The Nature Conservancy

Incentives for Sustainable Soy in the Cerrado

November 2019

Summary

The Nature Conservancy analyzes land-use dynamics, economics and producer business models for soy expansion in the Cerrado, a vast tropical savanna of Brazil, and presents financial incentives and other measures that can support increased soy production without further conversion of native vegetation.

The growing global demand for soy products represents a critical risk to the Cerrado, particularly in the MATOPIBA[1] region, where more than 80% of the soy expansion since 2000 has occurred over native vegetation. The expansion of soy production and cattle ranching has been the primary driver of habitat conversion in the Cerrado in recent decades, resulting in the loss of approximately half of the biome's native vegetation.

In addition to the Cerrado's value as a carbon sink in the global effort against climate change, scientists have shown that clearing native vegetation is already increasing local temperatures[2], changing rainfall patterns and adversely affecting soy yields[3].

This study indicates that it is possible to greatly minimize or even stop further conversion of habitat in the Cerrado by focusing expansion on the areas that have already been cleared, mostly for low-productivity cattle pastures. There are approximately 18.5 million hectares (Mha) of existing pastureland that have been identified as suitable for conversion to soy crops – more than twice the amount of land needed for soy expansion over the next decade (an estimated 7.3 Mha)[4].

The challenge is that while the financial returns of converting pastureland to soy production are more favorable than for converting native vegetation, significantly lower land prices for native vegetation can tilt the balance in favor of clearing native vegetation in some areas of the Cerrado. An additional challenge arises with soy producers who can legally clear land[5] they have already purchased, and who therefore have a strong economic case for converting native vegetation.

These issues can be addressed, however. As this study shows, emerging financial mechanisms such as low-cost, long-term financing and low-cost crop finance can help shift the economics of expansion in favor of Deforestation and Conversion Free (DCF[6]) models. In cases where landowners already own the land with native vegetation, farmer compensation programs and other efforts can be deployed to change farmer incentives. These mechanisms can work as complements to market sourcing policies for DCF products.

There is also a significant untapped potential to increase the productivity of soy farms in the Cerrado over the next decade through broader implementation of improved farming practices that are demonstrated to increase soy yields by up to 25%[7].

A combination of these approaches could enable Brazilian agriculture to meet global demand for soy over the next decade, while avoiding an estimated 2.2 Mha of further conversion of native vegetation[8].

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The importance of the Cerrado

The Cerrado is larger than the combined territories of Germany, Spain, Italy, France and the United Kingdom, or almost five times the size of California. It is also one of the most important agricultural regions in the world and has become a key center of food production in recent decades. The expansion of cattle ranching and agriculture has led to the conversion of half of the Cerrado's native vegetation.

This loss of native vegetation leaves an extensive footprint in terms of carbon emissions and threatens the rich biodiversity of the region.

Under certain scenarios, local vegetation loss could lead to as much as a 10% reduction in soy yields in the Cerrado.

In addition, according to recent studies[9] led by Avery Cohn from Tufts University, higher temperatures and other weather anomalies are linked to deforestation in surrounding areas, with effects detected as far as 50 km of the cleared areas. Cohn's team estimates that under certain scenarios, local vegetation loss can lead to as much as a 10% reduction in soy yields[10].

The Nature Conservancy (TNC) and its partners analyzed land-use dynamics, economics and producer business models in order to identify new mechanisms that can foster DCF soy expansion in ways that benefit the economy, farmers, and the environment. Here, we present the main findings of these studies exploring land-use change, different profiles of soy farm owners, drivers and models of expansion, and conclude with our ideas for potential instruments that can be used to tilt the balance towards DCF production.

Additionally, new preliminary information from Embrapa[11] indicates that there is a significant opportunity to increase soy yield on the current production footprint. This and the economic benefits of crop-livestock integration are also briefly analyzed and discussed in the document as having the potential to help turn the tide against conversion of native vegetation to croplands.

01 Soy Production Area in the Cerrado

Source: TNC with data from Agrosatelite

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Soy production and expansion in the Cerrado biome

Brazil is one of the world´s top two producers of soybeans (along with the U.S.), with approximately 115 million tons produced in 2017, or nearly a third (31.3%) of the world's production volume.[12] The country is also the largest soybean exporter, representing 45% of the international trade for a total of USD 25.9 billion[13] in 2017. The total area used to produce soybeans in Brazil reached 35 Mha in 2017, of which about half (49% or 17.1 million Mha) is in the Cerrado.

According to studies conducted by Agrosatélite, TNC, and Agroicone, the area under soy production in the Cerrado region increased by approximately 9.6 million additional hectares or 128% between 2000 and 2017. Roughly 3.65 Mha – or 38% – of soy harvested in the 2016/2017 cycle was from land that was covered by native vegetation in 1999. MATOPIBA is, by far, the region of the Cerrado that is the most affected by this trend, as shown in figure 02.

The transition of a landscape from native vegetation to crops rarely occurs immediately. It is common for land to be cleared and then left unused during soil preparation, or simply abandoned for a few years before it is finally converted to soy. That process makes it difficult to determine the direct causes of conversion. However, TNC's remote sensing studies of land-use changes in the Cerrado[15] show that native vegetation areas converted to soy production often take up to five years before crop production can be detected.[16] Using this assumption that the clearing of native vegetation is attributable to soy production on properties where soy crops are evident within five years from the time they are cleared, soy production is clearly a primary driver of deforestation from 2007 to 2017 in most of MATOPIBA, with 74% of the land

cleared in Maranhão state attributable to soy, 38.1% in Tocantins, 94.5% in Piauí, and 60.6% in Bahia.

The MATOPIBA region also hosts the most significant remnants of native Cerrado that are on private land suitable[17] for soy production, with 45% of the Cerrado´s excess legal reserve of 10.7 Mha located in MATOPIBA (4.5Mha).[18] Of particular interest are areas of native vegetation on soy farms over the minimum conservation (set-aside) requirement established in the Brazilian Forest Code. Those areas add up to 1.2 Mha of native vegetation that could be legally cleared and converted and are most likely to be removed since they are located on active farms.

It is also worth noting that there are more than 18.5 Mha of pasture in the Cerrado biome that are suitable for soy production. [19] A combined response of repurposing much of this land to soy, while encouraging the sustainable intensification of cattle ranching on remaining pastureland, could potentially accommodate all of the future expected increase in demand for food from the Cerrado without further conversion of native vegetation.

02

Soy Production Areas In 2017 That Were Native Vegetation In 1999

MATOPIBA	2.24 Mha
Mato Grosso	1.08 Mha
Southern Cerrado[14]	0.33 Mha
TOTAL	**3.65 Mha**

Source: TNC with data from Agrosatélite

Drivers and agents of deforestation and conversion

Simply knowing where soy farms are expanding is not enough to design a strategy for sustainable production. We must also understand the dynamics of deforestation and conversion of native vegetation, the economic and financial drivers behind expansion, and the characteristics of the landscape where it occurs. TNC and Agroicone evaluated these and other factors to gain a better understanding of why DCF soy expansion is not the dominant business model, despite a surplus of suitable pastureland for soy near infrastructure and storage facilities.

Lower conversion costs and higher average productivity show a clear advantage of expanding soy over pastureland.

Economic factors such as costs of conversion, land prices, and yield potential play a significant role in determining expansion models and how they differ across regions of the Cerrado.

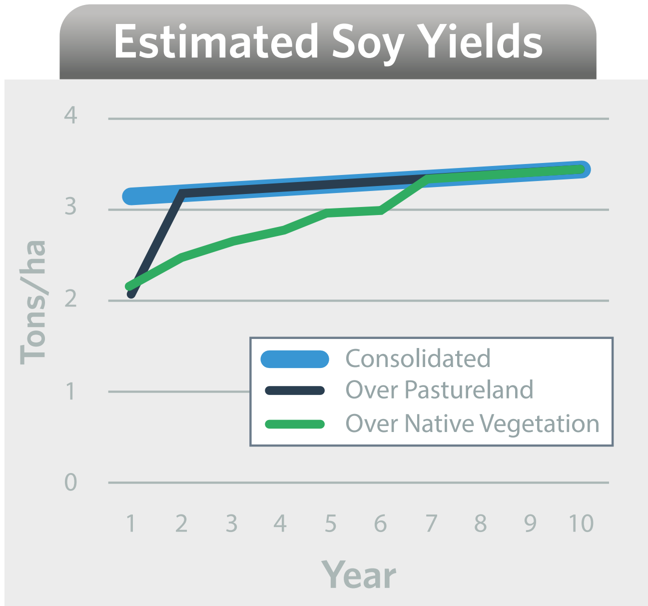
Agroicone estimated an average cost of conversion from native vegetation to crop agriculture of approximately BRL[20] 3,100 per ha, versus BRL 2,500 per ha to transform pastureland into productive cropping. Peak soy yields can also be achieved much faster when expansion occurs on pastureland instead of on recently-cleared native vegetation areas, which require more time, management, and resources to become adapted for crop production. Figure 03 demonstrates the growth of yield based on the land type.

Lower conversion costs and higher average productivity show a clear advantage of expanding soy over pastureland. However, interviews with key stakeholders[21] indicated another decisive factor in explaining expansion on native vegetation: land prices.

Figure 04 shows the price spread by land use in three different regions of the Cerrado biome: Southern Cerrado, Mato Grosso state, and MATOPIBA. In all areas, land under native vegetation is cheaper to acquire, which in some cases offsets the conversion costs and yield-time curve advantages of pastureland discussed above.

The price gap between different land uses also generates short-term business opportunities for agents focusing on real estate development, whose goal is not to produce crops but rather to achieve capital gain by acquiring cheap

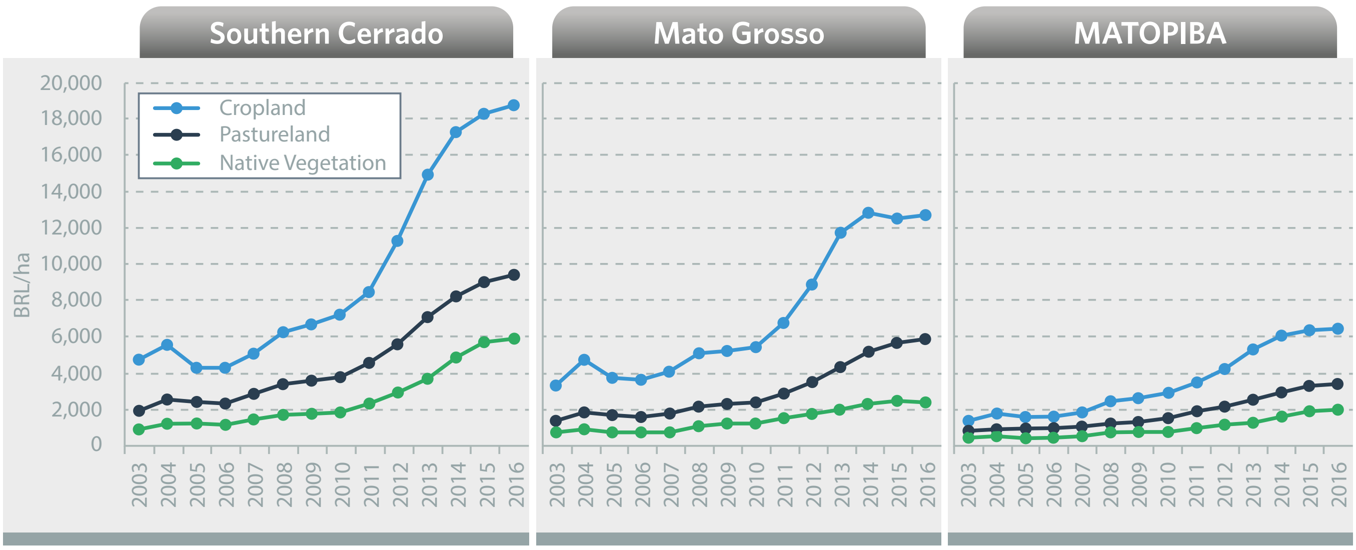
03



Source: Agroicone with information from CONAB

04

Land Prices In The Cerrado, By Land Use And Region (in BRL/Ha)



Source: Agroicone and TNC with data from FNP

land, developing it, and then selling it as already-cleared agricultural land.

A hypothetical investor[22] who, for example, acquires a relatively small 500 ha parcel of land with native vegetation in the MATOPIBA region and converts 400 ha to crop production, keeping the minimum required legal reserve of 100 ha, and then sells the whole area in year five at market conditions, would have an Internal Rate of Return (IRR) in real terms, (excluding the effects of inflation) of 19.4% in Brazilian currency. Considering a cost of capital of 7.6%, also in real terms, this investor would generate a Net Present Value (NPV) of BRL 2,800 per ha – more than BRL 1.4M for the entire property.

In addition to the value created from moving land from native vegetation to agriculture, landholders have in the past been able to realize large gains from the rapid price appreciation of and values overall, and especially agricultural land. However, there are signs that this market appreciation is leveling off as indicated in the charts.

More than 70% of the total soy production area in the Cerrado is concentrated on farms equal to or larger than 2,500 ha, which represents just 21.7% of the number of soy farms.[23] Farms larger than 2,500 ha also have most of the native vegetation area that is theoretically available for legal conversion: 86.5%. Only 4% of Cerrado soy properties have more than 100 ha of native vegetation that could be legally cleared.[24]

05

Profit by Conversion

BRL 2,800 per ha

Values estimated including native vegetation area acquisition and conversion costs and the sell of agriculture land on year 5. Discount rate of 7.6% yearly in real values.

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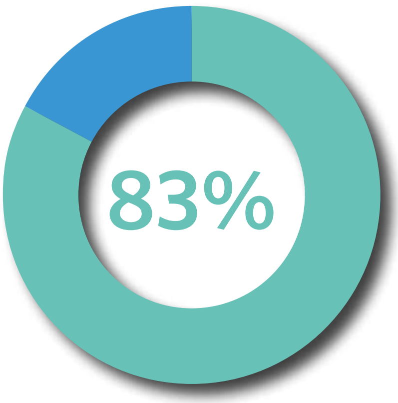
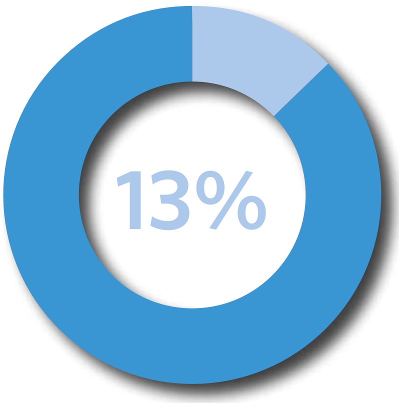
06

LOW IMPACT



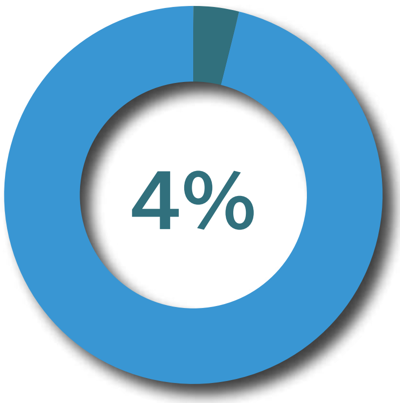
Soy farms with **less than 10 ha** of native vegetation that can be cleared legally on soy-suitable land

MEDIUM IMPACT



Soy farms with **10 - 100 ha** of native vegetation that can be cleared legally on soy-suitable land

HIGH IMPACT



Soy farms with **more than 100 ha** of native vegetation that can be cleared legally on soy-suitable land

Source: National Wildlife Federation (NWF)

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Future soy expansion and principle production expansion models

Legal Soy expansion can be broken down into four basic models:

I. Legal conversion of native vegetation areas above the Forest Code Legal Reserve requirement on properties already owned by the soy producer;

II. Acquisition of properties with surplus native vegetation;

III. Acquisition of pastureland and its transformation to crop production; and

IV. Lease of pastureland for soy production.

Models III and IV represent DCF expansion of soy, with a significant caveat that model III can be considered DCF expansion only if the current land use has been pasture for at least five years. The predominant model varies depending on the region, and particularly the dynamic of land prices in each area. In Mato Grosso, for example, where land prices are high, the most common path of expansion is via leasing of pasture for soy production, while in MATOPIBA the acquisition of pasture (often recently converted from native vegetation) appears to be the norm.

DCF forms of expansion are already prevalent if one considers the Cerrado as a whole – 61% of expansion across the biome has historically occurred on pastureland.[25] On the other hand, approximately one-third of the future expansion is expected to take place on native vegetation, converting an additional 2.2 Mha of Cerrado biome into soy fields by 2030. In this scenario, roughly 80% of the conversion would be in the MATOPIBA region.

This situation can be avoided. As previously mentioned, there is more than twice the required area for soy

> Although conversion of native vegetation to soy remains a major threat to the Cerrado biome, soy expansion on already-cleared pasturelands is already an established business model.

expansion in sparsely occupied pasturelands[26] that are already highly suitable for crop production. That implies that a combination of actions that can support cattle ranching intensification, which could free up low productivity pasturelands, and conversion of those underused areas to crops, could potentially enable Brazilian agriculture to become a powerhouse producer of DCF beef and soy.

To better understand soy expansion and propose alternatives that make DCF the optimal expansion path, TNC and Agroicone assessed different producer profiles and business models from a financial and economic perspective.

Generally, soy producers can be divided into four main groups:

- Large land development companies and institutional investors operating fundamentally with a land development model, in most cases focusing on appreciation of their assets. Acquisition of undervalued and underdeveloped land is particularly attractive to these companies. Annual cash flow can be generated by leasing land to farm operators. Recently, the MATOPIBA region appears to be a hotspot for the activities of land development companies. Complex shareholder structures allow investment from international companies, which is usually done through local subsidiaries.
- Large agribusiness companies and large family-owned business groups focusing on generating cash flow from agricultural production. For this purpose, they usually own several properties and typically tens or even hundreds of thousands of hectares, but sometimes also rent land from cattle ranchers, small landowners, and land development companies. Large groups adopt several different business models, which may include non-farming activities such as commodity trading, land development, and food processing.
- Small family groups and individual soy farmers focusing on agriculture production, usually adopting some form of crop rotation which, in Mato Grosso and Southern Cerrado, typically includes a second harvest with corn, forage, and sometimes cotton. This segment represents the majority of the producers in numbers, but only approximately 30% of the soy producing area. These soy producers typically own relatively small farms – under 1,000 ha – but will frequently manage several different farms, including rented land.
- Informal land developers operating mostly by acquiring and formalizing land rights, sometimes clearing native vegetation, and then selling the land for profit usually within a short time frame. These are usually individuals or small groups that acquire and legalize rights to lands, in some cases developing it with basic infrastructure and some form of production that can increase the value for selling purposes.

07

Expected Soy Expansion Until 2030

3.8 MH in MATOPIBA	**3.5 MH** in MT, GO, DF and MS
2 MH expanding on **pasture**	**3.1 MH** expanding on **pasture**
1.8 MH on **native vegetation**	**0.4 MH** on **native vegetation**

Source: Agroicone

Economics of alternative expansion models

A study coordinated by TNC and conducted by Agroicone analyzed a typical soy property (1,500 ha of planted area) and compared various forms of expansion with and without native vegetation conversion. The study evaluates the value added by expanding productive area by an additional 410 ha in terms of Net Present Value (NPV) and Internal Rate of Return on Equity (IRR) in real local currency terms (excluding the effects of inflation). The soy expansion models evaluated in the study were those described above:

I. On native vegetation within the owned property (Forest Code Surplus).

II. On native vegetation from areas acquired from other landowners.

III. On pastureland from areas acquired from other landowners.

IV. On pastureland from areas leased from cattle ranchers.

Unsurprisingly, the option with the most substantial financial return for producers is expansion over native vegetation surplus within the owned property (I - 21.1% IRR in MATOPIBA and 21.0% in the Southern Cerrado area). The main reason behind these figures is that producers do not face any land acquisition costs to expand within their owned property. In these situations, in which the opportunity cost to not convert excess native vegetation is very high for the producer, alternatives to foster DCF expansion must be stronger.

Interestingly, the financial simulations for MATOPIBA indicate that the returns from expanding over acquired or rented pasture are very close to those obtained by expanding over acquired native vegetation. The calculated IRR in local currency for each model was respectively, 13.8% (model III), 14.2% (IV), and 14.3% (II). This relatively small gap between expanding over acquired pasture and acquired native vegetation could be bridged or even reversed with some financial and non-financial mechanisms and instruments.

The results for Southern Cerrado and Mato Grosso are very similar to those observed in MATOPIBA simulations, with a larger gap in Southern Cerrado (14.2% on model II to 12.0% on model IV[27]). However, as "older" production areas, Mato Grosso and Southern Cerrado have significantly less excess Legal Reserve on properties. That explains why a significant part of current soy expansion is already taking place over pasturelands in those regions, whereas in MATOPIBA we see acquisition and conversion of native vegetation as the predominant model.


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Financial mechanisms

that can tilt the balance in favor of DCF soy production

A range of financial incentives could be used to improve the returns of a DCF alternative of renting or buying pasture relative to the option of expanding onto acquired lands with surplus native vegetation.

We analyze three examples:

- Low-cost working capital, or crop finance
- Long-term loans for pasture acquisition and conversion to soy
- ABC credit for pasture conversion to soy

There is great potential to use the existing official credit line for low-carbon agriculture (BNDES ABC[28]), which currently finances activities such as sustainable cattle ranching and crop-livestock integration, but not explicitly conversion of pastureland to soy.[29] While it would require some modification to the ABC program, our simulations indicate that using the ABC credit to finance pastureland conversion to soy[30] would increase a producer´s IRR in Brazilian Reais (model III) from 13,9% to nearly 16% - higher than the IRR of expansion over acquired native vegetation in almost any region in the Cerrado (model II) and closer to expansion over already-owned native vegetation (model I). The ABC program has some limitations, such as a maximum loan size of BRL 5 million, which may limit its penetration since it would be enough to cover the conversion costs of only about 2,000 ha for each producer. In addition, banks have been slow to extend loans using ABC funds due to the low fixed bank margins associated with this program.

Another option is a private long-term credit line for

pasture acquisition and conversion, an example of which is offered by a partnership of Santander, Bunge, and TNC, which has the potential to increase the IRR from 13.8% to 15.3% in MATOPIBA[31]. Meanwhile, a low-cost working capital credit, charging 4% interest rate in local currency instead of the current average of 7%, could produce, depending on the region and size of producer up to 0.5 percentage points higher internal rate of return on the expansion.[32] If farmers have access to a combination of these financial mechanisms, they could further increase their returns on DCF expansion.

As mentioned earlier, expansion onto already-owned surplus native vegetation yields higher returns than any of the alternatives due to the absence of land acquisition costs. In these cases, there are limited feasible alternatives that can restrain the conversion of Cerrado and foster DCF expansion of soy production. Options evaluated recently by TNC and its partners include: direct payments for environmental services (PES); subsidies to rent or acquire pastureland; and sectoral or jurisdictional commitments to block access to market of soy planted in land converted from native vegetation. Preliminary simulations put the opportunity cost of not producing on native vegetation that is already owned by the farmer at BRL 500-700[33] per hectare annually.

TNC also evaluated the returns for a typical cattle rancher who leases a portion of his pastureland for soy production and then invests the leasing income into intensifying his cattle production operations. In simulations for Mato

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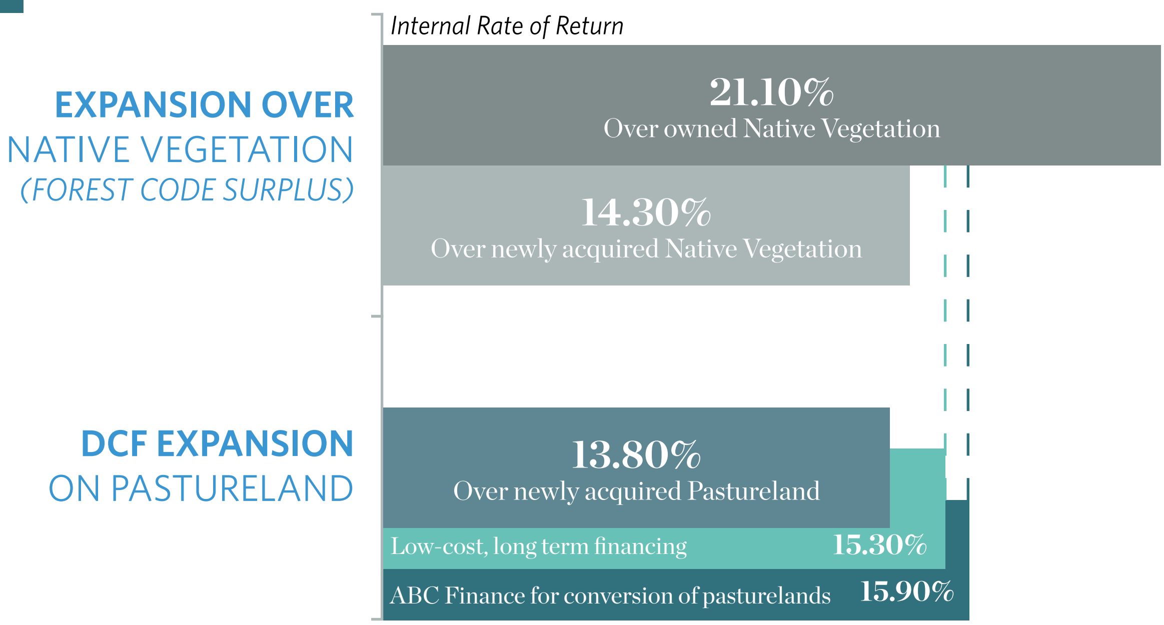
08



09 Financial Mechanisms assumptions

	Base Case with No New Mechanisms	Low-Cost Crop Finance	Long-Term Finance (LTF) for Pastureland Acquisition and Conversion	Long-term ABC Credit for Pasture Conversion to Soy
Items financed	Annual working capital costs[34]	Same as Base Case	Working capital financed same as Base Case plus long-term loan for: • Land acquisition • Cost of conversion of pasture to soy[35]	Working capital financed same as Base Case plus ABC loan for: • Cost of conversion of pasture to soy (no land acquisition)
Term	< 1 year	Same as Base Case	10 years	10 years
Grace Period[36]	NA	NA	1 year	5 years
Interest Rate (nominal values)	7.00%[37] BRL	4.00%[38] BRL	6.00% USD (Equivalent to 9.14% BRL)[39]	6.00% BRL

Grosso, the rancher´s returns increased from 15.3% in the business as usual case to 22.1%.[40]

There are other DCF production models and financial alternatives that can help direct soy expansion to already-cleared areas. One promising example is Embrapa's spatially-explicit analysis of soy yield[41], which shows a significant potential to increase soy productivity[42] in the Cerrado. Preliminary simulations run by Agroicone and TNC[43] estimate a potential IRR increase in Southern Cerrado[44] from 12.0% to 15.8% from improved agricultural practices. Crop-livestock integration was found to be even more attractive, with preliminary estimations showing an IRR of 18.5% for the soy farmer in the same expansion model and region.

Other measures have a key role in supporting DCF soy production, including but not limited to: supply chain sourcing policies, effective implementation of the Forest Code, and creating favorable enabling conditions for expansion on pastureland, such as improving soy-transportation infrastructure in traditional cattle-ranching regions and thereby facilitating the expansion of soy production on cleared land in those regions.

Conclusion

Business as usual soy expansion in the Cerrado will result in a future of continued conversion, risk of substantial yield losses, reputational risks, and reduced access to international markets. An alternative path is to develop incentives that shift the economics for farmers more consistently in favor of expansion on cleared lands, combined with DCF sourcing and other measures, to reduce the pressure on native conversion. This approach can effectively decouple soy expansion from habitat conversion and supply the growing global market for soy while avoiding the conversion of a projected 2.2 million hectares of Cerrado habitat over the next decade.

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[1] Includes the Brazilian states: Maranhão (MA), Tocantins (TO), Piauí (PI) and Bahia (BA).
[2] Cohn AS et al (2019). Forest loss in Brazil increases maximum temperatures within 50 km. Environmental Research Letters. 2019 Aug 14;14(8):084047.
[3] Costa MH el al (2019). Climate risks to Amazon agriculture suggest a rationale to conserve local ecosystems. Frontiers in Ecology and the Environment; doi:10.1002/fee.2124.
[4] Source: Agroicone, BLUM - Modelo de Uso da Terra para Agropecuária Brasileira
[5] "Reserva Legal" or Legal Reserve, as defined by the Brazilian Forest Code, ranges from 20% to 35% of the property area in the Cerrado biome, depending on the state where it is located. Above this threshold the owner can clear the land for production, with due administrative process.
[6] Understood here as defined by The Accountability Framework (i.e. no gross deforestation of natural forests or conversion of natural ecosystems). Source: https://accountability-framework.org/.
[7] Cuadra SV et al. Soybean Yield Gap over the Brazilian Cerrado. Study currently under development.
[8] Source: Agroicone, BLUM - Modelo de Uso da Terra para Agropecuária Brasileira.
[9] Cohn AS et al (2019). Forest loss in Brazil increases maximum temperatures within 50 km. Environmental Research Letters. 2019 Aug 14;14(8):084047
[10] Study currently under peer-review.
[11] The Brazilian Agricultural Research Corporation is a state-owned research corporation affiliated with the Brazilian Ministry of Agriculture.
[12] As of 2017, the United States of America is the largest producer with a total of 119.5 million tons of soy harvested. Source: FAOSTAT.
[13] Observatory of Economic Complexity (OEC) @ MIT.
[14] Southern Cerrado includes the Cerrado biome of four different Brazilian states: Mato Grosso do Sul (MS); Goiás (GO); Minas Gerais (MG); and São Paulo (SP).
[15] Ramos-Neto M, Baumgarten LC. Soybean conversion and cultivation pattern in the Brazilian Cerrado (1985-2017). Study currently under development.
[16] It is unlikely that other economic activities with lower returns may temporarily occupy the area, since the five-year time lapse considered by TNC is too short to generate cash flows that could justify conversion without the subsequent consolidation of Soy production.
[17] High and medium agricultural suitability with no altitude or slope restrictions. Source: TNC with data from Agrosatélite, Mapbiomas and Imaflora.
[18] This area includes "Legal Reserve" minimum areas that must be preserved according to existing Brazilian Forest Code. Source: TNC.
[19] Altitude or slope may limit land suitability for soy production. According to Agroicone's study, there are an additional 17.6 Mha of land highly suitable for crops production with one or both of those restrictions.
[20] Brazilian reais.
[21] Conducted by Agroicone under contract with TNC.
[22] Simulation for MATOPIBA considering the assumptions detailed before.
[23] Large farms also have a high share of deforestation, being responsible for 43% between 2000 and 2017.
[24] There are considerable differences by region. In Maranhão, for example, the number of farms that have native vegetation areas that can be legally cleared is 45.8%, while in Mato Grosso this proportion is 14.1%.
[25] Estimated by TNC with data from MAPBIOMAS 3.1 and Agrosatélite, considering soy expansion from 2000 to 2017.
[26] Even on traditional Beef producing areas, cattle ranching has a relatively low intensity. In the Cerrado portion of Mato Grosso State in 2016, there were only 0.91 head/ha according to Vale P, Gibbs H, Vale R, Munger J, Brandão A Jr, et al. (2019) Mapping the cattle industry in Brazil's most dynamic cattle-ranching state: Slaughterhouses in Mato Grosso, 1967-2016. PLOS ONE 14(4): e0215286. https://doi.org/10.1371/journal.pone.0215286.
[27] Renting pastureland for expanding soy production in Southern Cerrado and Mato Grosso is more attractive than acquiring pastureland, due to higher land prices than in the MATOPIBA region. IRR for expanding on acquired pastureland in the Cerrado was estimated at 10.2%.
[28] "Programa ABC" is the Brazilian Development Bank (BNDES) official credit line for investments that contribute to mitigate environmental impacts caused by agriculture and cattle ranching activities.
[29] Including soil correction, inputs, labor costs, ground preparation, among others.
[30] Although this possibility exists today, with current ABC program credit lines, the use of resources to finance pastureland conversion to crops is not explicitly mentioned. In order to foster the expansion of soy over low intensity pastureland, it would be impactful to include this possibility among available credit lines, or create one specific for this purpose.
[31] Expansion model III (over acquired pastureland).
[32] For example, increasing the IRR on acquired pastureland (model III) from 13.8% to 14.2%.
[33] Equivalent to USD 125 to 175 per ha per year considering exchange rate from November 2019.
[34] 56% of crop operating costs are assumed to be financed, of which 32% with a crop loan and 24% through a barter arrangement. Remaining costs are self-funded by the farmer.
[35] 80% of land acquisition and conversion costs including land preparation for soy growing.
[36] Interest only (no principal payments) during grace period.
[37] Interest rate on crop loan; barter arrangement is based on an exchange of inputs for future soy volumes.
[38] Interest rate on a new loan which replaces the Base Case crop loan and finances the costs covered through the barter arrangement.
[39] Swap rates calculated on October 11, 2019. May be subject to changes depending on market conditions.
[40] Including rent received and increased income due to cattle ranching intensification (from low to high productivity).
[41] Cuadra SV et al. Soybean Yield Gap over the Brazilian Cerrado. Study currently under development.
[42] The Yield-gap analysis was developed in partnership with TNC, EMBRAPA and other strategic partners for the Agroideal initiative (https://agroideal.org/).
[43] The Strategical Committee Soy-Brasil (CESB, from portuguese Comitê Estratégico Soja Brasil) organizes a yearly productivity challenge. Using data from this challenge, with Embrapa's support, Agroicone and TNC estimated production and financial conditions that could lead to a leap in current productivity in a model farm, achieving 80% of the potential described in the challenge.
[44] Considering the scenario of the expansion model IV (leased pastureland).

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