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Corn and Soybean Cost of Production in Brazil and the United States

Constanza Valdes, Jeffrey Gillespie, Daniel Bonin,
and Sara Scott





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Corn and Soybean Cost of Production in Brazil and the United States

Constanza Valdes, Jeffrey Gillespie, Daniel Bonin, and Sara Scott

Abstract

This study compares corn and soybean production costs and returns between Brazil and the United States. It centers on farm-level production costs for the 2023–25 period, comparing input usage and farm practices. Prices received by farmers and average yields for each crop in each country are analyzed to calculate producer returns. The comparison is situated within the broader context of the two countries' importance in global markets for these crops. Brazil and the United States collectively accounted for 58 and 83 percent of global trade in corn and soybeans in marketing year 2025/26, respectively. Brazil has emerged as a major competitor to the United States, driven by expansion of soybean production and double cropping systems—particularly second-crop corn following soybeans—which has reshaped global export patterns. This study's findings highlight a range of factors that influence production costs and returns of these countries for corn and soybeans, such as production practices and technological advancements, and examines the differences. The roles of Government policies, infrastructure developments, and access to global markets are also discussed.

Keywords: United States, Brazil, cost of production, corn, soybeans

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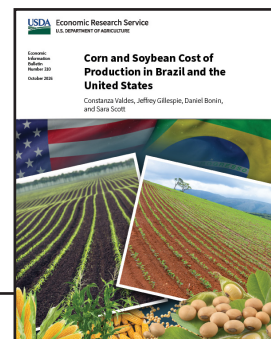
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A report summary from the Economic Research Service

Corn and Soybean Cost of Production in Brazil and the United States

Constanza Valdes, Jeffrey Gillespie, Daniel Bonin, and Sara Scott



Key Points

- Brazil has emerged as a major competitor to the United States in global corn and soybean markets.
- Estimates suggest:
 - Brazil's farmers face lower per acre corn and soybean costs than farmers in the United States because of factors including lower land costs, benefits from double cropping, and lower seed costs.
 - U.S. total corn costs per bushel exceed those of Brazil's Mato Grosso State but are similar to Brazil's national per bushel costs.
 - The United States has lower operating costs per acre and per bushel for soybeans, but higher total costs compared to Brazil.
 - For corn, Brazil's Mato Grosso State has a higher return over total economic cost than the U.S. Heartland region, while the two areas have similar returns over operating cost. However, at the national level, the United States has higher returns than Brazil both over operating cost and total economic cost.
 - For soybeans, Brazil has a higher national average return over total economic cost than the United States, whereas the United States has a higher national average return over operating cost than Brazil.

Why Does This Matter?

Brazil and the United States collectively dominate global markets for soybeans and corn, jointly supplying nearly 83 and 58 percent of exports in marketing year 2025/26, respectively. Over the last 20 years, Brazil has emerged as a major competitor for the United States, concurrent with Brazil's expanded adoption of genetically engineered (GE) corn and soybean seeds, widespread use of double cropping systems, and farmer returns that have supported increased production. As a result, Brazil's agricultural sector has experienced significant growth, with exports of corn and soybeans reaching new highs. Comparing

differences in the costs of production faced by farmers in Brazil and the United States provides insight into sources of competitive advantages in both soybean and corn markets. Using official Government data, this report explores how cost categories such as seed, fertilizer, hired labor, taxes and insurance, and others compare across the two countries. As part of the comparative framework, this report looks at costs on a per acre (per hectare) and a per bushel (per ton) of production basis, underscoring how yield and production system differences in the United States and Brazil affect relative farmer returns.

A Few More Details

The Governments of the United States and Brazil survey corn and soybean farmers extensively and publicly report official data on costs and returns at national and regional levels. This allows for comparison of the major corn and soybean production zones in both countries. For the United States, this is the Heartland region. For Brazil, this is Mato Grosso—the principal State producing second-crop corn (also known as safrinha) and soybeans. Estimates for the United States are based on data collected via the USDA's Agricultural Resources Management Survey (ARMS). For Brazil, estimates are based on annual production costs, returns, and price data for inputs and services collected via Brazil's National Supply Company survey.

Cost comparisons are made for a variety of categories and sub-categories, including total costs (sum of operating costs and allocated overhead costs), operating costs (mostly cash costs), and allocated overhead costs. To reduce variability, soybean and corn costs are compared using 3-year averages for 2023–25. Brazil costs are arranged to fit the U.S. structure, recognizing distinctions in measurement for some items (e.g., capital recovery of machinery and equipment, land, taxes). Direct Government payments are not included in the estimates.

Differences in production practices, access to capital, and the evolving use of technology influence both the per acre and per bushel cost estimates. For example, while farmers in both countries use GE seeds, corn yields in the United States are nearly double those realized by farmers in Brazil, leading to lower per bushel costs for some cost categories. Safrinha corn grown in Brazil following the soybean harvest benefits from soybeans' nitrogen-fixing abilities, reducing fertilizer demand and associated costs in corn production. In contrast, much of Brazil's soybeans are grown in the Cerrado region, which is characterized by heavily weathered tropical soils that require relatively more fertilizer, incurring higher per acre and per bushel fertilizer costs as compared to soybeans grown in the United States.

Estimates from this study indicate:

- Between 2023 and 2025, the total costs per acre to produce soybeans in the United States were \$656.16, with the U.S. Heartland averaging about 6.5 percent higher than the national average.
- Total costs per acre to produce soybeans in Brazil were \$558.97, with Mato Grosso averaging about 3.6 percent below the national average.
- Total costs per acre to produce corn in the U.S. Heartland were \$951.82 per acre, compared to \$420.57 per acre for Brazil's Mato Grosso.
- Brazil has generally lower allocated overhead costs, primarily for land; this is aided by widespread practices of double cropping.
- Operating costs are higher in Brazil compared to the United States for soybeans, accounting for 63 percent of total costs in Mato Grosso. The largest components of operating costs in Brazil are fertilizers (35 percent), chemicals (34 percent), and seeds (13 percent). In comparison, in the U.S. Heartland these components and their percentages of operating costs are fertilizers (23 percent), chemicals (22 percent), and seeds (25 percent).
- Brazil benefits from double cropping—a practice that allows farmers to grow two crops on the same land within the same year—and currency devaluation, both of which boost net returns.
- Brazil's inland soybean transportation cost from market of first sale to port does not differ greatly than that of the United States.
- Road infrastructure developments to northern ports in Brazil have lowered shipping costs compared to southern ports.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

Corn and Soybean Cost of Production in Brazil and the United States

Introduction

Global corn and soybean trade is dominated by the United States and Brazil, which collectively supply most of the world market. The United States remains the leader in both corn production volume and yield efficiency, while Brazil has overtaken the United States as the world's top producer and exporter of soybeans. In the United States, most corn is used domestically for animal feed and ethanol manufacturing, while 25–35 percent of soybeans are exported annually (USDA, Foreign Agricultural Service (FAS), 2026b). Brazil exports the bulk of its soybean output while also increasing crush capacity and crush volume to meet the growing domestic demand for soybean oil as feedstock in biodiesel production but retains much of its corn for domestic livestock feed and its rapidly expanding corn-ethanol industry (USDA, FAS, 2026d; USDA, FAS, 2026e).

The United States produces about a third of the world's corn supply, with nearly 378 million metric tons in marketing year (MY) 2024/25. Brazil has also become a major contributor to global output. Together, the two countries accounted for 42 percent of the world's 1.2 billion metric tons of corn produced in 2025. Producing 35 percent as much corn as the United States, Brazil is now the world's second-largest corn exporter. Brazil's corn production has risen rapidly over the last two decades, outpacing growth in domestic food and feed demand, leaving surplus production for more exports. Brazil typically supplies over 20 percent of global corn exports, but a bumper harvest in 2023 increased its share to nearly 30 percent, with Brazil briefly overtaking the United States as the world's leading corn exporter (USDA, FAS, 2024). The United States and Brazil are also the world's leading producers and exporters of soybeans, jointly supplying nearly 83 percent of soybeans in 2025/26 (USDA, FAS, 2026a).

The emergence of Brazil as the largest U.S. competitor in corn export markets represents a long-term shift in global corn production and trade patterns. Double cropping, or planting two crops in the same crop year, is common across much of Brazil because of its favorable climate and a year-round growing season. Between 76 and 80 percent of corn in Brazil is harvested as a second crop (safrinha), planted after soybeans. The rapid expansion of second-crop corn has intensified Brazil's presence in the global export market, including shipments to China, the primary destination for corn exports from Brazil.

Brazil's second-crop corn also influences the seasonal pattern of global corn trade. Brazil's second-crop corn production and exports coincide with U.S. Northern Hemisphere production, affecting the seasonal export pattern of U.S. exports and lowering harvest-season U.S. corn prices. Because safrinha corn is harvested later in the calendar year (appendix table A.1), Brazil's corn exports tend to be greatest from September through January. Soybean shipments dominate Brazil's port capacity from March through June, shifting corn shipments later in the year. In addition, as Brazil's soybean crop expands each year, soybean shipments extend into summer and fall months, also impacting soybean shipments in the September–October period coinciding with the U.S. harvest time. As a result, in the Southern Hemisphere, Brazil's corn exports are concentrated in months normally associated with Northern Hemisphere exporters. Since 2009, the seasonality of Brazil's corn exports has changed, with shipments from March through July at relatively low levels and an increasing export pace during August through January—a pattern of corn exports that is expected to persist.

Corn production in Brazil is expected to reach 139 million metric tons in 2026 (5.4 billion bushels). This growth reflects expanded acreage and increased productivity resulting from changes in farming practices and technology, particularly of its second-crop corn, which has grown nearly ninefold in the past 15 years. Brazil's growing corn production is also linked to expanding demand for corn used as animal feed and for ethanol production; the country is the world's second-largest ethanol producer, with a growing corn ethanol industry.

This study compares the costs of corn and soybean production in the United States and Brazil for years 2023–25. Cross-country comparisons of production costs help to inform broader analysis and research on the drivers of farm costs and returns associated with corn and soybean production. Previous USDA, Economic Research Service (ERS) studies documented the costs and returns of the world's leading soybean exporters, documenting how changes in costs and returns in the United States and Brazil affect each country's competitive position in the global corn and soybean markets (Valdes et al., 2023; Meade et al., 2016). This study builds on that work by providing updated statistics and analysis across regions of both countries, with more detailed analysis of the cost interactions for corn and soybeans and the role of Brazil's expanding second-crop corn in shifting relative costs. However, an important caveat for assessing cost of production when accounting for second-crop production is the possibility of under-counting production costs for the second crop, despite best efforts to allocate fixed and shared operational expenses across the soybean-corn (safrinha) system. To provide a more thorough understanding of cost of production, this study also examines input usage and practices for seeds, fertilizers, and chemicals in the production of corn and soybeans in the United States and in Brazil.

Several studies have compared corn and soybean production costs in Brazil and the United States (Colussi & Langemeier, 2026a; Richards & Meyer, 2026; Valdes et al., 2023; Meade et al. 2016). Meade et al. (2016) found that production costs per bushel for soybeans during 2010 were lower in Brazil than the United States, but production costs per bushel for corn during 2010 were lower for the United States. Valdes et al. (2023) found that Brazil had lower total costs per bushel for soybean production than the United States in 2021. Various studies have highlighted the input vulnerability arising from supply-chain shocks in global fertilizer markets and the volatile depreciation of the Brazilian real against the U.S. dollar (Colussi & Langemeier, 2026b; Scarpinelli, 2025). Using a representative farm analysis approach, Colussi and Langemeier (2026b) refer to corn competitiveness in the United States and Brazil as being affected not only by differences in production costs, but also by distinct production systems. Swanson (2026) highlighted input price differences for chemicals used for corn and soybeans in the United States and Brazil. Other studies have focused on recent macroeconomic shifts, particularly price and currency volatility, playing a central role in shaping costs and the role of logistics and infrastructure development on cost efficiencies and impact on exports (Valdes et al., 2023; Meade et al., 2016).

In this study, crop production costs are separated into operating and allocated overhead components. We report production costs measured per unit of land area (acre or hectare) and per unit of production (bushel or ton). Since yields can vary considerably across countries and regions, costs of production per bushel can vary substantially. Detailed costs-of-production tables by country, commodity, and crop season (i.e., first- and second-crop corn in Brazil) are presented, with data from the largest production region as well as an estimated national average for 2023–25. In addition, prices received by farmers and average yields for each crop in each country are analyzed to calculate producer returns.

The costs and returns data for the United States come from the USDA, ERS Commodity Costs and Returns data, which is derived primarily from USDA's Agricultural Resource Management Survey (ARMS). Estimates at both the national level and for the nation's largest corn and soybean production region are presented. For Brazil, we present national and regional-level estimates using official data from Brazil's National Supply Company (CONAB, 2026a). For example, for corn, we estimate production costs for second-crop corn in Mato Grosso (Brazil's largest corn- and soybean-producing State) and single-cropped corn in Rio Grande do Sul (Brazil's largest first-crop corn-producing State) using official data. To enable comparison between Brazil and the United States, the cost-of-production data from CONAB are re-organized to fit the U.S. format for operating and allocated overhead crop costs to allow for comparisons of cost-of-production across both countries.

There are several noteworthy limitations of this study, some of which will be discussed in greater detail throughout this report. First, while Brazil's data collection for cost of production has similarities to those of the United States and costs are harmonized for the two countries to the greatest extent possible, some differences in measurement and underlying assumptions are always present in estimates made from distinct institutions. We discuss some of the differences in measurement and caveat our conclusions about cost differences accordingly. Second, Government payments, crop insurance payments, and costs associated with purchasing crop insurance are not included in these estimates, though they can impact farm profitability. Third, while we provide average costs and returns estimates for the two countries, actual costs among producers can vary widely. For example, using USDA's ARMS data, Vaiknoras et al. (2023) showed that the lowest-cost quartile of U.S. soybean farms in 2018 had average costs of \$6.75 per bushel, while the highest-cost quartile had costs of \$15.36 per bushel. Likewise, Saavoss et al. (2021) showed that the lowest-cost quartile of U.S. corn farms in 2016 had average costs of \$2.83 per bushel, while the highest-cost quartile had costs of \$6.32 per bushel. Fourth, exchange rate policies impact the relative corn and soybean cost of production comparisons, particularly for the case of Brazil, where the exchange rate between the U.S. dollar and the Brazilian real has experienced significant variability over time.

Economic and Agricultural Characteristics of the United States and Brazil

The United States and Brazil feature diverse macroeconomic characteristics, trade, land use, and agricultural structure. The U.S. economy is significantly larger than Brazil's, and its population is about 1.6 times larger than Brazil's. The United States is the fourth-largest country by land mass at 9.5 million square kilometers (2.2 billion acres), while Brazil is the world's fifth-largest country with 8.5 million square kilometers (2.1 billion acres). Agricultural land (pasture and cropland) plays a more prominent role in land use in the United States. U.S. agriculture contributes about 1.2 percent of the country's Gross Domestic Product (GDP), compared with 6.1 percent for Brazil, while agriculture accounted for 5.2 percent of Brazilian exports and 10 percent of U.S. exports.

Box table 1

U.S. and Brazil economic and agricultural characteristics

	United States	Brazil
Population (million people)	341.8	212.8
GDP (billion U.S. dollars)	30,769.7	2,279.9
GDP per capita (U.S. dollars)	90,026.5	10,713.3
Agriculture's share of GDP (percent)	1.2	6.1
Labor force (million people)	174.8	108.3
Agriculture's share of labor force (percent)	1.5	7.6
Total merchandise imports (billion U.S. dollars)	3,393.5	293.7
Total merchandise exports (billion U.S. dollars)	1,759.1	348.3
Agricultural exports (billion U.S. dollars)	171.4	18.1
Agriculture's share of total exports (percent)	10.0	5.2
Land area (million hectares)	915.0	850.7
Share of pastureland (percent)	28.9	22.5
Share of cropland (percent)	16.7	7.2

GDP = Gross Domestic Product.

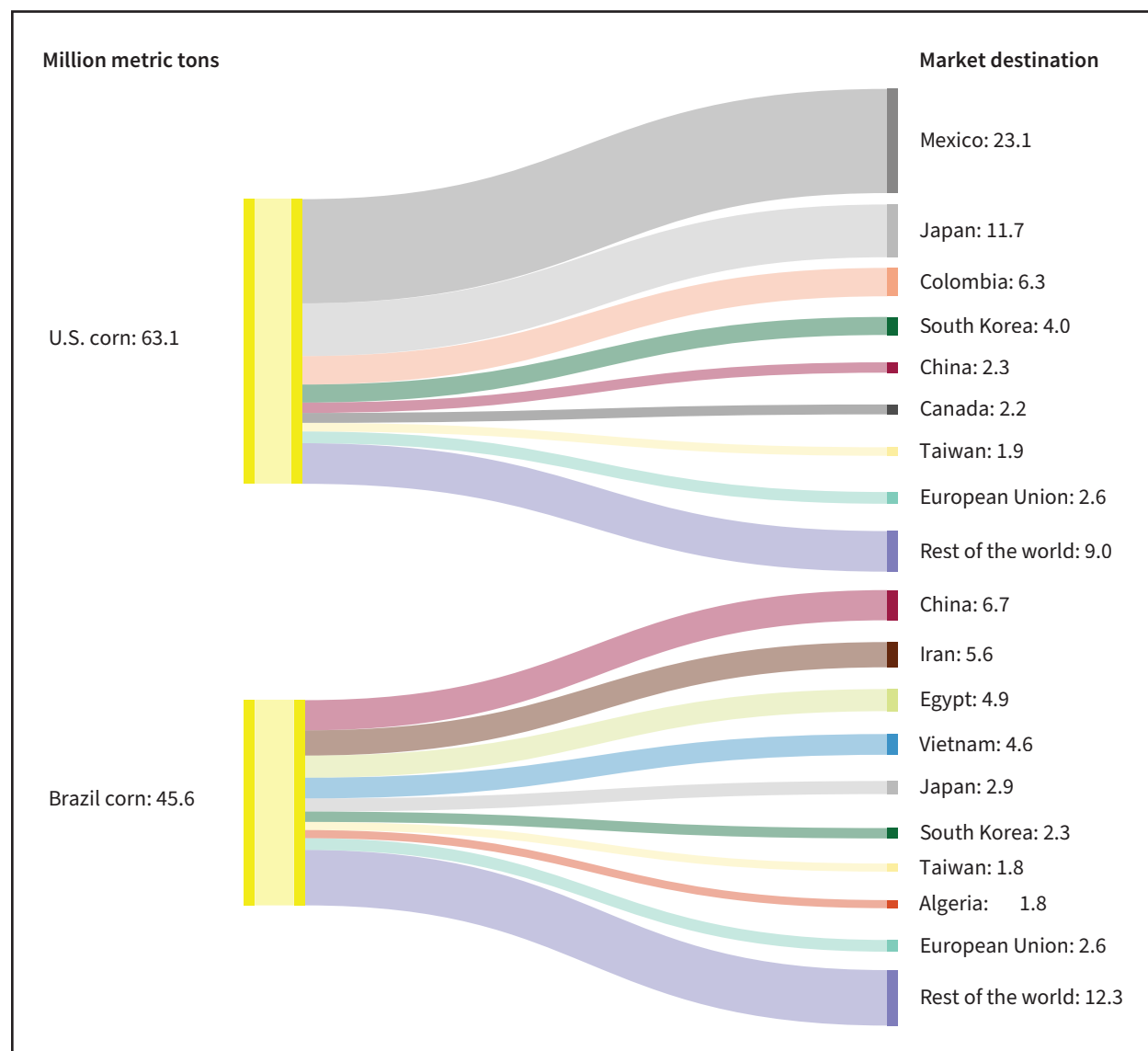
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of the Census (2026) and the World Bank's World Development Indicators Database (2026).

The United States and Brazil Are Large Corn and Soybean Suppliers

Brazil and the United States collectively dominate global markets for corn and soybeans, with 58 percent and 83 percent of global trade, respectively, in marketing year 2025/26 (USDA, FAS, 2026a). In the 2025/26 global corn market, the United States maintained its position as the world's leading corn exporter, with a record 86 million metric tons exported. Brazil's export volumes reached 42 million metric tons in 2025/26, rapidly expanding domestic consumption limited the country's export capacity. In 2025/26, Brazil's record volume of soybean exports reached 115 million metric tons, accounting for 61 percent of the global market, widening its lead over the United States as the world's largest soybean exporter (USDA, FAS, 2026b). Soybean exports from the United States in 2025/26 totaled 41.4 million metric tons, accounting for 22 percent of global soybean trade (USDA, FAS, 2026b).

Between 2023 and 2025, the United States averaged 63.1 million metric tons of corn exports. The primary destination was Mexico (23.1 million metric tons). Other leading destinations for U.S. corn exports include Japan, Colombia, and South Korea (figure 1). During the same period, Brazil averaged 45.6 million metric tons of corn exports and targeted entirely different destinations. Brazilian corn exports reflect a heavy reliance on China (6.7 million metric tons), accompanied with a significant market diversification toward traditional markets, including Iran, Egypt, Vietnam, and Japan (figure 1).

Figure 1

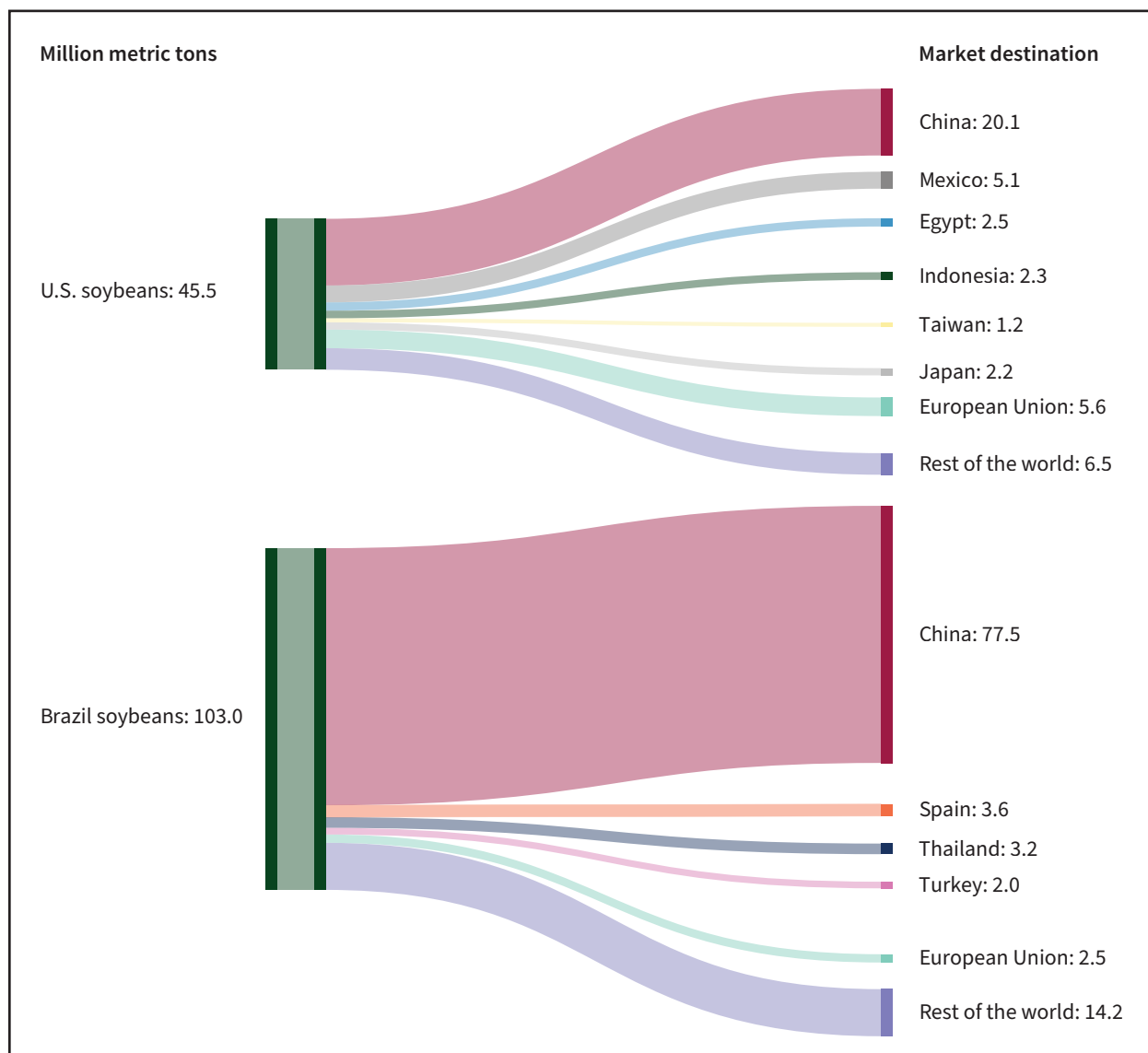
Corn exports from the United States and Brazil, 2023–25 average

Source: USDA, Economic Research Service using data from the U.S. Department of Commerce, Bureau of the Census, as compiled by USDA, Foreign Agricultural Service (2026).

During the 2023–25 period, the United States exported 45.5 million metric tons of soybeans, primarily to China (20.1 million metric tons), Mexico (5.1 million metric tons), and Egypt (2.5 million metric tons) (figure 2). During the same period, total soybean exports from Brazil reached 103 million metric tons, with China taking the larger share of the country's total exports (77.5 million metric tons) (figure 2).

Figure 2

Soybean exports from the United States and Brazil, 2023–25 average



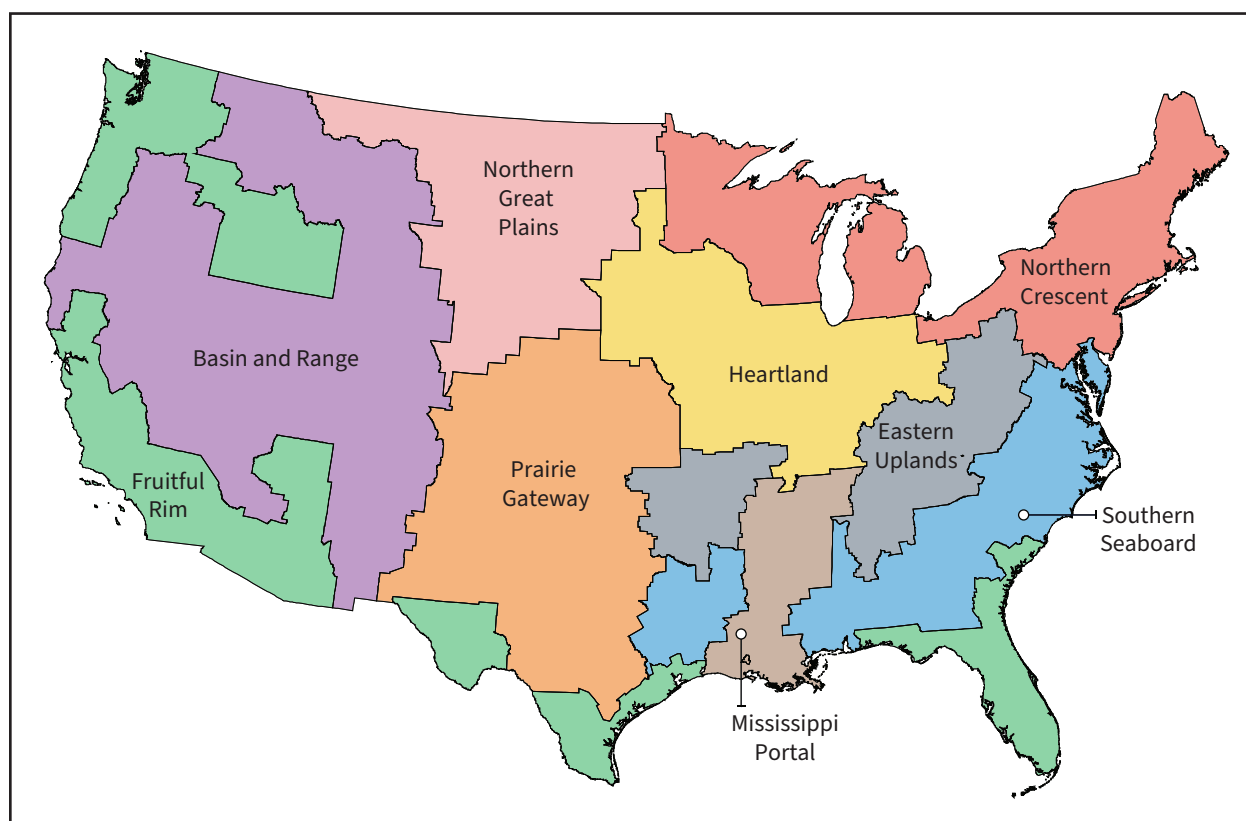
Source: USDA, Economic Research Service using data from the U.S. Department of Commerce, Bureau of the Census, as compiled by USDA, Foreign Agricultural Service (2026).

Corn Production

The United States

The largest U.S. corn production region is the Heartland (figure 3). This region includes Illinois, Indiana, Iowa, and parts of Kentucky, Minnesota, Missouri, Nebraska, Ohio, and South Dakota.¹ In 2021, 58 percent of U.S. corn planted acres were in the Heartland, followed by (from largest to smallest) the Prairie Gateway, Northern Crescent, Northern Great Plains, Southern Seaboard, and Eastern Uplands regions. We estimate both U.S. national and Heartland costs in this study to capture differences between the main production region and the country as a whole.

Figure 3
USDA, Economic Research Service Farm Resource Regions



Source: USDA, Economic Research Service.

¹ For the analysis of U.S. corn and soybean production practices and regional delineations, we use the most recently available USDA data sources. The most recent USDA ARMS survey for corn, which includes production practice and regional data, was conducted for crop year 2021. Thus, we refer to recent publications that utilized 2021 ARMS corn data and, in some cases, conduct analysis using 2021 ARMS corn data to provide information about U.S. corn production, input use, and costs. The most recent USDA ARMS survey for soybeans was 2023, so most discussion of soybean production practices and regional delineations refer to 2023.

Corn yields have historically been highest in the Heartland region (Saavoss et al. 2021). For example, calculations using USDA, ERS's Commodity Costs and Returns data indicate the Heartland region had the highest average corn yield² during 2023–25 at 208 bushels per acre, compared with the U.S. average of 192 bushels per acre (USDA, ERS, 2026a).

To better understand the production environment of the major U.S. corn-growing regions, USDA data also report input usage and practices used in producing corn. In 2021, nitrogen (N) was applied to 95 percent of planted corn acres at an average rate of 150 pounds per treated acre; phosphate (P_2O_5) to 75 percent at 64 pounds per treated acre; and potash (K_2O) to 65 percent at 77 pounds per treated acre (USDA, National Agricultural Statistics Service (NASS), 2022).³ USDA, NASS (2022) also provides chemical usage for 2021, showing that herbicides were applied to 96 percent of U.S. corn acres, fungicides to 19 percent, and insecticides to 14 percent. Irrigation was used on 10 percent of planted corn acres in 2021, with the Prairie Gateway region having the highest percentage of planted acres under irrigation at 27 percent (USDA, ERS, 2026a). USDA's ARMS 2021 data indicate the average U.S. seeding rate for corn in 2021 was over 30,000 seeds per acre. The USDA, NASS June 2025 *Acreage* report indicates that 94 percent of U.S. corn planted in 2025 was genetically engineered (GE), using insect-resistant and/or herbicide-resistant biotechnology.

U.S. corn producers also adopt a range of soil health management practices, such as conservation tillage and use of cover crops, which have benefits such as reduced soil erosion and weed control. In 2021, conservation tillage was used on 75 percent of U.S. corn acreage, with 36 percent under a no-till system (Bowman et al., 2025). In 2021, a cover crop was used on 8 percent of corn acreage planted for grain (Bowman et al., 2025). Use of these conservation practices impacts the number of field operations for the farm, and thus labor, fuel, and machinery costs.

Brazil

Since marketing year 2004/05, corn production in Brazil has seen a nearly four-fold increase, reaching 139.0 million metric tons in 2025/26, equivalent to 10.8 percent of global corn production and making it the third-largest producer in the world (USDA, FAS, 2026a). Brazil's National Supply Company (CONAB) projects corn farmers will harvest corn on a record 22.6 million hectares (55.8 million acres) in 2025-26 (CONAB, 2026b). Corn is now Brazil's second-largest crop (after soybeans), accounting for 27 percent of planted area (CONAB, 2026b). Brazil primarily produces corn through a double-cropping system. Due to a favorable climate and all-year growing season, double cropping is possible in much of the country (though not in some areas in the south), and generally between 76 to 80 percent of corn in Brazil is harvested as a second crop (safrinha), planted after soybeans. A smaller third corn crop has been planted since 2018/19, with production reaching 2.7 million metric tons (129.9 million bushels) in 2026 (CONAB, 2026). Appendix table A.1 shows typical corn planting and harvesting dates for first- and second-crop corn in different regions of Brazil.

Brazil's National Supply Company (CONAB) surveys and reports cost of production for all major field crops in Brazil, while the Brazilian Agriculture Research Corporation (EMBRAPA) reports input usage and management practices in the production of commodities, crucial elements to understand factors affecting cost of production and returns. In the case of corn, inputs such as fertilizers, seeds, and

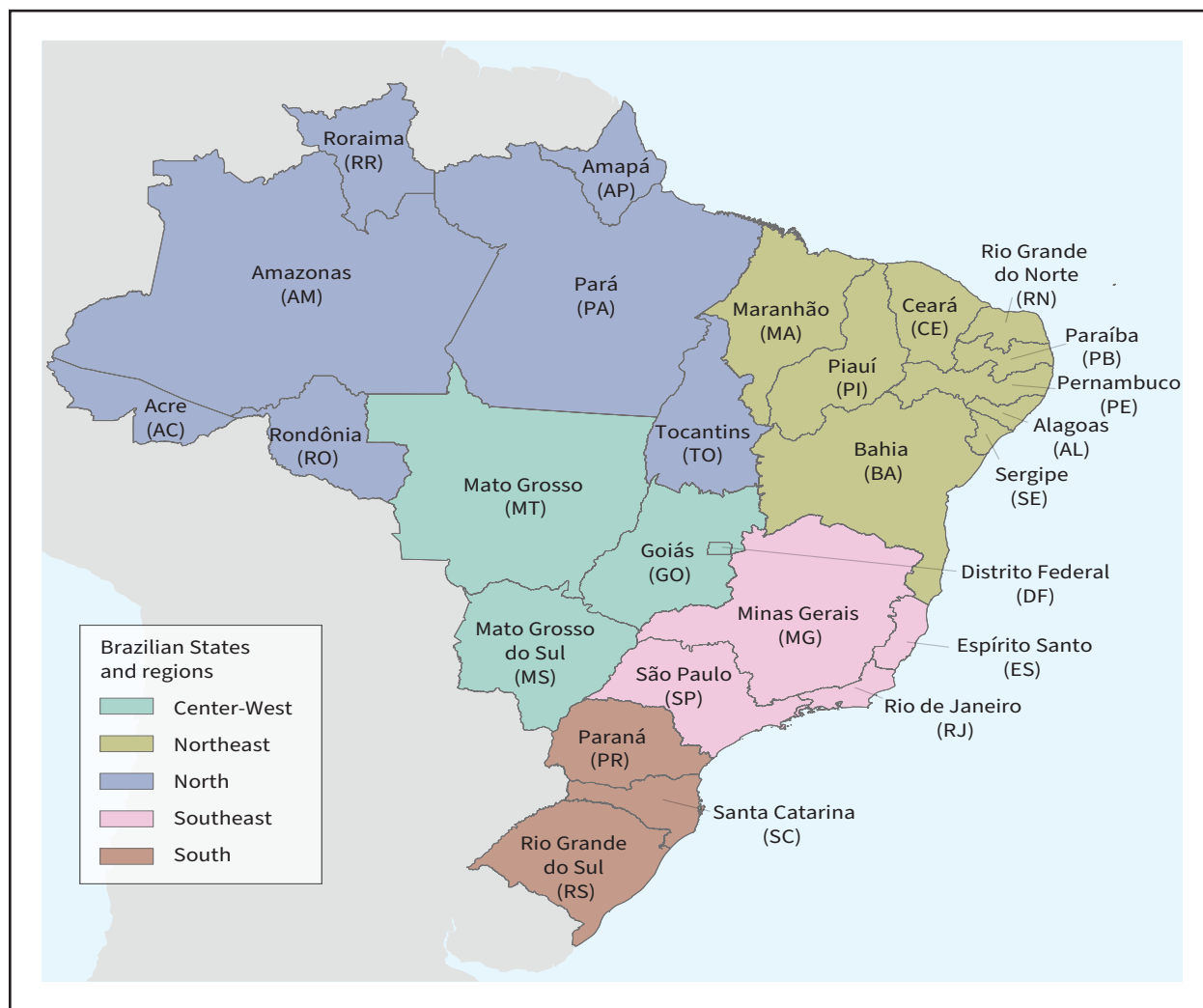
² For comparison, average 2023–25 corn yields per planted acre were: Northern Great Plains (197 bushels per acre), Eastern Uplands (180 bushels per acre), Northern Crescent (175 bushels per acre), Prairie Gateway (156 bushels per acre), and Southern Seaboard (151 bushels per acre).

³ The USDA, ERS (2026b) Fertilizer Use and Price Data showed that the most common sources of nitrogen fertilizers used in the United States in 2015, in total (not for any specific crop) by weight, were nitrogen solutions, followed in decreased usage by urea, anhydrous ammonia, ammonium sulfate, and others.

chemicals account for the bulk of operating expenses (CONAB, 2026a). In the Cerrado region, where most rainfed second-crop corn farming takes place, Brazilian farmers apply nitrogen and phosphorus to amend soils for higher yields (EMBRAPA, 2026). About 90 percent of all corn acreage in Brazil receives nitrogen fertilizer, and application rates range between 45 and 90 kilograms of nitrogen per hectare (40–80 pounds per acre), depending on soil characteristics (Simão et al., 2020). Nitrogen sources used by Brazilian farmers include mostly urea (45 percent nitrogen), but also ammonium sulfate (20 percent nitrogen) and ammonium nitrate (32 percent nitrogen) (EMBRAPA, 2026). EMBRAPA indicates that a metric ton of soybeans corresponds to 17 kilograms per hectare (about 15 pounds per acre) of nitrogen in the crop residue, providing nitrogen for the second-crop corn and serving to adjust nitrogen fertilization to second-crop corn, thus reducing costs (Simão et al., 2020). Because Brazil imports about 96 percent of its nitrogen, global market shifts affect costs and profit margins (USDA, FAS, 2022). Corn production accounts for about a third of all nitrogen fertilizer used by Brazilian crops (Risi et al., 2024).

Nearly all farmers in Brazil use phosphorous (P), relying heavily on the global market to meet this demand, importing about 72 percent of their phosphorous needs (Colussi & Langemeier, 2026c). The recommended application varies between 100 and 200 kilograms per hectare (89–178 pounds per acre) of phosphorous, depending on soil characteristics (Duarte-Monzón et al., 2026). The use of chemicals for pest control is extensive in Brazil because of the tropical climate; the most common are glyphosate and atrazine, generally applied at rates of 1.5–3.5 liters per hectare (0.6–1.4 quarts per acre), depending on the region (Procópio et al., 2024). The typical corn seed application rate in Brazil ranges from 50,000 to 75,000 seeds per hectare (20,243–30,352 seeds per acre), depending on soil fertility and whether it is the first-crop corn planting or the safrinha crop (Da Silva et al., 2021). Much of corn production in Brazil is under a no-tillage system. For example, about 79 percent of corn in Paraná State (figure 4) is produced under no-tillage (Mantovani et al., 2024).

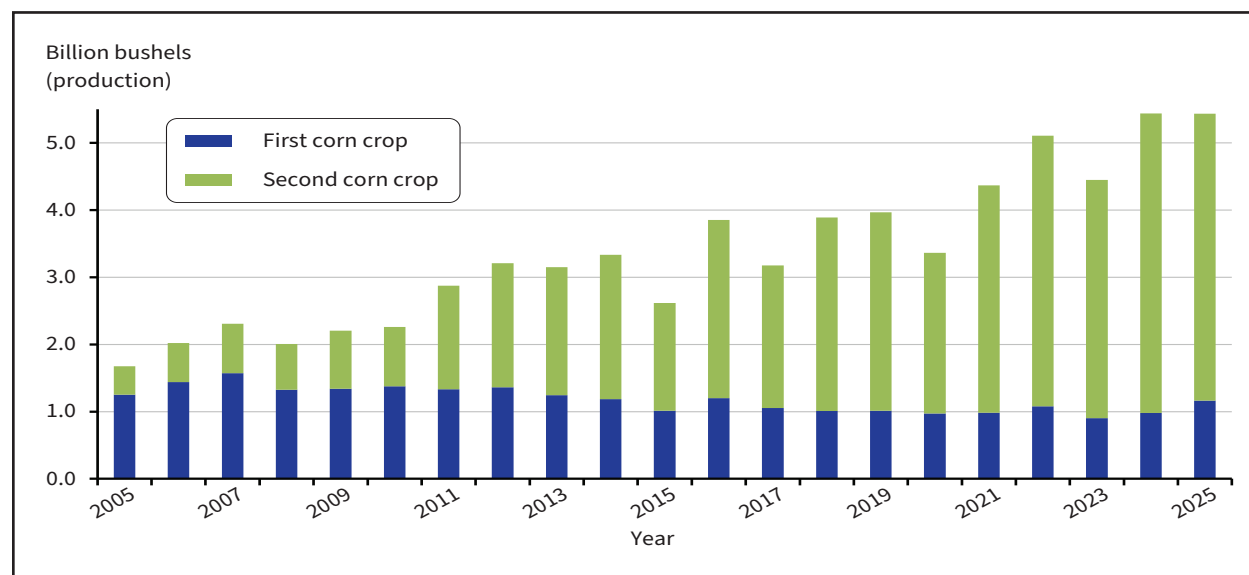
Figure 4

Brazilian States and regions

Source: USDA, Economic Research Service.

Mato Grosso (figure 4) is the largest producer of second-crop corn, accounting for 52 percent (58.0 million metric tons or 2.3 billion bushels) of Brazil's total in 2025/26 (CONAB, 2026b). In Mato Grosso, second-crop corn planted following soybeans has increased 64 percent in area over the last 10 years, reaching 7.5 million hectares (18.6 million acres) in 2025/26 (equivalent to 33 percent of the country's total harvested area), as a result of technological improvements, including the use of lime to reduce acidity levels in the soil and the adoption of no-tillage systems. The most significant driver of corn cultivation in the Center-West region of Brazil has been EMBRAPA's development of cultivars better suited to the tropical climate (i.e., high-yielding corn hybrids and soybean varieties that have complemented the correction of nutrient deficiencies in low-fertility Cerrado soils) (USDA, FAS, 2025a). The safrinha crop increased from 22 percent of total corn production in 2004/05 to more than 80 percent of production in 2024/25 (figure 5).

Figure 5
Brazil's corn production, 2004/05 to 2024/25



Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, Production, Supply, and Distribution data.

Double cropping of corn production occurs across 19 States in Brazil; four States (Goiás, Mato Grosso, Mato Grosso do Sul, and Paraná) account for 71.2 percent of corn production in Brazil (appendix table A.2) (CONAB, 2026b).

Policies in Brazil that support production in various ways contribute to costs and prices in ways that are difficult to explicitly quantify. In Brazil, the large number of programs that provide subsidized credit for corn production (including soil preparation, seed, fertilizer, chemical purchases and applications, custom operations, and machinery purchases) contribute to lower operational costs for small producers. In addition, prices received by Brazilian corn farmers are impacted by a minimum price support policy and increase calculated producer returns. Minimum guaranteed prices are announced before the start of the planting season and indicate the Government's commitment to buying or subsidizing corn, if its market price falls below the minimum price (USDA, FAS, 2025c).

Second-crop Corn and Corn Ethanol Production

A key factor arising in recent years and affecting returns to the soybean-corn production system in the Center-West region, and in Mato Grosso in particular, is the production of ethanol from second-crop corn. At times, when demand for ethanol is high, Brazilian second-crop corn farmers may receive a premium for corn sold to ethanol producers that is above the price received for corn sold for feed use. In these cases, second-crop corn replaces sugarcane as the feedstock for ethanol production when sugarcane for ethanol is scarce. These periods amplify the economic returns per acre received under the soybean-corn production system. Production of ethanol from second-crop corn has been growing rapidly since the early stages of the industry a decade ago, increasing from 0.5 million liters in 2017 to 10 billion liters of ethanol from corn in 2025—representing approximately 15 percent of the corn crop and almost a third of all ethanol consumed in Brazil⁴ (National Petroleum Agency (ANP), 2026; USDA, FAS, 2024) (see appendix B).

⁴ ANP oversees compliance with RenovaBio (Brazil's national biofuels policy). The mandatory blending rate for regular gasoline in Brazil is 32 percent anhydrous ethanol (E32).

Brazil is projected to produce nearly 17 billion liters of ethanol from corn by 2034/35, according to the *USDA Agricultural Projections to 2034* (USDA, OCE, 2025). Currently, 31 ethanol plants operate in the Center-West region, with additional corn-ethanol distilleries planned, reflecting the rapid growth of second-crop corn in the last decade. Mato Grosso accounts for about 41 percent of total ethanol production, while the rest is being supplied by Mato Grosso do Sul (28 percent) and Goiás (31 percent) (ANP, 2026). In the United States during marketing year 2025/26, 33.5 percent of the total U.S. corn supply went for fuel alcohol (USDA, ERS, 2026c).

Soybean Production

The United States

As with corn, U.S. soybean production is greatest in the Heartland region. In 2023, 58 percent of soybean planted acres were in the Heartland region, followed by (from largest to smallest) the Northern Great Plains, Mississippi Portal, Prairie Gateway, Northern Crescent, Southern Seaboard, and Eastern Uplands regions. U.S. soybean yields have been highest in the Heartland region; for example, the 3-year average yield per planted acre using USDA, ERS's Commodity Costs and Returns data shows the Heartland had the highest average yield during 2023–25, 58 bushels per acre,⁵ compared with the U.S. average of 55 bushels per acre (USDA, ERS, 2026a).

USDA also reports input usage and production practices used for U.S. soybean production, providing additional context for U.S. soybean costs of production. In 2023, potash was applied to 46 percent of U.S. planted soybean acres at an average rate of 88 pounds per treated acre, phosphate was applied to 44 percent of U.S. planted soybean acres at an average rate of 57 pounds per treated acre, and nitrogen was applied to 30 percent of U.S. planted soybean acres at an average rate of 22 pounds per treated acre (USDA, NASS, 2024). USDA, NASS (2024) also provided chemical usage for 2023, showing that herbicides were applied to 96 percent of U.S. soybean acres, fungicides were applied to 22 percent of U.S. soybean acres, and insecticides were applied to 21 percent of U.S. soybean acres. Irrigation was used on 11 percent of soybean acres planted in 2023, with the Mississippi Portal region having the highest percentage of acres under irrigation, 50 percent (USDA, ERS, 2026a). Using ARMS 2023 soybean data, the average seeding rate for U.S. soybeans in 2023 was over 150,000 seeds per acre. This seeding rate followed at least 23 years of declining seeding rates for soybeans in the United States (Swearingen & Vaiknoras, 2024). The USDA, NASS June 2025 *Acreage* report indicates that 96 percent of U.S. soybeans planted in 2025 were GE using herbicide-resistant biotechnology.

⁵ In comparison, average 2023–25 soybean yields per planted acre were: Northern Crescent (55 bushels per acre), Mississippi Portal (55 bushels per acre), Prairie Gateway (58 bushels per acre), Eastern Uplands (48 bushels per acre), Southern Seaboard (44 bushels per acre), and Northern Great Plains (44 bushels per acre).

Conservation practices also play a notable role in soybean production, influencing how producers organize fieldwork and manage inputs in soybean production. In 2023, conservation tillage was used on 81 percent of U.S. soybean acreage, with 45 percent under a no-till system (Bowman et al., 2025). In 2023, a cover crop was utilized on 11 percent of soybean planted acreage (Bowman et al., 2025).

In the United States, soybeans are sometimes double cropped with another field crop during the same crop year. According to Parjev and Holshouser (2025), the most common double-cropping system in the United States involves planting soybeans directly following the harvest of winter wheat, though soybeans may also follow other winter crops. Producers typically double-crop wheat and soybeans to boost profitability, a technique that also bears potential ecological benefits. Double cropping, however, can result in lower soybean yield relative to single-crop soybeans (Parjev & Holshouser, 2025). In 2025, 6 percent of U.S. soybeans were double cropped, compared with 4 percent in the previous 3 years (2022–2024) and 5 percent in 2021 (USDA, NASS, 2025). Among the three U.S. States whose crop acreage lies entirely in the Heartland region (Illinois, Indiana, and Iowa), double cropping during 2021–25 ranged from 4 to 6 percent in Illinois and 2 to 6 percent in Indiana, while no double cropping was reported for soybean production in Iowa (USDA, NASS, 2025). Some other States, including Alabama, Delaware, Georgia, Kansas, Kentucky, Maryland, North Carolina, Oklahoma, Pennsylvania, Tennessee, and Virginia, had at least 1 year between 2021 and 2025 in which 20 percent or more of soybean acres were double cropped (USDA, NASS, 2025).

Brazil

Soybean production in Brazil stands out at the center of the country's farm sector expansion and its ascent as a top global supplier of agricultural products. Brazil is the world leader in soybean production and exports. CONAB projects soybean farmers will produce 180.6 million metric tons (equivalent to 6.62 billion bushels) in marketing year 2025/26, harvested on a record 48.6 million hectares (120.1 million acres) (CONAB, 2026b). Brazil's increased soybean production is based on area expansion and changes in technology and management practices over the past 25 years. A rapid process of intensification of agricultural production started in 2000, with cropland use increasing 2.3 percent per year. Meanwhile, the soybean-corn cropping system in Mato Grosso consolidated with the migration of the broiler and hog industries from southern Brazil to Mato Grosso (Barros, 2009). GE soybeans were legalized in 2003 and sustained growth and investments in agriculture, expansion of second-crop corn, and rapidly expanding demand from China (principally for soybeans and beef) fueled development in Mato Grosso since 2004/05 (Barros, 2009). This surge also drove the agricultural frontier's expansion to northern export ports, aiming to reduce transportation costs. The Center-West region of Brazil doubled the area under soybean cultivation between 1999/2000 and 2004/05. The introduction of financial reforms, deregulation, privatization, and trade liberalization led to the opening of the soybean sector to traders and processors (Cardoso, 2011). The growth in the soybean sector accelerated after 2008, and soybeans accounted for 50 percent of total Brazilian field crops output by volume in 2025/26. A significant share of this agricultural production expansion has been destined for exports.

EMBRAPA researchers report soybean seeding rates of 420,000 seeds per hectare (170,000 seeds per acre); potash applications at 72–80 kilograms per hectare (64–71 pounds per acre) and phosphate applications at 55–80 kilograms per hectare (49–71 pounds per acre) (Simonetto et al., 2022). No-tillage is used on approximately 75 percent of soybean area in Brazil (EMBRAPA 2026). Factors behind no-tillage adoption in Brazil are tropical erosion, pasture degradation control, and multi-crop management practices with sequential double- and triple-cropping to boost farm productivity (EMBRAPA 2026).

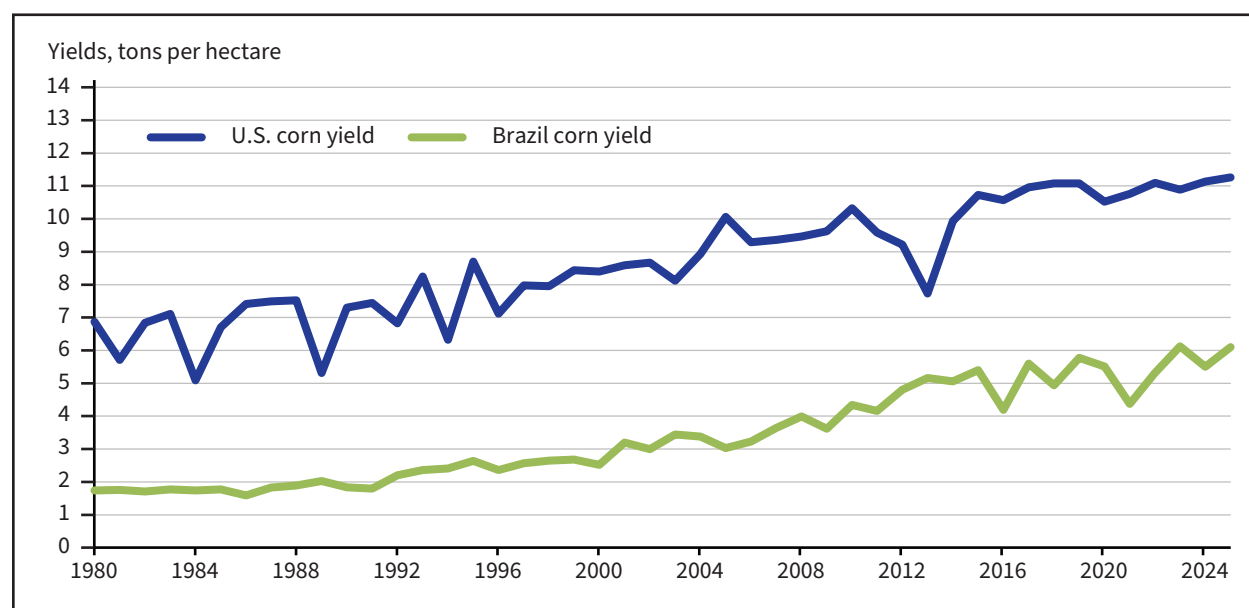
Agricultural Yields in the United States and Brazil

Corn

Despite high Brazilian investments in research and development and international transfers of technology to Brazil, the gap in corn yields between Brazil and the United States has continued (figure 6).

Figure 6

The yield gap for corn between Brazil and the United States has continued



Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, Production, Supply, and Distribution data.

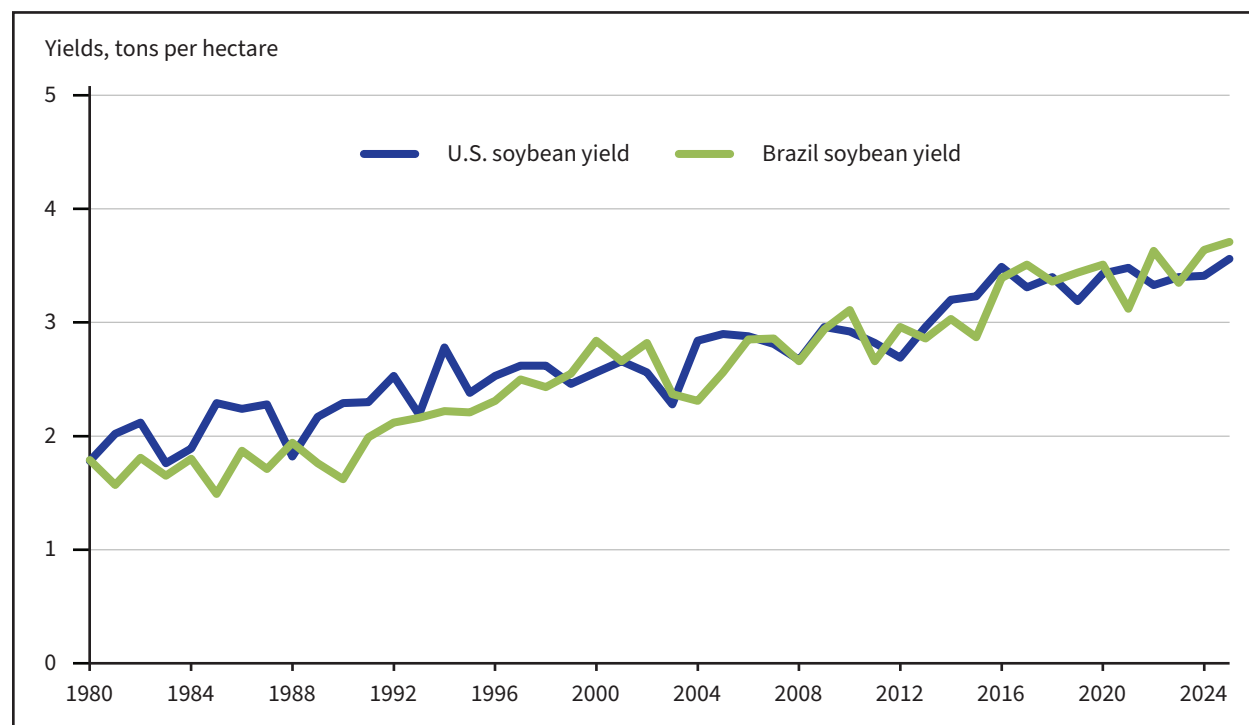
The adoption of GE technologies in 1992, paired with the agricultural intensification of double cropping soybeans with corn contributed to a strong growth rate in Brazil in the past three decades (USDA, FAS, 2026c). Still, at 6 tons per hectare (96 bushels per acre), corn yields in Brazil represent just over half the corn yields obtained in the United States (11.3 metric tons per hectare or 179.3 bushels per acre in 2024). Because most of the gains in technologies are location-specific, corn yields in the agricultural frontier regions of Brazil are higher. In the Center-West region of Brazil, more advanced technologies for soil and pest management and adoption of varieties more tolerant to drought, diseases, and pests have resulted in corn yields in Mato Grosso and Goiás that are higher than the country's average in 2024 (8.4 tons per hectare or 133.8 bushels per acre, and 7.7 tons per hectare or 122.7 bushels per acre, respectively) (CONAB, 2026b).

Soybeans

Average soybean yields also differ between the United States and Brazil, but compared to corn, the yields in both countries have been quite comparable in recent years. Soybean yields in Brazil increased at an average annual rate of 2.4 percent over the 1980-1999 period. This strong growth was the result of the successful adaptation of Brazilian soybean cultivars to tropical conditions, the introduction of mechanized farming systems, and the adoption of GE varieties. In 2000-25, the average annual growth in soybean yields was similar in the two countries: 1.5 percent for Brazil and 1.4 percent for the United States.

Figure 7

The yield gap for soybeans between Brazil and the United States has narrowed



Source: USDA, Economic Research Service using USDA, Foreign Agricultural Service, Production, Supply, and Distribution data.

Estimation of Crops Costs and Returns

To compare the costs and returns of corn and soybean production in the United States versus Brazil, economic production costs are estimated. These costs include not only accounting costs, which are mostly cash costs, but also the opportunity costs of resources such as land, unpaid labor, and equipment. While covering accounting costs is essential for short-run viability, a more accurate assessment of costs requires considering full economic production costs since, in the long run, resources would be switched to a different use if opportunity costs are not covered. In this analysis, costs are organized into two major categories, operating costs and allocated overhead costs, consistent with recommendations by the American Agricultural Economics Association Task Force on Commodity Costs and Returns (AAEA, 2000). Operating costs are mostly cash costs, such as for seed, fertilizer, chemicals, fuel, electricity, repairs, and purchased irrigation water. This category also includes custom services, where an individual is hired with their machinery to conduct field operations, and interest on operating capital. Allocated overhead costs, which are costs that are generally incurred at the farm level but allocated to a specific crop or livestock enterprise based upon use, include hired labor, the opportunity cost of unpaid labor, capital recovery of machinery and equipment, the opportunity cost of land if the land is owned, land rent if the land is rented, taxes and insurance, and general farm overhead.

The cost data for the United States is from USDA, ERS Commodity Costs and Returns data, which are derived from ARMS. We report both U.S. national and Heartland region costs and returns estimates for both corn and soybeans, as the Heartland is the largest U.S. corn- and soybean-producing region. For Brazil, we estimate production costs for second-crop corn at the national level and for Mato Grosso (Brazil's largest corn- and soybean-producing State) and also provide an analysis of single-

cropped corn in Rio Grande do Sul (Brazil's largest first-crop corn-producing State) using official data. For soybeans, we estimate production costs for Mato Grosso and a national average. The Brazilian National Supply Company (CONAB) adopted methods consistent with ARMS for its cost estimation, thereby reducing the challenges associated with making comparisons between the United States and Brazil. To enable the comparison between Brazil and the United States, the cost-of-production data from CONAB are re-organized to fit the U.S. format for operating and allocated overhead crop costs to harmonize cost-of-production comparisons across both countries.

To smooth the impact of market, weather, and policy factors affecting yields and prices, 3-year average yields and prices (using 2023–25) are incorporated into the comparison of per bushel costs and returns. U.S. commodity costs and returns estimates result from periodic ARMS surveys of farms producing the reference commodity every 4–10 years. For years between surveys, survey-year estimates are updated using new price and production data, holding underlying input use and technology constant. For purposes of this study, the 3 years of examination, 2023–25, are all associated with one survey for each commodity, since the most recent corn (soybean) survey was conducted for crop year 2021 (2023). ARMS gathers detailed information on the input use of a particular field on the farm, as well as whole-farm economic data, which are used to estimate commodity costs and returns. Each farm in ARMS represents a known number of farms and production within a State. Weights included in the data allow for expansion to the target population. Supplementary price and production data are used as needed to estimate costs and returns. Government payments are not included. Estimates are made using four different approaches depending on the cost category: direct costing, valuing input quantities, indirect costing, and allocating whole-farm expenses. Choice of which estimation approach to use depends mostly on survey respondent ability to provide the data. Gillespie et al. (2025) provides details on how costs and returns are estimated for U.S. crops. For Brazil, cost data corresponds to the actual annual costs incurred by producers and collected and reported by CONAB. The accuracy of the cost results is further evaluated by a panel of representatives of all participants in the production process, including farm operators, input industry representatives, brokers, contractors, and lenders. For Brazil, cost structures are converted to U.S. dollars using yearly changes of real exchange rates. While the structure of cost accounts for Brazil is reorganized to fit the ARMS format, prices received by farmers and average yields for each crop in each country are used to calculate producer returns. As with the United States, Government payments are not included in Brazil estimates.

Comparing Costs Across Countries

Comparisons of costs and returns across countries provide significant challenges for a number of reasons, including but not limited to differences in cost categories and associated definitions, and measurement methods. Several cost categories can provide particular challenges. Custom services includes costs associated with hiring individuals and their machinery for specific types of specialized work. For the United States, this includes field operations, commercial drying, technical services, and contract labor; these costs are assessed via direct costing by asking survey respondents how much was spent for each category (Gillespie et al., 2025). For Brazil, custom services includes field operations and technical services such as soil testing.

Capital recovery on machinery and equipment refers to the cost associated with the value of the machinery used up in that year in the production process, which is a measure of depreciation, and the opportunity cost associated with the remaining value of the machinery. For the United States, capital recovery of machinery and equipment for crops includes costs associated with all machinery used for field operations, including hauling to the first point of sale, drying, and irrigation. For field

operations for each farm, these costs are determined on the basis of new machinery prices and salvage value, hours of use for the crop, useful life, and long-term interest rate (Gillespie et al. 2025). For Brazil, capital recovery includes depreciation and opportunity cost components for machinery, including implements and irrigation systems. Depreciation is based on a straight-line method tracking hours worked, considering value of the new machine and its salvage value. The opportunity cost, or expected return on capital invested in machinery, is estimated using the average price of the asset, annual savings account yield rate, useful life of the equipment, and number of hours worked. Though specific methods for capital recovery on machinery and equipment for the United States and Brazil are not the same, both track usage of machinery and equipment and provide measures of depreciation and opportunity cost of ownership.

For the United States, land cost is determined as the cash rental rate for land, as reported by respondents who rented land. For owned land, ARMS data are used to determine a mean ratio of rental value to land value on farms that produce the commodity, by State (Gillespie et al., 2025). In Brazil, land cost is determined as a percentage of the average market price for land producing the commodity, by region, (Valdes et al., 2023). Taxes and insurance costs are likely to differ by country because of differences in tax and insurance structures in the two countries. For the United States, taxes included in the estimates include property taxes paid on machinery, livestock, and other farm production items, but not on real estate. Insurance includes all crop or livestock insurance (deducting expenses for Federal crop insurance), hail insurance, casualty insurance, and motor vehicle liability and blanket insurance policies. These whole-farm costs are allocated to the commodity on the basis of the crop's share of the farm's gross margin (Gillespie et al. 2025). For Brazil, taxes include a special contribution for rural social security, which is calculated as a percentage of the gross revenue from sales. Insurance includes rural insurance that is a part of agricultural policy, with several types of insurance included in this category. Some of the insurance types are excluded from the Brazil commodity cost of production estimates.

Corn Cost of Production in Selected Regions of the United States and Brazil

Brazil farm-level production costs were estimated for second-crop corn (planted January–March), following the soybean crop in Mato Grosso and at the national level for 2023, 2024, and 2025. These costs are compared to corn costs in the United States for the same years. Mato Grosso is the largest corn- and soybean-producing state in Brazil. Second-crop corn production in Mato Grosso accounts for 52 percent of Brazil's total production. Mato Grosso also accounts for 30 percent of total soybean production in the country. Using 2023–25 cost of production data from CONAB and prices and yields for the same period, per acre total economic cost in Brazil Mato Grosso was estimated to be less than half of U.S. Heartland costs (tables 1 and 2, figure 9).

Though estimates suggest U.S. Heartland *per acre* costs were much higher than Brazil Mato Grosso (figure 9), estimated U.S. Heartland and Brazil Mato Grosso *per bushel* costs differed by less (Brazil Mato Grosso total economic costs were 75 percent of U.S. Heartland costs) because higher yields in the United States partially offset its higher per acre production costs (figure 8). Higher land and capital recovery (which reflect machinery and equipment use) costs in the United States explain much of the difference in costs and reflect diverse cost structures. The proportion of estimated total costs attributed to operating costs versus allocated overhead costs differed between the two countries. In

the United States—both Heartland and national—operating costs and allocated overhead costs *each* made up roughly half of the total costs (table 1).

In Brazil, operating costs accounted for about 60 percent of the total corn costs, on average, in 2023–25 (table 2). Brazil’s corn producers spent less on fertilizers per acre than producers in the United States (\$82.84 in Brazil Mato Grosso versus \$174.08 in the U.S. Heartland), a reflection of double cropping with soybeans. Allocated overhead costs are estimated to be lower in Brazil compared with the United States, due primarily to Brazil’s lower land cost, where land cost as reported for Brazil refers to land cost for the second crop corn only.⁶ Corn yields of 122 bushels per acre in Brazil Mato Grosso were substantially lower than U.S. Heartland yields of 208 bushels per acre during 2023–25, and the national average differences were even greater: 97 bushels per acre in Brazil versus 192 bushels in the United States. However, yields are not the sole factor in determining returns per acre, as Brazilian farmers can grow 2–3 crops a year.

At the national level, producers in the United States received higher prices for their corn during 2023–25 than Brazilian producers, though Brazil Mato Grosso prices were close to United States prices. The average price received by U.S. Heartland producers from 2023–25 was \$4.25 per bushel (figure 10). For Brazil, the average national corn price was \$3.37 per bushel in 2023–25, but the Brazil Mato Grosso corn price was \$4.17. The average 2023–25 return less total economic cost per bushel was estimated to be higher in Brazil Mato Grosso than the U.S. Heartland, at \$0.72 per bushel in Mato Grosso versus -\$0.32 in the Heartland (figure 11). However, the United States had a higher estimated return less total economic costs at the national level (-\$0.38 in the United States versus -\$1.51 for Brazil). Note that total economic costs include non-cash opportunity costs, so negative return less total economic cost does not necessarily imply the average farm producing corn is not covering cash costs. Return less operating cost was estimated to be closer for Brazil Mato Grosso and the U.S. Heartland, at \$2.09 per bushel and \$2.00 per bushel, respectively (figure 12). Estimated return over operating costs for the total of both Brazil and the United States was higher in the United States, at \$0.58 and \$1.91, respectively. This is due primarily to the higher corn price in the United States than Brazil.

Yields for Brazil’s second-crop corn are variable, as planting occurs during a narrow window following soybean harvest, and climate variability may affect the optimal planting opportunity. Brazilian producers of second-crop corn report lower fertilizer costs, fuel, capital recovery, and land costs. Corn is an intensive crop user of phosphate and potash, but since planting second-crop corn follows soybeans, some nutrients remain on the soil, precluding large purchases of fertilizers for second-crop corn and reducing costs (EMBRAPA, 2026).

⁶ In Brazil in 2025, 83 percent of corn acreage was double cropped, while 37 percent of soybean acreage was double cropped (CONAB, 2026b). This helps to explain why the land cost was higher for soybeans than for corn since land cost is allocated between the two crops with double cropping.

Table 1

U.S. corn production costs per planted acre, Heartland region and U.S. total, 2023–25 average

Item	Heartland			U.S. national average		
	Costs		Share of total costs	Costs		Share of total costs
	(U.S. dollars)			(U.S. dollars)		
	Dollars per planted acre	Dollars per bushel	Percent	Dollars per planted acre	Dollars per bushel	Percent
Operating costs:	469.04	2.25	49.3	451.50	2.36	50.7
Seed	121.03	0.58	12.7	112.70	0.59	12.7
Fertilizer	174.08	0.84	18.3	163.41	0.85	18.3
Chemicals	53.48	0.26	5.6	53.02	0.28	6.0
Custom services	36.82	0.18	3.9	35.92	0.19	4.0
Fuel, lube, and electricity	26.82	0.13	2.8	28.08	0.15	3.2
Repairs	46.21	0.22	4.9	47.88	0.25	5.4
Purchased irrigation water	0.00	0.00	0.0	0.28	0.00	0.0
Interest on operating capital	10.61	0.05	1.1	10.21	0.05	1.1
Allocated overhead:	482.78	2.32	50.7	439.34	2.29	49.3
Hired labor	3.42	0.02	0.4	4.54	0.02	0.5
Opportunity cost of unpaid labor	31.29	0.15	3.3	30.69	0.16	3.4
Capital recovery of machinery and equipment	170.39	0.82	17.9	168.89	0.88	19.0
Opportunity cost of land	228.68	1.10	24.0	189.51	0.99	21.3
Taxes and insurance	20.80	0.10	2.2	19.77	0.10	2.2
General farm overhead	28.19	0.14	3.0	25.94	0.14	2.9
Total costs	951.82	4.57	100.0	890.85	4.65	100.0

	Heartland	U.S. national average
Supporting information		
Yield (bushels per planted acre)	208	192
Price (U.S. dollars per bushel)	4.25	4.27
Enterprise size (planted acres per farm)	274	296

Source: USDA, Economic Research Service.

Table 2

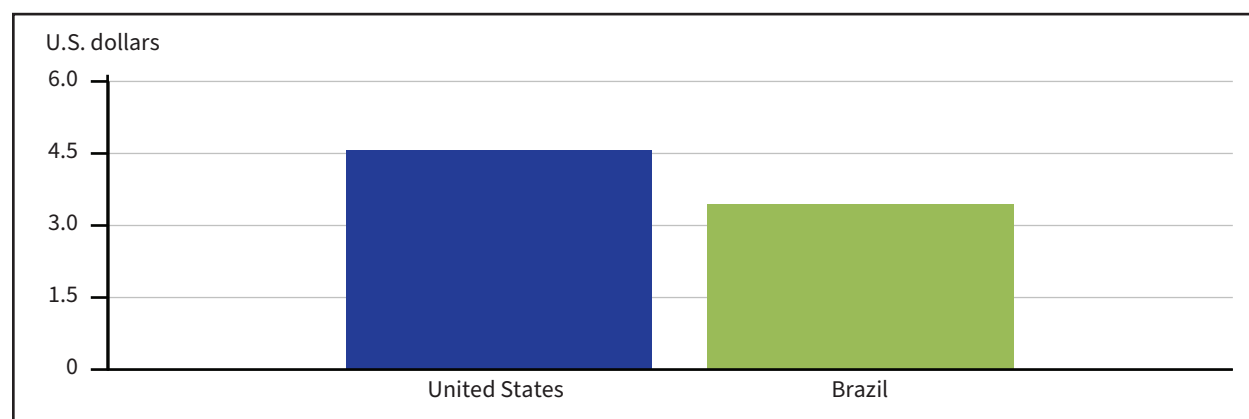
Brazil corn production costs, Mato Grosso region and Brazil total, 2023–25 average

Item	Mato Grosso			Brazil national average		
	Costs (U.S. dollars)		Share of total costs	Costs (U.S. dollars)		Share of total costs
	Dollars per planted acre	Dollars per bushel	Percent	Dollars per planted acre	Dollars per bushel	Percent
Operating costs:	254.29	2.08	60.5	270.42	2.79	57.2
Seed	51.10	0.42	12.2	68.14	0.70	14.4
Fertilizer	82.84	0.68	19.7	84.07	0.87	17.8
Chemicals	53.53	0.44	12.7	49.61	0.51	10.5
Custom services	36.57	0.30	8.7	31.04	0.32	6.6
Fuel, lube, and electricity	15.43	0.13	3.7	20.75	0.21	4.4
Repairs	2.41	0.02	0.6	4.28	0.04	0.9
Purchased irrigation water	0.00	0.00	0.0	0.00	0.00	0.0
Interest on operating capital	12.41	0.10	3.0	12.54	0.13	2.7
Allocated overhead:	166.28	1.36	39.5	202.73	2.09	42.9
Hired labor	6.75	0.06	1.6	7.38	0.08	1.6
Opportunity cost of unpaid labor	0.86	0.01	0.2	8.14	0.08	1.7
Capital recovery of machinery and equipment	67.40	0.55	16.0	52.36	0.54	11.1
Opportunity cost of land	61.65	0.51	14.7	97.14	1.00	20.5
Taxes and insurance	9.81	0.08	2.3	21.10	0.22	4.5
General farm overhead	19.81	0.15	4.7	16.61	0.17	3.5
Total costs	420.57	3.45	100.0	473.15	4.88	100.0

	Mato Grosso	Brazil national average
Supporting information		
Yield (bushels per planted acre)	122	97
Price (U.S. dollars per bushel)	4.17	3.37
Enterprise size (planted acres per farm)	898	114

Source: USDA, Economic Research Service.

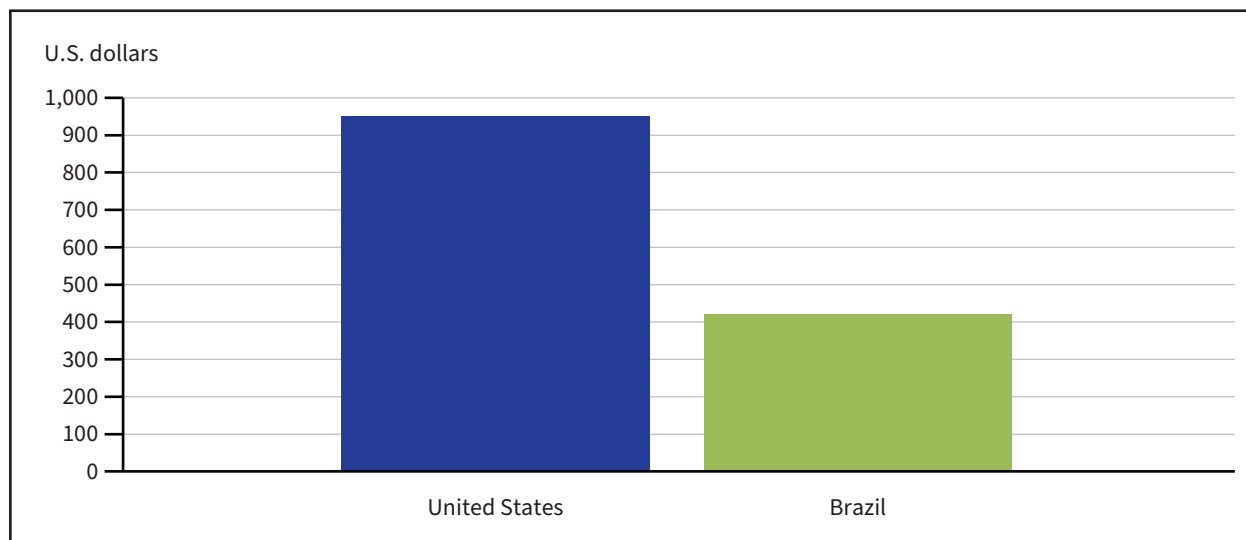
Figure 8

Corn production costs per bushel, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average

Source: USDA, Economic Research Service.

Figure 9

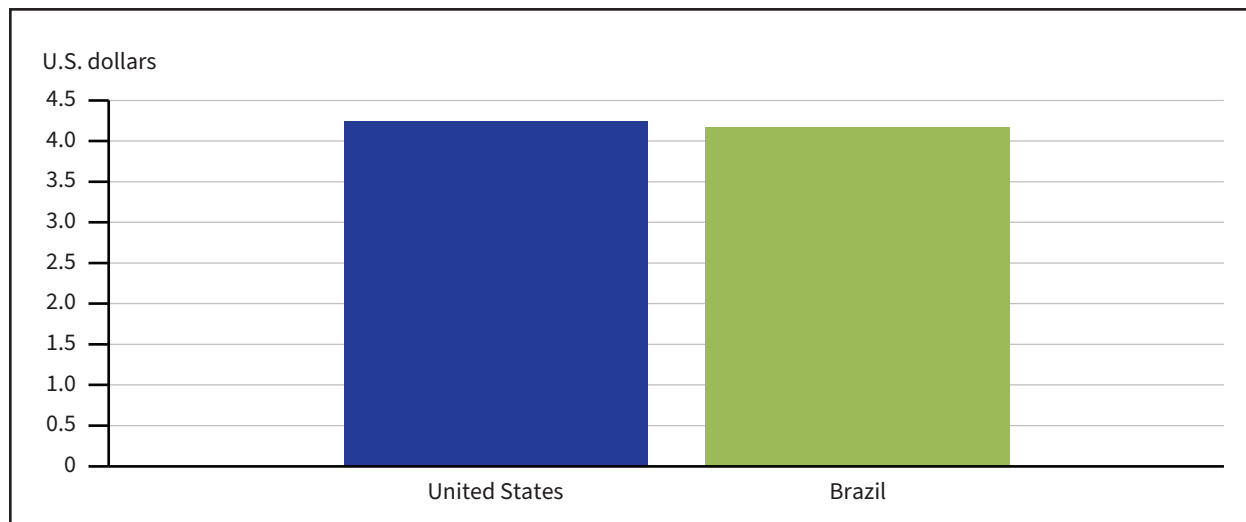
Corn production costs per acre, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

Figure 10

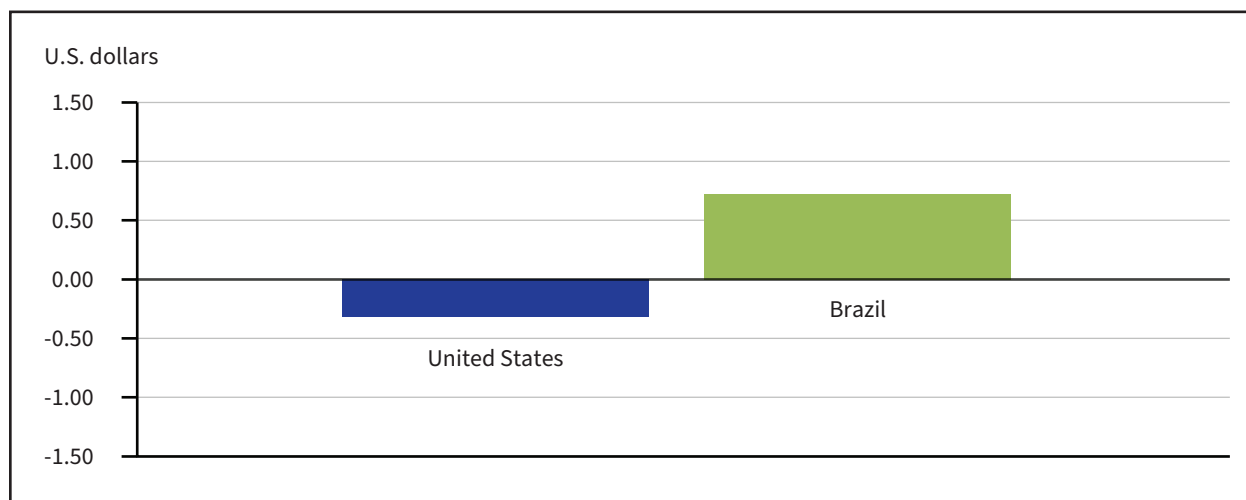
Price per bushel of corn, U.S. Heartland and Brazil Mato Grosso regions, harvest month, 2023–25 average



Source: USDA, Economic Research Service.

Figure 11

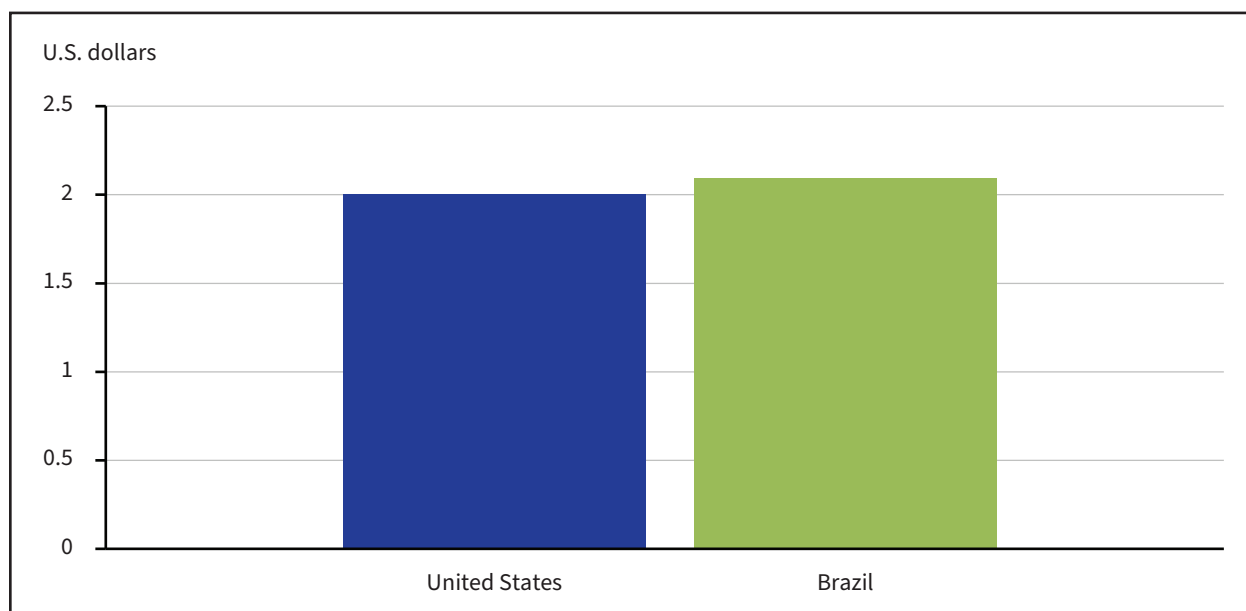
Return above total costs per bushel of corn, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

Figure 12

Return over operating costs per bushel of corn, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

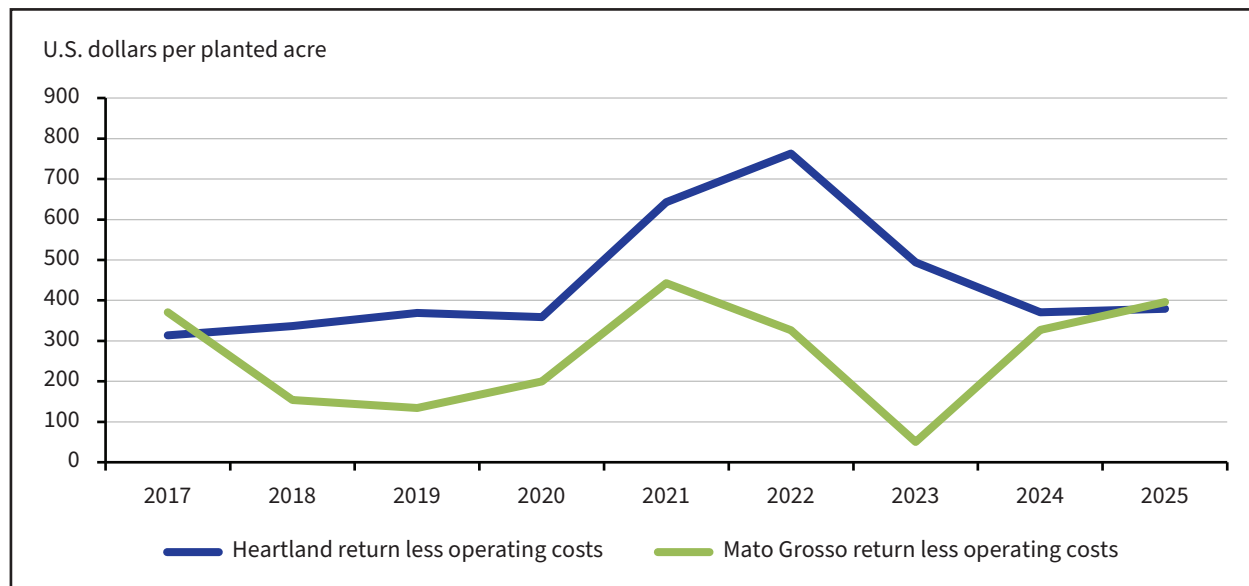
Estimated Profitability of United States and Brazil Corn Production

Estimates provided for 2023–25 corn show a generally higher net return over operating cost for the United States and a higher net return over total cost for Brazil Mato Grosso. However, different production conditions, prices, exchange rates, and other factors between the countries can impact relative profitability over time. Figures 13 and 14 show estimated gross value of production less operating costs and gross value of production less total costs for corn for the U.S. Heartland and Brazil Mato

Grosso since 2017. Over the 9-year period, estimated U.S. Heartland gross value of production less operating costs has exceeded that of Brazil Mato Grosso for all years except for 2017 and 2025. On the other hand, Brazil Mato Grosso's estimated gross value of production less total costs has exceeded that of the U.S. Heartland for most years during the 9-year period, with U.S. gross value of production less total costs exceeding that of Brazil in only 2022 and 2023. These results show that our 2023–25 estimates suggesting higher gross value of production less operating costs in the United States and higher gross value of production less total costs in Brazil Mato Grosso are mostly consistent over the longer 9-year period but are not necessarily consistent on a year-by-year basis.

Figure 13

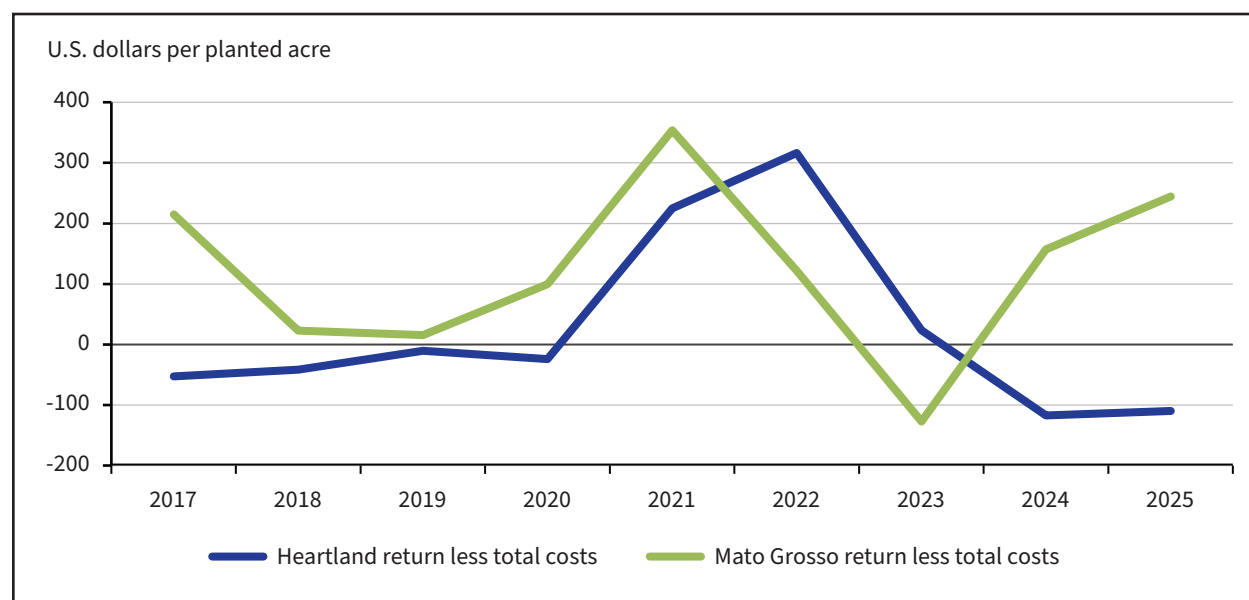
Estimates of corn gross value of production less operating costs per acre, U.S. Heartland and Brazil Mato Grosso, 2017–25



Source: USDA, Economic Research Service.

Figure 14

Estimates of corn gross value of production less total costs per acre, U.S. Heartland and Brazil Mato Grosso, 2017–25



Source: USDA, Economic Research Service.

Cost Comparison of Second-crop Corn and First-crop Corn in Mato Grosso

To frame Brazil's cost estimates within the broader U.S.–Brazil comparison, we note the production cost differences between Brazil's own first and second corn crops. Despite best efforts to allocate fixed and shared operational expenses across the soybean-corn (safrinha) system, the possibility of under-counting production costs for the second crop may underreport total economic costs per acre, when accounting for second-crop production. Farm-level production costs were estimated for second-crop corn following the soybean crop in Mato Grosso for 2023–25. Farm-level production costs for first-crop corn were calculated for Rio Grande do Sul, the largest first-crop corn-producing State, accounting for 19 percent of total first-crop corn area and 22 percent of first-crop corn production in Brazil in 2025 (CONAB, 2026b).

Total economic costs per acre to produce first-crop corn in Rio Grande do Sul averaged \$782.12 in 2023–25—86 percent higher than for second-crop corn cost in Mato Grosso (\$420.57 per acre). Corn price and yield were higher for first-crop corn (box table 1). Brazilian producers of second-crop corn report lower fertilizer costs, fuel, interest, custom services, labor, and land costs. Producers of second-crop corn had higher national average returns per bushel over total economic costs than first-crop corn: \$0.72 compared with -\$0.32 (box figure 1). However, on a per-acre basis, this has not been the case in 3 of the past 9 years (box figure 3).

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Box Table 1

Brazil's first-crop corn, second-crop corn, and soybean production costs, average 2023–25

Item	First-crop corn		Second-crop corn		Soybeans	
	Costs (U.S. dollars)	Share of total costs	Costs (U.S. dollars)	Share of total costs	Costs (U.S. dollars)	Share of total costs
	Dollars per planted acre	Percent	Dollars per planted acre	Percent	Dollars per planted acre	Percent
Operating costs:	448.28	57.3	254.29	60.5	338.93	62.9
Seed	128.83	16.5	51.10	12.2	44.18	8.2
Fertilizer	155.94	19.9	82.84	19.7	118.52	22.0
Chemicals	31.42	4.0	53.53	12.7	114.67	21.3
Custom services	50.89	6.5	36.57	8.7	24.47	4.5
Fuel, lube, and electricity	31.95	4.1	15.43	3.7	17.07	3.2
Repairs	8.75	1.1	2.41	0.6	1.94	0.4
Purchased irrigation water	0.00	0.0	0.00	0.0	0.00	0.0
Interest on operating capital	40.49	5.2	12.41	3.0	18.07	3.4
Allocated overhead:	333.84	42.7	166.28	39.5	199.73	37.1
Hired labor	12.14	1.6	6.75	1.6	9.10	1.7
Opportunity cost of unpaid labor	37.74	4.8	0.86	0.2	1.44	0.3
Capital recovery of machinery and equipment	67.04	8.6	67.40	16.0	73.36	13.6
Opportunity cost of land	112.71	14.4	61.65	14.7	87.37	16.2
Taxes and insurance	63.22	8.1	9.81	2.3	17.79	3.3
General farm overhead	40.98	5.2	19.81	4.7	10.67	1.2
Total costs	782.12	100.0	420.57	100.0	538.65	100.0

	First-crop corn	Second-crop corn	Soybeans
Supporting information			
Yield (bushels per planted acre)	153	122	58
Price (U.S. dollars per bushel)	4.79	4.17	10.22

Note: First-crop corn costs are for Rio Grande do Sul, second-crop corn and soybean costs are for Mato Grosso.

Source: USDA, Economic Research Service.

Box figure 1

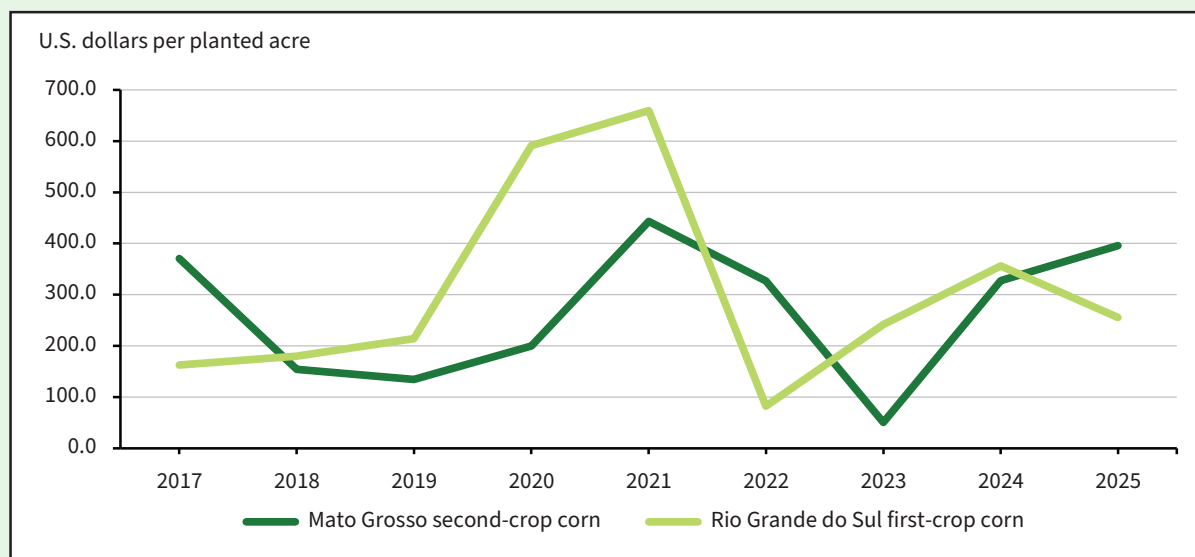
Return above costs per bushel of corn, first and second corn crop, 2023–25 average

Source: USDA, Economic Research Service.

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Box figure 2

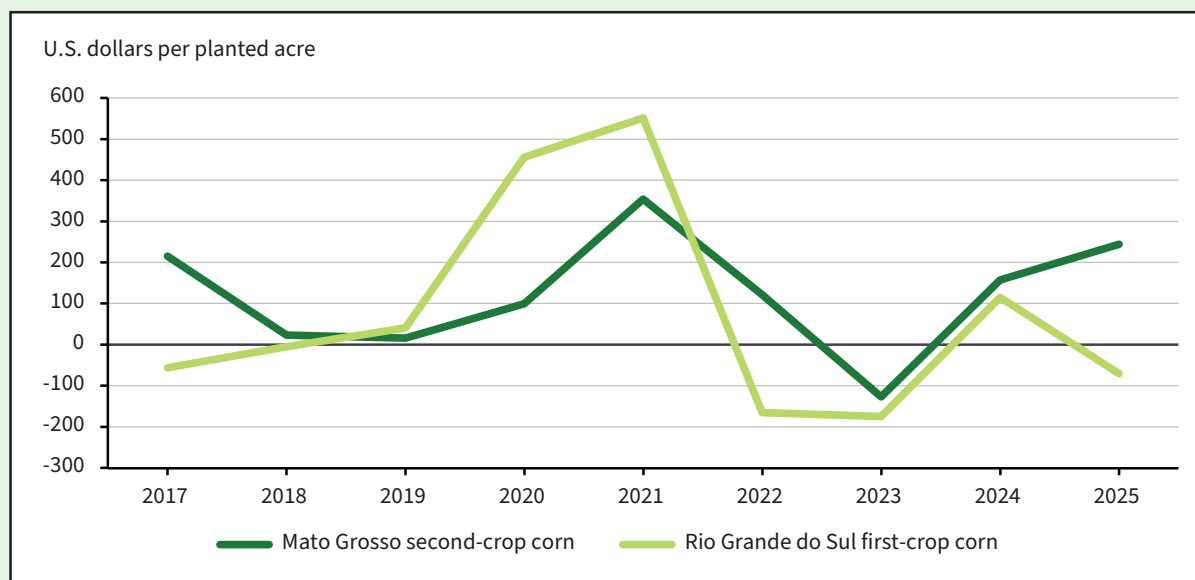
Estimates of corn gross value of production less operating costs per acre, Mato Grosso and Rio Grande do Sul, 2017–25



Source: USDA, Economic Research Service.

Box figure 3

Estimates of corn gross value of production less total costs per acre, Mato Grosso and Rio Grande do Sul, 2017–25



Source: USDA, Economic Research Service.

Soybean Cost of Production in Selected Regions of the United States and Brazil

Based on cost of production data for 2023–25, the estimated national average soybean total production cost per bushel was \$10.35 in Brazil and \$11.85 in the United States (tables 3 and 4). Brazil's Mato Grosso State had an estimated average total cost per bushel of \$9.29, while U.S. Heartland region producers had a cost of \$11.96 (figure 15). Soybean yields are similar for the two countries. Brazilian national average harvest-month soybean prices of \$10.63 per bushel in 2023–25 were close to U.S. levels at \$10.81 per bushel. During this same period, prices received by soybean producers in Mato Grosso (\$10.22 per bushel) were estimated to be 3.9 percent lower than the Brazilian national average and 5.7 percent lower than U.S. Heartland soybean prices (figure 17).

Using itemized cost of production data for 2023–25, results indicate that producers in the United States' Heartland incurred about 37 percent of their total soybean costs on operating costs, while 63 percent of total costs were operating costs for Brazilian Mato Grosso producers (tables 3 and 4). Both per acre and per bushel operating costs for soybean production were estimated to be lower in the United States Heartland (\$256.38 per acre), compared with operating costs in Brazil Mato Grosso (\$338.93 per acre), while allocated overhead costs were estimated to be higher in the United States, mainly because of the higher costs of land and capital recovery of machinery and equipment (tables 3 and 4).

In 2023–25, estimates suggest Brazil's soybean producers spent more on fertilizers and chemicals per acre and per bushel than producers in the United States, a reflection of traditionally low-nutrient soils in the Center-West region, high pest prevalence in tropical weather, and the cost to transport by truck imported fertilizers and chemicals to the major production regions of the Center-West. In contrast, seed costs were the largest operating expense in the United States at \$64 per acre in the Heartland, compared with \$44 for Brazil Mato Grosso (tables 3 and 4). Both countries plant GE varieties. Several reasons are behind the estimated difference in seed costs, the most significant being the differences in the average number of traits (stack size) between Brazil and the United States. The average seed planted in the United States has more traits than the average seed planted in Brazil. While smaller, non-commercial Brazilian farmers are legally allowed to produce their own seeds—precluding the need to purchase new seeds from seed companies every year, which reduces seed costs, farmers still need to pay intellectual property rights for GE seeds (ABRASEM, 2025). Estimated total economic costs per acre to produce soybeans in the U.S. Heartland were \$699.12, with the national U.S. total averaging about 6.1 percent lower. The total economic cost per acre to produce soybeans in Mato Grosso was \$538.65 (figure 16), with the total Brazil crop averaging about 3.8 percent higher (tables 3 and 4).

The average estimated 2023–25 returns less total operating cost per bushel was lower in Brazil Mato Grosso (\$4.38) than the U.S. Heartland (\$6.45) (figure 18). The average estimated net return over total cost per bushel of soybeans—which also includes allocated overhead costs, such as non-cash opportunity costs, ownership, and farm overhead costs—was higher in Brazil Mato Grosso (\$0.93) compared with -\$1.12 in the U.S. Heartland (figure 19). Higher U.S. land cost, at \$3.82 per bushel in the Heartland region compared with \$1.50 per bushel in Brazil Mato Grosso, was the largest allocated overhead cost for both countries. Similar results are found for the total Brazil and United States soybean crops, with higher estimated return over operating cost in the United States and higher estimated return over total cost in Brazil.

Table 3

U.S. soybean production costs, Heartland region and U.S. total, 2023–25 average

Item	Heartland			U.S. national average		
	Costs (U.S. dollars)		Share of total costs	Costs (U.S. dollars)		Share of total costs
	Dollars per planted acre	Dollars per bushel	Percent	Dollars per planted acre	Dollars per bushel	Percent
Operating costs:	256.38	4.39	36.7	252.20	4.56	38.4
Seed	64.22	1.10	9.2	62.76	1.13	9.6
Fertilizer	58.66	1.00	8.4	56.09	1.01	8.5
Chemicals	57.06	0.98	8.2	52.80	0.96	8.0
Custom services	12.89	0.22	1.8	13.12	0.24	2.0
Fuel, lube, and electricity	15.41	0.26	2.2	17.89	0.32	2.7
Repairs	42.36	0.72	6.1	43.68	0.79	6.7
Purchased irrigation water	0.00	0.00	0.0	0.18	0.00	0.0
Interest on operating capital	5.77	0.10	0.8	5.68	0.10	0.9
Allocated overhead:	442.74	7.57	63.3	403.96	7.29	61.6
Hired labor	5.68	0.10	0.8	9.21	0.17	1.4
Opportunity cost of unpaid labor	16.99	0.29	2.4	16.16	0.29	2.5
Capital recovery of machinery and equipment	166.70	2.85	23.8	165.26	2.98	25.2
Opportunity cost of land	223.40	3.82	32.0	182.36	3.29	27.8
Taxes and insurance	11.88	0.20	1.7	12.26	0.22	1.9
General farm overhead	18.08	0.31	2.6	18.72	0.34	2.9
Total costs	699.12	11.96	100.0	656.16	11.85	100.0

	Heartland	U.S. national average
Supporting information		
Yield (bushels per planted acre)	58	55
Price (U.S. dollars per bushel)	10.84	10.81
Enterprise size (planted acres per farm)	334	374

Source: USDA, Economic Research Service.

Table 4

Brazil soybean production costs, Mato Grosso region and Brazil total, 2023–25 average

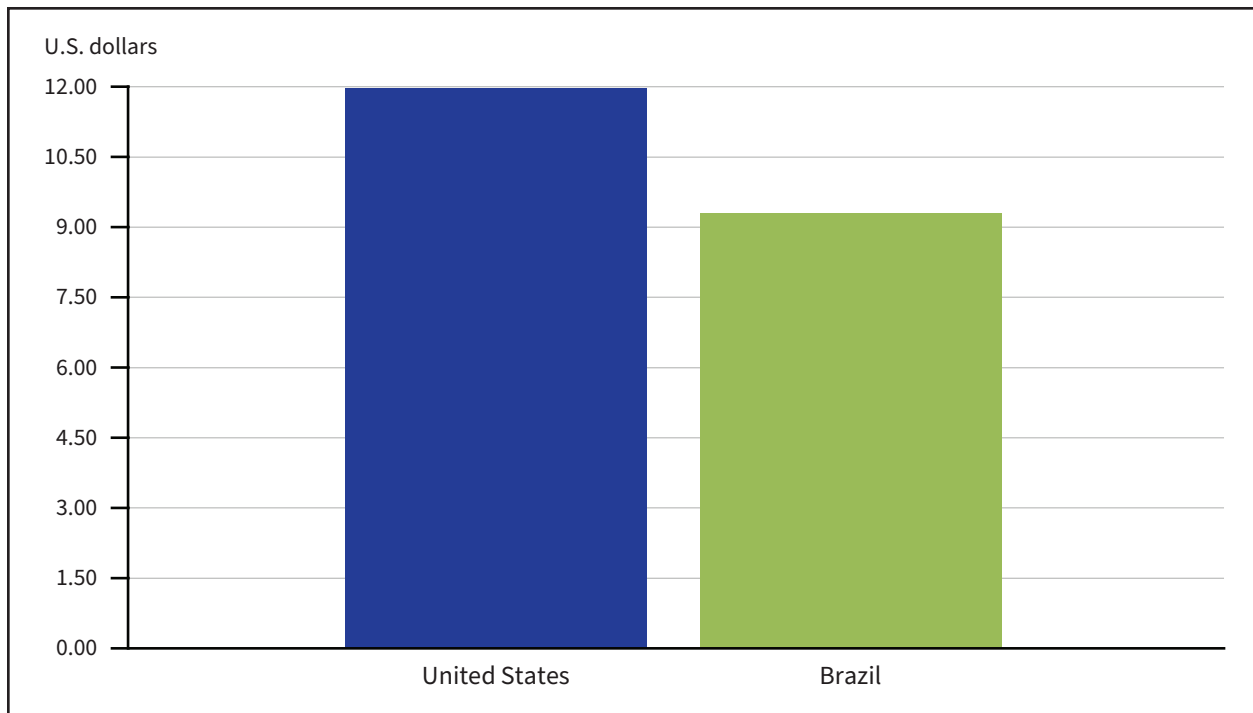
Item	Mato Grosso			Brazil national average		
	Costs (U.S. dollars)		Share of total costs	Costs (U.S. dollars)		Share of total costs
	Dollars per planted acre	Dollars per bushel	Percent	Dollars per planted acre	Dollars per bushel	Percent
Operating costs:	338.93	5.84	62.9	320.82	5.94	57.4
Seed	44.18	0.76	8.2	57.24	1.06	10.2
Fertilizer	118.52	2.04	22.0	96.64	1.79	17.3
Chemicals	114.67	1.98	21.3	96.54	1.79	17.3
Custom services	24.47	0.42	4.5	33.62	0.62	6.0
Fuel, lube, and electricity	17.07	0.29	3.2	15.48	0.29	2.8
Repairs	1.94	0.03	0.4	3.86	0.07	0.7
Purchased irrigation water	0.00	0.00	0.0	0.00	0.00	0.0
Interest on operating capital	18.07	0.31	3.4	17.44	0.32	3.1
Allocated overhead:	199.73	3.44	37.1	238.15	4.41	42.6
Hired labor	9.10	0.16	1.7	8.98	0.17	1.6
Opportunity cost of unpaid labor	1.44	0.02	0.3	7.98	0.15	1.4
Capital recovery of machinery and equipment	73.36	1.26	13.6	79.37	1.47	14.2
Opportunity cost of land	87.37	1.50	16.2	106.63	1.97	19.1
Taxes and insurance	17.79	0.31	3.3	23.75	0.44	4.2
General farm overhead	10.67	0.18	1.2	11.43	0.21	2.03
Total costs	538.65	9.29	100.0	558.97	10.35	100.0

Supporting information	Mato Grosso	Brazil national average
Yield (bushels per planted acre)	58	54
Price (U.S. dollars per bushel)	10.22	10.63
Enterprise size (planted acres per farm)	3,086	321

Source: USDA, Economic Research Service.

Figure 15

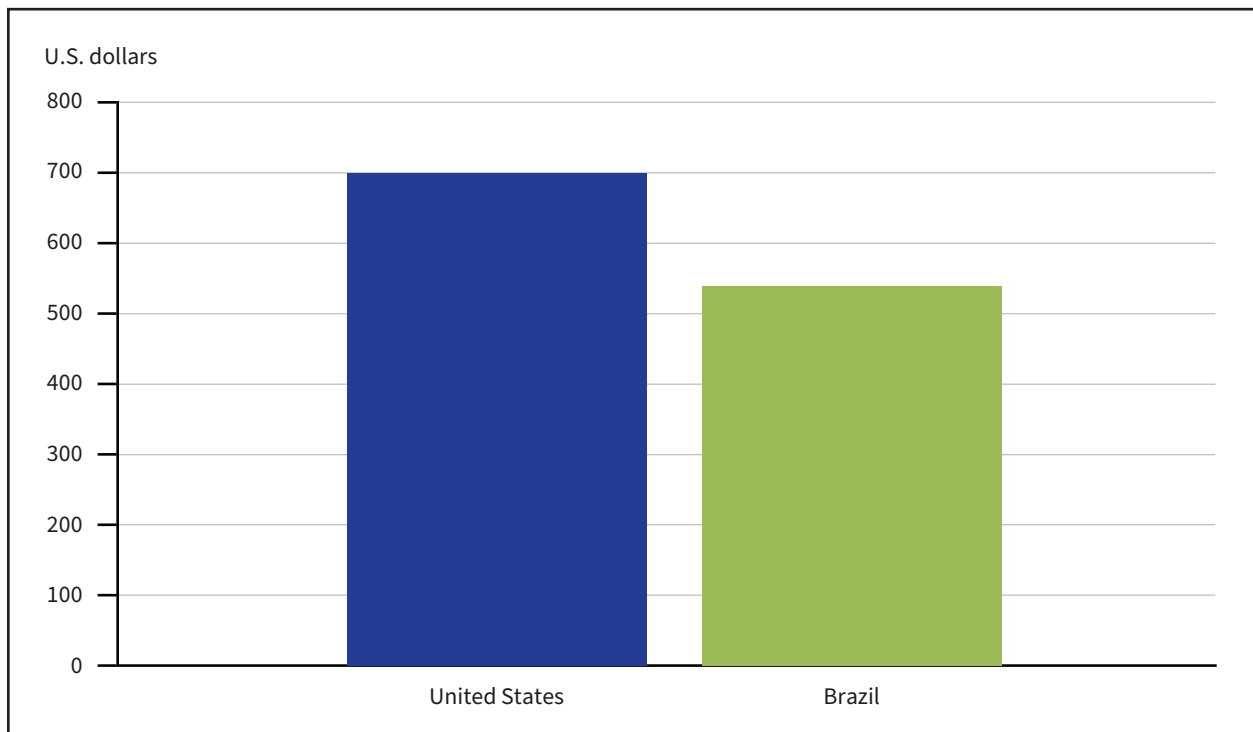
Soybean production costs per bushel, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

Figure 16

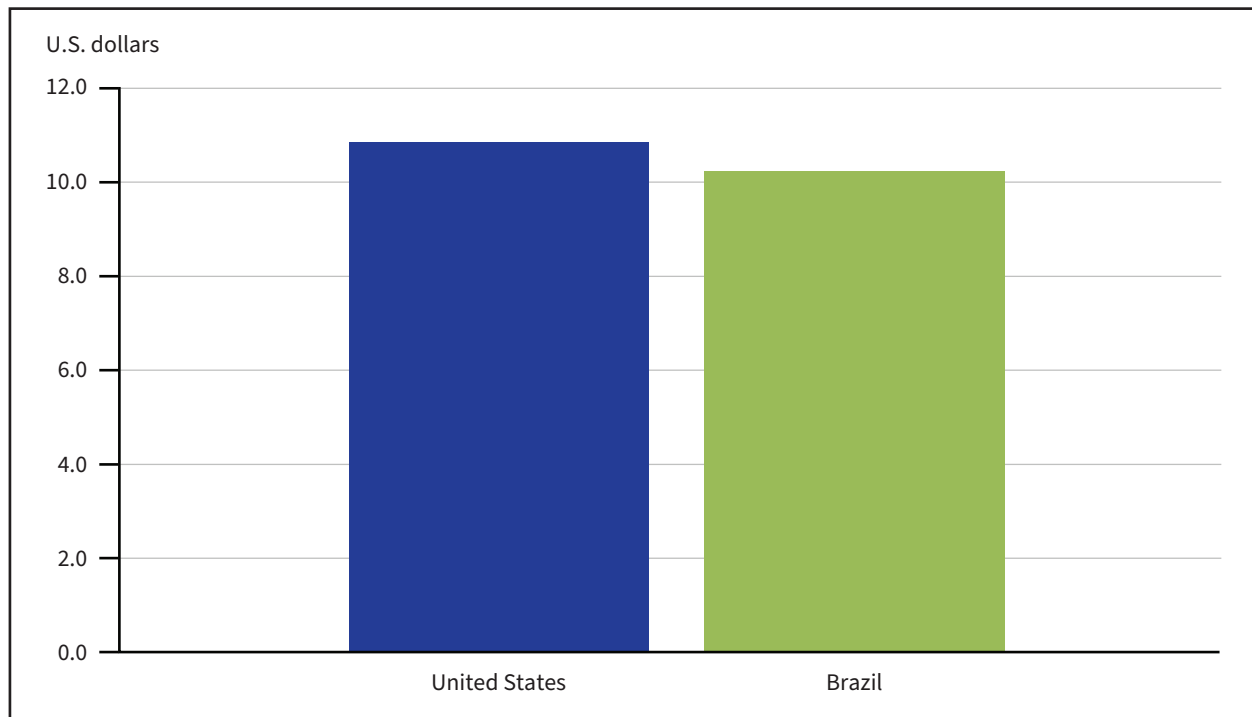
Soybean production costs per acre, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

Figure 17

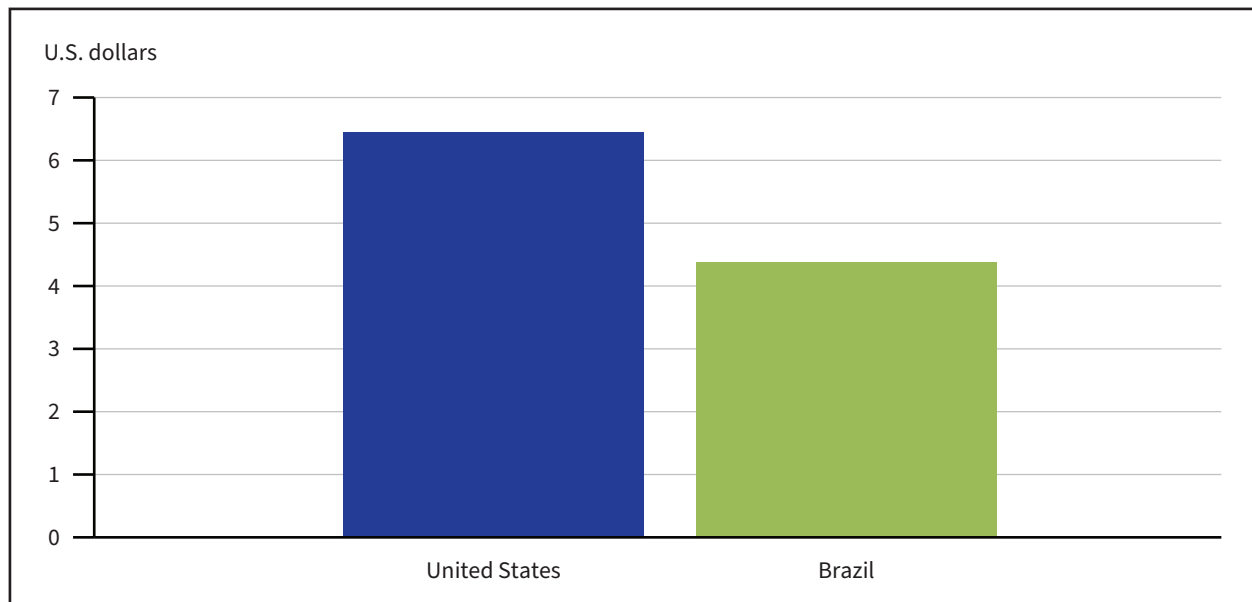
Price per bushel of soybean, harvest month, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average



Source: USDA, Economic Research Service.

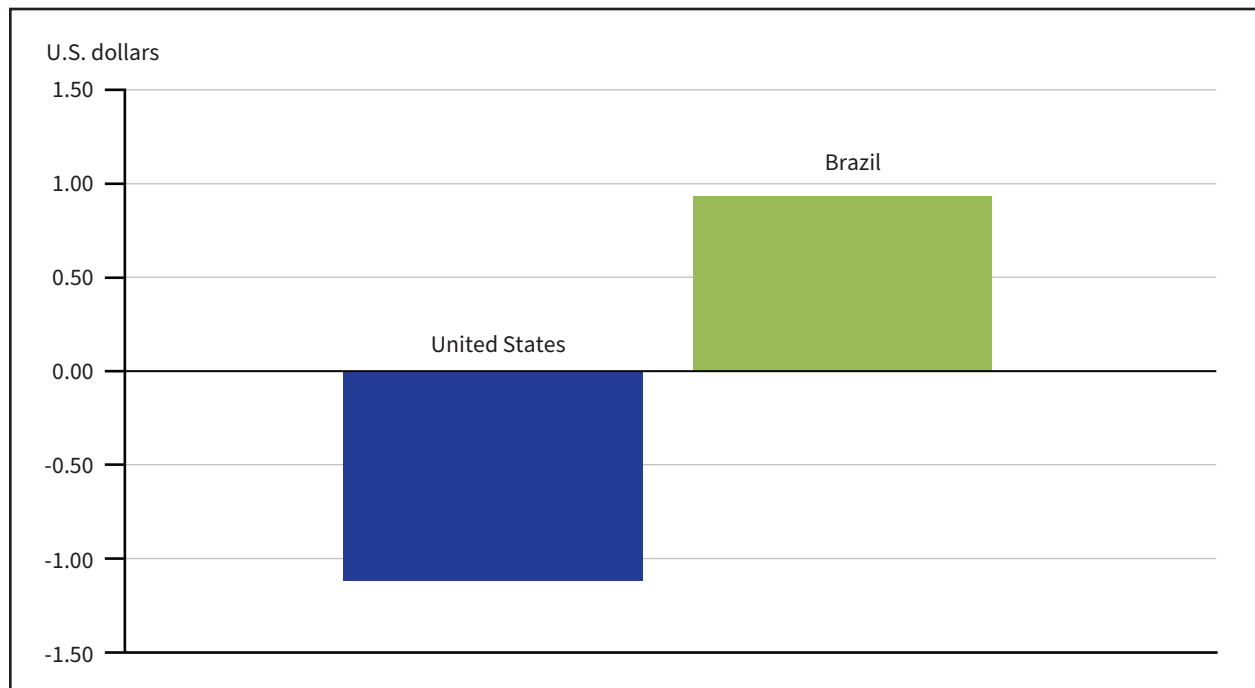
Figure 18

Return above operating costs per bushel of soybean, U.S. Heartland and Brazil Mato Grosso regions, 2023–25



Source: USDA, Economic Research Service.

Figure 19

Return above total costs per bushel of soybean, U.S. Heartland and Brazil Mato Grosso regions, 2023–25 average

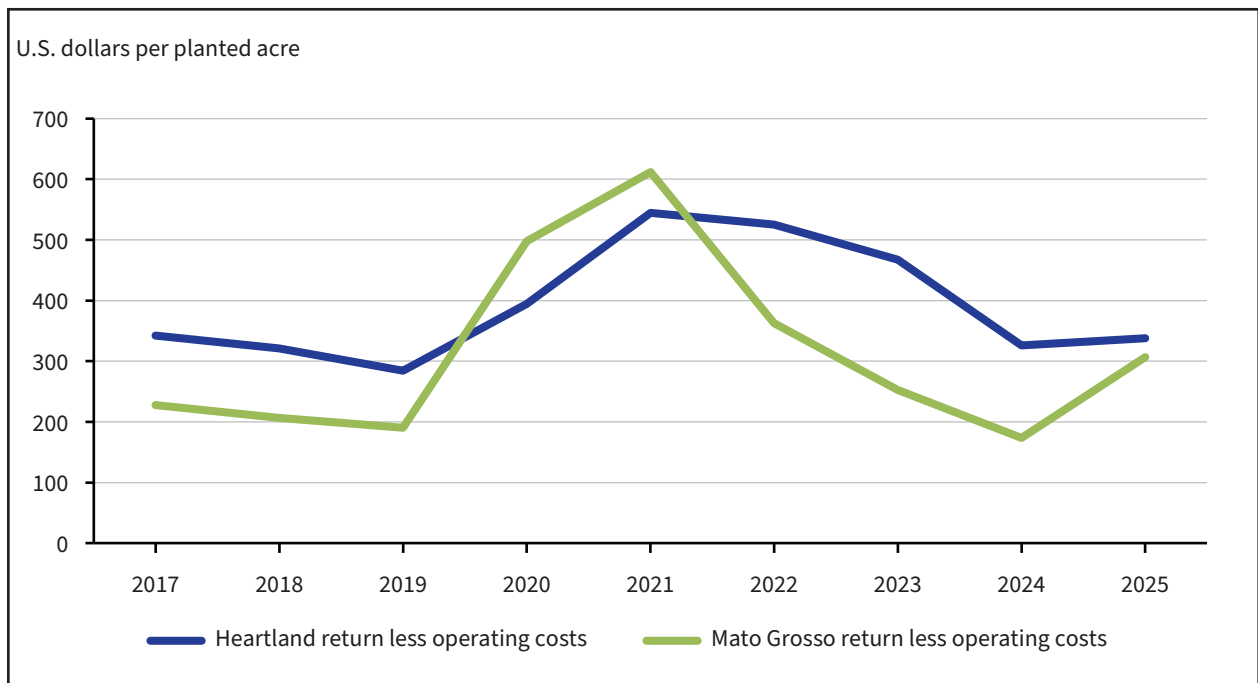
Source: USDA, Economic Research Service.

Estimated Profitability of United States and Brazil Soybean Production

Estimates provided for 2023–25 for soybeans show a mostly higher net return over operating cost for the United States and a higher net return over total cost for Brazil. However, different production conditions, prices, exchange rates, and other factors between the countries can impact relative profitability over time. Figures 20 and 21 show estimated gross value of production less operating costs and gross value of production less total costs for soybeans for the U.S. Heartland and Brazil Mato Grosso since 2017. Over the 9-year period, estimated U.S. Heartland gross value of production less operating costs has exceeded that of Brazil Mato Grosso for 7 of the 9 years, the exceptions being 2020 and 2021. On the other hand, over the 9-year period, estimated Brazil Mato Grosso gross value of production less total costs has exceeded that of the U.S. Heartland for all of the 9 years. These results indicate that our 2023–25 estimates showing higher gross value of production less operating costs in the United States are mostly consistent over the longer 9-year period but are not necessarily consistent on a year-by-year basis.

Figure 20

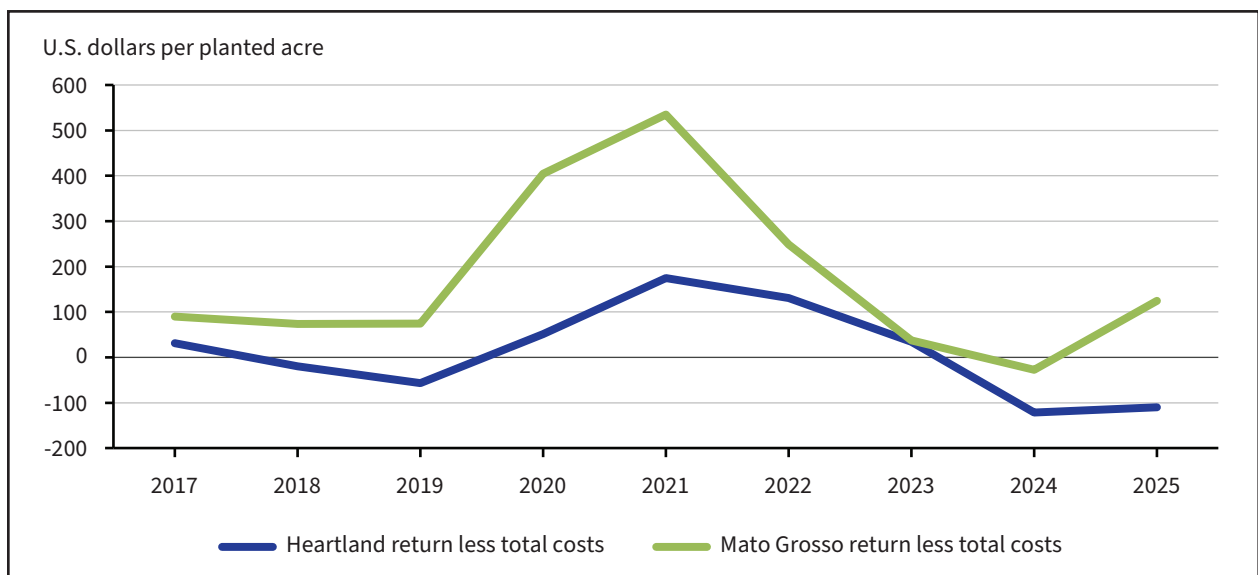
Estimates of soybean gross value of production less operating costs per acre, U.S. Heartland and Brazil Mato Grosso, 2017–25



Source: USDA, Economic Research Service.

Figure 21

Estimates of soybean gross value of production less total costs per acre, U.S. Heartland and Brazil Mato Grosso, 2017–25



Source: USDA, Economic Research Service.

Costs and Returns of a Soybean-corn Rotation and Soybean-corn Double Crop System

Corn and soybeans can be grown in the United States in a rotation, with one crop grown each year. A practice some regions of Brazil employ is double-cropping soybeans and corn, where soybeans are planted and harvested, followed by a corn planting and harvest in the same crop year. We compare costs and return estimates associated with the two systems at the farm level for the U.S. Heartland and Brazil's Mato Grosso regions. For the U.S. Heartland, we assume soybeans are planted in 2024 and corn is planted in 2025. For this analysis, only soybean farms where corn was planted in the field in the previous year were included, and only corn farms where soybeans were planted in the field in the previous year were included. This controls for economic benefits associated with a soybean-corn rotation, which can lead to higher corn yields and/or lower fertilizer usage. For Brazil Mato Grosso, we analyze farms that planted soybeans, harvested them, and then planted corn during the same crop year. The 2024–25 comparison of these two systems should be viewed as an illustration rather than a conclusive analysis of the relative differences in costs and returns between the two systems, as it is recognized that a longer time period would be needed to fully analyze their relative profitability.

Box table 3 shows average annual nominal (not inflation-adjusted) returns, costs, and net return over costs for 2024–25 for a U.S. Heartland soybean-corn rotation and a Brazil Mato Grosso soybean-corn double-crop system. For this scenario for 2024–25, note the higher estimated total gross value of production per acre and higher total operating costs in Brazil Mato Grosso because two crops are grown in the same year in Brazil Mato Grosso and one in the U.S. Heartland. Note also lower estimated total allocated overhead costs in Brazil Mato Grosso primarily due to lower land cost and higher estimated net value over costs in Brazil Mato Grosso. While these are cost estimates over the 2024–25 period for two specific crop production systems, results can be expected to differ for other years depending on specific crop and input prices in those years.

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Box table 3

Average annual costs and returns of a U.S. Heartland soybean-corn rotation and Brazil Mato Grosso soybean-corn double crop system, 2024–25

	Heartland Soybean (2024)-corn (2025) rotation	Mato Grosso Soybean-corn double-crop system
	Costs	Costs
Item	U.S. dollars per planted acre	U.S. dollars per planted acre
Gross value of production	710.04	1,147.13
Operating costs:	351.97	544.81
Seed	91.00	95.79
Fertilizer	112.13	171.01
Chemicals	51.94	155.60
Custom services	26.35	59.31
Fuel, lube, and electricity	19.54	31.54
Repairs	43.68	4.31
Interest on operating capital	7.34	27.25
Allocated overhead:	468.52	352.47
Hired labor	4.61	14.52
Opportunity cost of unpaid labor	24.78	2.28
Capital recovery of machinery and equipment	170.41	137.22
Opportunity cost of land	228.63	141.41
Taxes and insurance	16.54	25.74
General farm overhead	23.57	31.30
Total costs	820.49	897.28
Net value		
Net value less total costs	-110.45	249.84
Net value less operating costs	358.07	602.32

Source: USDA, Economic Research Service.

Factors Affecting Direct Input Costs

Seed Technologies and Costs

The United States and Brazil are the largest producers of biotech crops, cultivating 75.4 million hectares and 69.6 million hectares, respectively, in 2025. The biotech crop area in the United States represented 38 percent of the global crop area planted with GE traits, compared to Brazil's 28 percent share of the global biotech crop area of 190.4 million hectares (International Service for the Acquisition of Agri-biotech Applications (ISAAA), 2026).

Given the widespread adoption of GE crops in both countries, differences in the types and costs of GE seed are a key component of the comparison. Most commercialized GE crops in the United States and Brazil contain input-focused traits, such as herbicide tolerance (HT) or insect resistance (IR). HT crops are genetically engineered to tolerate applications of specific herbicides, allowing farmers to apply chemicals like glyphosate or dicamba after crop emergence to kill weeds while leaving the crop

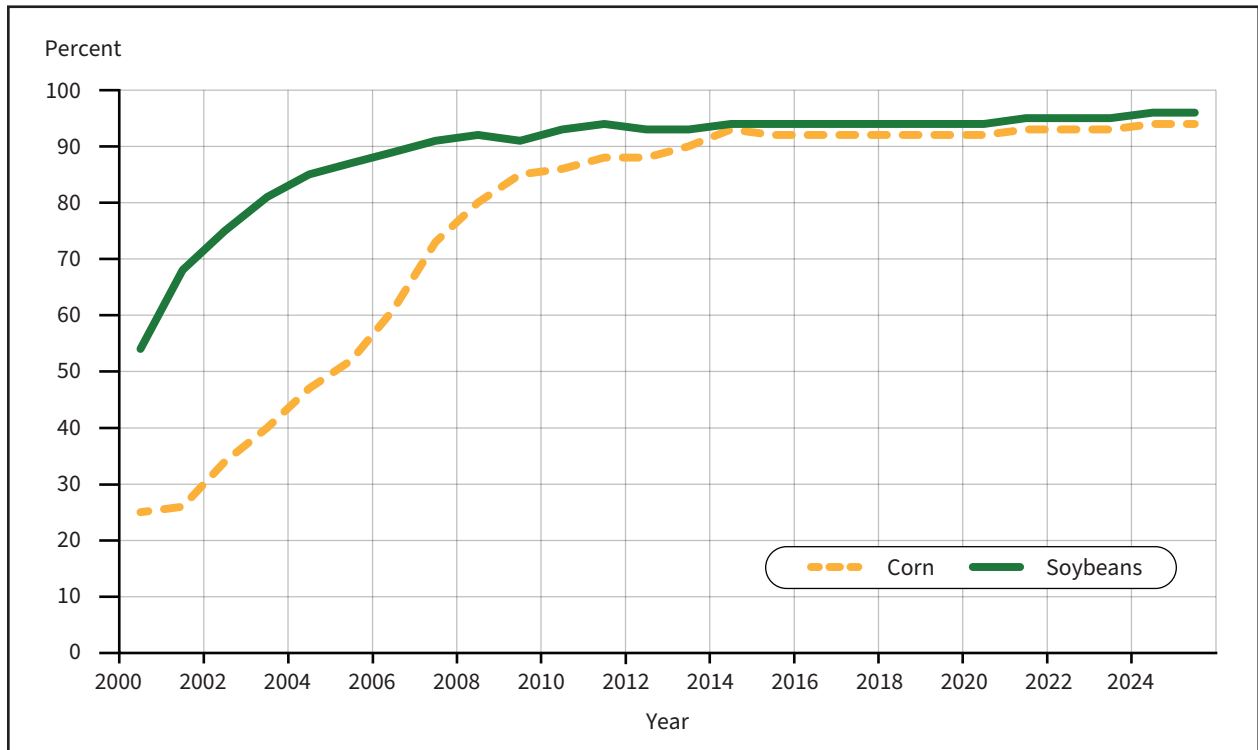
unharmful. Insect-resistant crops produce proteins that are toxic to certain insect species (Bonin et al., 2026). This section compares seed use and farmers' costs for corn and soybeans in the United States and Brazil, considering the GE traits contained in the seeds planted by farmers and the prices paid for those seeds. Seed cost comparisons are made based on the HT and IR categories below reported for the United States and matching the seed traits commercialized in Brazil.

The timing and pace of GE adoption have also differed between the United States and Brazil. GE crops were introduced in the United States much earlier than in Brazil, and adoption rates were much higher in the United States until 2014. HT corn and soybeans were introduced in the United States in 1996. IR corn was introduced in the United States in 1997, while stacked corn was introduced in 2000.

In Brazil, more than 4.53 million tons of seeds were produced in 2024, with soybean seed accounting for 81.6 percent and corn seed for 4.1 percent (ABRASEM, 2025). Production of seed is carried out by farmers, cooperatives, EMBRAPA, and multinational corporations (ABRASEM, 2025). Use of improved seeds is widespread, with adoption rates of 67 percent for soybeans and 91 percent for corn (ABRASEM, 2025). The use of seeds produced outside Brazil's System of Seeds and Traits (Sistema Nacional de Sementes e Mudanças (SNSM) or Seed Law, remains a concern; a recent study reports that about 11 percent of area planted to soybeans use pirated seeds (ABRASEM, 2025). Government support for the seed sector in Brazil includes R&D of new seed varieties, seed production, marketing programs, and production credit (ABRASEM, 2025). The passage of Cultivar Law in 1997 and the 2003 Seed Law No. 10.711 (SNSM) regulated the production, trade, and utilization of seed in Brazil, leading to greater private investment and expanded intellectual property rights of seed developers (USDA, FAS, 2010). GE soybean seeds were approved in 2003 while GE corn was approved in 2006 (ABRASEM, 2025). Since 2021, both GE corn and soybeans have been more commonly planted in Brazil, although they are nearly universal in both countries (figures 22 and 23).

Figure 22

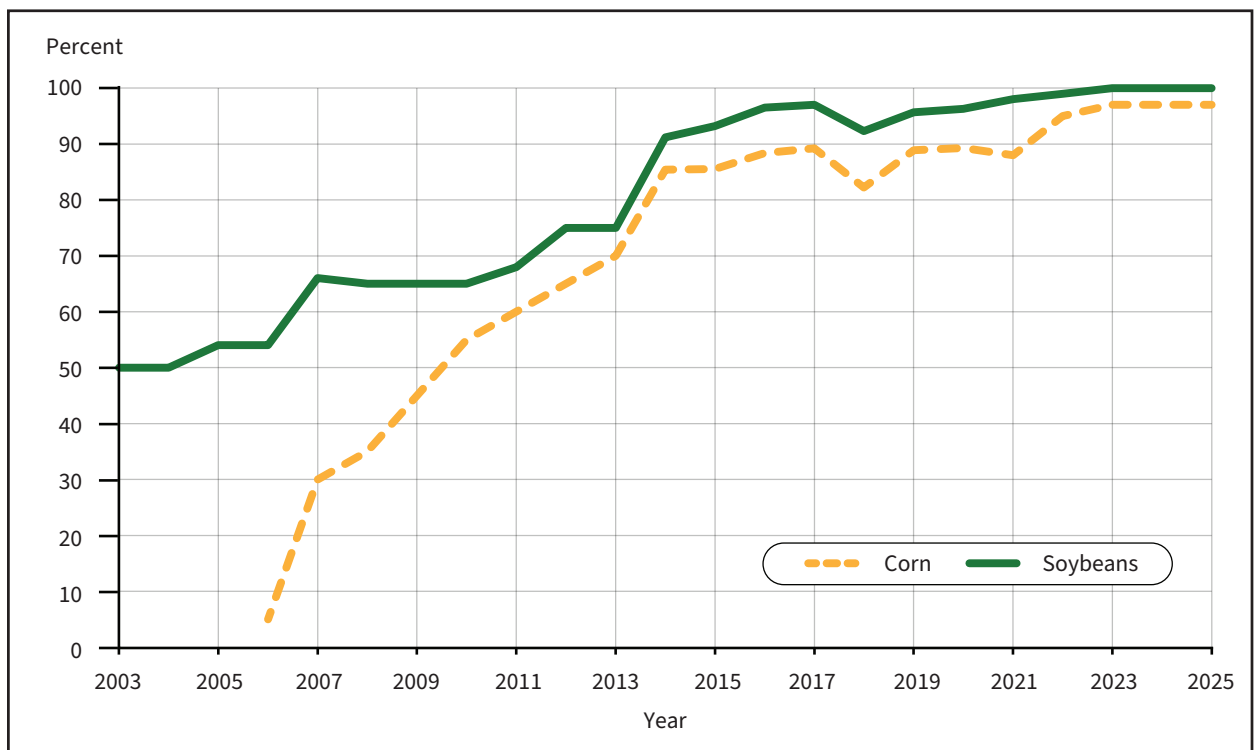
Adoption of genetically engineered (GE) corn and soybeans in the United States, 2000–25



Source: USDA, Economic Research Service calculations using data from S&P Global.

Figure 23

Adoption of genetically engineered (GE) corn and soybeans in Brazil, 2003–25



Source: USDA, Economic Research Service calculations using data from S&P Global.

Although GE adoption rates are now high in both countries, the GE seed technologies used by farmers differ in their trait composition and complexity. Commercial corn and soybean farmers in the United States and Brazil principally plant GE varieties—typically with HT and/or IR traits—as well as those that are genetically engineered for drought tolerance or high oleic acid content. Expenditures for corn seeds are calculated for a combination of up to eight HT, IR, and GE traits and soybean seeds with up to seven HT, IR, and GE traits. The analysis covers IR seeds that target corn borer, corn rootworm, corn ear worm, and fall army worm. The analysis also includes HT seeds designed for tolerance to glyphosate, glufosinate, 2,4-d choline, dicamba, and HPPD.

Analysis of farmers' expenditures on GE corn and soybean seeds by trait indicates that seed costs increase as the number of traits (stack size) increases for both countries. The average seed planted in the United States has more traits than the average seed planted in Brazil. In addition, the available seeds on the market differ substantially between the two countries. Even seeds with similar trait stacks often differ in which specific genetic modifications were used to create the trait and always differ in the underlying germplasm. Expenditure shares of similar seeds vary greatly between the United States and Brazil. There are also high rates of use of seeds used only in one country. In some cases, those seeds are more complex than what is available in the other, and in other cases they are older, less complex seeds. Some of the differences in available seeds are due to demand (pest pressures and other growing conditions), while others are due to supply (regulatory approvals and technological advancements) (appendix C).

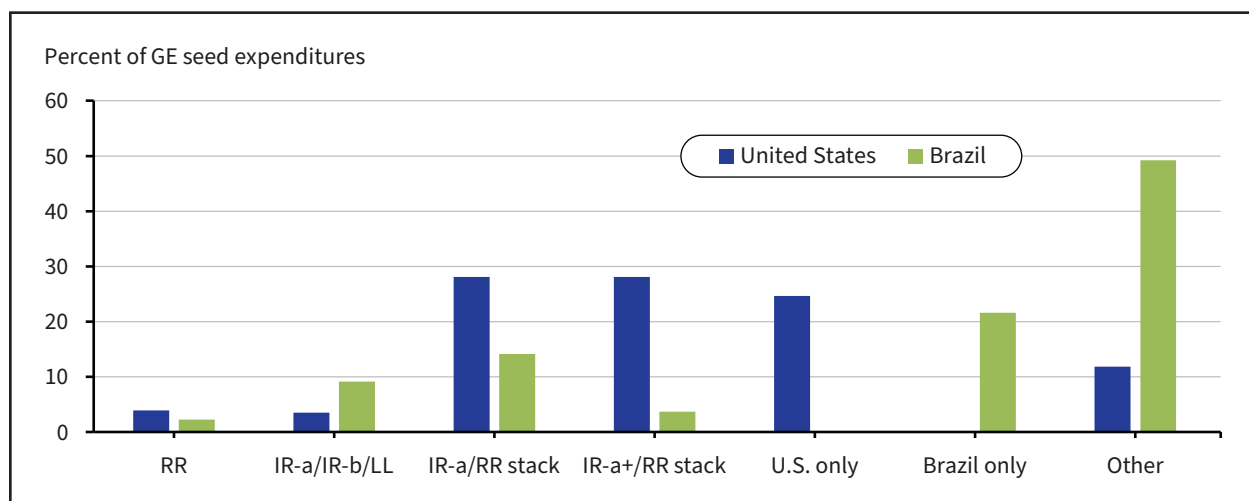
Figure 24 shows that there are large differences among the types of corn seeds used in Brazil and the United States. In the case of corn, less than half of GE seeds currently approved are used in both countries and several seeds are used only in one country or the other. Additionally, seeds that are used in both are used in different proportions. The majority of U.S. corn seed expenditure is on relatively complex seed technologies. The most common Brazilian corn seed is an older seed technology, and accounts for over 20 percent of seed expenditures in Brazil. Increased adoption of drought-tolerant corn seeds in Brazil's Central-West region has led to an expansion of the use of these seeds by 0.3 percent annually (S&P Global, 2024).

There are also differences between the versions of these seeds that are available in each country. U.S. and Brazilian products often differ in whether they protect against both above and below ground pests or above ground pests only. There can also be significant differences in how advanced similar seeds are in the two countries, with the more advanced seeds having traits with improved efficacy or additional modes of action.

The differences between U.S. and Brazilian seed technologies also extend to the underlying germplasm. Even when the genetic modifications are the same or similar, the seeds being modified were bred for the conditions in the country in which they will be grown. That means U.S. and Brazilian seeds differ in three key aspects: underlying germplasm, specific genetic modifications, and prevalence of different seed types.

Figure 24

Different countries, different traits: share of producers' expenditures on genetically engineered (GE) corn seed by trait, 2022–23 average

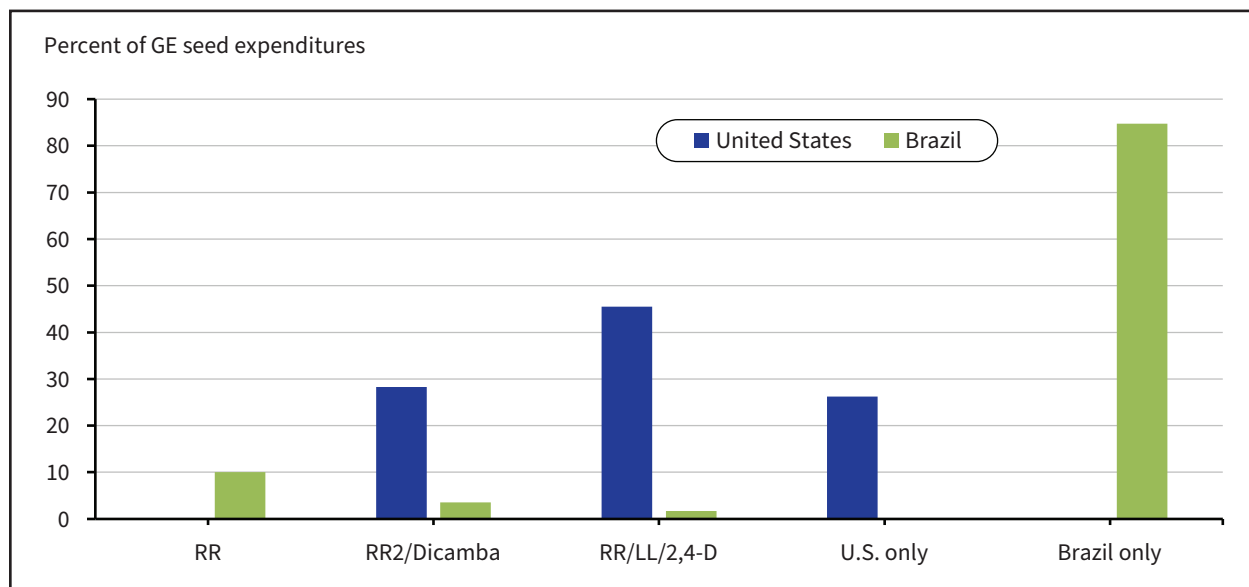


Note: Seeds are matched between countries by similarities in their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.

Figure 25

Different countries, different traits: share of producers' expenditures on genetically engineered (GE) soybean seed by trait, 2022–23 average



Note: Seeds are matched between countries by similarities in their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.

Chemical Use and Costs

The different pest pressures on U.S. and Brazilian farms are reflected in which pesticides are used in each country. Using 2022–2024 data from S&P Global, we see that Brazilian soybean farms use a

greater total volume of pesticides across categories (herbicides, fungicides, insecticides). This reflects, in part, the greater soybean acreage in Brazil. However, the differences in fungicide and insecticide use are greater than the difference in herbicide use, suggesting that insect and fungal pests are more pronounced in Brazil.

There is some overlap in the types of pesticides most commonly used on U.S. and Brazilian soybean farms. Glyphosate products are common herbicides in each country, with each of the top three Brazilian herbicides being glyphosate products. Fungicides are more varied between the U.S. and Brazil, although formulations including prothioconazole and trifloxystrobin are among the highest valued products in each country. Products containing acephate and bifenthrin are among the most valuable insecticide products in each country.

However, the differences between which pesticides are used in the United States and Brazil affect the comparability of the costs of chemical inputs (table 5). U.S. soybean farmers use more expensive herbicides, like glufosinate and 2,4-D, to a greater extent than Brazilian farmers do. With fungicides, U.S. farmers apply smaller amounts at higher unit costs on fewer acres. While acephate insecticide products are popular in both countries and U.S. farmers pay more per hectare for theirs, the top products in the two countries are different formulation types, which come with significant quality differences.

In both countries, there are differences in the total area treated and net area due to farmers applying herbicides, fungicides, or insecticides to their fields multiple times per season (table 5). Swanson (2026) found that product mix and market structure also help explain per hectare costs differences across several crop protection categories in both countries. The top glyphosate products in the two countries are different formulation types and the top products of the same formulation type are from different manufacturers, so there may again be significant quality differences between these seemingly similar products. (See appendix D for detailed information on herbicides, fungicides, and insecticides used on soybeans in the United States and Brazil).

Table 5

Top chemicals used on soybeans by market value in the United States and Brazil, 2022–2024 average

Country	Active ingredients	Value (million U.S. dollars)	Area treated (thousand hectares)	Net area (thousand hectares)	Cost per hectare (U.S. dollars)
Herbicides					
U.S.	Glyphosate	525	36,279	22,437	23.41
U.S.	2,4-D	302	16,164	11,372	26.53
U.S.	Glufosinate	296	9,642	6,903	42.87
Brazil	Glyphosate	1,374	131,912	120,744	11.38
Brazil	Haloxypop	159	19,227	19,135	8.30
Brazil	Clethodim	192	38,577	35,026	5.49
Fungicides					
U.S.	Azoxystrobin/Propiconazole/Pydiflumetofen	63	1,570	1,478	42.75
U.S.	Difenoconazole/Pydiflumetofen	53	1,566	1,535	34.55
U.S.	Fluopyram/Prothioconazole/Trifloxystrobin	42	1,070	1,037	40.09
Brazil	Bixafen/Prothioconazole/Trifloxystrobin	427	22,316	18,057	23.67
Brazil	Benzovindiflupyr/Prothioconazole	92	4,585	4,195	21.98
Brazil	Cyproconazole/Picoxystrobin	118	13,684	12,065	9.76
Insecticides					
U.S.	Acephate	22	1,510	1,093	20.34
U.S.	Bifenthrin	20	2,545	2,405	8.24
U.S.	Lambda-cyhalothrin	20	2,623	2,520	8.08
Brazil	Acephate	370	48,505	42,576	8.69
Brazil	Chlorantraniliprole	177	22,291	20,978	8.46
Brazil	Acetamiprid/Bifenthrin	107	16,817	12,583	8.51

Note: Net area refers to the physical space to which chemicals were applied. Area treated may be larger than net area due to multiple applications.

Source: USDA, Economic Research Service calculations using data from S&P Global.

Fertilizer Use and Prices

Brazil is the world's largest fertilizer importer, with 45.5 million metric tons imported in 2025 compared to 10 million metric tons imported by the United States (Trade Data Monitor (TDM), 2026). Brazil imports about 95 percent of the nitrogen used by Brazilian farmers, 72 percent of its phosphate consumption, and 96 percent of its potash needs; major suppliers include Russia, China, Canada, and Morocco (TDM, 2026). By contrast, the United States imports about 13 percent of its nitrogen consumption, 16 percent of the country's phosphate needs, and 95 percent of the potash used by farmers (TDM, 2026).

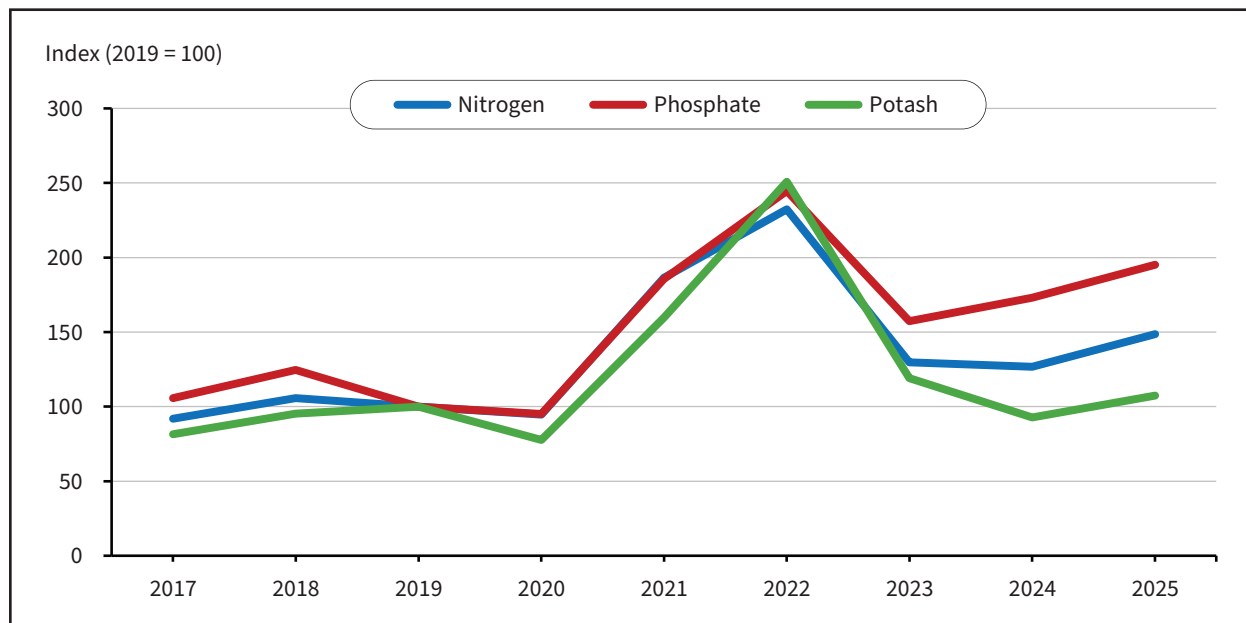
Brazil is also the fourth-largest consumer of fertilizers globally, behind China, India, and the United States, accounting for about 8 percent of global fertilizer consumption, with potash being the main nutrient consumed by Brazilian farmers (38 percent), followed by phosphorus (33 percent of total fertilizer use in the country) and nitrogen (29 percent of domestic fertilizer use in Brazil) (PNF, 2022).

Brazil's agricultural land expansion (cropland and pastureland) occurs principally in the Cerrado region (tropical savannah). With Cerrado soils being acidic and nutrient-deficient, Brazilian farmers purchase relatively large amounts of phosphate, potash, and lime (EMBRAPA, 2026). The United States is the third-largest consumer of fertilizers globally, with nitrogen fertilizer being the main nutrient used by U.S. farmers (54 percent of fertilizer consumption by volume), followed by phosphate (34 percent), and potash (12 percent) (Williams et al., 2025; International Fertilizer Association (IFA), 2026).

In 2023–25, soybean fertilizer costs represented 35 percent of operating costs in Mato Grosso (\$118.52 dollars per planted acre) and 30 percent of operating costs at the national level (\$96.64 dollars per planted acre) (table 4). U.S. Heartland fertilizer expenses were substantially lower, averaging \$58.66 per planted acre (about 23 percent of total operating costs) in 2023–25 (table 3). In the case of corn, fertilizer accounted for 33 percent of operating costs in Mato Grosso (\$82.84 per planted acre) and 31 percent of operating costs at the national level (\$84.07 per planted acre) (table 2). First-crop corn fertilizer costs were higher, accounting for 35 percent of operating costs in Rio Grande do Sul (\$155.94 per planted acre) (box table 2). U.S. fertilizer expenses totaled \$174.08 in the Heartland and \$163.41 at the national level, averaging 37 percent and 36 percent, respectively, of total operating costs in 2023–25 (table 1).

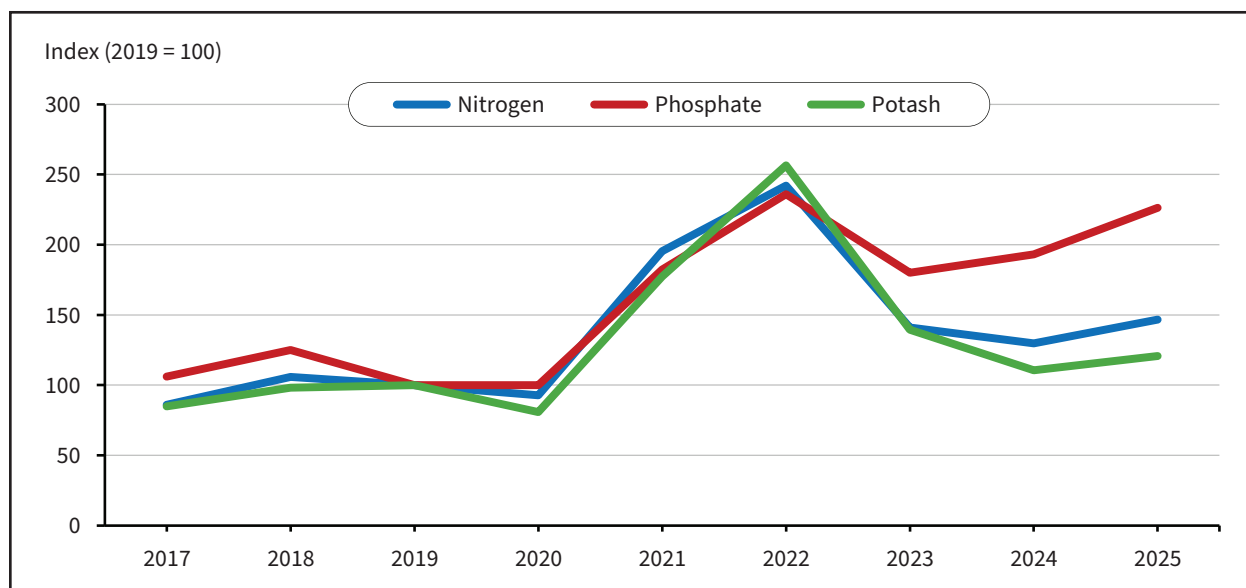
Over the 2017–25 period, Brazilian fertilizer prices showed mixed trends across nutrients, with phosphates, nitrogen, and potash prices reported by S&P Global generally higher than in the United States (S&P Global, 2026). For both Brazil and the United States, nitrogen, phosphate, and potash prices increased sharply in 2022 due to Russia's invasion of Ukraine, before declining in 2023. Record fertilizer price increases are seen in figures 26 and 27, as a result of this war. During 2023–25, nitrogen and phosphate prices increased an average of 7 percent and 11 percent annually per year in Brazil, compared to annual average increases of 2 percent for nitrogen and 12 percent for phosphate in the United States (S&P Global, 2026). Potash prices in Brazil and the United States decreased on average 5 and 7 percent annually during 2023–25, respectively (S&P Global, 2026).

Figure 26
Brazil's fertilizer prices, 2017-25



Source: USDA, Economic Research Service calculations using data from S&P.

Figure 27
United States fertilizer prices, 2017-25



Source: USDA, Economic Research Service calculations using data from S&P.

Additional Factors Affecting Crop Production in Brazil

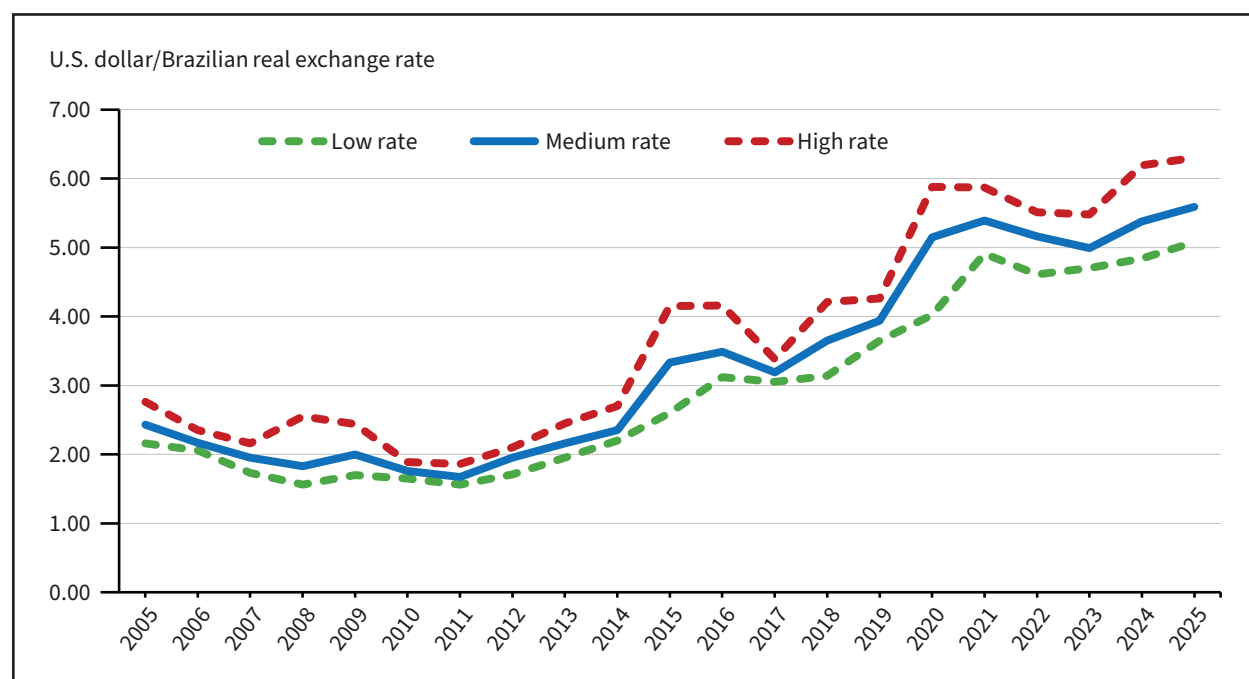
In addition to production practices, the development of ethanol plants using corn as the primary feedstock, and the increased use of soybeans as feedstock in biodiesel production leading to soybean use for domestic crush to meet the growing demand for soybean oil, several other factors influence corn and soybean production in Brazil, including the impact of exchange rate variability and improvements in transportation infrastructure.

Impact of Exchange Rate Variability of the Brazilian Real on Costs and Returns

Brazil's exchange rate policy, where a weakening (strengthening) of the real will lower (increase) commodity and input prices in U.S. dollar terms, will influence Brazil's cost of production results. The exchange rate between the U.S. dollar and the Brazilian real has experienced significant variability over time (figure 28). Various researchers have found that exchange rate variability impacts input prices, farm profitability, and export margins (Muhammad, 2015; Davis et al., 2014). Figure 28 presents the minimum and maximum exchange rates reported by Brazil's Central Bank observed from 2005 to 2025, as well as the exchange rate included in our calculations.

Figure 28

The Brazilian real-U.S. dollar exchange rate has shown significant variability, 2015–25



Source: USDA, Economic Research Service using data from Brazil's Central Bank (BCB), 2026.

Detailed data for Brazilian soybeans cost of production under alternative exchange rate scenarios and the comparison with soybeans cost of production included in our calculations are presented in table 6. The data presents the cost of production estimated in the Brazilian real, as well as the costs in U.S. dollars using the minimum and maximum exchange rates observed from 2023 to 2025 (table 6). Results confirm estimated operating costs in Brazil to be typically higher than U.S. operating costs, but this difference (the cost gap) narrows when the Brazilian real is highly depreciated (table 6). Conversely, the difference between Brazilian and U.S. operating costs widens when the Brazilian currency appreciates (table 6). Prices are also influenced by exchange rate movements as soybeans

are priced in U.S. dollars but paid in Brazil's real. With devaluation, prices of commodities in local currency will increase, and costs measured in foreign currency will decrease, leading to higher profit margins and increased revenues when the increase in output prices in the local currency more than offsets the greater cost impact on imported inputs after a devaluation.

Table 6

Soybean cost structure and impact of Brazil's Brazilian real-U.S. dollar exchange rate variability, 2023–25

	U.S. national average	Brazil national average	Brazil national average		
	2023–25	2023–25	2023–25	2023–25	2023–25
	U.S. dollars per planted acre	Reals per planted acre	U.S. dollars per planted acre	U.S. dollars per planted acre	U.S. dollars per planted acre
Item			Brazilian real per U.S. dollar 4.87	Brazilian real per U.S. dollar 5.32	Brazilian real per U.S. dollar 5.99
Operating costs:	252.20	1,706.76	350.22	320.82	284.94
Seed	62.76	304.52	62.49	57.24	50.84
Fertilizer	56.09	514.12	105.50	96.64	85.83
Chemicals	52.80	513.59	105.39	96.54	85.74
Custom services	13.12	178.86	36.70	33.62	29.86
Fuel, lube, and electricity	17.89	82.35	16.90	15.48	13.75
Repairs	43.68	20.54	4.21	3.86	3.43
Purchased irrigation water	0.18	0.00	0.00	0.00	0.00
Interest on operating capital	5.68	92.78	19.04	17.44	15.49
Allocated overhead costs:	403.96	1,266.95	259.98	238.15	211.51
Hired labor	9.21	47.79	9.81	8.98	7.98
Opportunity cost of unpaid labor	16.16	42.47	8.72	7.98	7.09
Capital recovery of machinery and equipment	165.26	422.25	86.64	79.37	70.49
Opportunity cost of land	182.36	567.27	116.40	106.63	94.70
Taxes and insurance	12.26	126.35	25.93	23.75	21.09
General farm overhead	18.72	60.81	12.48	11.43	10.15
Total costs	656.16	2,973.71	610.20	558.97	496.45

Source: USDA, Economic Research Service.

Internal Transport and Marketing Costs for Brazil

Inland transportation costs for Brazil's agricultural cargo are largely shaped by the country's reliance on road infrastructure. This dependence directly influences the cost of moving grain from production regions to export ports, with improvements in road networks lowering Brazil's freight costs. The freight mode for total soybean volume transported is 60 percent by road, 33 percent by rail, and 7 percent by waterway (Salin, 2024). In 2013, 1 year after Brazil surpassed the United States to become the world's largest soybean exporter, the Brazilian Government increased efforts to develop the Arco Norte (Northern Arc), which included development of export ports and completed the paving of 850 kilometers (528 miles) of the BR-163 highway in the center of the country's grain belt (Agência Nacional de Transportes Aquaviários, ANTAQ, 2026). Development of BR-163 and the northern ports alleviated bottlenecks caused by rapid agricultural production increases in the Center-West while reducing trucking

freight cost for hauling soybeans from Mato Grosso. Mato Grosso accounts for a third of the country's total soybean exports to the Santos and Paranaguá ports in the south (ANTAQ, 2026).

As discussed in Valdes et al. (2023), development of the north corridor with new barging operations linked the ports of Barcarena and Miritituba on the Tapajos-Amazon waterway (Salin, 2017). Furthermore, combined with completion of BR-163 in 2019 from North Mato Grosso to the Port of Miritituba, the cost of hauling soybeans for export decreased and allowed for backhauling of fertilizer imports (Salin, 2021). The northern ports increased their soybean export share to over a third of Brazil's soybean exports in 2025 (Ministerio do Desenvolvimento, Industria e Comercio Exterior (MDIC), 2026).

To assess the impact of improving inland infrastructure in Brazil on the relative costs when exporting soybeans, we considered all costs associated with transporting soybeans inland from producing regions to export ports. To estimate port (free on board or FOB) prices, farm-level per bushel costs of production in each country were converted into costs per metric ton (table 7). For Brazil, a separate estimate was made between the costs to move the soybeans from the State of Mato Grosso to the Port of Santos in the south and the costs to move the soybeans through the newly developed northern ports. Brazil's improvements in overland transportation following the completed paving of BR-163 in central Brazil to access the northern Port of Miritituba in Pará State led to lower trucking costs and a savings of \$31 per metric ton at the port when compared with soybean exports via southern ports. Consequently, the export price (FOB port price) for soybeans grown in Mato Grosso was lower at northern ports (table 7, items 4 and 4b). Between 2014 and 2025, soybean exports through the Arco Norte expanded from 10.9 million tons to 34.4 million tons per year, increasing its share of total Brazilian exports from 24 percent to 32 percent (Salin, 2026). Summing cost of production and inland transport costs using 2023–25 data and comparing to Valdes et al. (2023) results using 2017–21 data, Mato Grosso has consistently shown an advantage in soybean production plus shipment costs to ports (table 7). Soybean production plus inland transportation costs for 2023–25 summed to \$402–\$433 per metric ton in Mato Grosso, depending on whether northern or southern ports were accessed, compared to \$510 per metric ton in the U.S. Heartland.

Table 7

Impact of estimated inland transport cost on Brazil's soybean free-on-board port price

	Heartland	Mato Grosso	Heartland	Mato Grosso
	2023–25		2017–21	
Costs	U.S. dollars/metric ton			
(1) Farm price	398	376	355	375
(2) Cost of production	439	341	361	308
(3) Inland transport cost	71	92	58	77
(3b) Inland transport cost–north Mato Grosso	NA	61	NA	49
(4) FOB port price	469	468	414	452
(4b) FOB port price–Brazil northern port	-	437	-	424
	Heartland	Mato Grosso	Heartland	Mato Grosso
	2023–25		2017–21	
	Percent			
(5) Inland transport percent of port value	15.1	19.7	14.1	17.0
(5b) Inland transport percent of port value–Brazil northern port	-	14.0	-	11.5

Note: NA refers to “not applicable.”

Source: USDA, Economic Research Service using data from Brazil's Companhia Nacional de Abastecimento (CONAB, 2026a); Salin (2024); USDA, Agricultural Marketing Service (2026); and Valdes et al. (2023).

Conclusion

The United States has long been a leading exporter of corn and soybeans, but Brazil's growth in production, expanding crop area, and improved logistics have strengthened its position as a major competitor in global markets. Brazil's rising output reflects gains in yields and the widespread use of double-cropping systems, particularly in the Cerrado region, where soybeans are followed by second-crop corn. At the same time, the United States continues to benefit from high productivity and well-established market infrastructure.

While the cost of production comparison relied on original-format harmonized cost surveys from the United States and Brazil, differences remain between accounting formats and the impacts of variations in annual prices and yields on input cost and use and returns, which help to explain some cost asymmetries and the drivers behind the costs gap. Of note is Brazil's advantage in soybean seed costs, which benefit from large-scale purchases for large farm operations in Cerrado (ABRASEM, 2025). Brazil's ability to expand land under cultivation in new frontier agricultural regions, reflected in lower land purchase and rental prices, helps to explain lower land cost estimates compared to the United States. Another notable difference in calculating the costs of planting and harvesting soybeans is Brazil's management practice to outsource more of its services through custom operations, compared to capital investment and maintenance of machinery utilized for field operations (Valdes et al., 2023).

During 2023–25, cost of production data suggest distinct differences between U.S. and Brazilian corn and soybean systems. For corn, estimates suggest the U.S. total cost of production per acre was about double that of Brazil. However, because U.S. corn yields were nearly double those of Brazil, return over total economic costs per bushel for U.S. corn was estimated to be on par with that of Brazil, with Brazilian Mato Grosso estimated higher than the U.S. Heartland, but national U.S. estimates exceeding national Brazilian estimates. Estimates suggest return over operating costs differed little between Brazil Mato Grosso and the U.S. Heartland, but national U.S. returns over operating costs exceeded that of Brazil.

For soybeans, the estimates suggest the United States had higher per acre total economic costs than Brazil, but unlike corn, the two countries' soybean yields did not differ greatly. As a result, estimates suggest U.S. soybean total economic costs per bushel were higher than in Brazil. Soybean operating costs per bushel and per acre, however, were estimated lower in the United States than Brazil. Returns over total economic costs were estimated higher in Brazil than the United States, but the U.S. return over operating cost per bushel was estimated slightly higher.

The cost shares of production cost components differed across countries. For corn in the United States, operating and allocated overhead costs accounted for roughly equal shares of total costs, reflecting higher machinery, equipment, and land costs. In Brazil, operating costs represented a greater share of total expenses. For soybeans, a similar pattern of higher percentages of total costs as allocated overhead costs and lower percentages as operating costs were found. Differences in cropping systems also affect cost patterns; Brazil's corn producers commonly plant second-crop corn following soybeans, which reduces fertilizer requirements for corn relative to single-crop systems. With improved inland transportation infrastructure, Brazil's costs in transporting soybeans from the market of first sale to port do not differ greatly from those in the United States.

Taken together, estimates suggest that the United States maintained comparable per bushel costs and returns for corn because of higher yields and higher prices received during 2023–25, while Brazil held

an advantage in covering total economic costs for soybeans. The estimates indicate that the United States' estimated return over operating costs for soybeans was slightly higher than that for Brazil. However, there are limitations to the study that affect the interpretation of these cost and return results. Specifically, while the Brazil cost components have been re-organized to fit the U.S. format for comparison purposes, some differences in the measurement of specific cost components can always be expected when making comparisons of estimates developed by different institutions. Thus, while we are providing estimated costs for the United States and Brazil, we do not purport to provide precise differences in costs between the countries. In addition, we are comparing costs and returns across 3 specific years, 2023–25, so any inferences made beyond those 3 years should keep this in mind. For example, Valdes et al. (2023) compared soybean costs and returns for the two countries using similar data sources for 2021 but return over costs during that year were considerably higher than for the 2023–25 period.

Differences in seed technology and farmer practices between the United States and Brazil are also reflected in the costs producers incur for corn and soybean production. In both the United States and Brazil, adoption of GE corn and soybeans is nearly universal, with the two countries together accounting for two-thirds of global GE crop area (ISAAA, 2025). However, the technologies used—and the costs associated with them—differ. U.S. producers typically plant seeds containing more stacked traits per seed, and seed prices typically rise with the number of traits included. Brazilian farmers, by contrast, more commonly use older or less complex seed technologies. Differences in the underlying germplasm, which is bred for local conditions, also influence seed performance, pricing, and availability. In addition, seed-saving practices and legal protections differ. U.S. farmers face strict legal restrictions on saving and replanting GE seeds, which contributes to higher seed expenses. Brazilian farmers have traditionally had looser protections, enabling some to reduce costs by saving or producing their own seed. Together, these differences help further explain variation in corn and soybean production costs between U.S. and Brazilian producers.

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Appendix A: Brazil's Corn and Soybean Planting Season and Location

Table A.1

Brazil's first- and second-crop corn calendar by region and State

Region/State ¹	First-crop planting	Second-crop planting	First-crop harvesting	Second-crop harvesting
Center-West				
Mato Grosso	October–December	January–February	February–May	May–July
Mato Grosso Sul	October–December	January–February	January–April	May–July
Goiás	October–December	January–February	January–April	May–July
South				
Paraná	September–November	January–March	January–May	May–September
Rio Grande do Sul	August–November		February–May	
Southeast				
Minas Gerais	October–December	February–March	February–May	June–September
São Paulo	October–December	January–March	January–May	May–September
Northeast				
Bahia	October–January	May–July	February–June	August–November
Maranhão	November–February	February–March	May–September	June–July
Ceará	January–April		June–August	
North				
Rondônia	August–October	January–March	January–April	June–July
Pará	October–December		January–May	

¹Brazil's five regions are defined by State boundaries and similar characteristics for climate, topography, soil, and land use.

Source: USDA, Economic Research Service using information from Companhia Nacional de Abastecimento (CONAB).

Table A.2

Brazil's first- and second-crop corn, soybean crop by State and region, 2025

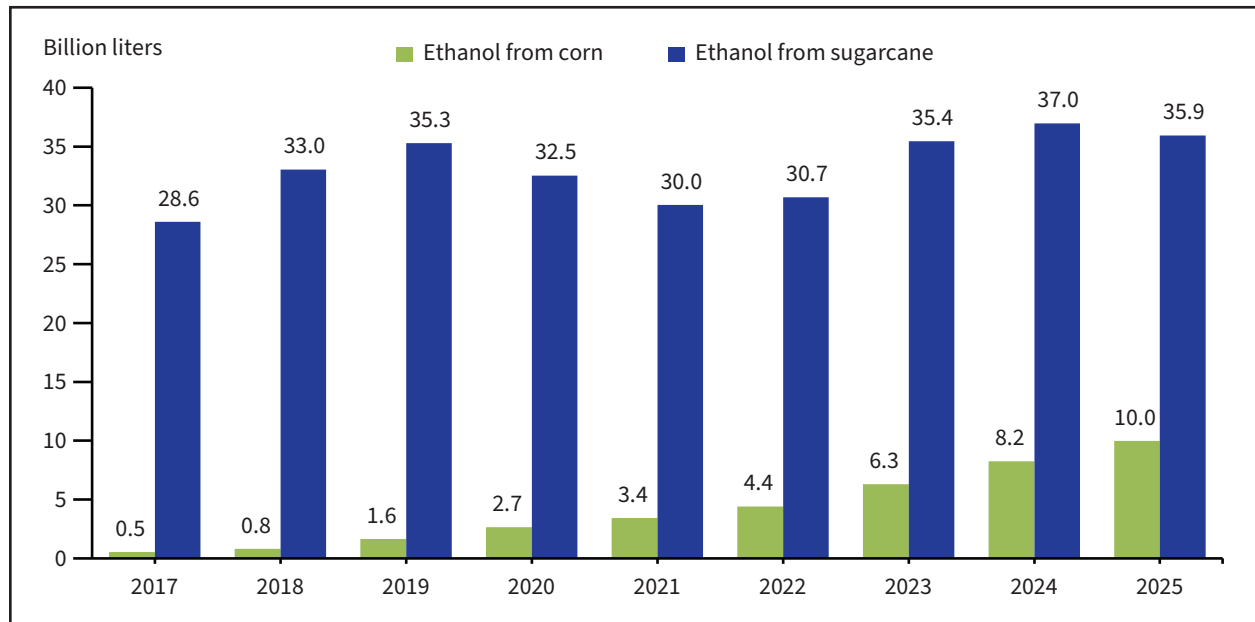
States	First corn crop planting	Second corn crop planting	Soybeans planting
Frontier region			
Bahia	x		x
Goiás	x	x	x
Maranhão	x	x	x
Mato Grosso		x	x
Mato Grosso do Sul		x	x
Minas Gerais	x	x	x
Piauí	x	x	x
Tocantins		x	x
Traditional region			
Paraná	x	x	x
Rio Grande do Sul	x		x
Santa Catarina	x		x
São Paulo	x	x	x

Source: USDA, Economic Research Service using data from Companhia Nacional de Abastecimento (CONAB).

Appendix B: Ethanol Production in Brazil

Figure B.1

Brazil ethanol from sugarcane and ethanol from corn, 2017–25



Source: USDA, Economic Research Service using data from Agencia Nacional do Petroleo (ANP) and from União Nacional do Etanol de Milho (UNEM).

Appendix C: Genetic Engineering Regulation in Brazil and the United States

Table C.1

Genetically engineered (GE) soybean trait approvals in the United States and Brazil

Trade name	Commercial trait	GE trait	United States cultivation approval date	Brazil cultivation approval date
RR	HT-Singular	HT-Glyphosate	1994	1998
Liberty Link	HT-Singular	HT-Glufosinate	1996	2010
Treus, Plenish	Singular-PQ	HT-Sulfonylurea; Md. oil/fatty acid	2010	2018 ¹
Cultivance	HT-Singular	HT-Sulfonylurea	2014	2009
Enlist E3 SB	HT-Stacked	HT-Glufosinate; Glyphosate; 2,4-D	2014	2015
Conkesta Enlist E3	HT+IR-Stacked	HT-Glufosinate; Glyphosate; IR-Lepidopteran; 2,4-D.	2014 ²	2017
RR Liberty Link	HT-2	HT-Glufosinate; Glyphosate		2023
Verdeca HB4 SB	ST-Singular	Drought Stress Tolerance	2019	2019
Intacta RR 2Pro	HT+IR-Stacked	HT-Glyphosate + IR-Lepidopteran		2010
Genuity RR 2 Xtend	HT-Stacked	HT-Glyphosate + HT Dicamba	2015	2016

¹ Not approved for cultivation but approved in 2018; for imported food and feed.

² The Conkesta Enlist E3 stacked trait product was developed specifically for Brazil; however, the individual component traits, Enlist E3 (HT) and Conkesta (IR), received separate regulatory approvals in the United States in 2014.

Source: USDA, Economic Research Service compilation using data from the International Service for the Acquisition of Agri-biotech Applications (ISAAA), 2026.

Regulatory Framework

Seed intellectual property rights and legal protections differ between Brazil and the United States. Intellectual property protection in the United States strongly limits U.S. farmers' ability to save and replant GE seeds. Legal protections for seed and chemical companies in Brazil have traditionally been weaker but are increasingly being upheld in Brazilian courts, limiting Brazilian farmers' ability to reduce costs through seed saving. Brazil has two agencies in charge of the product and process-based regulations for the cultivation and trade of GE crops. The National Biosafety Technical Commission (CTNBio) is charged with formulating technical norms regarding the authorization of GE research related activities and their commercial use, including the evaluation for human health and environmental risks (S&P Global, 2024). The National Biosafety Council (CNBS) is responsible for formulating and implementing the National Biosafety Policy. This council, under the office of the President, is responsible for clearing the commercial use of GE events and their by-products and is authorized to refute the commercial approval of GE events. If refutation does not occur within 30 days, the product is automatically authorized for use in Brazil (S&P Global, 2024).

The regulatory framework involving GE crops is under Brazil's Biosafety Law No. 11.105 of 2005, which sets the standards and inspection mechanisms for the cultivation, production, transportation, trade, storage, research, marketing, and consumption of GE crops (S&P Global, 2024). In Brazil, biotechnology is regulated by various ministries and agencies, including the Ministry of Agriculture, Livestock and Food Supply (MAPA) which is in charge of agricultural compliance; the Brazilian National Health Surveillance

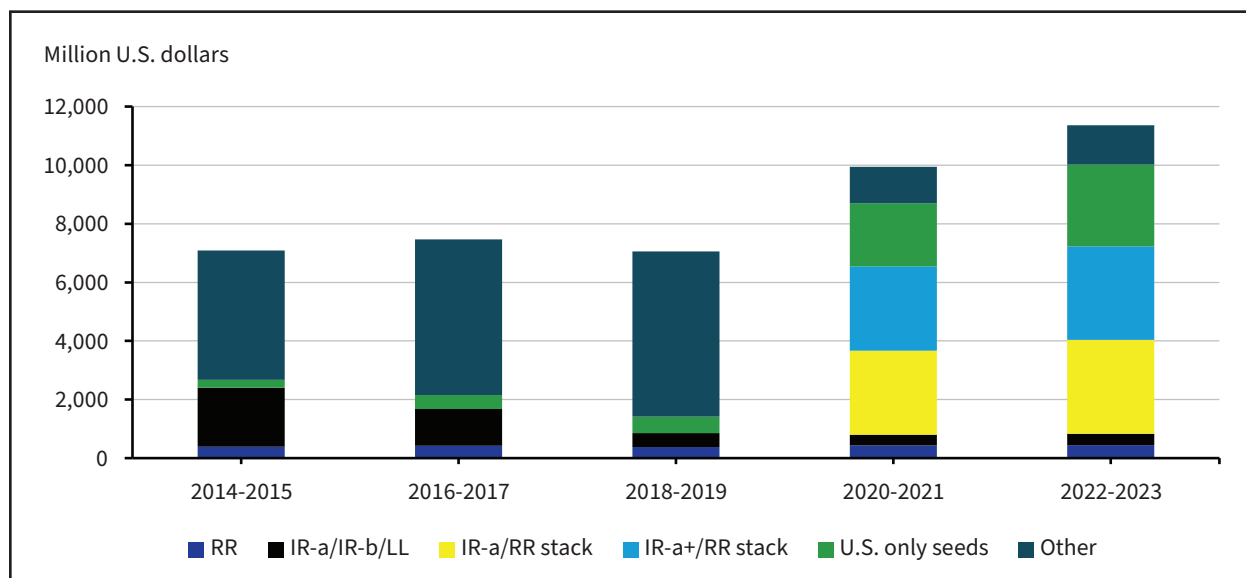
agency (ANVISA) which is responsible for the approval, inspection, and regulation of products that may pose health risks; and the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) which monitors and inspects GE impacts on the environment (S&P Global, 2024).

U.S. biotech regulations are implemented by several agencies that operate under the Coordinated Framework for the Regulation of Biotechnology (CF). The CF states several principles describing the regulatory approach: Regulations should apply to specific uses of products (like animal feed, human consumption, etc.), must be based on science and the product itself (rather than the production process), and are proportionate to risks posed. The process can take years to clear for trait developers and add millions to tens of millions of dollars in development costs (Bonin et al., 2026).

Appendix D: United States and Brazil Expenditures on GE Corn and Soybean Seeds

Figure D.1

Traits change: United States expenditures on genetically engineered (GE) corn seeds, 2014–23

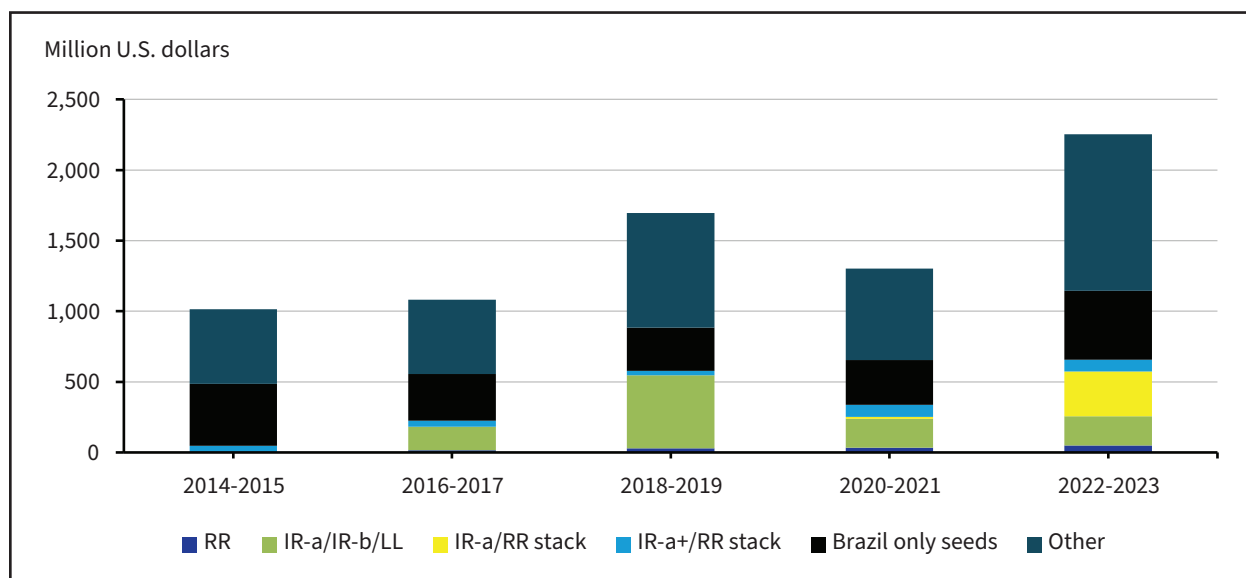


Note: Seeds are matched between countries by similarities in their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.

Figure D.2

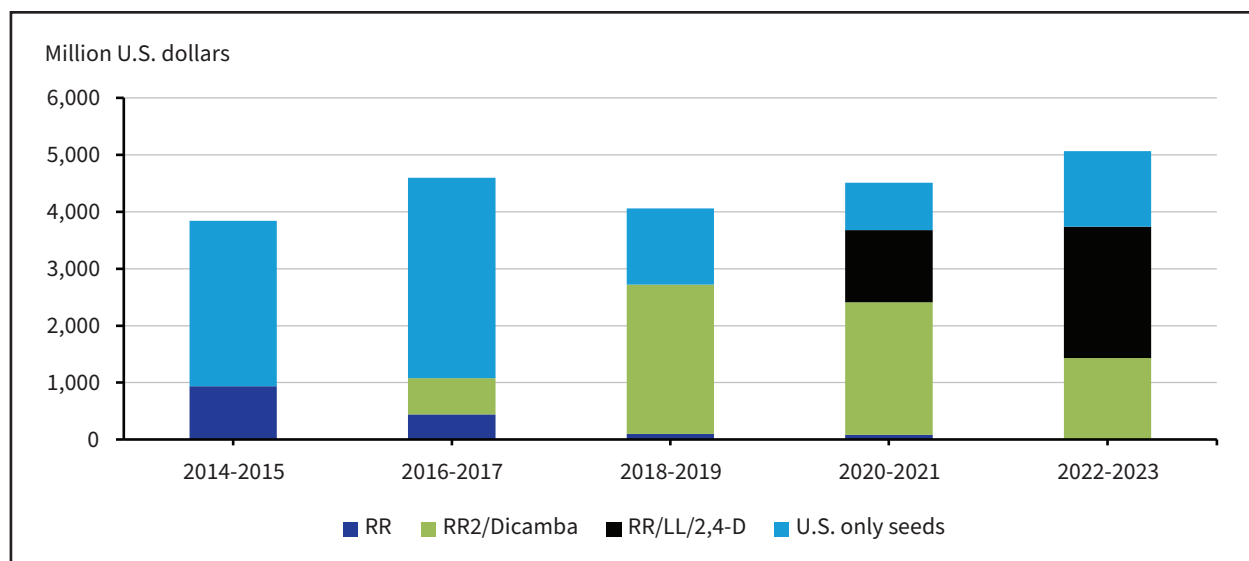
Traits change: Brazil expenditures on genetically engineered (GE) corn seeds, 2014–23



Note: Seeds are matched between countries by similarities in their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.

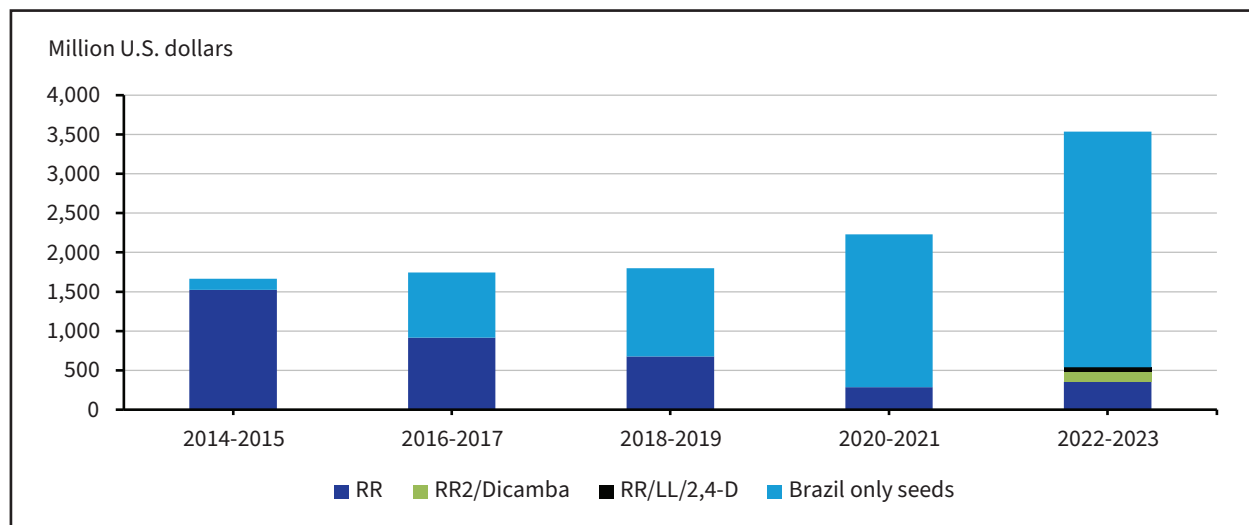
Figure D.3

Traits change: United States expenditures on genetically engineered (GE) soybean seeds, 2014–23

Note: Seeds are matched between countries by similarities in their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.

Figure D.4

Traits change: Brazil expenditures on genetically engineered (GE) soybean seeds, 2014–23

Note: Values in the chart represent seeds that share the listed their trait stacks. Values in the chart represent seeds that share the listed traits, but may differ in other traits. Seeds that have no close analogue in the other country are categorized as either "U.S. only" or "Brazil only" seeds. Seeds that have a close analogue are classified as "Other" when the data for the analogous seed is unavailable.

Source: USDA, Economic Research Service calculations using data from S&P Global.