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BRAZIL 2050

A vision for global
food security

By Valentina Sader and Peter Engelke

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Cover photo: Mass soybean harvesting at a farm in Campo Verde. Shuttersock/Alf Ribeiro.

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Introduction

Feeding a growing world population is a significant global security concern. Geopolitical instabilities, climate change, and population growth are major challenges exacerbating global food insecurity. How can the world meet this growing demand for food while also adapting to climate change? Finding solutions will require innovation, imagination, sound investments, smart policies, and cooperation.

Only a few of the world's breadbaskets have the potential to further meet growing global food demand. Here, Brazil is at the top of the list. Over the past half century, Brazil has established itself as one of the world's largest producers and exporters of food and ranks among the great breadbaskets of the world. Its production and exports across a wide variety of agricultural commodities, such as soybeans and corn, are critical to world trade in food and essential to the security of global food supply. Owing to its incredible natural endowment, its advanced agribusiness and research sectors, its stability within an unstable world, and its well-developed integration into global agriculture and food markets, Brazil is now and will remain a leading

agricultural powerhouse and a critical partner in addressing the global food crisis.

Global population growth, changing demographics, and decarbonization efforts will shape how food is produced in the years to come, increasing the need for solutions from leading breadbaskets such as Brazil. By 2050, the world population could increase to as many as ten billion people, with higher incomes and the more protein-heavy diet often associated with them. These factors prompt rising demand for food, while a warming climate could significantly impact agricultural productivity, and geopolitical disruptions could further exacerbate global food supply chains.

Brazil is already an important and reliable breadbasket for the world. But to help create a more resilient and sustainable food system for the future, Brazil must strategically prepare its domestic capabilities to meet the projected demands of 2050—and it should do so in partnership with the private sector and the international community.

Global context

Climate change, the COVID-19 pandemic, and Russia's war on Ukraine have shed light on the vulnerabilities of the current global food system. The world has seen historically high temperatures and changes in precipitation patterns, impacting harvests and productivity,¹ along with significant supply chain disruptions, such as a shortage of fertilizer.² These forces affect both food demand and supply.

Today, the world has 8.1 billion people, every one of whom needs regular access to sufficient calories and nutrients. Although the world produces enough food to meet current demand, hunger and food insecurity remain high, especially due to conflict, income, and food loss and waste, among other issues.

In 2022, between 691 million and 783 million people worldwide faced hunger, with roughly 2.4 billion people—29.6 percent of the world's population—experiencing either moderate or severe food insecurity.³ From this segment of the global population, nearly twenty percent of Africa's population faces hunger, a significantly larger proportion compared with other world regions.

Worldwide, those experiencing severe food insecurity totaled about 900 million people in 2022, or 11.3 percent of the global population. In comparison with the previous year, Africa, North America, and Europe have shown worsening food insecurity levels, while Asia improved slightly and Latin America and the Caribbean, mostly driven by South America, saw significant progress in food

security.⁴ Addressing the amount of food lost or wasted is also imperative to food security. In 2022 alone, 19 percent of all food available to consumers was wasted, in addition to the 13 percent of food lost in the supply chain.⁵ These figures underscore the persistent challenges faced in ensuring adequate access to food for a substantial portion of the world’s population, despite the abundance of food being produced at a global level.

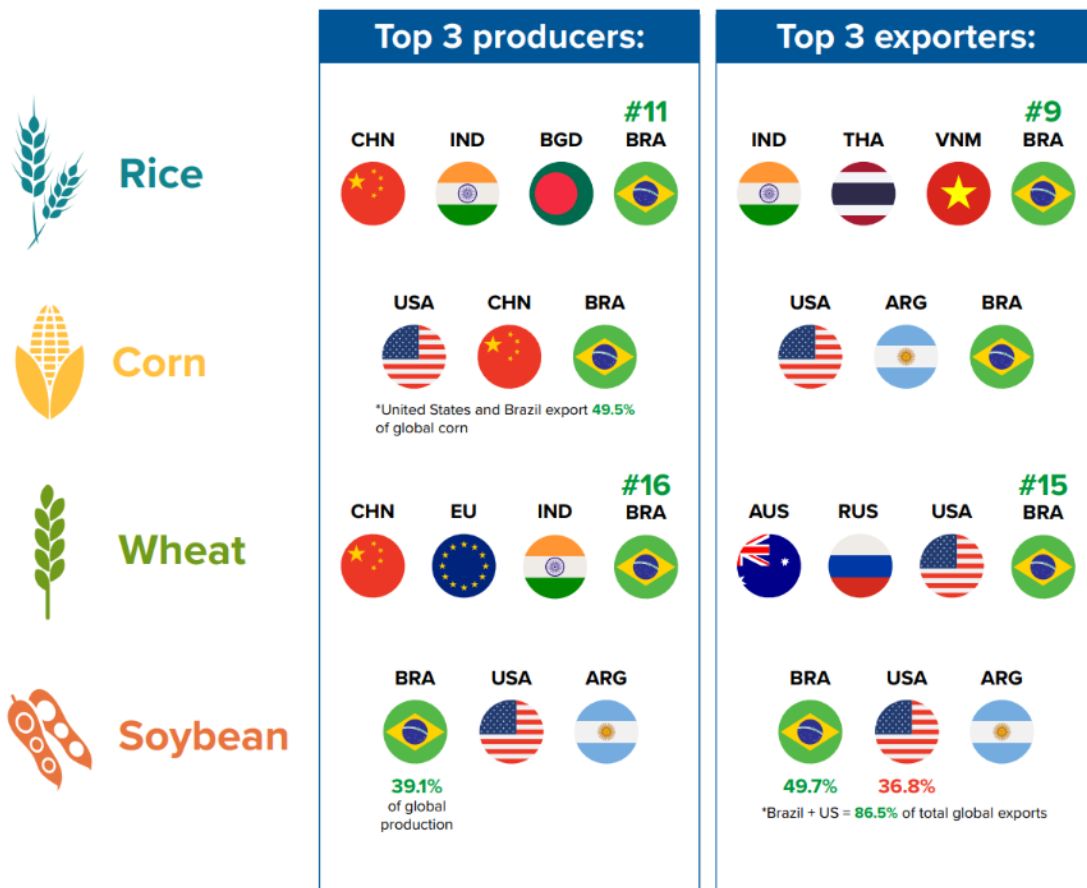
Even so, the demand for food will increase as the global population grows, and as wealth increases, demand for protein typically increases as well. The United Nations Food and Agriculture Organization (FAO) projects that the global demand for food will increase by 60 percent over the next two decades,⁶ driven by population increases and shifts in dietary patterns. To meet this increased demand, projections suggest that global food production will need to provide 47 percent more crop calories

in 2050 than in 2011 to feed 9.75 billion people.⁷ Increased production will be critical to ensure that people living in population growth centers—namely Africa, the Middle East, and Asia—are fed.

Where is food produced?

Rice, wheat, corn, and soy make up almost half of the daily calories of the average global diet.⁸ These crops are mostly produced in a handful of regions located in the United States, Brazil, China, India, Ukraine, and Russia—often called the world’s breadbaskets. These producers have the agricultural capacity to grow at scale and to export the key crops to supply a significant portion of the current global demand for food. But given climate change and geopolitical disruptions (e.g., war and trade conflicts), only a few of these breadbaskets have the potential to meet 2050 food demand. Brazil tops the list.

Figure 1. Brazil is a significant producer and exporter of key crops



Sources: US Department of Agriculture (USDA), Foreign Agricultural Service production data for 2023, accessed April 2024; and “Trade Map,” International Trade Centre export data for 2022, accessed April 2024.

Forces that will shape the future global context

How food is produced, consumed, and distributed will change significantly between now and 2050. While some of these disruptions pose significant challenges, others hold the promise of transformative change, offering new opportunities to enhance the resilience, sustainability, and equity of global food systems.

Geopolitical forces

The world is not a flat trading plane for agricultural products, owing in part to geopolitical forces that have made global trade in food much more challenging. Recent geopolitical disruptions have highlighted vulnerabilities of global trade systems for food. From the COVID-19 pandemic supply chain disruptions⁹ to wars, conflicts, and government-imposed trade restrictions, these disruptions pose a significant challenge to food security now and in the years ahead. And these forces are likely to continue, and perhaps, get worse.

Trade is an important factor toward global food security as it connects those who produce food to those who need it. “From 1995 to 2022, food and agricultural trade has more than doubled in volume and calories,” according to the UN FAO.¹⁰ Geopolitical disruptions, including trade restrictions and bottlenecks, can have significant implications for food access and prices, and could become more common. For example, Russia’s war on Ukraine had a significant impact on fertilizer exports, affecting agricultural production globally.¹¹ India, the largest exporter of rice, recently imposed an export ban on grain¹² to secure its own domestic supply, causing ripple effects to the global supply and price of rice. In the Red Sea, Houthi rebels’ attacks on commercial ships have caused shipping delays and a rise in transportation costs,¹³ and the route to the Suez Canal is of major importance to international trade between Europe and Asia. In the Americas, a drought has caused delays and raised costs for ships transiting the Panama Canal.¹⁴

Policymakers in national capitals around the world will need to redouble their focus on maintaining open trade in food, especially during geopolitical crises and other shocks that will induce many states

to protect domestic supplies. This is why food security and the open trade in grains and foodstuffs should be a priority agenda item for countries’ domestic and foreign policy efforts. International cooperation is imperative for food security, including at multilateral forums such as the Group of Twenty (G20) and G7 summits, where the largest economies of the world, representing a great part of global trade, discuss global priorities and ways to jointly address global issues.

Climate change

A dramatically altered climate almost certainly will be a problem that policymakers, agronomists, researchers, agribusinesses, and farmers will be unable to avoid. Although scientists continue to debate the dates when global temperatures will broach the barriers of 1.5°C and 2°C, it is reasonable to expect that the first limit and possibly the second will be surpassed before 2050 even under lower emission scenarios.¹⁵ Under a median projection (called SSP2-4.5 in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change), Brazil in 2050 might be up to 2.81°C warmer than preindustrial averages, with precipitation dropping by up to a quarter, depending on the region and the time of year.¹⁶

Changes to climate are already being felt globally with direct implications for how and where food is produced. A recent example is the torrential rain that flooded most of Brazil’s southernmost state of Rio Grande do Sul in May 2024.¹⁷ In addition to the humanitarian consequences of those floods, Rio Grande do Sul produces 70 percent of Brazil’s rice and is a significant soybean and meat-producing state¹⁸—key Brazilian exports—which can create additional pressure on Brazil’s production and trade potential and the world’s food system.

Climate resilience and adaptation should be front and center of global policy action, including in efforts to address food security and create a more sustainable and resilient food system. This requires collaboration among governments and the private sector to find solutions, and provide the tools, resources, and policies for sustainable production.



Farmers look at a large grain harvester during the Agrishow farm equipment fair in Ribeirao Preto, Brazil, May 1, 2019. Picture taken May 1, 2019. REUTERS/Marcelo Teixeira.

Land use constraints

Perhaps the most obvious solution in meeting future food demand is to expand the amount of land dedicated to agriculture. But a significant portion of available arable land worldwide lies beneath grasslands and forests, which are crucial for carbon sequestration and biodiversity conservation. And while this way forward is not desirable, the pressure on forested land by 2050 will be immense.¹⁹

Over centuries, crop yields have increased consistently and dramatically. While the expansion of arable land has played a crucial role, productivity gains have been a central catalyst for enhancing food security globally.²⁰ Smart public policies, along with technological gains and changes in farming practices, could limit the pressure on agricultural land expansion (see figure 2).

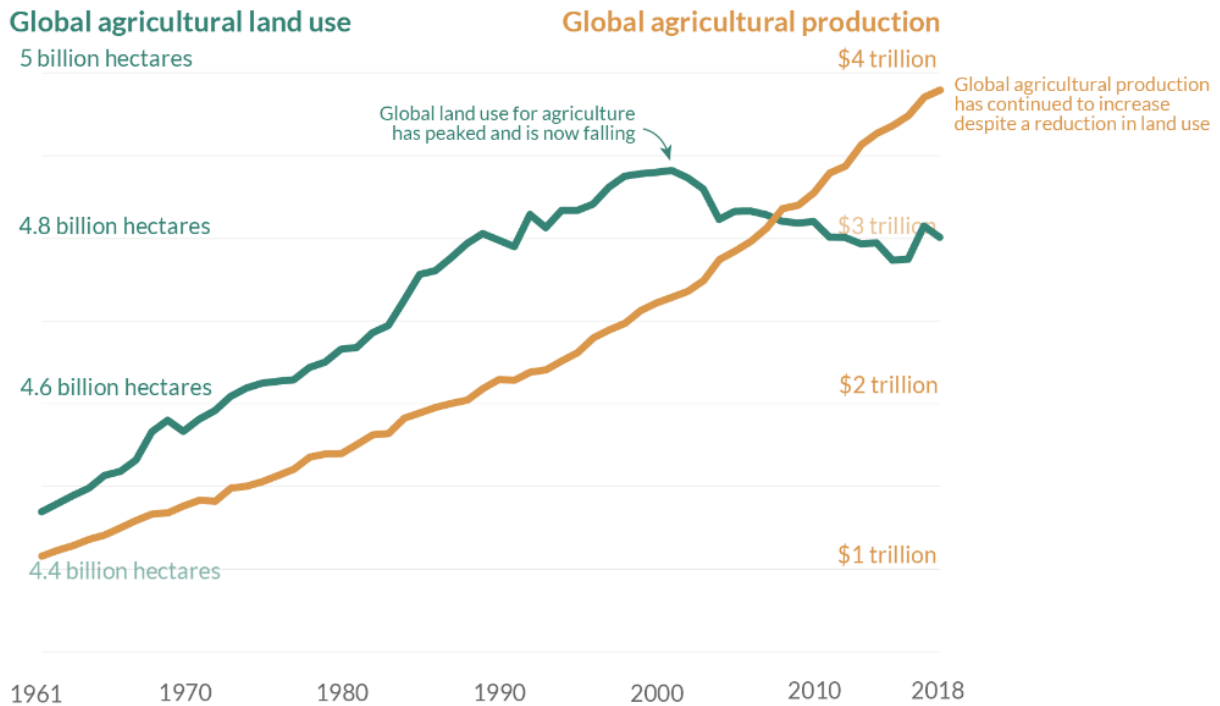
Brazil is a particularly interesting case.

On land regulation, the country has robust forest protection laws that allow private land in forested areas, such as the Amazon, but stipulate that up to

80 percent of native vegetation must be protected.²¹ Despite recent reductions in deforestation levels in the Amazon,²² forests in the Cerrado and Amazon biomes—the two largest and most heavily forested regions of Brazil—have historically been retreating in the face of conversion pressures from multiple directions.²³ Here, enforcement of existing regulations and oversight is key, especially given illegal activities in the regions that contribute to deforestation.

Brazil is also uniquely gifted with conditions that allow farming practices that increase agricultural output without the need for more land conversion. Double cropping, for example, allows for Brazil to have two, sometimes even three crops out of the same plot of land in a season—a significant competitive advantage for global food production, which could be a model that can be adjusted for other regions of the world.

Figure 2. Food production is rising as agricultural land use declines



Source: World in Data, <https://ourworldindata.org/peak-agriculture-land>.

Innovation, Infrastructure, and Investment for productivity gains

A few factors can explain these historical gains and be positive disruptors that will foster increased productivity in a more sustainable way.

- Innovation and technological advancements:** For centuries, technological adoption and innovation in agriculture have dramatically changed the way the world produces food. The mechanization of production, new crop rotation methods, and new inputs such as fertilizers, irrigation systems, and more have revolutionized how (and how efficiently) the world produces food. Brazil is an example of a country that was import-dependent for food, yet transformed itself through technological advancements, innovative practices, and targeted public policies (among other factors) into an agricultural powerhouse and leading food exporter.²⁴ To increase productivity efficiently, the development and adoption of new technologies

for efficient and sustainable food productivity is imperative. These include biotechnologies, precision agriculture, on-farm robotics, and new innovations and practices (including farming practices).

- Infrastructure:** Infrastructure is critical for intranational and international trade. Lack of or unstable access to energy, poor transportation networks (i.e., roads, railways, and ports), or inadequate storage infrastructure are direct hindrances to agricultural productivity and economic growth through trade.²⁵ The lack of adequate infrastructure has been a significant challenge in Africa, for example. Investment in infrastructure is essential for more efficient agricultural production and better flow of products nationally and internationally, but also for sustainable economic development. For export-leaning countries like Brazil, strategic and early investment in transportation infrastructure will facilitate trade, and lower costs of production now and in the future.



A rural worker operates a harvester during a record soybean harvest season in Brazil's southernmost state on a farm in Sarandi, state of Rio Grande do Sul, Brazil, April 2, 2024. REUTERS/Diego Vara

- **Human capital:** Skilled human capital leads to improved resource management and increased adoption of technological innovations. In the case of Brazil, human capital investments have positively impacted agricultural production of soybeans and maize as well as livestock operations,²⁶ while also improving responsiveness to external disruptions.²⁷ Investing in human capital going forward is important and building partnerships that facilitate the exchange of best practices, know-how, and skill sets among farmers from different parts of the world could contribute to a virtuous cycle toward more efficient and sustainable food production.
- **Capital investment:** Access to capital helps drive agricultural growth. Increasing farmers' access to credit and investment allows them to invest in modern equipment and adopt new technologies

and practices, leading to increased productivity and profitability. In addition to government subsidies for agriculture, targeted government investments, private-sector investments, and microfinancing initiatives can shift incentives toward sustainability, land restoration, and collaboration,²⁸ while providing farmers with the necessary funding to expand their operations, diversify their crops, and adopt sustainable agriculture practices.

Given Brazil's key role in the current global food system and, most importantly, its potential to become an even more important breadbasket to the world in the future, Brazil must be at the forefront of innovation and adoption of positive disruptors like access to capital and climate smart agricultural practices, while preemptively adapting to negative ones.

The case of Brazil: A 2050 vision for global food security

The world might be facing challenges ahead when it comes to food security, but in this picture, Brazil is critical. Brazil, the United States, and other like-minded partners must work together to ensure that global food supply grows to meet rising demand in the future in ways that are both environmentally and economically sustainable. Here, Brazil's agricultural sector must continue to serve as one of the world's great breadbaskets, producing more food while also becoming more sustainable—reducing its impact on land and water resources and the country's rich biodiversity heritage—and more resilient, especially in the face of climate change. If one could paint such a portrait of the future, what might a best-case scenario for Brazil look like?

A 2050 best-case scenario is a Brazil that produces more food and remains a reliable exporter of food, including during global food crises. Brazil would grasp the diplomatic mantle, becoming a forceful voice in ensuring that food security remains a priority issue on the global stage. At home, Brazil would produce more food while preserving the integrity of its natural endowment: its increased agricultural production would go hand in hand with protection of the natural environment, including protection of its forests and enhancement of the on- and off-farm natural resources upon which its agriculture depends (e.g., soils, surface water, and groundwater).

To achieve such a hopeful vision, Brazilian food producers have the markets, incentives, technical support and capital needed to adopt advanced farming and ranching practices that enable them to produce more and be rewarded for their nature-positive practices. A Brazilian Agricultural Research Corporation (Embrapa) foresight study correctly states that future “productivity

increases [in Brazilian agriculture] should . . . be associated with a decrease in the carbon footprint, water conservation, the maintenance of soil nutrients, the controlled use of antimicrobials and pesticides, [and] the reduction of losses and waste” through advanced farming techniques including regenerative agriculture. “In this process,” the report continues, “digital solutions, robotics and automation will be fundamental” to realizing such a future vision, as will more generally remote sensing, biotechnologies, nanotechnologies, and advanced computation including artificial intelligence-based applications.²⁹ Here both Embrapa, a state-owned research corporation, and Brazilian agribusinesses are uniquely positioned to lead the world toward 2050, given Brazil's history at the cutting edges of finding agricultural technology, or AgTech, solutions to farming in tropical and subtropical regions.³⁰

Any scenario that portrays Brazilian agriculture in 2050 as productive, sustainable, and resilient must include the conservation of natural heritage, especially forests. However, such pressure can be alleviated in the coming decades if Brazilian agriculture increases yields through adoption of ecologically sensitive yet technologically advanced practices—per the above argument—and by expanding only onto land that already has been used for other purposes. Importantly, Brazil has the land available to avoid deforestation while dramatically increasing agricultural output through improved utilization of degraded pastureland—up to seventy million hectares are suitable for conversion to cropland—and intensification of existing cropland through expanded double cropping.³¹ Addressing illegal activities that are detrimental to the natural heritage of these regions, such as illegal mining, land grabbing, and logging, is also imperative to curb deforestation while also developing the region.

Recommendations

As the world grapples with ensuring that global food supply matches rising demand, Brazil’s agricultural sector can and must continue to serve as one of the world’s great breadbaskets, while also becoming more sustainable and resilient. Brazilian leaders in the public and private sectors must make choices and investments that both retain Brazil’s innovative edge and sustain the natural ecosystems that enable its agriculture to thrive out to the year 2050. But Brazil does not have to take on this task alone. As a global concern, ensuring food security in a sustainable way will require collaboration and sustained partnerships—between governments, with the private sector and multilateral institutions—to scale critical capabilities and solutions.

The recommendations that follow outline critical areas for bilateral and global cooperation to achieve such a vision.

1. Retain a commitment to global food security. Perhaps the most important single recommendation is to ensure that policymakers in Brazil and other countries, including those in the G7 and G20 forums, retain a commitment to global food security, in particular during geopolitical upheavals and climate-driven drought. Given their economic and diplomatic weight, these countries must be the vanguard for maintaining a global focus on food security and finding solutions to food insecurity. Brazil’s roles as host of the G20 and the UN COP30 climate talks in 2024 and 2025, respectively, give it important platforms for marshaling that resolve.

A critical component of global food security is ensuring food can move across borders. As climate change affects where and how food will be produced, the collective goal should be to ensure that there is sufficient production, done in the right way, in the right places, and to ensure that food can be traded from places of surplus to places of deficit. Brazil’s meteoric rise to the first rank of global food producers is in part due to its adoption of an outward-facing model that has embraced global trade. During global food security crises, Brazil’s policymakers have largely recognized the dangers of and

resisted protectionist measures to restrict its agricultural exports, unlike several other major producers.

Policymakers in the United States, Brazil, and other major agricultural producers should sustain and deepen their leadership on sustainable food production within multilateral institutions and forums. Brazil’s President Luiz Inácio Lula da Silva has been forceful in placing hunger and food security atop Brazil’s foreign policy agenda.³² At the G20 Brazil Summit, Lula is expected to announce a Global Alliance Against Hunger and Poverty, the purpose of which will be to “raise resources and knowledge [globally] for implementation of public policies and social technologies” surrounding food security.³³ Such initiatives ought to be welcomed by policymakers in the G7 and G20, including by the United States and its allies and partners, and serve as a platform for collective action.

Global forums, such as the G20 and COP30 meetings, provide important platforms to gather the support of the largest economies of the world to place food security at the forefront of development and strategic priorities. But perhaps most importantly, given that the demand for food will mostly come from developing countries, these forums are an important space for knowledge transfer and shared best practices on how to increase food production and trade sustainably. Here, Brazil has a lot to teach the world.

2. Improve infrastructure. For decades, Brazil has been investing in its infrastructure to catch up with the rapid expansion of agriculture into the country’s interior.³⁴ A December 2023 report released by the US Department of Agriculture observed that the pacing of such investments has increased over the past decade, given the importance of reducing Brazil’s historically high transportation costs for export competitiveness. Fueled in part by Chinese capital, Brazil has sped up its investments in roads, railways, storage and processing facilities, and ports. The USDA report asserted that such



A view shows a task force meeting of the Global Alliance against Hunger and Poverty in Rio de Janeiro, Brazil, July 24, 2024. REUTERS/Tita Barros.

investments have “significantly alter[ed] the relative competitiveness” of Brazil and the United States, in Brazil’s favor.³⁵ As Chinese investment continues to grow in Latin America and the Caribbean, the United States should prioritize Brazil not as a competitor but an ally, ensuring greater cooperation, increased investments, and technical exchanges of best practices for better and more sustainable solutions to agriculture. Continued investment in infrastructure would allow Brazil to become an even more competitive agricultural exporter in at least some major crops, including soybeans.

- 3. Partner to scale the adoption of regenerative farming techniques and technologies.** Brazil has a rich history of embracing new approaches to farming, including innovative technologies, stretching at least as far back as Embrapa’s founding and its success in developing approaches to tropical grain production.³⁶ Despite this history, Brazil’s farms are by no means oversaturated with technology, as there appears to be significant room for on-farm

growth and profit to derive from utilization of the latest technologies.³⁷

Advanced farming techniques present another opportunity. Regenerative agriculture and related approaches focus on integrating ecological principles into advanced farming operations to preserve biodiversity, improve soil health and prevent erosion, conserve water, and increase carbon capture and sequestration. Methods include agroforestry (introduction of trees into a farmed landscape), conservation tillage, integrated pest management (use of pest control methods beyond chemicals), integrated crop-livestock systems (the integration of animals into cropland), and intercropping (fielding multiple crops at once).³⁸ Brazil already is a world leader in utilization of some of these methods, for example, no-till farming (planting crops without tilling the soil), which has great potential to preserve soils while sequestering carbon.³⁹ Governments can play an important role in helping to facilitate the development of transparent and high-integrity markets



Harvesting machines in operation during the opening ceremony of the Grain Harvest in Caseara, Brazil February 15, 2018. REUTERS/Ueslei Marcelino.

that provide economic rewards to farmers for such investments and practices, generating both environmental outcomes and economic opportunity.

Prioritize underutilized pastureland. To minimize pressure on Brazil's vast forest endowment while reducing carbon emissions, policymakers should incentivize farmers to prioritize expansion of grain and legume production (especially soybeans) on underutilized pastureland.⁴⁰ Such a strategy could succeed on all three fronts—increased production plus reduced deforestation and emissions. A recent Embrapa-led study estimated that some twenty-eight million hectares of Brazil's degraded pastureland could be brought into grain production, increasing the total planted grain area in Brazil by a full 35 percent.⁴¹ Another study found that a combination of improved yields and expansion of production to current pastureland would generate one-third more soybeans with no additional deforestation and with significantly lower carbon emissions.⁴²

Brazil has available arable land—from degraded pastureland and existing cropland—to increase its agricultural output without the need for further deforestation.

4. Expand double cropping. Brazil has a significant advantage over competitors in temperate regions owing to weather conditions that allow year-round planting and harvesting, leading to the country's ability to produce more than one crop per year—two crops or even three, depending on the crop and conditions.⁴³ This practice has been growing in Brazil, as farmers have found it economically advantageous to do so, and should continue growing into the future.⁴⁴ This system should encompass as high a percent of Brazil's farmland as practically feasible, given its dual roles to expand agricultural output and limit pressures on converting Brazil's forested land to agricultural production. While Brazil has strong forest protection laws, more effective enforcement of land use controls to reduce forest conversion combined with an appropriate

mix of incentives would help to mitigate illegal activity and support farmers in shifting toward improving production on existing cropland through succession cropping.⁴⁵ Brazil's capacity to combine multiple cropping, utilizing existing degraded land, and adopting regenerative agricultural practices presents a unique and significant potential to produce food with lower carbon intensity.

- 5. Prioritize water-efficient irrigation.** Irrigated farmland, whether in Brazil or anywhere else in the world, tends to increase crop yield.⁴⁶ According to Brazil's water agency, the country has sufficient water resources to allow a tenfold expansion of its irrigated crop area.⁴⁷ However, the trouble with irrigation around the world, even in Brazil, lies mostly in overuse of scarce water resources.⁴⁸ Brazil has suffered from increasing drought and aridity in some regions, and from overuse of groundwater and surface

water.⁴⁹ Brazil should prioritize adoption and expansion of water-efficient irrigated systems in those regions that can sustainably support water withdrawals from underground and surface sources.

Brazil's contribution to food security globally is undeniable—as is its potential to continue to be an even more important and resilient breadbasket for the world. But to secure sufficient food for a growing population in a sustainable way will require collaboration and global action. Ensuring that Brazil increases its food production while also protecting the environment will require the cooperation of Brazilian policymakers, the private sector, and farmers themselves as well as international support and investment. With the potential to be the largest exporter of food in the world, Brazil must strategically prepare for this role and the world should support it.

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