Cerrado Ecosystems

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The Cerrado is the richest savanna in the world and is undergoing one of the planet's most rapid land transformations for pasture and agriculture; around 45% of the biome has been deforested. Agriculture is of strategic importance to Brazil, but it also modifies ecosystems and jeopardizes habitats and biodiversity. Well-managed agricultural lands can have a favorable impact on environmental conservation.

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1. Introduction

The Cerrado biome is seen as one of the last major land frontiers of the world. It also harbors high biodiversity, diverse landscapes, and is critical to protecting water resources, as it hosts the headwaters of important Brazilian hydrographic basins which supply nearly all the nation's biomes.

It has become Brazil's largest source of soybeans and pastureland, and a significant producer of corn, cotton, sugarcane, and timber. Land use decisions are driven by technological innovations, capital investments, knowledge, and policy interventions. The primary objective of Cerrado land use is to expand intensive agriculture to meet the demand for agricultural products in Brazil and internationally. Pastures cultivated with African grasses, cash crops and planted forests are the main types of land use that today cover 40% of the Cerrado; native vegetation still covers 56% of the biome [1][2].

The strong performance of the Brazilian economy during the 1960s and 1970s, associated with a national development policy aimed at integrating the "empty" spaces of the Cerrado and Amazon biomes into the Brazilian economy, created the business environment for investments. Policies aimed at expanding the agricultural output of the Cerrado included subsidies, developmental programs, and the use of new technologies [3][4][5][6][7].

From a revenue-generation perspective, the benefits of commercial agriculture in the Cerrado are a success: soybeans and soy products are among the largest of Brazil's export commodities, and it supports the largest cattle herd in the country. Even so, the development of modern agriculture in the region has exacerbated social inequality at a high environmental cost, leading to landscape fragmentation, loss of biodiversity, biological invasion, soil erosion, water pollution, land degradation, heavy use of chemicals, changes in fire regime, and alterations of carbon and water cycling. Transformation of the landscape continues, but a series of new policies and instruments are being implemented that may change the future direction of land use in the Cerrado.

Several environmental and economic conditions have favored these transformations. Although rainfall distribution throughout the year is uneven, the mean total annual rainfall is considered sufficient for crop production. Sunshine is year around and mild temperatures do not restrict photosynthesis. The Cerrado's level topography suits mechanization, and the savannas are cheaply and more easily cleared for farming or cattle ranching than tropical rainforest.

2. Building a Better Future for Sustainable Agricultural Production in the Cerrado

There is an unprecedent opportunity to develop sustainable solutions for the Cerrado by bringing the main stakeholders together—the business sector, foundations, public policy makers, researchers, rural farmers, and civil society. The goal is to understand the trade-offs between ongoing land use transformation and the consequences to ecosystems in the Cerrado, to identify opportunities for land use decisions that maintain ecosystem functions without constraining food and bioenergy production, and to build a new narrative for ecosystem services for the Cerrado.

Brazil's abundant lands in the Cerrado and the ingenuity and hard work of its farmers and producers have transformed the nation into a global agricultural powerhouse. Today, Brazil ranks as one of the world's leading agribusiness producers and exporters [4]. From 1977 to 2019, Cerrado agricultural production skyrocketed from 8 Mt to 130 Mt. Yet to maintain Brazil's global standing to meet the world's food demand, reduce hunger, and rehabilitate land, a new and ambitious roadmap for production in the Cerrado is needed; one that is rooted also in environmental sustainability.

Brazil has already proven that agricultural development can continue to grow even when deforestation is curbed, if technology, policies, and science is correctly deployed. The next step is to demonstrate how ecosystem protection can add economic value to agricultural production in the Cerrado.

Our current scientific knowledge shows that Cerrado's natural vegetation can play a fundamental role in conserving water and protecting the healthy functioning of ecosystems. Therefore, Brazil's private and business sectors need to join forces with national and international academics, civil societies, nonprofit organizations, and governments to improve practices and supply the rising demand for agriculture products that have been developed sustainably.

Fortunately, Brazil is ideally positioned for creating a more sustainable business model (see MAPA 2020 [8]). The Cerrado's business and policy environment has many strengths that already bring agribusinesses and conservationists together [9][10], including:

A highly competitive agribusiness industry.

A vigorous commercial pulp, paper, and timber industry.

The ability to increase productivity in the region significantly through improved technology.

An innovative and growing economic restoration industry.

An advanced research and development (R&D) capacity.

Consolidated civil society organizations.

The opportunity to cultivate already cleared areas and lands for agricultural production.

A strong policy framework to promote ecosystem services and conservation in private lands.

Evidence that shows the increased enforcement of deforestation does not undermine agricultural productivity or economic growth.

Proven scientific and technical capacity to monitor ecosystems and deforestation.

This new collaboration between agribusiness and ecosystem conservation, if fully developed in the Cerrado, will create a transformative new business model for Brazil and the world. Formulating a new land use agenda will require buy-ins from both the agricultural and environmental constituencies and must be based on solid science. If successful, Brazil has the potential to double its agricultural productivity while protecting its natural resources [11]. The new business model would establish Brazil as an example for the world and a global leader in agricultural growth and ecosystem protection.

Ensuring the Potential of the Biome

We propose to develop a pragmatic agenda for the Cerrado together with the agribusiness and conservation constituencies. The Cerrado has already seen many concrete examples of agribusinesses and conservationists working together successfully:

Many farmers are seeking to achieve higher agriculture productivity while also seeking compliance with environmental regulations.

Think-tanks, NGOs, academics, and traders are building strategies for zero-deforestation in the mid-term.

Financial flows and the mobilization of private investments have increased for green investments.

New technologies and artificial intelligence are being deployed for better planning of the farming landscape.

Farmer awareness regarding the environmental risks associated with agricultural production has increased.

In addition, much of Brazil's 180 Mha of pastureland is degraded with low productivity, and therefore represents a major opportunity for agriculture, bioenergy, and beef production to expand into this pastureland without further deforestation [12]. In several locations, low productivity pastureland is already being replaced by more intensive techniques and knowledge. Examples such as that described by Assunção et al. [13] for Mato Grosso do Sul underscore the potential to achieve the dual goals of improved productivity and reduced deforestation in the Cerrado.

The insufficient scientific knowledge on ecosystem services must not justify inaction. Our knowledge would be of benefit if studies sought to find synergies between changes in land use/land cover and how they affect natural ecosystems and agroecosystems. To be policy relevant, knowledge from ecosystem services must clearly specify the spatial and temporal scales from which the best results are achieved. Assessments of ecosystem services must perform quantitative predictions and specify the implications for the existing policy options.

Knowledge about ecosystem services must provide evidence that benefits stakeholders. A key for protecting the Cerrado biome is to understand how the existing policy framework (especially compliance with the Forest Code, which demands huge investments in how best to design the landscape) can support decision-making by farmers about where to conserve the natural vegetation as required by the law.

A pragmatic and conciliatory land use agenda must be based on scientific knowledge and must support innovative decision-making solutions for policymakers and stakeholders. To make scientific knowledge policy-relevant, it must be combined with stakeholders' and institutions' engagement, particularly farmers and donors. Farmers will ultimately have to decide on the “design” of landscapes in the Cerrado. Donors should support this goal through the creation and dissemination of relevant ecosystem services knowledge and by working with others (e.g., the finance sector; the public sector) to stimulate the creation of incentives for farmers to make the best use of ecosystem services.

To move forward with an agribusiness landscape where the importance of ecosystems and ecosystem services are fully integrated, it will be crucial to facilitate participation among the region's different stakeholders and organize where they fit into the new business model.

Three primary strategies must be used to build the road map that will lead to the new business plan for the Cerrado:

Create an active, solution-focused dialogue among farmers and organizational stakeholders in the Cerrado. Engaging farmers will help ensure that the new solutions for improved business practices can be leveraged and scaled up. Farmers and producers must be at the table in the development of the agribusiness–ecosystem business model so that they may benefit fully from the new actions taken under the model.

Develop, field test, and implement new business intelligence and tools that help farmers to manage or reduce agribusiness risk from degraded ecosystems. The development of critically needed business tools can be achieved

by studying new farming practices and interviewing farmers, examining how state-of-the-art cleantechs and agtechs are operating, identifying, and mobilizing new financial mechanisms and capital, and learning from new public–private approaches. The development of ecosystem indicators, environmental monitoring, economics studies, and the development of tailor-made solutions with farmers about how best to implement the Forest Code, must come in tandem as a component of this business intelligence.

Formalize partnerships wherever possible that serve the development of the new agribusiness–ecosystem business model. Throughout the Cerrado, numerous organizations and funders are seeking to advance agribusiness–ecosystem ideas like these, but they often lack farmer input and coordination at the regional level.

The “design” of landscapes in the Cerrado depends on each farmer or producer’s decisions. The landscape/watershed scale seems to be the most relevant for decision-making on how to achieve production and conservation results in the Cerrado, and therefore the most promising for analytical work. The landscape/watershed scale also appears to be an appropriate level for engaging with stakeholders because at this scale, the knowledge about ecosystem services would most probably match stakeholders' demands related to the benefits accrued by ecosystem services.

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