketing campaign to support Brazilian beef by emphasizing the products natural, environmental, and health benefits which has helped the country improve its reputation in the EU, the Middle East, and Russia.

Worldwide demand for safe, quality products has led food retailers to become more interested in selling products under their own labels. This desire makes them increasingly dependent on a smaller number of large suppliers who can guarantee safe, quality products at competitive prices. Traceability programs have been adopted by major processors, who continue to vertically integrate. This industry consolidation continues to force producers to invest in new products and services that will justify a higher price.

TRENDS IN GLOBAL AGRICULTURE AND BEEF CONSUMPTION IMPACT LAND USE CHANGE IN BRAZIL

Rise in beef consumption
The USDA has reported that world beef consumption went from 20 million tons CWE in the early 1960s to 60 million tons CWE by 2010. During this same period, Brazil’s production grew from 1.2 million to 10 million tons, and consumption went from 1.2 million to 7.5 million tons (Figure 6). Brazil’s domestic beef market currently consumes about 72.5 percent of total domestic production. Per capita consumption is 37 kilograms of CWE per person per year.

---

60 Steiger, Carlos. "Modern Beef Production in Brazil and Argentina."
Global beef consumption has declined slightly over the past 4 years. Between 2007 and 2010, consumption decreased from 116,266 to 113,088 thousand metric tons carcass weight (Table 1).64

However, looking at global consumption conceals the differences between the developed and the developing world (Figure 7); as of 2010, this difference was 80 kilograms versus 32 kilograms per person, respectively.65 Additionally, meat consumption in middle-income countries, such as Brazil and China, has been rising. Between 1973 and 1997, beef consumption per capita increased from 4 to 6 kilograms in developing countries and is projected to grow by almost 3 percent per year.66 Figure 8 shows how per capita meat consumption varies across countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>58,133</td>
<td>57,975</td>
<td>56,668</td>
<td>56,544</td>
</tr>
<tr>
<td>United States</td>
<td>12,830</td>
<td>12,452</td>
<td>12,239</td>
<td>12,040</td>
</tr>
<tr>
<td>European Union</td>
<td>8,690</td>
<td>8,352</td>
<td>8,262</td>
<td>8,185</td>
</tr>
<tr>
<td>Brazil</td>
<td>7,144</td>
<td>7,252</td>
<td>7,374</td>
<td>7,592</td>
</tr>
<tr>
<td>China</td>
<td>6,065</td>
<td>6,080</td>
<td>5,749</td>
<td>5,589</td>
</tr>
<tr>
<td>Russia</td>
<td>2,452</td>
<td>2,616</td>
<td>2,347</td>
<td>2,307</td>
</tr>
<tr>
<td>Argentina</td>
<td>2,771</td>
<td>2,731</td>
<td>2,727</td>
<td>2,305</td>
</tr>
<tr>
<td>India</td>
<td>1,735</td>
<td>1,880</td>
<td>1,905</td>
<td>1,930</td>
</tr>
<tr>
<td>Mexico</td>
<td>1,961</td>
<td>2,033</td>
<td>1,971</td>
<td>1,944</td>
</tr>
<tr>
<td>Pakistan</td>
<td>1,363</td>
<td>1,394</td>
<td>1,461</td>
<td>1,491</td>
</tr>
<tr>
<td>Japan</td>
<td>1,182</td>
<td>1,173</td>
<td>1,211</td>
<td>1,224</td>
</tr>
<tr>
<td>Canada</td>
<td>1,068</td>
<td>1,036</td>
<td>1,016</td>
<td>999</td>
</tr>
<tr>
<td>Other countries</td>
<td>10,872</td>
<td>10,976</td>
<td>10,406</td>
<td>10,938</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>116,266</strong></td>
<td><strong>115,950</strong></td>
<td><strong>113,336</strong></td>
<td><strong>113,088</strong></td>
</tr>
</tbody>
</table>

**Table 1: Global beef consumption (Thousand metric tons CWE)**


---

**Figure 7: Expected meat consumption in developed and emerging markets**

There are several demographic drivers of increasing beef consumption in the developing world, including increasing population, urbanization, and rising income levels. The United Nations estimated that the global population will grow by 40 percent to 9.1 billion people by 2050. This increase is expected to happen almost exclusively in developing countries. Almost half of the global population, approximately 3 billion people, currently lives in an urban setting. This percentage is projected to increase to 61 percent, or 5 billion people, by 2030 (see Figure 9). The global middle class is estimated to rise from 1.8 billion in 2009 to 4.9 billion by 2030. The increase in size of this segment of the population represents an

---


increase in per capita income and has historically been a driver of growth. Middle class demand is expected to grow from $21 trillion in 2009 to $56 trillion by 2030.69

![Graph showing projected size of the world's urban and rural population, 1950-2050.](image)

**Figure 9: Projected size of the world's urban and rural population, 1950-2050.**


**Agricultural trends**

Agriculture is increasingly becoming a demand driven sector due to rising demand for food, fuel, and fiber. Increasing food consumption in general, and meat consumption in particular, have led to an increase in the amount of grains that are needed to fulfill dietary and animal feed requirements.

Increasing demand from the biofuels industry for agricultural products, driven by high oil prices and policies promoting renewable energy, is also putting pressure on agriculture. Brazil has increased production of biofuels in order to meet a growing demand from the EU. At the same time that demand is increasing, the growth in production of grains is decreasing as the yields per harvested area level off or decline. Decreased spending on agricultural research as well as the challenge of obtaining adequate amounts of water are

---

both drivers of falling yield growth. As a consequence, more land will need to be converted to agricultural uses in the coming decades in order to keep up with growing demand.\textsuperscript{70}

**Impacts of global climate change on agriculture**

Many aspects of climate change will impact agriculture throughout the world. Some crops may benefit from higher temperatures and increased CO\textsubscript{2} levels, as long as other needs, such as water and nutrient demands, are met. However, all agriculture will likely be impacted negatively by increased frequency and severity of storms, droughts, and floods. Increased temperatures will stress livestock, leading to death directly or indirectly through increased susceptibility to diseases. For grass fed livestock, droughts can decrease the productivity of pastures and the amount of forage that is available for animals. For grain fed animals, drought will decrease crop productivity, decreasing the amount of grains available and increasing the price that farmers will have to pay to secure sufficient grain supplies. Higher temperatures, leading to less severe winters, will allow parasites and diseases to survive in greater numbers and have a greater impact on animals.\textsuperscript{71} Figure 9 gives an overview of how climate change may impact agriculture and biodiversity.


BEEF PRODUCTION IN BRAZIL HAS SIGNIFICANT SOCIAL, ECONOMIC, and ENVIRONMENTAL IMPACTS

The social, economic and environmental impacts of global beef production are many and varied. From greenhouse gas emissions and freshwater contamination to antibiotic resistance and disease, mass production of beef is resource intensive and can cause problems that extend far beyond the ranch, or the conventional industrial farms that are common in the United States. As global consumption rises, the need for more sustainable methods increases. Livestock production has led to degradation of 20 percent of the world’s pasture lands, consumes eight percent of human water use, and is the leading cause of water pollution that leads to eutrophication, reef degradation, health problems and antibiotic resistance. Nevertheless, over 1.3 billion people, many of whom live in poverty,
rally on the livestock industry as their primary source of employment. In total, the livestock sector accounts for 40 percent of global agricultural GDP.\textsuperscript{72}

In Brazil, increasing global demand has brought Brazil into a leadership position as one of the largest producers and exporters of beef in the world in 2012.\textsuperscript{73} This high level of production over the past decade has had many socio-economic and environmental impacts on the region.

\textbf{Socioeconomic issues}
Brazil’s over 600,000 indigenous persons are heavily concentrated in the Amazon and central-western Brazil (99 percent). The government estimates that over half of these indigenous communities face threats to their traditional ways of life due to land development, agriculture and extractive industries. Most legal conflicts between indigenous and non-indigenous persons stem from either land development or resource exploitation. These conflicts have been known to exacerbate poverty in indigenous communities and lead to violence and murders.\textsuperscript{74}

Stemming from 19th century colonial roots, forced labor has long been a problem in rural Brazil. While the 1888 \textit{Lei Aurea} (Golden Law) prohibited human ownership, debt slavery persists. Lured from their villages by the promise of jobs, laborers leave their homes and become perpetually indebted to estate owners for transportation, food and basic household items, which must be purchased from the estates at high mark-ups. Future earnings are required for payment, and workers cannot leave the property until their debt is paid.\textsuperscript{75} As such, they are forced into a continuous cycle of labor and debt. After these problems came...

\textsuperscript{72} Steinfeld, et al. “Livestock’s Long Shadow” Environmental Issues and Options.”
to light in the late 1990s, the Brazilian government has taken steps to eradicate the problem. Much progress has been made, but forced labor continues to be a problem in remote areas. A 2007 study found that among estates found to be employing forced, or slave, labor, 62 percent were engaged in cattle production.\textsuperscript{76} Several countries, companies and non-governmental organizations limited or boycotted imports of Brazilian beef on claims of unfair labor practices – even forced and child labor in some regions. In 2009, Ireland attempted to ban the import of Brazilian beef and in 2005, Farmers for Action (FFA) called for Tesco to stop purchasing all Brazilian beef.\textsuperscript{77}

Demographically, most forced laborers in Brazil, unlike other Latin American countries, are not indigenous persons. Rather, they are mostly non-white workers from Northeastern Brazil, particularly in the states of Para, Mato Grosso and Tocantins. Poverty is highly concentrated in these areas, and economic inequality features a wide split between white and black or mixed race citizens.\textsuperscript{78} Estates in which laborers work are spread across the Legal Amazon, and much of their work is linked to deforestation activities to make way for pasture or agricultural lands.

Within the forced workforce, child labor, despite government progress, continues to be a problem, particularly in the agricultural sector.\textsuperscript{79} While 16 is the minimum age to be eligible for work, and education is compulsory

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure10.png}
\caption{Percent of Brazilian children employed, by age group.}
\end{figure}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Age & 0.7\% & 6.9\% & 27.4\% \\
\hline
5-9 & & & \\
\hline
10-14 & & & \\
\hline
15-17 & & & \\
\hline
\end{tabular}
\end{table}

\textsuperscript{76} Costa. “Fighting Forced Labour: The Example of Brazil.”
\textsuperscript{77} “FFA and Tesco locked in beef dispute,” Farmers Guardian, October 14, 2005, 6-6.
\textsuperscript{78} Costa. “Fighting Forced Labour: The Example of Brazil.”
through age 17, a 2009 study estimated that about 4.25 million children between ages five and 17 were employed (see Figure 10). Working primarily in undocumented jobs (90 percent), about half of all child laborers are unpaid, and most of the rest are paid well below the minimum wage yet work far in excess of 40 hours per week.

**Economic Impacts**
Economically, the growing beef industry has been an important source of revenue for the Brazilian economy contributing a large portion of the 5.5 percent agricultural GDP in 2011. Development economics have traditionally held that increased trade between developing and developed countries improves economic conditions. Research on increased trade in agricultural commodities, however, reveals that in many cases, increased trade in regions heavily dependent on export commodity markets leads to widening income disparity, lower per capita GDP, and rapid environmental degradation and biodiversity loss. Data on the growth of the Brazilian beef export market has shown decreases in GDP, food security and biodiversity. Meanwhile, conflict over natural resources has grown, along with increased unemployment and poverty. The economic benefits of the increased trade are not evenly distributed; in Brazil, over two thirds of all cattle are owned by less than ten percent of ranchers.

**Environmental Impacts**
Environmental degradation associated with increased beef production in Brazil has been highly visible and garnered much media and political attention. Unlike cattle in the United States, Brazilian cattle are predominantly grazed, with increasing percentages of cattle being finished on grain supplements in the final stages before slaughter. Still, most of their lives are spent grazing, which some advocates in the US and Europe see as preferable to the

---
conventional grain-fed systems of more developed countries. However, cattle ranching in Brazil has led to significant rates of deforestation in the Amazon. As producers in the southern part of the country respond to increased export demand, ranchers have been moving north, into the Amazon, to raise cattle for domestic consumption. To meet the need for pasture to allow continuous grazing year round, Brazilian pastureland has grown by 1.9 million hectares per year. Much of this conversion is taking place in previously forested lands; pasture is the primary use for newly deforested land in the Amazon (60-75 percent), 90 percent of which is being used for beef.\(^84\) Previously, methane from enteric fermentation has been the primary focus of research on greenhouse gas emissions from livestock production. However, in 2010, Cederberg et al. sought to include emissions from land use change in a life cycle assessment of Brazilian beef. The results were shocking; whereas previous estimates of greenhouse gas emissions were about 28 kg CO\(_2\)e per kg carcass weight (CW), the researchers found that deforestation increases those estimates to 44 kg CO\(_2\)e/kg CW when the emissions from land use change are spread across all Brazilian beef. When allocated only to beef produced on newly deforested land, the number skyrockets to over 700 kg CO\(_2\)e/kg CW. So, although only about six percent of Brazilian beef is produced on newly deforested land, the magnitude of the emissions associated with deforestation increase the emissions of all Brazilian beef by almost 60 percent.\(^85\) In fact, emissions from conversion of forests to pastureland are estimated at about nine percent of global greenhouse gas emissions.\(^86\)


\(^85\) Cederberg et al., 1776.

\(^86\) Steinfeld, et al., xxi.
UNDERSTANDING THE BRAZILIAN BEEF VALUE CHAIN

The value chain for Brazilian beef is a critical component of identifying and implementing intervention strategies that WWF and the GRSB can facilitate. Value chains have been successfully identified across geographies and commodities including Mexican shrimp fisheries, the U.S. beef and dairy industry, and Mexicali Valley crops. These studies provide an analytical framework for studying actors required to produce global goods and services. They also identify market dynamics and opportunities for achieving sustainability and adoption of environmentally efficient technologies and practices.87

Value chains depict the logic behind why systems behave the way they do. The value that is created and captured at each stage is ultimately a sign of profit and influence. Thus, this analysis of the Brazilian beef value chain is key to understanding which actors along the chain can help drive change in an effort to reduce deforestation. Contributions from each actor to the chain are influenced by many of the characteristics already identified in preceding chapters, including:

• Economic characteristics of beef (e.g. price, quality, quantity)
• Environmental conditions such as laws, regulations, policies, and infrastructure that determine the ease in which beef moves from actor to actor.
• Relationships among actors across the value chain.
• Supporting markets like financial institutions and NGO’s that contribute to investment and productivity growth.88

The value chain for beef in Brazil is found in Figure 11. For this study we divided the value chain into six segments: inputs, ranches, slaughterhouses, processors and distributers, sales outlets, and consumers. Each of these is described in detail below.

Inputs and Raw Materials

Developing calves into viable cattle for beef production requires feedstock, genetic, and medicinal inputs. Both embryo transfer and artificial insemination (AI) are used to engineer cattle with superior quality and weight. In 2009, 300,000 embryo transfers occurred and 7-12 percent of cattle were conceived using AI in Brazil, compared to less than 10 percent in the US. Historically, Brazilian ranchers relied exclusively on native grasslands for pasture grazing. However, as increased evidence suggests supplemented feed produce heavier cattle and allow slaughtering at an earlier age, more ranchers are
introducing corn and soy into cattle diets. Today, 50 percent of Brazilian cattle receive some grain feeding.  

Cattle Ranchers
Nearly a quarter of cows sent for slaughter are raised on large farms with herd sizes of at least 1000 cattle. However, these ranches represent less than one percent of the total ranches and are largely owned by conglomerates such as JBS and Marfrig. The vast majority of ranches (90 percent) are smaller operations with less than 100 head of cattle. These ranches represent 34 percent of cattle produced. Although industry consolidation is underway, 35,000 cattle ranches are still in operation. Efforts to genetically engineer cattle and to supplement feed are mainly exercised by the large ranches. Additionally, those responsible for much of the social and environmental impacts can be traced to small and medium size farms, which are more difficult to track and regulate. Feedlots are a quickly growing trend with seven percent of cattle in 2010 passing through that type of system.

Slaughter and Processing
In 2012, Brazil produced 9.2 million metric tons CWE of beef. Several Brazilian companies are responsible for the vast majority of cattle slaughter and processing in Brazil; namely, JBS, Marfrig, and Minerva.

JBS, a Brazilian multinational company, is one of the largest animal processors in the world, capable of slaughtering a total of 90,000 head per day. In a 2011 article in the Washington Post, 

---

Post, CEO Wesley Batista says JBS has 10 percent of the world’s slaughtering capacity and is responsible for 25 percent of worldwide beef trade.

Given the large percentage of cattle raised in Brazil, it is unsurprising that JBS would have a large stake in that country. In fact, JBS has 35 cattle slaughtering facilities in Brazil, its highest number per country; for comparison, the company has ten slaughter units in Australia and eight in the US. JBS produces fresh cuts of beef, canned, frozen, and ready-to-eat meals under a host of brand names.

Marfrig Alimentos S.A. is a Brazilian multinational company with operations in 16 countries, specializing in production, processing, and distribution of animal meats and other foods. The company is split into two main units, Marfrig Beef, which operates in Brazil, Argentina, Uruguay, and Chili, and Seara Foods, which produces poultry, pork, prepared, and processed products. The company produces specialty cuts of meat, sliced meat, hamburgers, and packaged, ready-to-eat meals, such as lasagnas. Marfrig has global slaughtering capacity of

---

20,730 cattle per day, with 16 production units in operation in Brazil. Figure 12 shows Marfrig’s own assessment of the company’s share of cattle slaughtering in Brazil.

Minerva Foods is the third leading exporter of Brazilian beef. The company has a daily slaughter capacity of 11,500 head of cattle and daily deboning capacity of 2,240 tons. Minerva has 10 slaughtering units, 8 of which are located in Brazil (see Figure 13 for a map of facilities). The company draws cattle from over 7,000 Brazilian suppliers. Minerva produces chilled and frozen beef, cubed and portioned beef, as well as ready-to-eat and frozen foods. Of total revenue in the second quarter of 2012, 33 percent came from the domestic market, and 67 percent from exports.

**Sales to Retailers and Brand Manufacturers**

The major processing and distribution firms sell to a diffuse network of retailers, brand manufacturers and other end users around the world. The primary export destinations of Brazilian beef are Hong Kong, Russia, Venezuela, Egypt and Chile. See Figure 14 for export distribution.

---


Global beef retailers and other outlets can be categorized into brands, food service companies, supermarkets, fast food, and hygiene & beauty products. While Branded products and Hygiene & Beauty products eventually end up on supermarket shelves, at this stage we consider fresh and frozen cuts of beef as destined directly for supermarket retail. A 2008 study by GreenPeace identifies some of the major customers of the major beef processors. These sales relationships are depicted in Figure 15.

Figure 15: Retail sales relationships in the Brazilian beef value chain
Sources: GreenPeace, Slaughtering the Amazon; Hoovers, company reports
Consumer beef outlets

The sale of Brazilian beef is highly fragmented. More than 80 percent of production is consumed domestically. Domestic consumption of bovine products surged from 24.9 kg/year per capita in 1987 to 37.2 kg/year per capita in 2007.\(^98\)

By the early 2000s, Brazilians were purchasing a greater amount of beef from supermarkets than from the more traditional butcher shops, approximately 65 percent and 30 percent respectively.\(^99\) While there are several large retailers operating in Brazil, the market is still fragmented. As of 2006, the five largest supermarket chains made up 36.5 percent of the market while the 300 largest chains made up 58.7 percent of the market.\(^100\) In 2012, the largest supermarkets in Brazil included Companhia Brasileira de Distribuição (CBD), Carrefour, Wal-Mart Brasil, Cencosud Brasil Comercial Ltda., and Companhia Zaffari Comércio e Indústria.\(^101\)

---


In addition to food retailers, food service providers also supply approximately 30 percent of food to the Brazilian market. While this share is small when compared to the 70% that food retailers supply, it is trending upward (see Figure 16).102

As of 2011, the top five food service providers were McDonald’s, Al Saraiva Empreendimentos, Brazil Fast Food, Doctor’s Associates, and Restpar Alimentos. The combined sales from these five companies made up 53 percent of the consumer food service sales for 2011.103

![Figure 16: Food distribution in Brazil, by channel](http://www.slideshare.net/dimolition15/brazil-food-and-beverage-market-astor-group)

**Insights from the Brazilian beef value chain**

Our analysis reveals increased consolidation in all links of the chain with a particular emphasis on the processing and slaughtering phases. The global power of Western retailers has put pressure downstream for safe, high quality products. This has allowed JBS, Marfrig,

---


and Minerva to dominate the market and has resulted in asymmetric power relationships between ranchers and producers. The wholesale market is largely being eliminated through vertical integration as producers and retailers begin branding beef under their own names. The ranching phase is extremely fragmented with 99 percent of ranches being small to medium in size. Additionally, the one percent of ranches that control 27 percent of the cattle herd are likely already monitored for compliance with deforestation policies. Externalities are the greatest at this stage, but margins are the lowest. Addressing deforestation at this phase will thus be difficult for the GRSB. Viable solutions will likely require leveraging producer-rancher relationships for communication and compliance of environmental commitments.

Another barrier to addressing deforestation is the lack of traceability mechanisms from ranch to table. Processors and retailers have adopted traceability programs to ensure the health safety of their products, but these only extend between farm and slaughterhouse. Demand for sustainably ranched beef will likely come from branders and retailers, which requires a more comprehensive traceability program that monitors both health and sustainability standards. Finally, Brazil is at the forefront of reproductive and genetic technologies, but we suspect that much of this is taking place at the largest ranches only. Since efficiency gains are closely tied to these technologies, there may be an opportunity to garner best practices and disseminate them to smaller scale ranches.
POSSIBLE SOLUTIONS TO THE PROBLEM OF CATTLE-RELATED DEFORESTATION IN THE AMAZON

Through conversations with our client at WWF, we identified several possible solutions to cattle-based deforestation in Brazil, including increased productivity through genetics and feed efficiency, diversification of farm income, land use planning through agroecological zoning and use of degraded lands for cattle pasture, and financing mechanisms such as REDD and low interest loans. We researched each of these solutions to evaluate their efficacy and to determine which solutions WWF and the GRSB should focus their efforts on.

The following sections provide detailed analysis of six possible solutions to cattle-based deforestation in the Amazon. While we have researched each of these solutions individually, an overarching view of all of these solutions has allowed us to see places where they connect to each other. As a result of this high level view, we have developed four broad recommendations for the GRSB that incorporate learning from all six of the solutions we investigated.

To develop our recommendations, we considered the timeline of these solutions (that is, what is the current status of initiatives addressing the solution) and leverage points in the value chain that the GRSB could impact. In recognition of the limited resources that the GRSB will have available to it, we wanted to think critically about
the estimated efficacy of these solutions in reducing deforestation, and the strength of the specific impact the GRSB could have in each area. Therefore, although all of these possible solutions could have positive impacts on deforestation, from our research we decided not to recommend the GRSB and WWF focus on all of these areas at this time. Figure 17 shows a graphical representation of the connections between the six solutions we investigated and the four recommendations we make for the GRSB.

I: Increased productivity through genetics or feed efficiency

Genetic manipulation has been shown to increase reproductive performance that leads to a reduced need for natural resources to build and strengthen the herd. For example, estrous synchronization (ES) and timed artificial insemination (TAI) shorten calving season, increase calf uniformity, enhance pre-weaning growth, and produce heavier calves at weaning. TAI synchronizes ovulation among cattle that are in various stages of the estrous cycle by using hormones to induce ovulation and specified times. Cows undergoing TAI treatment were shown to subsequently wean a calf five percent more often than the control group (at the 95 percent confidence interval). Additionally, weaning weights increased from 175.9 (± 4.3 kg) to 193.4 (± 4.3 kg) at the 99 percent confidence interval. Heavier calves eventually generate higher economic returns; the economic advantage is valued at $49.14 per cow exposed to TAI treatment

Figure 18: Survival analysis of the percentage of cows calving by day during the calving season. John C. Rodgers et al., “An economic evaluation of estrous synchronization and timed artificial insemination in suckled beef cows,” Journal of Animal Science, 90 no. 11 (November 2012), accessed October 1, 2012,
compared to the control treatment.\textsuperscript{104}

ES is a process used to control ovulation in females so that breeding can be completed in a shorter amount of time. Synchronization can shorten breeding time from a 21-day period to as low as a five-day period. Calves derived from ES have also been shown to be ten days older at weaning, also resulting in heavier calves. Estimates of daily growth rate are approximately 0.91 kg/day resulting in a total gain of 9.1 kg and an economic return of $16.23.\textsuperscript{105}

Feed efficiency is an important factor in directly reducing the number of resources used in cattle operations. Herds that require fewer acres for grazing generally translates to fewer acres of forest needed to be cut down. Feed efficiency is largely determined by genetics in both growing and adult cattle. Estimates show that as much as 80 percent of costs related to cattle ranching are earmarked for cattle feed. Improving the efficiency of feed by one percent has an equivalent economic value of improving weight gain by three percent. Interestingly, improved feed efficiency has been shown to increase the age at which a heifer first calves (although no further effects of reproductive performance have been reported).\textsuperscript{106}

As a rule of thumb, cattle require six pounds of feed for every one pound of weight gain. The industry has thus far made little gains in genetic alteration to increase feed efficiency with only a one-pound gain in the last few decades.\textsuperscript{107} Unfortunately, efficiency is difficult to measure because social interaction and normal eating habits require test and control

\textsuperscript{104} An economic evaluation of estrous synchronization and timed artificial insemination in suckled beef cows


groups to intermingle. Systems like GrowSafe utilize RFID technology to measure feed intake. While these systems make data collection easier, they are expensive. GrowSafe uses RFID ear tags and feed trough antennas that record feed disappearance while the animal is present at the trough. This technology provides evidence that genetic selection for lower net feed intake during post-weaning will lead to a decreased feed intake by young and mature cows with no compromise in growth or size.

**Recommendation 1: Do not spend resources on feed and genetic efficiency at this time**

Improved productivity has long been sought by all types of businesses to reduce waste and increase profits with the beef industry being no exception. Although it is possible that increased productivity through genetics and feed efficiency could reduce the need for land use change, we do not feel there is enough evidence that this solution could provide additional significant impact on deforestation at this time. First, large-scale producers have already adopted most of the efficiency gains possible through current technology. Second, these efficiency measures have proven to be challenging for small ranches to adopt; pursuing genetic and feed efficiency requires significant investment, education, and genetic research. Systems like GrowSafe are expensive and require significant user education. Last, we find that this solution lacks evidence of efficacy specific to the Amazon region; it is difficult to determine the precise impact on rainforest depletion that spreading efficiency to small farmers could achieve, due to differences in soil and vegetation quality and type between Brazil and the areas that have been currently studied. Taking all of this into consideration, and being cognizant of the GRSB’s limited time and resources, we believe efficiency is not the most attractive solution for land use change for the GRSB to focus on at this time.

If the GRSB still wants to prioritize this solution, several implementation measures should be considered. First, since large producers are already employing this technology, efforts should be concentrated on small and medium ranches. These ranches currently lack the knowledge, expertise, and capital for adoption, and all three barriers must be addressed in
tandem to produce results. Historically, NGOs have been the primary source for on the ground education and could work in partnership with companies like JBS and Marfrig as well as with universities such as the University of Missouri, which places doctorate students on the ground for research purposes. Capital investment will likely be hard to garner without solid research relating genetics to a reduction in rainforest destruction. Without such evidence, private and public assistance may be scarce. The GRSB could leverage the processor segment of the value chain to provide the resources necessary to help small and medium ranchers adopt efficiency technology, as processors have an incentive to buy uniform and heavy cattle from ranchers.

II: Diversification of farm income
Agricultural diversification has been proposed as a solution to Amazonian deforestation related to cattle ranching. Sociologists have long posited that traditional cultures and economies are better stewards of the native environment, due to centuries of trial and error. European colonists introduced mono cropping in Brazil, and these practices were introduced to the Amazon during the economic development efforts of the 1960-80s. These types of intensive, single product farming systems have been incompatible with conservation, leading to a cycle of continued deforestation, as soils become degraded and unsuitable for crops or pasture and agricultural developers must clear cut new land.¹⁰⁸ Diversification arises in traditional societies as a way for small-scale farmers, with few assets, to spread risk. Much like modern portfolio management theory in the financial industry, farmers are

¹⁰⁸ Jill Caviglia-Harris and Erin Sills “Land use and income diversification: comparing traditional and colonist populations in the Brazilian Amazon,” Agricultural Economics. 32 (2005): 222-234.
able to hedge against environmental and macroeconomic risks of highly productive and lucrative crops (i.e. cattle or soybeans) by integration of diverse crops into an agricultural portfolio.\textsuperscript{109} By preserving ecosystem services and natural habitat, diversification is a more sustainable approach to farming over the long-term.

The prevalence of single crop farms and cattle ranches implies that concentration on high value crops is financially lucrative, but empirical research has begun to show that this is not the case. Perz (2001) studied agricultural diversification in the rural Amazon and found that farmers engaged in diversification have both higher incomes and higher property value.\textsuperscript{110} This finding makes a significant contribution to efforts to reduce deforestation in the Amazon, because there is a negative correlation between agricultural diversification and deforestation rates, even when the crop mix requires cleared lands.\textsuperscript{111} By allowing for crop rotations and replenishment of soil nutrients, farmers can more intensively cultivate land for longer periods than in a mono-cropping situation where new deforestation is required to replace degraded lands.\textsuperscript{112} In the recent period, where land has been widely available and inexpensive, the incentives for monoculture have been high. As the availability of land decreases, however, farmers become more receptive to mixed-use strategies of farm diversification.\textsuperscript{113} Intercropping, or raising multiple crops simultaneously on a plot of land, has been proven to be successful both with mixed plant crops and livestock. One of the most successful examples of this globally is the widespread use of coconut – cattle intercropping in the Asian tropics. The U.N. finds that the same principles that allow cattle to successfully graze among coconut trees are applicable to

\textsuperscript{109} Caviglia-Harris and Sills. “Land use and income diversification: comparing traditional and colonist populations in the Brazilian Amazon.”


\textsuperscript{111} Caviglia-Harris and Sills. “Land use and income diversification: comparing traditional and colonist populations in the Brazilian Amazon.”

\textsuperscript{112} Perz. “From Sustainable Development to 'Productive Conservation:' Forest Conservation Options and Agricultural Income and Assets in the Brazilian Amazon.”

crops grown in Brazil, such as coffee, rubber, palm oil and many fruit trees. The cows graze amid the trees, while providing nutrients back to the soil. Figure 19 shows an example of a mixed crop-livestock system.

**Recommendation 2: Promote diversification of farm income**

As outlined above, there are many benefits of farm diversification. First, small-scale farmers with few assets can spread their risk over several commodities, such as coffee, cattle, and soy. Farmers engaged in diversification have been shown to have higher incomes and higher property values. By allowing for crop rotations and replenishment of soil nutrients, farmers can more intensively cultivate land for longer periods than in mono cropping, thus reducing the need to clear new land to replace degraded lands. Intercropping also adds nutrients to the soil and preserves water. For example, in rotating cattle pastures with crop pastures, cattle manure replenishes soil nutrients for future planting, and the movements of cattle hooves naturally rotate soil and provide aeration and better absorption of water.

In order to implement this strategy to reduce deforestation, education for small-scale ranchers and farmers is key. The existing system of mono cropping is already entrenched, and farmers may not have the resources, knowledge, or interest in adding crops or cattle to their portfolio. Ranchers will need to be educated on what crops can be raised with cattle, how to rotate pastures, etc. Fortunately, this is an area in which the GRSB can play a positive role. NGO members of the GRSB, such as WWF and Rainforest Alliance, already have expertise in creating the type of education networks that could be effective in spreading information about the benefits of diversification and methods of implementing these practices.

As the GRSB considers creating its own certifications, or building off existing standards like the Rainforest Alliance certification for cattle farms, diversification should be included as one of the strategies for ensuring sustainable practices. The Rainforest Alliance

---

certification starts with an initial audit that helps the farmer to identify gaps between current production and the certification standards. The next step is to educate farmers and develop a three-year management plan that aims to increase the sustainability of the farm. So far, the focus has been on educating the farmers rather than certifying them. The education piece here is critical, and the Rainforest Alliance has a proven model. Through workshops, an online training platform, and distribution of posters and pamphlets in local agricultural communities, the Rainforest Alliance introduces farmers to the standards and supports them along the way. In many regions, training is carried out through local partners such as extension agencies, or farmers that have successfully completed this training. Using this type of train-the-trainer model will help farmers learn from each other, and provide credibility to the education. Additionally, lack of investment has been a substantial barrier to the complete role out of the program.

**Leveraging the value chain:** The strategy of farm diversification most directly impacts the ranching stage of the value chain, as farmers and ranchers learn how to efficiently integrate cattle with other crops and capture the economic benefits of crop and pasture rotation. However, in addition to addressing the ranching stage of the value chain, we believe this strategy could also leverage the processor and sales segments. First, the GRSB could investigate the impact of instituting at the processor level preferential buying policies from diversified farms. This could provide an economic incentive for ranchers to invest time and money into learning how to diversify their operations. Second, the GRSB could build diversification into standards for labeling sustainable beef in retail channels, leveraging growing consumer demand for certified sustainable beef.

**Risks and barriers:** This strategy is not without some risks. On one hand, while more intensive land use practices is beneficial from a deforestation perspective, it tends to lead to greater reliance on pesticides and herbicides, to keep smaller plots of land productive.

---

for longer periods.\textsuperscript{117} It is imperative that a diversification solution does not trade one environmental hazard for another. Next, switching agricultural practices is likely to be costly in the short term and may turn out to have minimal benefits for some. If early adopters do not see strong gains, others are unlikely to follow suit. Finally, smallholders may face greater risks than large ranchers and industrial farmers. If they do not have adequate resources, or are uninterested in developing other crops, they could be cut out of the beef value chain. It will be important to ensure that a diversification solution is carried out equitably and addresses the different needs of large and small landholders accordingly.

\textbf{III: Land-use planning: agroecological zoning}

One initiative that could guide further economic development related to cattle ranching while preserving the valuable ecosystems that are at risk is agroecological zoning – sometimes referred to as “go/no go” planning. Presidential decrees put into place agroecological zoning for sugarcane in 2009 (ZAE Cana) and palm in 2010.\textsuperscript{118} We will take a closer look at sugarcane zoning in order to gain insights into how to implement zoning for cattle ranching.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{sugarcane-go-no-go-areas.eps}
\caption{Sugarcane go/no go areas, as established by ZAE Cana.}
\label{fig:sugarcane-go-no-go-areas}
\end{figure}


\textsuperscript{117} Caviglia Harris and Sills, 234.
The standards relating to expansion of sugarcane production were determined through multi-stakeholder engagement efforts with members of industry, civil society, academia, and government. Discussions led to the identification of areas where sugarcane production should be sanctioned and where it should be prohibited. The zoning laid out a comprehensive map (Figure 20) and the following guidelines around go/no-go areas for sugarcane production:

- Production is prohibited in the Amazon region, the Pantanal wetlands and its hydrographic basin, and the Upper Paraguay River Basin. Installation of new units of ethanol production is not allowed in these ecologically critical areas.
- Producers are prohibited from expanding into areas with native vegetation and are not allowed to remove native vegetation to expand sugarcane cultivation.
- Production is prohibited in areas with more than a 12-degree slope. This rule was approved to incentivize mechanical harvesting over manual cutting and improve labor conditions for field workers.
- Sugarcane production expansion is encouraged in areas where full irrigation is not needed. Weather and soil conditions were considered to identify areas where sugarcane could be grown using the least amount of irrigation.
- Production is encouraged in degraded or underutilized areas and on land already used for pasture. The Brazilian government identified over 34 million hectares, including land already used for livestock, suitable for sugarcane production. The policy suggests that increasing livestock efficiency (measured as head of cattle per hectare) may free some of this land for sugarcane.119

The Brazilian government has found that, according to these guidelines, 92.5 percent of Brazil’s territory is unsuitable for sugarcane production. However, the suitable areas identified are considered to be more than sufficient for future cultivation. Currently less than one percent of the country’s land is used for sugarcane, and projections by the

---

Ministry of Agriculture estimate that at most 1.7 percent of total land will be required to meet demand by 2017.

In implementing agroecological zoning, developing strategic oversight systems is critical. The agroecological zoning for sugarcane strategically uses pressure points related to financing and processing to structure enforcement and consequences. Access to capital is tied to compliance with the zoning laws, as national financial institutions are required to evaluate all loans for large farming operations based on observation of agroecological requirements. If activity in conflict with the laws is found, the government can refuse granting or renewing permits to processing facilities. This is a serious threat, as most sugarcane producers have access to only one processing plant in their areas, and sugarcane must be processed within a few hours of harvest.\textsuperscript{120} Placing enforcement mechanisms at these two points – banking and processing – puts the burden of oversight into more easily observable parts of the value chain. An important note about ZAE Cana is that these rules do not apply to industrial units already in use, or their planned expansion.

A similar policy could be created, outlining go/no go regions for cattle ranching in Brazil. As in the sugarcane agroecological zoning policy, identifying the strategic points in the beef value chain where compliance can most easily be monitored is critical to making this type of policy workable.

\textbf{IV: Land-use planning: use of degraded land}

Land is considered degraded once nutrients are eroded from the soil and it is unable to support crops. Typically, farmers use clear-cut areas for crops, but the nutrients in forest soils are too nutrient-poor to sustain crops for long. Within two to three years crop yields fall, fields are abandoned, and grass begins grow. For ranchers these grassy fields are an ideal establishment for raising cattle. However, within five to ten years overgrazing and nutrient loss will turn the fields into wasteland.

\textsuperscript{120} Leopold. “Agroecological Zoning in Brazil incentivizes more sustainable agricultural practices.”
Research has shown that if cattle grazing on degraded land are well managed, the soil will improve, native grasses will return, and the land will become a carbon sink. Moreover, the land will be able to double or even quadruple livestock capacity over time. The process is quite simple and ideally mimics the grazing behavior of undomesticated cattle. The animals chew what is initially available on the land so as to stimulate plant and root growth. Then the herd moves on in a leisurely way. The deep-rooted plants enrich the soil and the hoof movements rotate the hardened earth so that seeds can grow and water can penetrate. Use of degraded lands translates directly into profitability – feed and labor costs plummet, the land is more resilient, and native grasses limit opportunistic/unpalatable plants from invading.121

The Savory Institute is an organization whose mission is to promote “large-scale restoration of the world’s grasslands through holistic management.” According to the approach “Holistic Management teaches people about the relationship between large herds of wild herbivores and the grasslands and then helps people develop strategies for managing herds of domestic livestock to mimic those wild herds to heal the land.” 122 In Australia the Mosley family provides a good example of how holistic management can be adopted by ranchers around the world. The Mosley’s fenced 18,000 ha into 18 paddocks in which two herds rotate through two paddocks at a time. Each paddock is rested for 120 days with the goal of extending the rest period to 150-180 days in order to allow the pastures more time to recover. The results have been extraordinary: animal production is more predictable due to less of a boom-bust cycle; animal handling is streamlined since the herd is simply split in two; the temperament of the cattle has improved due to less handling and the ability of the herd to graze together instead of individually scouring the land for viable feed; the increased ground cover provides better water infiltration and protection

from wind and water erosion; and profitability is up, putting them in the top ten percent of producers in terms of profitability after previously being average to below average.123

V: Financing mechanisms: low interest loans
Low interest loans for farmers are commonplace in many developed and developing countries. However, these loans can decrease deforestation if they are tied to environmental performance. A Brazilian law passed in 2008, Resolution 3545, limits low interest loans for rural farmers to those that can provide proof of compliance with current environmental laws. This type of law will impact agricultural operations that are the most capital constrained, such as cattle ranching. Studies have shown that this law has restricted credit and decreased deforestation in the Legal Amazon region. However, consensus has not been achieved regarding the amount of decreased deforestation that was caused by this law versus by other factors, such as macro economic factors and private initiatives.124 While the Brazilian government has not been able to monitor the environmental compliance of all cattle farms they may be able to prioritize monitoring the farms that receive low interest loans. Decreasing the number of farms that are monitored would decrease the amount of resources that are needed to ensure compliance.

In addition to tying low interest loans to environmental compliance, policies must also ensure that loan requirements do not promote land clearing. Low interest loans to people in areas threatened by deforestation, such as the Brazilian Amazon, should not be tied to occupation of land if occupied is defined as land that is cleared.125 If loans are decoupled from occupation, then one of the incentives for people to clear land will be removed.

Recommendation 3: Agroecological zoning for cattle

Creating go/no go zones for cattle ranching can have a huge impact on deforestation. Similarly to how the Brazilian government has sanctioned palm oil and sugarcane cultivation in specified zones, and outlawed it in environmentally sensitive zones, agroecological zones can be created for cattle ranching. Clearly laying out sanctioned land and developing easy to understand standards, similar to the ones laid out in ZAE Cana, makes it easier for ranchers to comply with laws already in place regarding deforestation.

For ZAE Cana to be successful, a multi-stakeholder group was convened to determine the standards that would govern zoning. This is where the GRSB can play a valuable role, bringing the appropriate parties to the table to help set standards for ranching lands. The GRSB can also lobby the government to adopt cattle zoning standards that are most effective for reducing deforestation.

We recommend cattle zoning include promotion of the use of degraded lands for cattle grazing. This has already been modeled in sugarcane zoning, where ZAE Cana has encouraged the use of degraded or underutilized areas by identifying these areas as “go” zones. In the same way, standards for cattle zoning should incorporate prioritization of degraded land. Use of degraded land can have huge impacts on land quality and land conversion with minimal investment. Not only can these techniques curb deforestation, they can provide steadier animal production, better cattle temperament, more prosperity of native vegetation species, and increased land protection from water and wind erosion. Use of degraded lands is a largely holistic process and thus has few, if any, environmental risks.

The main challenge to agroecological zoning for cattle ranching is establishing effective incentives, punishments, and systems of oversight. Once again, sugarcane zoning can be used as a model. Under that system, national financial institutions are required to investigate all loans for large operations to ensure they are in compliance with ZAE Cana, providing a financial oversight mechanism. As we have discussed, access to capital is an
important component of economic development, especially for small, rural farms, and can be used to regulate land use. We therefore recommend that access to low-interest loans be used as a mechanism for enforcing compliance to cattle zoning law. Resolution 3545, passed in 2008, restricts low interest loans to rural farmers who are able to provide proof of compliance with current environmental laws. Once cattle zoning is passed, Resolution 3545 should include the new environmental regulations related to ranching. The type of monitoring required by this law can be expensive and time-consuming; certainly the government will not be able to monitor the environmental compliance of all cattle farms. However, a policy that focuses on low-interest loans allows the government to prioritize the monitoring of small ranching operations, which are more likely to encroach on protected lands.

*Leveraging the value chain:* Additional oversight should take strategic advantage of the pressure points in the value chain. In sugarcane production, the most effective point identified is the processing facilities. If sugarcane originating from a no-go zone is found at a processing facility, that unit may not have its operating permit renewed. Similarly, the slaughter/process stage is a good leverage point for oversight in cattle ranching. There are only a handful of companies that are responsible for the vast majority of processing. Since the value of beef increases significantly at the processing stage, these companies have a lot to lose if production has to be temporarily halted. In addition, cattle ranchers depend on these companies to buy cattle for slaughter and process, so the threat of temporarily losing their regional customer if the processing unit is temporarily closed could make ranchers accountable to each other.

A significant barrier is, of course, getting the relevant parties to submit to monitoring. Since JBS and Marfrig are both members of the GRSB, this body can certainly play a role in advocating for agroecological zoning policy, if these companies can be brought on board. The advantage of the GRSB is that it includes companies farther down the value chain, like Walmart and McDonald’s. These consumer-facing companies and brands have an incentive to keep a clean name as consumer awareness about where beef originates is heightened. As these companies alter their standards, they can put pressure on producers such as JBS and
Marfrig to buy from sustainable ranchers. If these retailers can work with the nonprofit and government bodies on the board to encourage processors to submit to oversight, great strides could be made with agroecological zoning.

Of course, compliance with zoning and use of degraded lands also requires action at the ranching phase of the supply chain. Specifically, this solution targets small and medium size ranches that often bypass government enforcers and instead cut down forests and institute land tenure. At this stage, a barrier to large-scale adoption of agroecological zoning and use of degraded lands is education. If new zoning laws are put into place, ranchers will need to be educated to understand how to stay within compliance with the laws. This is a place where NGOs on the GRSB can play a big role. The Rainforest Alliance has already been working diligently to certify cattle ranches in the amazon through techniques that aim to reduce the carbon footprint of cattle ranches, but engaging ranchers has been the most difficult part of the process. Rainforest Alliance extends invitations to ranchers for workshops but does not place pressure on attendance. However, it only takes a few champions in a region for these types of programs to have success. The education process involves not only certifying the ranch but also the rancher to go out into the community and teach others. This system allows for more rapid success and knowledge transfer.

**Risks and barriers:** Getting producers to submit to monitoring for compliance mechanisms is a barrier already discussed above. Another major barrier is lack of government enforcement. The Forest Code has been in place for decades, yet many agree enforcement has not been consistent. If agroecological zoning laws are similarly considered toothless, this policy will not have significant impact on land conversion. This is why it is critical that the GRSB help develop an oversight system that is enforceable at the ranching and processing stage of the supply chain.

**VI: Financing Mechanisms: REDD**
Reducing Emissions from Deforestation and Degradation (REDD) financing has the opportunity to provide a new source of funding for developing countries that are trying to
stop deforestation while benefiting many stakeholders. Under a REDD market, credits are established and verified for land that is protected from deforestation. Those credits are then sold on a credit market and bought by companies to meet emissions reduction obligations. Figure 21 gives an overview of how REDD creates a financial incentive for conserving forest, and how funds from REDD credits are reinvested to support alternatives to land clearing. Developing countries have the greatest potential for CO₂ mitigation through decreasing deforestation and degradation and the greatest opportunity to sell certified credits. Currently, 36 percent of voluntary credits are made up of Forestry-based credits, for a total value of $331 million.¹²⁶

There are three possibilities for REDD financing: a voluntary fund, a market mechanism, and hybrid mechanism. A voluntary fund could operate on many levels (national or international) and could source capital from both public and private sources. In a market mechanism, REDD credits would be traded with other certified credits by companies seeking to meet emissions reduction targets. In a hybrid system, funding would be generated through an auction or a market in which REDD credits link to, but are not traded alongside, certified credits. Several hybrid systems have been proposed, such as Norway’s Assigned Amount Units (AAUs) auction and the Center for Clean Air Policy’s “Dual Markets” approach.

Most likely, a combination of these mechanisms will be needed for REDD financing in addition to a large role for governments. The voluntary funding could be most useful at the
beginning in order to develop a strategy surrounding REDD at the national level and to strengthen institutions that will be needed for the market mechanism. After the initial round of financing, additional funding could be linked to both decreased deforestation results and the application of the national REDD strategy. Once countries have begun to implement REDD strategies and the necessary institutions and infrastructure is in place, the funding system could transition to a market based mechanism where certified emissions reduction credits would be traded alongside other certified credits.127

Several concerns and barriers currently exist with regard to the implementation of REDD financing mechanisms. One concern is that the large number of potential forestry-based credits could flood current credit markets, causing the price to crash. Another possible barrier is that the voluntary market for emissions reductions credits currently provides a small amount of funding for REDD financing and this would likely need to be ramped up considerably.128 In addition, there is concern about the poor that live in the areas that would be most impacted by REDD financing, including issues surrounding land tenure and the right to use the land. Furthermore, there is criticism that this type of funding would benefit developing countries that currently have high deforestation rates and penalizing those with low deforestation rates.129

**Recommendation 4: Pilot REDD**

We recommend the GRSB partner with other stakeholders to pilot a REDD program in Brazil. Brazil could be an important market for Forestry-based credits due to the immense size of the Amazon as

127 Simula, M. “Redd Financing: Overview of Key Issues.”
129 Simula, M. “Redd Financing: Overview of Key Issues.”
well as the history of deforestation and associated CO₂ emissions. While deforestation in the Amazon has decreased significantly since 2004 (see Figure 22), approximately 2500 square miles of forest were lost in 2011 alone.\textsuperscript{130}

One of the major benefits of REDD financing is its ability to move funding from CO₂ emitting developed countries to cash strapped developing countries. This is especially relevant in the Amazon due to the large amount of land that is impossible for the Brazilian government to police with current environmental funding. The onerousness of ensuring that deforestation isn't occurring could be moved from governments to private credit certification organizations. It also offers the opportunity for companies in developed countries to offset their emissions by purchasing forestry-based credits that prevent deforestation or make reforestation possible.

There are three recommended phases for implementing REDD.\textsuperscript{131} In phase I, a national strategy is built to tackle the drivers of deforestation. This stage involves analyzing forest governance gaps and developing strategies to address those gaps, establishing national forest reference levels and systems for monitoring changes in forest area, and initiating

\begin{itemize}
\end{itemize}
pilot activities. Phase II focuses on building the frameworks necessary for implementing REDD on a national level. This involves training the appropriate groups in regulatory frameworks and enforcement practices, creating a system for the distribution of benefits, and developing the portfolio of funding options. In Phase III, REDD is formally implemented. At this point, payments based on performance are disbursed using carbon markets or fund-based mechanisms. In addition, third party verification of emissions reductions takes place.

REDD is still in the initial stages of development around the world. Figure 23 shows examples of some of the REDD markets currently underway; as evidence in this map, many REDD systems are still in the design phase. For this reason, we recommend the GRSB work with other stakeholders to conduct the initial research that will be necessary to determine if REDD is appropriate for Brazil, and to run a pilot test of the market. The GRSB can also play a role in developing a funding pool for the pilot phase of REDD. Two GRSB members, JBS and Marfrig, are Brazilian-owned companies; we hope that these companies, along with some of the large consumer-facing companies in the beef value chain, would be invested in providing some of the funding needed for a pilot market. Putting money towards a pilot would demonstrate a commitment to working towards a more sustainable beef value chain. Another source of funding could be the $1billion Norway committed to financial assistance of Brazil’s efforts to reach its climate goals.132 Finally, the NGO members of the GRSB could be involved in the education campaign that would be necessary should REDD be adopted in Brazil.

132 Nepstad et al, “The End of Deforestation in the Brazilian Amazon.”
Several stakeholders will be needed in order to allow forestry-based credits to make a significant impact on deforestation. Developed country governments and trading scheme architects will be needed in order for forestry-based credits to be allowed in the next round of trading schemes. NGOs will be needed in order to educate developing world ranchers, especially the smallest and poorest, about the benefits of credits. Developing country governments will be needed to ensure that the proper institutions and infrastructure is in place to allow credit markets to operate efficiently in their countries. Finally, private companies or NGOs will be required in order to certify that forestry-based credits are actually decreasing deforestation.

**Leveraging the value chain:** Forestry-based credits would be implemented in the ranching stage of the beef value chain. This strategy is designed to give ranchers an economic

---

**Figure 23:** Map of some of the REDD markets currently underway around the world. Source: Environmental Defense Fund, March 2010. Retrieved April 16, 2013 from http://www.edf.org/sites/default/files/10892_REDDmap_EDF_0.pdf
incentive for preserving forest, and should provide a second form of income for cattle ranchers.

*Risks and barriers:* The largest barrier to REDD financing is the uncertainty of future carbon markets. If companies are not certain that they will have to reduce or offset their carbon emissions, then they will be reluctant to spend resources on forestry-based credits. Additionally, forestry-based credits are currently only allowed in voluntary trading schemes. This limits the market for credits and the funding that is available to flow into developing countries. Furthermore, if forestry-based credits are introduced into current emissions trading schemes the large number of potential credits could flood current markets, causing the price to crash.

One of the environmental risks is that forestry-based credits benefit countries with high rates of deforestation more than those that have policies in place to keep deforestation low. This may encourage deforestation in developing countries in order to increase opportunities for forestry-based credits.

In addition to environmental risks, critics also have socioeconomic concerns. One of the main concerns is for the poor citizens living on land that would be eligible for forestry-based credits. It is possible that credits could impact land tenure as well as the right to use land.133

A possible economic risk that could be created by forestry-based credits is the dependence on foreign funding that occurs through markets. The history of emissions trading schemes and reduction credits has included significant drops in credit prices. If the developing world becomes dependent on credit markets and a price crash occurs, economic consequences could be severe and deforestation could jump.

---

133 Simula, M. “Redd Financing: Overview of Key Issues.”
NEXT STEPS FOR THE GLOBAL ROUNDTABLE FOR SUSTAINABLE BEEF

We have investigated six possible solutions to cattle-based deforestation in the Amazon. From research into these solutions, we have developed four recommendations for the GRSB, including three courses of action we propose the GRSB take, and one solution we recommend the GRSB not put resources towards at this time. Our research also allowed us to qualitatively estimate the political viability and the effectiveness at reducing deforestation for each of these recommendations. Figure 24 shows how each recommendation maps out by those measures. Based on this analysis, we recommend a timeline for the GRSB to pursue these recommendations. Figure 25 shows this timeline, along with a recap of the specific roles we believe the GRSB is suited to take in each of these areas, and the additional stakeholders that must be engaged for these efforts to be successful.

Because farm diversification methods have already been researched and proven, we believe diversification can be implemented in the short term. The main barrier remaining at this time is education, and this is an area where the GRSB can play a role. The GRSB can also be involved in building diversification into the standards for sustainable beef that are being developed, and can investigate the possibility of building diversification into preferential buying practices.

Agroecological zoning will require significant involvement from the Brazilian government, so we recommend this for implementation in the medium term. The GRSB can take action
by lobbying the government to pursue the same sort of zoning laws for cattle that have already been put into place for sugarcane and palm oil, and by being a part of the multi-stakeholder group that will be necessary to develop zoning standards. A cattle zoning law will absolutely require monitoring and enforcement to be effective, so the GRSB members can pave the way for cattle agroecological zoning by agreeing to submit to monitoring and enforcement measures. NGOs on the GRSB can take part in the education campaign that will be necessary once zoning law goes into effect.

**Figure 25: Recommended course of action for the GRSB**

The most effective methods of implementing a REDD credit market are still being researched by conservation groups around the world. For that reason, we recommend the GRSB make REDD a long-term priority. The role of the Roundtable will be to engage with other stakeholders in the cattle value chain to pursue phase I of REDD implementation, and to investigate funding options for the pilot phase.
Although the GRSB includes members from all parts of the beef value chain, this body will certainly not be able to work in isolation. Each of our recommendations will require engaging with outside stakeholders. In particular, Brazilian cattle ranchers are not directly represented on the Roundtable, but are a critical stakeholder for the success of any of these solutions. Government bodies will need to be involved in creating laws or policies that will support agroecological zoning and a REDD market. In order to address one of the main concerns of REDD – that the economic benefits of the credit market truly reach the rural populations responsible for conserving forest land instead of developing it – rural populations will need to be engaged in implementing REDD. Last, financial institutions will be necessary to support the REDD credit market.

**REVISITING OUR RESEARCH QUESTION**

Our project aimed to pinpoint the leverage points in the value chain for reducing cattle-based deforestation. Not surprisingly, we found that the middle segments of the value chain, from ranchers to sales companies, are the most critical. Figure 26 shows which segments of the value chain the recommendations we have outlined most aim to affect. Importantly, our research sheds light on the fact that, while ranchers are the ultimate target of the solutions to cattle-based deforestation in the Amazon, this is a very fragmented group, which can make it difficult to implement practices that would decrease the impact of the beef value chain on deforestation. We find that, to be successful in

![Figure 26: Recommendations mapped to the beef value chain](image-url)
implementing our recommendations, the GRSB will need to use the power and influence of the slaughter/process/sales segments of the chain to implement change. These are the segments of the value chain with the most resources and power, and these are the segments of the chain that are the target of consumer demands for sustainable beef. By getting the slaughter/process/sales segments of the chain on board with solutions to cattle-based deforestation, the GRSB should be able to push the Brazilian government to implement the recommendations we have outlined, and the GRSB should make use of its NGO members to make sure ranchers have a voice at the table.

**CONCLUSION**
The links between deforestation in the Brazilian Amazon and the cattle ranching industry are clear. As Brazilian ranchers and farmers respond to global pressures for more beef, compete for arable land for food, fuel and fiber cropping, and take advantage of policies and incentives for cultivation in the Amazon region, ranchers have moved into the more remote regions of the country in search of grazing land. The environmental implications of deforestation are global; greenhouse gas emissions from deforestation are a leading contributor to climate change, countless keystone species are at risk due to habitat and biodiversity loss, and cleared lands are subject to severe degradation.

Non-governmental organizations like the World Wildlife Fund have taken note, and are at the center of multi-stakeholder dialogues about reducing the deforestation impacts of the growing beef industry. As a founding member of the Global Roundtable on Sustainable Beef, WWF is seeking solutions that will engage players from across the value chain in enhancing sustainability of the industry.

A value chain assessment reveals that while the ranching stage of the chain is the most highly fragmented, this is where changes must occur. Therefore, solutions must involve players from more concentrated stages like processing and distribution in initiatives that will place pressure on ranchers to produce beef in a more sustainable way.
Three primary solutions are recommended for the GRSB to pursue. In the short term, farm diversification initiatives will provide greater financial security for farmers and ranchers while reducing deforestation pressures. This practice can be built into sustainable beef certification standards like those of the Rainforest Alliance, to create awareness and demand among end consumers. Through a train-the-trainer model, Rainforest Alliance can help ranchers overcome the knowledge barriers that prevent intercropping and reach those in the most remote regions of the Amazon.

In the medium term, agroecological zoning is an attractive option for better land use planning with regards to cattle ranching. The model has been successfully proven in the Brazilian sugarcane industry, with downward pressure for compliance coming from the processors who are monitored at the slaughterhouse stage. It will take time for a new government policy such as this to come into effect, but engagement from the GRSB can help move the scientific foundation for zoning designations forward.

Finally, REDD financing will be an important element of the solution to Amazonian deforestation in the long-term. There are still significant barriers to implementation of REDD, primarily the lack of a global market for certified carbon credits, but the GRSB can contribute a strong voice of support to the global dialogue. GRSB members can build on-the-ground support for REDD, help design financing mechanisms, and provide education to local ranchers about forthcoming programs to ensure that the financial benefits are transferred to the communities who deserve them most.

While there is no silver bullet for solving the problem of beef related deforestation in the Brazilian Amazon, the World Wildlife Fund and the Global Roundtable for Sustainable Beef are in a unique position to provide direction. Thoughtful development of these initiatives can meet the needs of players throughout the entire value chain, and leverage their respective interests to build successful programs for reducing deforestation.
Appendix A: WWF Bios

Alex Bjork
Senior Program Officer, Agriculture
World Wildlife Fund, US

Alex joined WWF in 2009 and is a member of the agriculture team in WWF’s Market Transformation program. In this role he has helped launch Global Roundtable for Sustainable Beef multi-stakeholder initiative, supported the development of WWF’s supply risk assessment tools for corporate engagement, and coordinates various supply chain innovation projects with corporate partners.

Alex has a B.A. (History) from Concordia College in Moorhead, MN and a M.B.A. (International Business) and M.A. (Global Finance & Trade) from the University of Denver. Prior to attending graduate school and joining WWF, Alex worked in public education for four years as a classroom teacher and community director in Minneapolis and Denver.

David McLaughlin
Vice President, Agriculture
World Wildlife Fund, US

David McLaughlin has 28 years production experience working with Chiquita Brands in Central America. While with Chiquita, David held a wide variety of financial, production and management positions in both palm oil and banana production in Costa Rica and Panama. These assignments included managing Chiquita’s largest palm oil plantation and running two extraction mills, establishing and managing Chiquita’s banana production operations on the Atlantic coast of Costa Rica, and managing Chiquita’s banana production operations in Panama. While managing Chiquita’s operations in Costa Rica, David led Chiquita’s efforts with the Rainforest Alliance to implement environmentally friendly production practices on Chiquita’s farms. This experience led to an eight year effort developing and leading Chiquita’s strategy on improving environmental and social performance in all of Chiquita’s operations worldwide, implementing Rainforest Alliance certification, developing a Code of Conduct for Chiquita, achieving SA8000 certification in all Chiquita owned operations, implementing GlobalGap certifications and actively
participating in developing a Corporate Responsibility strategy for Chiquita and issuing public reports on progress and issues encountered. In addition, while at Chiquita, David was on Social Accountability’s Advisory Board and Chairman of the International Banana Association Science Committee.

His work at WWF includes an evaluation of planting practices to establish palm oil on degraded lands in Indonesia, an evaluation tool to access the establishment of biofuel crops, multi commodity risks assessments for major food companies, and field review of social and environmental programs, and establishing a due diligence process in commodity trading. In addition, David is the Sector Lead for Agriculture for WWF’s Market Transformation Initiative, which includes coordinating the various global commodity roundtables.

David has lived in Latin America for more than 40 years and has a BA in Government from Connecticut College and an MBA from Babson College with an emphasis in international finance.

**Bryan Weech**  
Director, Livestock World Wildlife Fund, US

Bryan Weech joins WWF with broad based experience in the beef and livestock industry. Most recently Bryan was responsible for procurement for Applegate Farms, a natural and organic meat processing company whose customers include Whole Foods, and other nationally recognized grocers. His responsibilities required him to source raw material from three different continents. Before that Bryan served as Director of Pricing and Analysis at Coleman Natural Foods, where he set pricing, scheduled production and analyzed market trends. Bryan’s other work experience includes working for Cattle-Fax, a non-profit, member owned market consulting firm, and ConAgra Beef Company now JBS Swift, as well as Gelvieh Profit Partners, an investor owned cattle feeding venture. Additionally, Bryan has worked for numerous ranches throughout the U.S. and has experience in the dairy industry as well. Bryan holds a Masters of Animal Science and an
MBA from Colorado State University and an undergraduate degree in Animal Science with a minor in management from Brigham Young University.

Bryan and his wife Becky have five children (Parker, McKenna, Haylie, Dallin and Andrew). Bryan and his family live in Parker, Colorado and enjoy the outdoors, including horseback riding, camping, hiking and coaching his children's sports teams.
**Works Cited**


Fearnside, Philip M. “Predominant Land Uses in Brazilian Amazonia.” Alternatives to Deforestation, 1990. http://www.academia.edu/1190143/Predominant_land_uses_in_the_Brazilian_Amazon.


Houghton, Chapter 1 of Moutinho, Schwartzman and Santilli, from EDF.org. “Tropical Deforestation and Climate Change” pg 13.


Marfrig Group. “Investor Relations.”


