



An Investor Brief on Impacts
That Drive Business Risks

BEEF

This brief provides a summary of the main environmental and social factors that affect beef production worldwide; however, it spotlights key players in the U.S. value chain.

KEY TAKEAWAYS

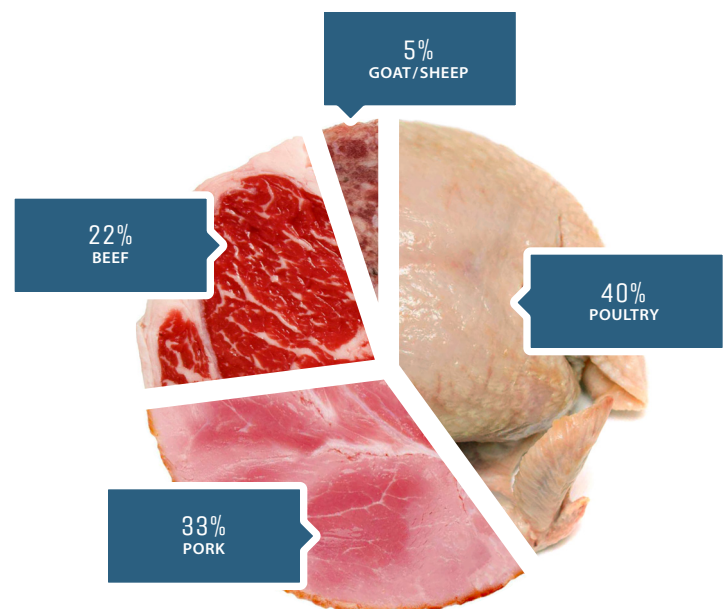
- Demand for beef is expanding, propelled by rising incomes and population growth.
- The U.S. and Europe are the two largest producers of beef worldwide.
- Beef production generates significant greenhouse gas emissions and wastes that contribute to water pollution, when handled poorly.
- Beef production also uses a lot of water. In the U.S., water availability is one of the key issues affecting beef production.
- The production of feed for beef and cattle uses a lot of land and also drives deforestation in countries like Brazil.
- Investors should address risk in the beef supply chain through direct engagement with their portfolio companies and support of relevant policies and multi-stakeholder collaborations. Effective implementation of a company's policies requires promoting commodity traceability and having a clear approach to supplier engagement, verification, and disclosure of progress.

COMMODITY OVERVIEW

Beef Is the Third Most Commonly Consumed Meat in the World, after Pork and Chicken

Beef products are typically sold as wholesale cuts, ground beef for commercial use, or packaged cuts sold in retail outlets.²

Beef by-products, including leather and fat, are used for many non-food items, including candles, crayons, paint, and shoes.



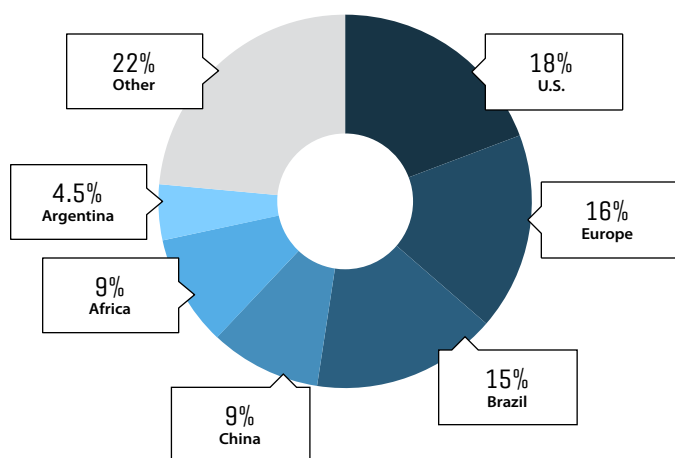
Global Meat Production, by metric tons²

GLOBAL PRODUCTION DATA

The U.S., Europe, and Brazil are the Largest Producers of Beef, Accounting for One-Third of Global Production

Global beef exports have risen in recent years from 5 percent annually to 20 percent in 2022. Challenges to beef exports include the heavy weight of beef, trade policies, concern about spoilage, and potential cold chain failures.²

TOP FIVE PRODUCTION REGIONS²



68 MILLION METRIC TONS

Average global beef production

\$292.2 BILLION

Global production value, 2018²

\$1.95 BILLION

Global production exported, 2020²

Rising Incomes Globally Drive Beef Demand and Production

Globally the demand for beef during the next several decades is expected to continue (by approximately 60 percent by 2050).² This increase is driven in large part by a growing global population, rising incomes, urbanization, and westernization of diets in developing countries.²

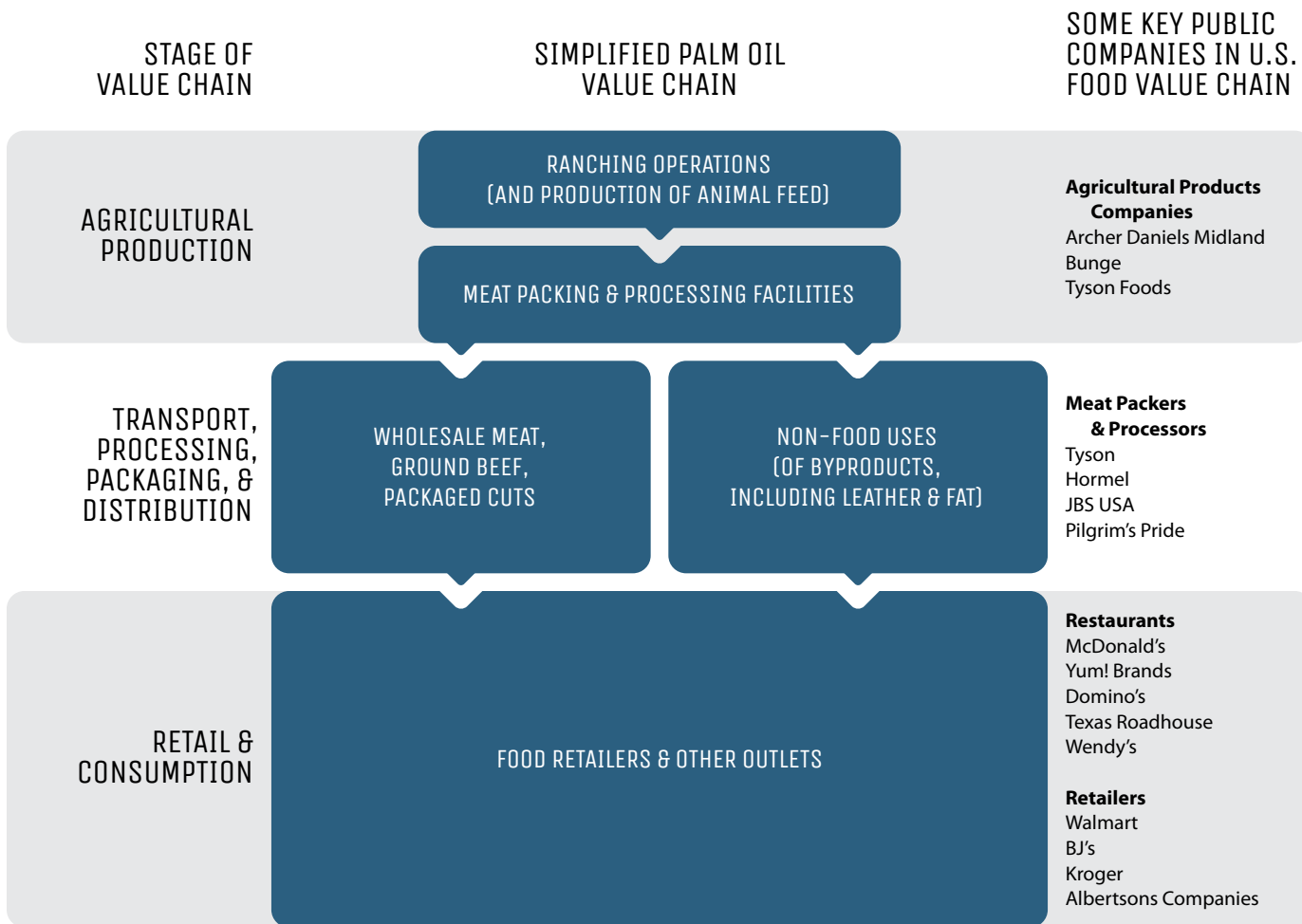
BEEF AND DAIRY SECTORS ARE LINKED IN SOME COUNTRIES

When assessing beef production trends, it is important to keep in mind that in some countries the beef industry is highly dependent on the dairy sector. This is the case in New Zealand and Europe, for example, where 80 percent of the total beef supply comes from dairy animals (culled dairy cows and surplus male calves).² By contrast, in the U.S., given abundant grasslands and a large grain supply, the beef industry is not as closely linked to the dairy sector.² An estimated 17 percent of all beef calories produced in the U.S. originated in the dairy system.²



THE BEEF VALUE CHAIN

The Beef Supply Chain is Complex, Involving Numerous Steps and Types of Operations



KEY PLAYERS

The following provides additional information about some of the companies in the U.S. beef food value chain. While the focus is on publicly traded companies headquartered in the U.S., some of the companies mentioned are headquartered outside the U.S. and/or are privately held.

RANCHING OPERATIONS

Before cattle are slaughtered by meat-packing or meat-processing companies, they are raised and handled at three distinct types of ranching operations: cow-calf operations, stocker and backgrounding operations, and feedlot operations.

Feedlots with less than 1,000 head of capacity compose the vast majority of U.S. feedlots, but market a relatively small share of fed cattle. In contrast, lots with 1,000 head or more of capacity compose less than 5 percent of total feedlots, but market 80 to 90 percent of fed cattle.² While there are many businesses involved in this sector, the top five states with large cattle feedlots (with a capacity more than 1,000 head) are Texas, Nebraska, Kansas, Colorado, and Iowa.²

AGRICULTURAL PRODUCTS COMPANIES

Companies that supply animal feed are critical actors in the beef supply chain. Beef raised in the U.S. is primarily finished² on grains, including corn, soybeans, and alfalfa (by comparison, beef produced in Brazil is mostly grass-finished).² The largest publicly traded U.S. agricultural products companies are Purina Animal Nutrition (subsidiary of Nestlé, a member cooperative), Tyson Foods, and Archer Daniels Midland (ADM). Collectively, these companies produce nearly 40 million metric tons of feed annually.²

BEEF PACKERS AND PROCESSORS

The U.S. beef packing industry is highly concentrated. Four companies control the large majority of beef slaughtering operations: Tyson Foods, JBS USA (headquartered in Brazil), Cargill (privately held) and National Beef (owned by Marfrig, which is headquartered in Brazil).² Other large companies involved in processing beef include Hormel Foods, Conagra Brands, and American Foods Group (privately held).²

RESTAURANTS AND RETAILERS

Restaurants and retailers play an important role in the beef value chain. These companies can indirectly influence production practices and supplier standards within their supply chain. Moreover, they are sensitive to external pressures as well as responsive to market trends and consumer preferences.

Roughly two-thirds of the U.S. beef supply goes into food service — restaurants and cafeterias — while the other third is sold in supermarkets.² Based on systemwide sales, the five largest burger chains in the U.S., in order, are McDonald's, Wendy's, Burger King (owned by Restaurant Brands International), Sonic Drive-In, and Jack in the Box.² In terms of supermarkets, the four largest food retailers in the U.S. are Walmart, Kroger, Albertsons, and Ahold Delhaize.²

Overview: The Stages of Beef Production

Beef production begins with a cow-calf producer who maintains a breeding herd of cows. Beef cows (and their calves) graze on range and pastureland, as such this stage involves very little, if any, grain input.² When calves are between six to twelve months of age, they are weaned and transported from their ranch or farm of origin. They may be sold at auction, sent to a stocker or backgrounder (if they are younger or lighter weight and need to graze longer), or go directly to a feedlot.

In a feedlot (sometimes called a feed yard), the animals are fed a grain-based diet if produced using conventional practices. The time cattle spend in a feedlot is often called the "finishing phase."² However, some producers choose to finish cattle on grass pasture, and the beef derived from these animals is "grass-finished" (sometimes called "grass fed"). Once cattle reach market weight they are sent to a processing facility to be harvested.²

ENVIRONMENTAL AND SOCIAL FACTORS



BIODIVERSITY



DEFORESTATION &
LAND USE CONVERSION



CLIMATE CHANGE



WATER USE & POLLUTION

Globally, the environmental and social issues linked to beef production include deforestation and land conversion, greenhouse gas (GHG) emissions, water pollution, animal welfare, and worker's rights. The scale of the impacts depends on the practices used by ranching operations and feed growers, as well as regional and local conditions.

1 CATTLE AND THEIR MANURE CONTRIBUTE SIGNIFICANTLY TO GREENHOUSE GAS EMISSIONS

Beef production has a significant impact on climate change, accounting for 9.4 percent of total anthropogenic greenhouse gas emissions.²

- Cattle contribute directly to greenhouse gas emissions when they digest their feed and produce manure. Fertilizers and energy used for growing the animal's feed also contribute to total greenhouse gas emissions.

- More than half of the global emissions from the livestock sector are related to beef and cattle milk (beef accounts for 41 percent; dairy cows for 20 percent).²

When calculating a "greenhouse gas footprint" for beef in any particular operation, it is important to understand how the cattle are raised, because their type of feed and other management practices affect the amount and type of greenhouse gas emissions generated.² Companies that fail to understand and manage impacts related to these issues may face litigation and operational risks.

2 POOR HANDLING OF MANURE, FERTILIZER, AND PROCESSING WASTES POLLUTE LOCAL WATER RESOURCES

Cattle operations can contribute significantly to water pollution when manure and feed crop production are poorly managed. The nitrogen and phosphorus nutrients from the manure and synthetic fertilizers used to grow crops can run off fields or leach into the water. This contributes to "dead zones,"² or areas of water bodies where aquatic life cannot survive because of low oxygen levels. Specifically, in the Gulf of Mexico (into which runoff from production in the Mississippi River watershed flows), the National Oceanic and Atmospheric Administration (NOAA) reported that the dead zone in July 2017 was the largest ever measured, covering an area about the size of New Jersey.²

Not only are these dead zones harmful for aquatic life, but they pose serious human health risks and contaminate local

drinking water supplies. The economic impact is significant with NOAA estimating that the harmful algae blooms causing dead zones cost the seafood, restaurant and tourism industries about \$82 million every year.²

Surface water and groundwater can also be contaminated by sediment from poor grazing management. Moreover, as the global cattle industry expands, so have the beef slaughter and leather industries. Slaughterhouse and tannery waste — rich in organic matter, heavy metals and caustic solutions — is highly polluting to local water resources when it isn't treated.²

Companies that fail to understand and manage impacts related to water pollution may face operational, reputational, and regulatory risks (see more at Ceres' *Feeding Ourselves Thirsty*).²

3 BEEF PRODUCTION CONTRIBUTES TO LAND CONVERSION

Raising beef uses more land — between three to ten times more — than any other meat, including chicken and pork.² Permanent pastures² (much of it used for cattle) make up 70 percent of all the land used for agriculture.² Overgrazing, soil compaction from cow's hooves, and poor agricultural practices can degrade topsoil and organic matter, which can take decades or centuries to be replaced.

When beef is raised in sensitive and important ecosystems, including the North American Great Plains, Brazilian Cerrado, the savannahs of Southern Africa, and the Great Barrier Reef watershed of Australia, the impact of beef production can be significant.² In the Chaco mixed grass

and woodlands of Paraguay and Argentina, between 1976 and 2020, more than 142,000 square kilometers have been converted for agricultural reasons. Primary agricultural drivers of this conversion include pastureland for cattle and soy production for cattle feed. In Brazil, cattle ranching occupies about 80 percent of the deforested area in the Amazon. While progress has been made in Brazil in the last decade to cut high rates of deforestation, ongoing action to avoid further conversion of native vegetation is required. Companies that fail to understand and manage impacts related to these issues may face market, litigation and reputational risks.

4 HIGH WATER DEMAND RELATED TO BEEF PRODUCTION CONTRIBUTES TO VULNERABILITY DURING DROUGHTS AND GROUNDWATER DEPLETION

Producing beef uses a lot of water — for irrigating pastures, producing feed, watering animals, managing manure, and processing products. Though beef's "water footprint" varies based on production and feeding systems, in most cases the crops used as cattle feed make up a large part of that footprint.² Among the different feed crop options, corn and alfalfa use the largest volume of irrigation water.²

As water stress increases, the vulnerability of beef production to drought and competition for other uses can increase:

- In early 2022, 50 percent of cattle inventory in the U.S. was within an area experiencing drought.²

- During the drought in California in 2014, dry pastures and higher hay and silage costs caused \$203 million in revenue losses for the dairy and livestock sector.²
- Several states in the U.S., including Colorado, Kansas and Texas, have a large number of cattle feedlots that rely on the already stressed Ogallala aquifer. About one-fifth of all U.S. cattle, corn, cotton, and wheat depend on the Ogallala.²

Companies that fail to understand and manage impacts related to these issues may face operational, reputational and regulatory risks (see more at *Ceres' Feeding Ourselves Thirsty*).²

U.S. SPOTLIGHT: OVERALL FOOTPRINT

One study calculated that beef production in the U.S. requires 28 times more land, 11 times more irrigation water, 5 times more greenhouse gases, and 6 times more reactive nitrogen, respectively, than other livestock categories (i.e., dairy, poultry, pork, and eggs).²

It takes **14,964 LITERS OF WATER** to produce **1 KG OF BEEF**
(weighted global average)²

U.S. SPOTLIGHT: ANIMAL DENSITY IMPACTS

In 2020 the U.S. produced approximately 27.2 billion pounds of beef, and in 2020 there were approximately 31.2 million beef cattle.² As animal density has increased in the U.S. (about 100 lots contain over 30,000 cattle), so have concerns about air and water quality, occupational health, and waste management.²

5 FARM ACTIVITIES CAN CREATE HAZARDOUS WORKING CONDITIONS AND AIR QUALITY CONCERNS

On ranches and farms, the greatest safety issues arise from operating heavy equipment and handling animals. In 2020, 55 people in the U.S. were killed while working in beef cattle ranching and farming, including feedlots. This represents around 11 percent of fatal injuries taking place in the agricultural sectors.² Dust generated by animals and their feed, along with gases from animal wastes can be hazardous to human and animal health.² The particulate matter and odor from farm activities can also negatively impact air quality.

Workers in slaughterhouse and meat processing plants can face hazards such as exposure to chemicals and pathogens, traumatic injuries from machines and tools, and chronic musculoskeletal injuries. Injury rates are higher than the rest of the manufacturing industry, yet are likely underreported. Workers are often immigrants or refugees and may underreport injuries or illnesses for fear of losing their jobs and livelihoods. Moreover, companies may underreport these grievances due to concerns about potential costs.²

6 HUMAN RIGHTS CHALLENGES COULD CONTRIBUTE TO CONSUMER CONCERN AND REPUTATIONAL RISK

Cattle and beef are reportedly produced with forced labor and/or child labor in a number of countries.² U.S. companies face reputational, market and litigation risks if importing beef

from countries where these challenges occur. Brazil is one of the countries that is an important exporter of beef to the U.S. and for which there is documented evidence of child labor.²



7 ANIMAL HEALTH AND WELFARE ISSUES SPUR CONSUMER AND PUBLIC HEALTH CONCERNS

Several animal health and welfare issues can create major reputational and regulatory risks for companies:

- Significant media attention has put the spotlight on “factory farming” and the industrialization of the beef business.² A majority of consumers care about animal welfare, according to surveys in Europe and North America, which creates a risk of contracts by corporate customers being terminated to meet consumer pressure.² In addition to the possible reputational risk, issues related to animal welfare link to food safety and drug use and are therefore critical for companies to take into account as a part of a comprehensive operational risk management strategy.²
- Routine, nontherapeutic use of antibiotics in food animal production is contributing to a growing crisis of antibiotic-resistant infections in humans.² By contrast, the therapeutic use of antibiotics is shown to have positive effects on animal health and welfare. In the U.S., for example, 75 percent of all antibiotics are given to farmed animals. The misuse of these drugs for nontherapeutic purposes poses a business risk not only from a reputational perspective, but also with respect to emerging regulatory and trade restrictions.²
- The use of growth-promoting hormone implants, designed to improve an animal’s weight gain and feed efficiency, may contribute to consumer concern and therefore reputational risk.²

8 SMALL PRODUCERS LACK ACCESS TO RESOURCES, LIMITING THEIR LIVELIHOODS AND ABILITY TO INVEST IN IMPROVED PRACTICES

In some countries, small producers are the largest producers of beef. They often don’t have access to the resources they need to sustain their livelihood and invest in improving farming and cattle raising practices.² In Brazil, for example, about 1.8 million ranchers raise cattle, with an average of only 110 heads of cattle per ranch. Small producers also may face

other challenges, including limited grazing and resource rights as well as access to credit, fair pricing, extension services and cold chain infrastructure.² Lack of attention to the issues involved with smallholder production can lower both the quality and quantity of supply for agribusinesses.

Slaughterhouse and Meatpacking Working Conditions Pose Potential Risk

Slaughterhouse and meatpacking workers are at higher risk of developing airborne illnesses, such as COVID-19. According to the NIH, 110,300 cases of COVID-19 were confirmed in beef meatpacking workers in the first year of the pandemic (April 2020 to May 2021), with a test-positivity rate over 50 percent at some of the largest plants in the U.S. Eighty-seven percent of these cases occurred in workers identifying as a racial or ethnic minority. These beef-specific facility outbreaks resulted in at least 6,070 deaths that can be attributed COVID-19.²



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