



Executive Summary

PRODUCTION AND PROTECTION: A FIRST LOOK AT KEY CHALLENGES IN BRAZIL

Climate Policy Initiative

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Brazil has vast natural resources that carry immense potential for the country's economic and environmental goals. As in many other nations, there is frequent tension between these goals, compounded by rising pressures from increasing global demand for food, along with climate change risk. Using land efficiently is crucial to achieve both sets of goals. Yet, the promotion of efficient land use still stands as a great challenge.

A Production and Protection (P&P) strategy is an integrated approach towards land use intended to help address these challenges. This report applies a P&P framework to Brazil to understand where land can be used more efficiently across important sectors within the country.

We find that there is ample scope for enhanced protection of natural resources and growth of agricultural production in Brazil within a P&P framework. From a protection standpoint, the country would benefit from developing mechanisms that significantly drive up the private cost of clearing native vegetation, as well as through the advancement of market-based incentives that promote sustainable practices. From a production standpoint, there is room to increase Brazilian agricultural production via productivity gains, at no apparent cost to environmental conservation.

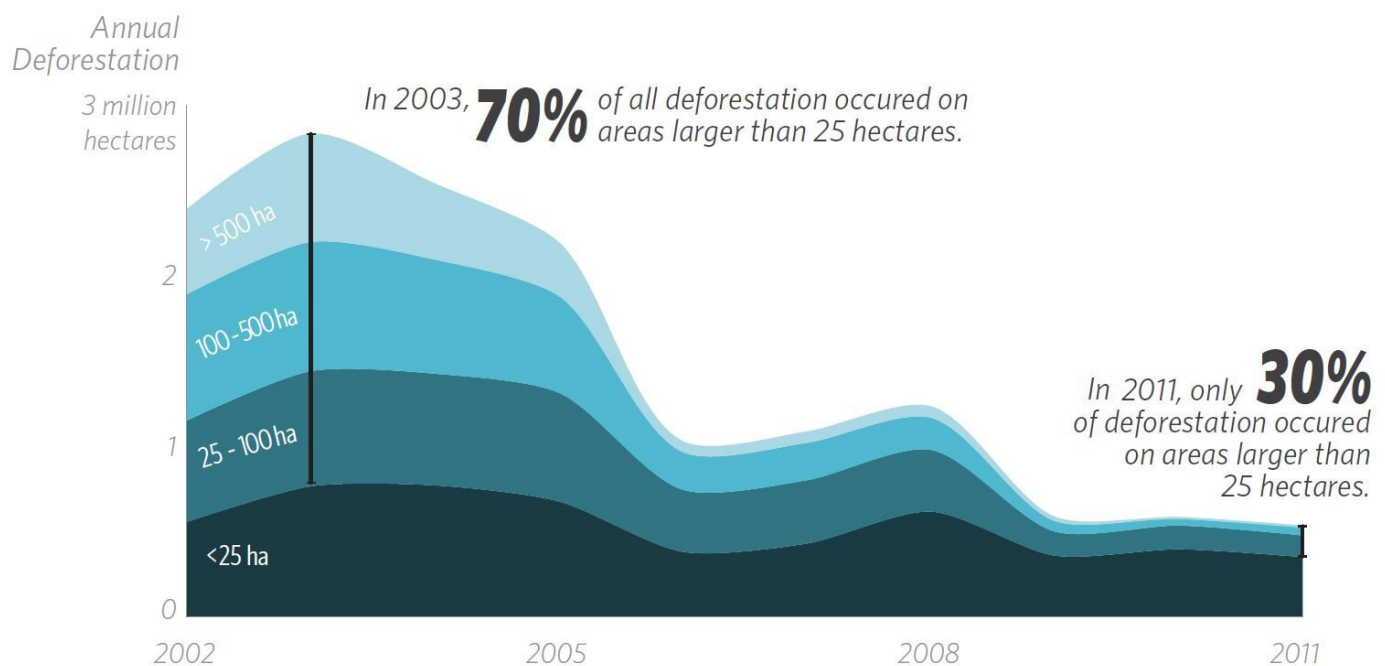
Environmental Protection

Over the past decades, Brazil has made significant progress in the protection of its natural resources. The country saw a vast expansion of protected territory – in 2006, protected areas occupied more than ten times the

area they covered in 1985. Today, Brazil has a relatively consolidated institutional framework and well-established instruments for the protection of natural resources in public lands. These have been extensively used in the Amazon. However, challenges remain in the protection of native vegetation cleared in small increments, on private property, and with Brazil's ecosystems beyond the Amazon, while sustainable forestry is underdeveloped.

Ways forward to address these challenges include:

- **Improve existing monitoring techniques to adequately deal with small-scale Amazon deforestation.** Once driven by large-scale forest clearings, Amazon deforestation currently results primarily from the cutting down of forest in small increments (see Figure 1). This is likely a symptom of some of the technical shortcomings of Brazil's current system for monitoring Amazon deforestation – the system can only track forest clearing activity above a certain level. Did those who clear forests in large increments adapt their behavior to the system's known limitations, or did the profile of deforesters actually change? Answering this question requires further analysis.
- **Use the Rural Environmental Registry to effectively implement the Forest Code on private property.** Forests occupy about a third of the area of rural private landholdings in Brazil, totaling 100 million hectares of native vegetation within private properties. The new Brazilian Forest Code establishes the regulatory framework for environmental conservation in private lands, and the Rural Environmental Registry provides the key instrument

Figure 1 Annual Amazon Deforestation Increments Grouped by Size of Forest Clearings, 2002–2011

The graph shows the participation in annual Amazon biome deforestation by forest clearing size category. Source: PRODES/INPE (2013).

for enforcing this framework. Although both framework and instrument are in place, effectively using the Rural Environmental Registry to implement the Forest Code remains a challenge. Enhanced understanding about rural property rights and compliance with environmental regulation within private properties in Brazil can provide critical insight into how to best enforce environmental regulation at the private property level.

- **Create mechanisms to deter deforestation outside the Amazon Forest.** To do this, Brazil needs to extend effective monitoring and law enforcement over its other five biomes, which also hold unique biodiversity and serve as carbon stocks. This applies particularly to the Cerrado biome, given that it is highly attractive to agricultural producers, and has already experienced a large extent of cleared native vegetation. A substantial share of clearings happening in this biome is legal in light of the Forest Code's regulations. Monitoring and law enforcement are therefore unlikely to single-handedly deter large amounts of deforestation in the Cerrado, reinforcing the need for incentive-based policies, such as payment for environmental services, to combat the clearing of native vegetation.

- **Develop a sustainable forestry sector and advance market-based incentives for the protection of natural resources.** Efforts aimed at promoting such actions in the country are still at very early stages. In particular, the role public policy plays in these efforts is mostly unknown.

Agricultural Production

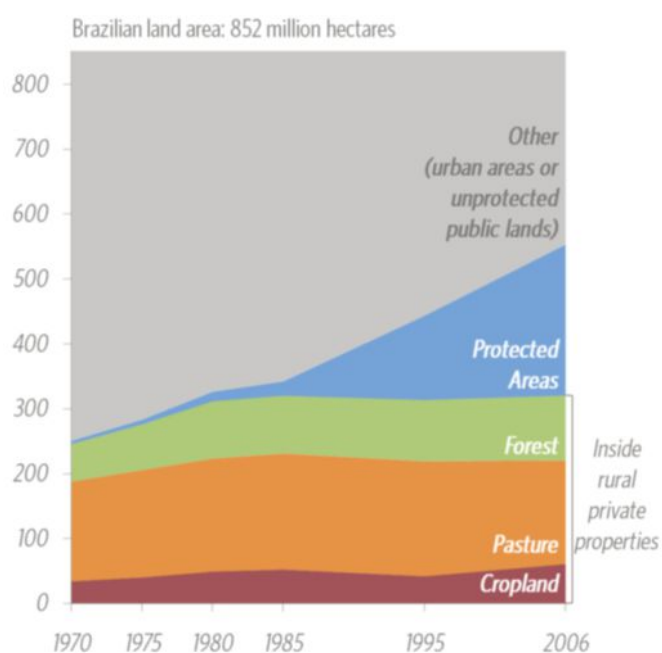
Brazil currently stands before a significant opportunity to increase its agricultural productivity. **There is substantial variation in agricultural productivity both across and within Brazil's five regions** (see Box 1). Geographical factors explain slightly over a third of the total variation in Brazilian agricultural productivity. Non-geographical factors including access to finance, technology, rental markets, cooperatives, and infrastructure account for a substantial part of the remaining variation. We make recommendations for how to realize productivity gains through improvements in each of the non-geographical factors in turn.

Box 1 – Regional variations in productivity across Brazil’s agricultural sectors

The 2006 Brazilian Agricultural Census, the latest available data set on countrywide agricultural production, reveals important characteristics of Brazil’s three main agricultural sectors – large-scale cattle ranching, large-scale crop farming, and small-scale agriculture.

Cattle ranching is Brazil’s most land-intensive agricultural activity. In 2006, pasture occupied half the area of private rural landholdings (see Figure 2). The South, Southeast, and North regions account for less than half of the cattle ranching area in Brazil, but have higher average cattle farm productivities (see Figure 3). The Center-West region, which covers nearly 20% of Brazilian territory and contains over 35% of the country’s pastureland, portrays lower cattle farm productivity.

Figure 2: Land Use in Brazil, 1970–2006

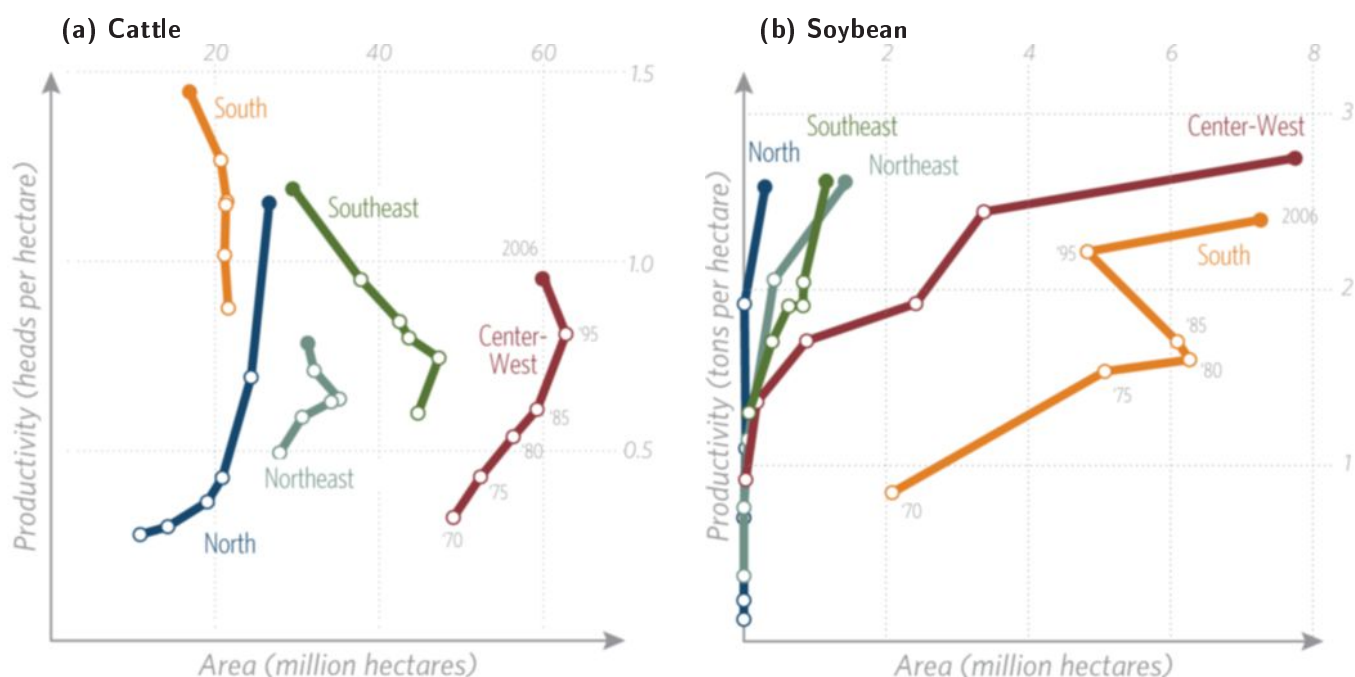


In turn, **crop farming occupies about one quarter of the non-forest area within rural private properties** (see Figure 2). Soybean, sugarcane, and maize account for approximately 60% of Brazil’s cropland. Soybean is largely concentrated in the

South and Center-West, and sugarcane in the Southeast, while maize is more widely distributed across regions. In 2006, crop farm productivity for soybean was similar across regions (see Figure 3), but both sugarcane and maize exhibited regional variation in productivity.

Small-scale agriculture occupies only about 25% of Brazil’s agricultural lands, but accounts for 75% of the rural labor force and over 80% of rural landholdings. Increasing productivity in small-scale agriculture can thus improve the economic situation of a large share of Brazil’s rural population. The distribution of land use in small-scale agriculture across cropland and pastureland is similar to that of large-scale agriculture. Yet, while large-scale crop farms are concentrated in soybean production, there is greater diversification across crops cultivated in small farms. Small-scale cattle ranching exhibits higher farm productivity in the South, while small-scale crop farming has higher farm productivity in the South and Southeast.

Land use in Brazil has become more efficient over time both across and within agricultural sectors. Indeed, average national crop farm productivity quadrupled and average national cattle farm productivity doubled between 1970 and 2006. Additionally, evidence suggests that there has been significant conversion of low-productivity pastureland into higher-productivity cropland. The share of cropland within private properties increased 37% in 40 years (see Figure 2). The Southeast region has seen a strong conversion of pastureland to sugarcane cropland since 1975. A similar trend has more recently started to occur in Brazil’s Center-West – after a significant expansion from 1970 through the mid-1990s, total pastureland area in the Center-West started to decrease in 1996, as soybean cropland moved into areas once occupied by pasture. Moreover, average soybean farm productivity increased substantially since 1970 across Brazilian regions (see Figure 3).

Figure 3 Evolution of Productivity and Area for Cattle and Soybean, 1970–2006

The graph shows the evolution of productivity and area for cattle ranching (left) and soybean farming (right) in each Brazilian region in 1970, 1975, 1980, 1985, 1995, and 2006. Source: IBGE, Brazilian Agricultural Census 2006

Opportunities to Improve Agricultural Productivity

Access to finance

In-depth analysis is needed to better understand the impact of the provision of rural credit, Brazil's most important agricultural policy, as well as that of other financial instruments. In 2013, over BRL 130 billion was set aside as rural credit, a large share of which was loaned under subsidized interest rates. Still, little is known about rural credit's effects on production, producers' livelihoods, and welfare in Brazil. Moreover, there is insufficient information on how policies interact with other available financial instruments, as well as on how well targeted the country's rural credit policies actually are.

Agricultural production is characterized by relatively long productive cycles brought about by the maturing of livestock, or by necessary intervals between planting and harvesting. These long productive cycles, combined with high exposure to weather and price risks render access to financial instruments crucial to enable rural producers to smooth out shocks. Credit and risk management are therefore the dimensions of financing that are most relevant to agricultural production. A variety of local arrangements are typically present in rural economies to

allow producers to meet their financing needs. These arrangements include, but are not limited to, rural credit, agricultural traders, credit cooperatives, credit from suppliers, buffer stocks, and social networks.

Two key issues for improving financing for Brazil's agricultural sectors are:

- Improve access to rural credit.** It is clear that credit significantly affects agricultural production decisions in Brazil – about 20% of the regional variation in Brazilian agricultural productivity is associated with credit availability, suggesting that greater access to credit could improve productivity. In 2006, nearly 75% of large-scale crop farmers and less than 20% of small-scale agricultural producers accessed credit. Poor access to risk management instruments imposes even greater limitations for small-scale producers – over 40% of small producers who report needing credit but not having access to it cite fear of indebtedness as one of the reasons for not seeking credit.
- Improve information about the mechanisms through which credit policy, financial instruments, and local arrangements operate to help farmers smooth out shocks, as well as about how they interact with one another.** Little

is known about how credit affects production decisions, how it interacts with the many existing local arrangements, and how this interaction influences producers as they attempt to smooth out production shocks. Additionally, knowledge about the role of other financial instruments used in the Brazilian agricultural sector is currently limited. These instruments account for over 25% of large-scale Brazilian crop farmers' external financing needs – this share is much larger in some regions, such as the Center-West, where it adds up to nearly half.

The spread of technology

Today, there is only a limited understanding about the leading channels for technological diffusion and the most relevant barriers to the spread of new technologies in Brazil. Improving this understanding can contribute to the design of policies capable of pushing producers closer to the agricultural production frontier, and even expanding the frontier itself.

The spread of new agricultural technologies contributes to productivity gains. Our analysis indicates that some of the main productivity-boosting practices in Brazil are rotational grazing and application of lime to pasture in cattle ranching, and use of direct planting systems and improved seeds in crop farming.

Three opportunities for technological diffusion currently stand out in Brazil:

- **Access to technical assistance plays a large role in increasing productivity in both cattle ranching and crop farming, regardless of the scale of production.** Assistance helps less educated farmers make better use of any given input. Its importance for small-scale agriculture in Brazil is heightened by small farmers' poor average educational levels.
- **Learning from peers, especially from those whose land shares similar characteristics, catalyzes technological adoption.** In Brazil, direct planting was more widely adopted in regions where producers had similar soil types, and therefore could more easily learn about the new technique from other nearby farmers with whom they shared production characteristics.
- **Access to formal education** Higher educational levels increase producers' overall ability to learn and implement better agricultural practices. In particular,

higher educational levels for small-scale producers significantly increase farm productivity. Evidence also suggests that while specialized training (college education) boosts crop farm productivity, cattle ranching only demands some level of formal education (elementary education) for the diffusion of good practices.

Well-functioning land rental markets

There is clear scope for public policy to improve conditions for the development of more active land rental markets, and thereby help catalyze the conversion of low-productivity to high-productivity land uses.

Land rental markets may increase efficiency of land use by placing more skilled operators on available land. Their capacity to improve land use holds particularly in a setting in which land is used for non-agricultural ends. This is especially relevant for Brazil – given the country's long history of macroeconomic instability, land ownership in Brazil yields non-agricultural benefits, such as hedging against inflation. In this context, an active land rental market offers the means to provide land access to more skilled operators and redistribute land according to its highest-value uses.

Indeed, leasing of land in Brazil is associated with greater farm productivity both for cattle ranching and crop farming. Land rental markets appear to contribute not only to the realization of productivity gains within specific land uses, but also to the acceleration of the conversion of land from low-productivity to high-productivity uses. Municipalities with higher rates of adoption of leasing contracts exhibit greater cattle and crop farm productivities. In addition, municipalities with higher rates of adoption in the Center-West region, which recently embarked on a process of conversion of pasture into cropland, have lower shares of pasture.

In spite of this, **Brazilian land rental markets are underdeveloped as compared with other countries.** Less than 5% of Brazilian agricultural land was under lease or used in partnership in 2006. In contrast, this figure is above 35% and above 65% for Europe and the United States, respectively. The reasons for this are unclear, though likely explanations include the country's lack of well-established property rights, high risk of eviction, and difficulty in enforcing contracts, among others.

Presence of cooperatives

There is mixed evidence on the impacts of cooperatives on agricultural production in Brazil. This is not entirely consistent with the expected benefits of cooperatives. Whether these findings represent a true picture of Brazil or are a result of the unavailability of appropriate data for the investigation of the impacts of cooperatives remains unknown. More suitable data and analysis are needed to better understand the role cooperatives play in Brazilian agricultural production.

Small-scale farms have less flexibility in the use of basic inputs such as tractors or technicians. Cooperatives in theory serve to overcome this problem, acting as instruments of scale. Once aggregated in cooperatives, small producers can more easily buy large or costly production inputs, they gain bargaining power in negotiations, and the spread of technology is accelerated via centralized access to technical assistance and facilitated diffusion of information. Cooperatives can also enable greater access to credit – in the South and Southeast regions of Brazil, credit cooperatives account for about 8% of financing for agricultural production. In this sense, cooperatives can enable the productivity gains brought about by other factors, such as technological adoption and credit.

However, data on the actual benefits of cooperatives are mixed. In Brazil, association with cooperatives exhibits large regional variation. Cooperatives are associated with productivity gains in large-scale crop farming, but not in large-scale cattle ranching; in small-scale agriculture, they are associated with higher farm productivity only for cattle ranching.

Quality of infrastructure

Indicators of better quality infrastructure are associated with increased productivity in large-scale cattle ranching, large-scale crop farming, and small-scale agriculture in Brazil. There is ample scope for public policy to improve the quality of infrastructure in the country and thereby help boost agricultural productivity.

Agricultural producers depend on infrastructure to reach both upstream and downstream markets. In determining producers' access to inputs and consumers, infrastructure alters the return on agricultural production and affects productivity. In-farm

infrastructure – particularly storage capacity – is also relevant to ensure the agricultural product meets requirements concerning quality and timing of delivery.

Despite being one of the most prominent agricultural producers in the world and an important exporter of agricultural commodities, Brazil suffers from poor infrastructure. This imposes a very high cost on agricultural production and thereby reduces agricultural productivity. The country's overall storage capacity is set at 80% of the total harvest, well below the Food and Agriculture Organization recommended level of 120%.

Transportation bottlenecks also burden agricultural production. Poor and inefficient roads make transportation costly – carrying a ton of soybean from one of Brazil's leading soybean production municipalities to its point of export is almost three times more expensive as it is to carry the same amount of soybean over a similar distance in the United States. In addition, lacking road infrastructure keeps production from being exported through more cost-effective ports – in some cases, this represents a near twentyfold increase in costs.

Where To Go From Here

This report offers a first look at some of the challenges Brazil faces in its effort to implement a P&P strategy. It identifies key issues affecting environmental protection and agricultural production in the country. **Enhanced understanding about these issues, and especially about the underlying mechanisms driving them, is needed to better tailor the set of policy actions capable of addressing each of them in turn.** An integrated P&P strategy provides such understanding. Yet, its implementation is based on two fundamental components – the regular and frequent monitoring of selected areas that represent key uses of land in Brazil and the creation of a public-private consortium – both of which must be in place prior to advancing the P&P strategy.

The systematic monitoring of selected areas with key land uses plays two major roles. First, it enables the collection of information needed to analyze these areas, which allows for the identification and assessment of potential efficiency gains. Second, it provides an opportunity for experimentation. The empirical testing of the impacts of policy interventions yields evidence on how policies work, what are the driving mechanisms behind their effect, and where there is room for improvement.

It can therefore support the design of more effective public policy.

It is crucial that monitoring and experimentation efforts focus on relevant and feasible interventions capable of producing tangible results at scale.

Therein lies the need for the public-private consortium. This group of actors plays an important part in steering the development and implementation of a P&P strategy, integrating action across key government agencies and leading private firms. **Through a combination of the complementary strengths of its members, the public-private consortium helps validate the identification of representative opportunities for systematic monitoring, determine the scope of the analytical efforts associated with the P&P**

strategy, formulate possible interventions, and implement experiments.

A better understanding of regional rural economies and the improved targeting of public policy have the potential to yield significant welfare, protection, and production gains. By promoting the transition into high-productivity, efficient land use at a national scale, a P&P strategy can accelerate the improvements in land use in the Brazilian rural economy. **The implementation of a P&P strategy in Brazil therefore presents itself as a practical means to realize social, economic, and environmental gains, enabling the country to achieve growth of its rural economy alongside enhanced protection of its natural resources. ■**

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