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DOSSIÊ: OS NOVOS DESAFIOS DO DESENVOLVIMENTO NA REGIÃO AMAZÔNICA

Chinese-driven frontier expansion in the Amazon: four axes of pressure caused by the growing demand for soy trade

Expansão de fronteira impulsionada pela China na Amazônia: quatro eixos de pressão causados pela crescente demanda pelo comércio de soja

Expansión de la frontera impulsada por China en el Amazonas: cuatro ejes de presión causados por la creciente demanda de comercio de soja

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Abstract: Chinese demand for the world's commodities has the capacity to shape agricultural frontiers in many parts of the world, including the Amazon. This article is a preliminary report on findings concerning the expansion of the agricultural frontier in the Brazilian Amazon driven by increases in soybean production, extension of cropped area, cross-referenced with satellite data on deforestation rates at the smallest possible scale: the municipal level. The study identifies 21 municipalities forming fours axes of frontier expansion in the Amazon, where soycrops may be the cause for displacement deforestation, as it is the case of cattle ranching. Despite the Soy Moratorium, frontiers in the Amazon keep shifting. The article advocates that further research in those four axes is needed to better understand the relationship between those two industries in terms of land use as well as the socio-environmental on the ground impacts. Furthermore, the connections between those areas with present and future infrastructure development in the Amazon, many counting with direct Chinese investment, will be key to the expansion of the soy value chain, bypassing the initial goal of zero-deforestation.

Keywords: Amazon. Agricultural frontiers. Deforestation. Soy. Chinese demand.

Resumo: A demanda chinesa por *commodities* tem capacidade para moldar fronteiras agrícolas em muitas partes do mundo, incluindo a Amazônia. Este artigo é um relatório preliminar sobre a expansão da fronteira agrícola na Amazônia brasileira, impulsionada por aumentos na produção de soja, extensão da área cultivada, cruzadas com dados de satélite sobre as taxas de desmatamento na menor escala possível: o nível municipal. O estudo identifica 21 municípios formando quatro eixos de expansão de fronteira na Amazônia, onde a lavoura de soja pode ser a causa do desmatamento indireto por deslocamento de outras atividades, como é o caso da pecuária. Apesar da Moratória da Soja, as fronteiras na Amazônia continuam mudando. O artigo defende que mais pesquisas nesses quatro eixos são necessárias para entender melhor a relação entre essas duas indústrias em termos de uso da terra, bem como os impactos socioambientais in loco. Além disso, é fundamental traçar as conexões entre esses eixos com o desenvolvimento presente e futuro de obras de infraestrutura na Amazônia, muitas delas com investimento direto chinês, para antever a expansão da cadeia de valor da soja, que pode estar ignorando de fato a intenção inicial de uma cadeia de valor de desmatamento zero.

Palavras-chave: Amazônia. Fronteiras agrícolas. Desmatamento. Soja. Demanda chinesa.

Resumen: La demanda china de *commodities* tiene la capacidad de dar forma a las fronteras agrícolas en muchas partes del mundo, incluida la Amazonía. Este artículo es un informe preliminar sobre la expansión de la frontera agrícola en la Amazonía brasileña, impulsada por el aumento de la producción de soja, la extensión de la superficie plantada, datos satelitales entrecruzados sobre las tasas de deforestación en la escala más pequeña posible: el nivel municipal. El

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estudio identifica 21 municipios que forman cuatro ejes de expansión fronteriza en la Amazonía, donde el cultivo de soja puede ser la causa de la deforestación indirecta debido al desplazamiento de otras actividades, como la cría de ganado. A pesar de la Moratoria de la soja, las fronteras en el Amazonas continúan cambiando. El artículo argumenta que se necesita más investigación sobre estos cuatro ejes para comprender mejor la relación entre estas dos industrias en términos de uso de la tierra, así como los impactos sociales y ambientales *in loco*. Además, es crucial establecer las conexiones entre estos ejes con el desarrollo presente y futuro de las obras de infraestructura en la Amazonía, muchas de ellas con inversión directa china, para prever la expansión de la cadena de valor de la soja, que de hecho puede ignorar la intención de una cadena de valor de deforestación cero.

Palabras clave: Amazonía. Fronteras agrícolas. Deforestación. Soja. Demanda china.

Introduction

The growth and internationalization of the Chinese economy is not a recent phenomenon any longer.[2] Nevertheless, in historical terms, we are witnessing the fastest gravitational shift in world trade[3] (Urban Mohan and Cook 2013). China has established itself as a matching force to the United States economy and a player open to multilateral negotiation forums. First, Chinese products competitively flooded the international markets during a period in which the domestic drivers of economic expansion were based on the relocation of workforce and capital. Following decades of land reforms, intense urbanization, and incorporation of workers by the industry, the Chinese economy now grows on a slower pace, but the country has become wealthier in the meantime and today represents around 19.25% of the world's GDP[4] Chinese reforms also fueled new trends in the populations' consumption patterns which combined with the its recent international policy orientation have transformed the country into one of the major consumer market for goods, especially commodities.

For other emerging countries, like Brazil, China has rapidly become a trade and investment partner of great weight. While in 2000 China ranked 12th, since 2012 it has replaced the United States as first ranked destination for Brazilian exports.[5] The share of the Chinese market is so influential that it has the capacity to pivot the international prices of commodities and push the expansion of agricultural frontiers way past the confinements of Chinese own national borders.

Beyond the realm of trade, Chinese investments in infrastructure have also crossed borders. Part of the national savings seek rent opportunities through investments abroad. This fact combined with Chinese national interest of ensuring greater and cheaper access to commodities have driven its long-term international strategy to conceptualize the "one belt, one road" initiative. More than a geopolitical strategy, the initiative is a pragmatic anchor for Chinese economic national interests: opportunities for investments and returns, greater infrastructure connection for facilitated access to commodities and markets, and (why not?) an agenda to "conquer" the minds, hearts and pockets of trade and investment partners.

Given the ambitious scope of these projects and the reach of their impacts, it is of ultimate importance for the target regions to understand how those dynamics interplay with their own local development strategies and, accordingly, enact policies that reflect on the desirability of this partnership, taking into consideration their combined and sometimes overlapping impacts over the people and the environment. This is the case of the soybean frontier expansion in the Amazon pushed by an increase in the external demand, mainly driven by China.

Before the Chinese demand boomed, the

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[3] Braga, Carlos A. P. 2019. Brazil *and China: back to the future.* Global Power Reconfigurations, 1st GIMLA Conference. University of St. Gallen and FEA-USP. São Paulo. The presentation (ppt) was personally sent to the author on April 4, 2019.

[4] International Monetary Fund Data (IMF).2019. IMF Data Tracker. Wolrd Economic Outlook. Accessed on: November 3, 2019. https://www.imf.org/external/datamapper/PPPSH@WEO/OEMDC/ADVEC/WEOWORLD.

[5] Ministério da Economia, Indústria, Comércio Exterior e Serviços (Mdic). 2019. Programa Comex Stat. Accessed on: September 20, 2019. http://comexstat.mdic.gov.br/pt/home.

agriculture and beef industries were already major drivers of deforestation in the Amazon (Walker Moran and Anselin 2000; Hecht and Cockburn 2010). Since the 1970s, incentivized by governmental policies that aimed at connecting and developing the Amazon through large infrastructure projects (dams, roads, and mines), colonization schemes, and facilitated access to credit, have rapidly engendered changes in land use and cover (Moran 1981). Those changes were reinforced since the 1990s by external factors related to the liberalization of the Brazilian market and the expansion of global demand for export crops such as soybean (Nepstad Stickler and Almeida 2006; Hargrave and Kis-Katos 2013); in addition, the devaluation of the local currency also generated increased occupation of land by soy crops as a supply area response in the late 1990s (Richards et al. 2012). Record deforestation rates happened between 2001 and 2006, when soybean plantations expanded by one million hectares in the Amazon directly converting forests into plantations (Gibbs et al. 2015).

Following an international outcry for the conservation of the Amazon, policy measures, including penalties to those farmers who deforest as well as suspended agricultural credit to blacklisted counties, combined with market interventions in the supply-chain governance, such as the Soy Moratorium,[6] have managed to considerably curb deforestation rates in Brazil, eventually turning the country into the number one in climate change mitigation (Nepstad et al. 2014).

Nevertheless, recent evidence points out to a new frontier expansion in the Amazon, directly and indirectly led by the interplays between the soy and beef industries, as well as enacted by large infrastructure projects that grant further incentives to the taking over of forest land. Since expansion of soy crops over land previously cleared by other activities in the Amazon, such as cattle ranching, is a possibility even according to the Moratorium terms, there is a strong case for evaluating the triangular relationship between those industries and their connections to infrastructure provision for exports. Previous researchers have already pointed out to the likelihood of new lands in the Amazon being brought into production directly or indirectly by the pressures caused by the growing external demand, commodity prices, currency devaluation, secondary displacement of pasture land, and weakening of monitoring mechanisms or a reduced perception of the risks incurred in deforestation (Arima et al. 2011; Barona et al. 2010; Richards et al. 2012; Nepstad et al. 2014).

This paper is a preliminary report on findings concerning dataset analysis of the recent pressures caused by the expansion of soybean frontiers from the first consolidated area in the south of Mato Grosso since the late 1990s further into other states and municipalities (*municípios*) that are at the borderline of the Amazonian arc of deforestation between 2007 and 2017. The datasets used combine information provided by the Brazilian Institute of Geography and Statistics at the smallest possible scale (municipal) concerning total area, as well as percentual growth of soy cropped land, with satellite data provided by the Prodes program of the Institute of Space Research (Inpe-Prodes)[7] concerning total deforested area at the same scale. The study pinpoints 21 municipalities in which direct or indirect pressures caused by an increase in soy production as well as the expansion of cropped area may be leading to deforestation. Further investigation is needed to confirm the hypothesis of displacement deforestation and on the ground research must evaluate the socio-economic transformation incurred by those regions as a consequence of land use and cover changes.

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[6] The Soy Moratorium was a voluntary zero-deforestation agreement signed by soybean traders committing not to purchase soy from properties which have deforested after July 2006. Monitoring was made through satellite in cooperation between the two main traders (vegetable oils and grains), civil society organization, the Ministry of the Environment and the Bank of Brazil. Non-complying producers were excluded from the market. The mechanism achieved a high compliance rate. Abiove. 2019. Soy Moratorium: Soy Moratorium – Report of the 11th Year, monitoring soy crops in the Amazon biome using satellite images 2017/2018 crops. Accessed on: November 9, 2019. http://abiove.org.br/en/relatorios/moratoria-da-soja-relatorio-do-110-ano/.

[7] Instituto Nacional de Pesquisas Espaciais – Inpe. 2018. Prodes Amazônia – Monitoramento do desmatamento da floresta amazônica brasileira por satélite. Accessed on: October 05, 2019. http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes/.

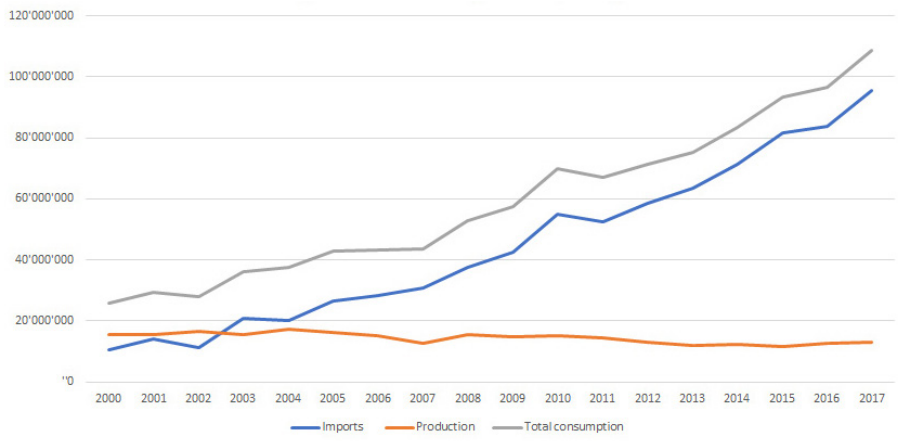
Whatever happens in terms of land reconfigurations in those areas may dictate the future of frontier expansion into the Amazon rainforest with unforeseen consequences for the ethnically diverse local populations and the biodiverse environment.

Soy trade between Brazil and China

China heavily relies on foreign production of soy to sustain its growing consumption levels. Domestic consumption has dramatically risen since 2000, and went from 25'000 to 109'000 tons, or a four-fold increase in 17 years. The growing demand for soy is related to the increased prosperity of the country, the fast-paced urbanization, growing household income and the parallel lifestyle changes of the new urban Chinese middle class, including the increase in the consumption of meat, which drives the demand of soybean for feedstock up.

Despite the growing domestic demand, Chinese soybean production has remained fairly stable. To compensate for that imbalance, imports have exploded and today account for 88% of the total Chinese consumption. In the year 2000, they only accounted for 40% (keeping in mind that the total volume of imports has also increased).

Figure 1 – Chinese soy consumption

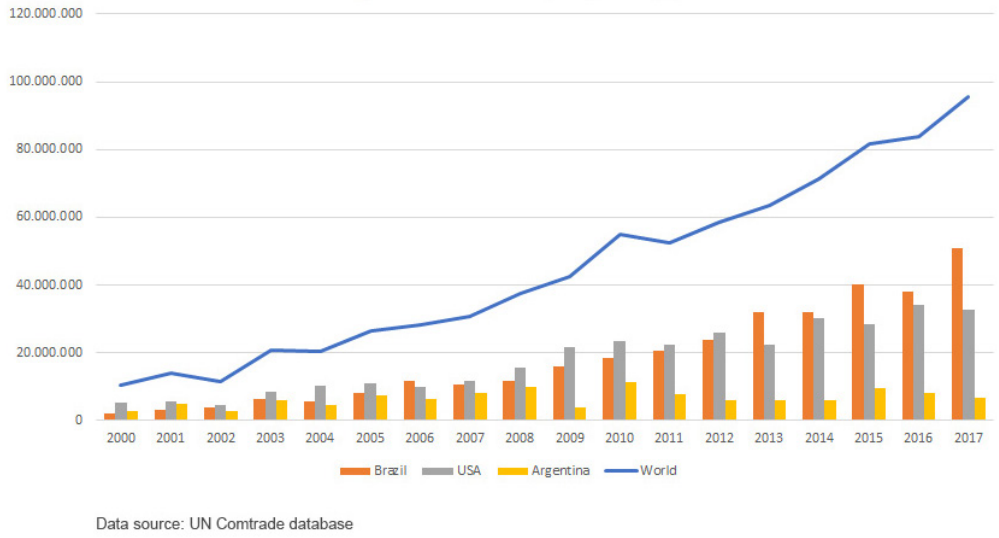


Data source: authors' own calculations using UN Comtrade and FAO Stat databasessource: authors' own calculations using UN Comtrade and FAO Stat databases

In this same year, Brazil occupied a relatively minor position as a supplier for the Chinese market: 20% of total supply. Nevertheless, in a very short timeframe since 2013 Brazil has become the most important provider of soybeans to the Chinese, even surpassing the United States as the main trade partner. Today, Brazilian soy represents more than half of all the soy imported by China, followed by the United States and Argentina (Figure 2).

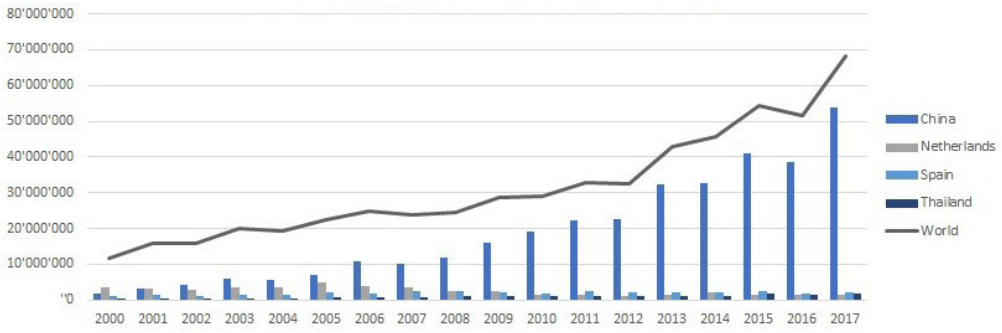
For Brazil, China has become the main trading partner. In fact, in 2017 almost 80% of all Brazilian soy exports went to China while it represented only 15% in 2000. More impressively, over the same period, not only percentages but the total volume of exports to China multiplied 3'000 times, while Brazilian exports to the rest of the world only grew by six-fold factor. Brazilian soy production increasingly goes to feed the Chinese market more than any other (Figure 3).

Figure 2 – Chinese soy suppliers



Data source: UN Comtrade database

Figure 3 – Brazilian soy exports main partners



Data source: UN Comtrade database

The growing Chinese demand changed the dynamics of soy trade in Brazil in at least three immediately observable ways. It has:

i. shifted Brazil's main trading partners;

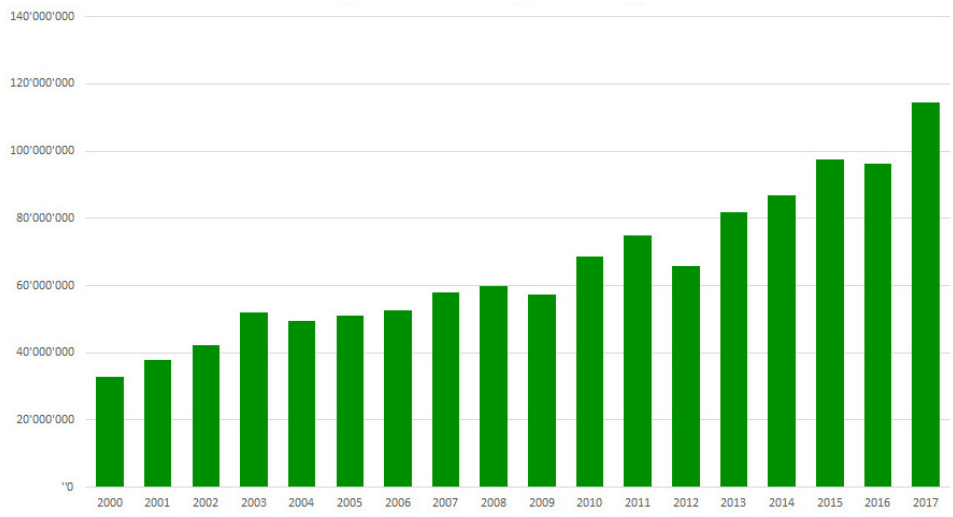
ii. granted external incentives to push the production capacity of the country up. According to the Food and Agriculture Organization (FAO), the soy production in Brazil grew by 3.5 between 2000 and 2017, coinciding with the boom in exports to China;

iii. diverted a percentage of soybean formerly destined to the domestic market to the Chinese.

In 2017, almost 60% of the soy production was destined for exports, whereas only 41% of production was exported in 2007.[8] The growth is substantial, not only in percentual terms, but in volume as well, as the output increase of the last 17 years shows (Figure 4). Given the trade and production patterns of soy in Brazil, it is not speculative to state that a great share of the increased production is driven by higher foreign demand, in particular, exports to China.

[8] Food and Agriculture Organization of the United Nations -FAO. 2019. Food and Agriculture Data (Faostat). Accessed on: October 04, 2019. https://thenew.org/org-people/#data/. United Nations Comtrade Database. Uncomtrade. 2019. Accessed on: November 08, 2019. https://comtrade.un.org/.

Figure 4 – Brazilian soy production



Data source: FAO Stat database

Such higher soybean production in Brazil is likely to have spillover effects. The growth in Brazilian output by a factor of almost four could be associated with the use of technology for more efficient agriculture, crop substitution (Souza et al. 2007), or an expansion of the agricultural frontier. The first two channels might make use of more aggressive pesticides, GMOs, or the expansion of the use of monocrops in general, which have their own negative impact on the environment. Despite their relevance, this discussion is outside of the scope of this paper.

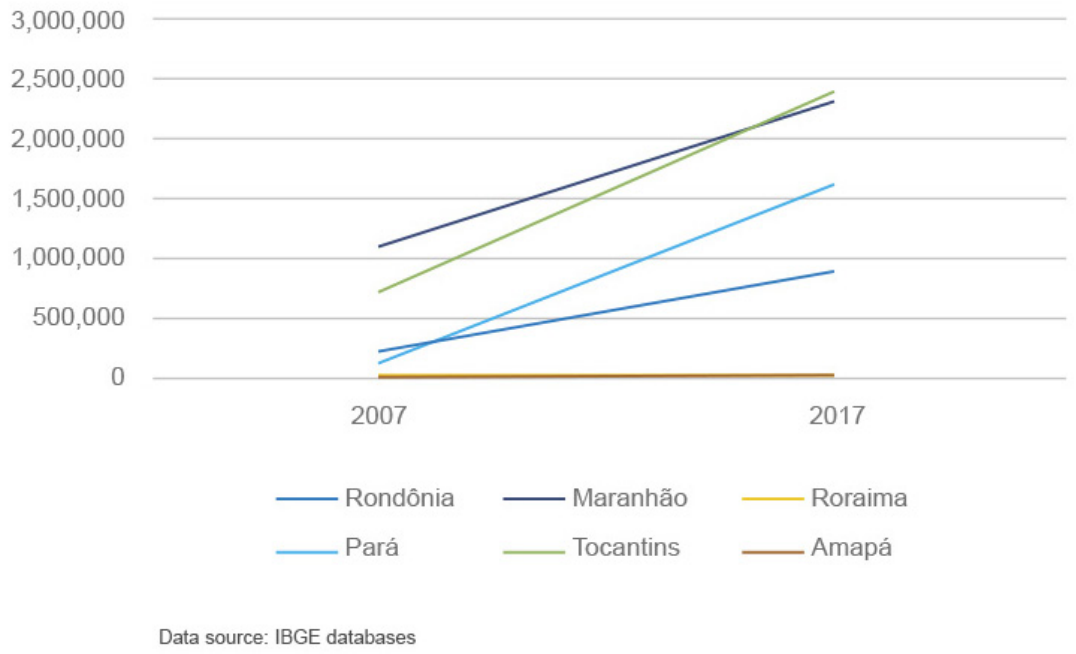
Our working hypothesis is that the increased demand for soybeans may be exerting pressure on the agricultural frontier towards the Amazon. Expansion for the purposes of this analysis implies intensifying and growing crops in lands previously not used for this end. Gains in planted area may be accomplished through crop substitution, displacement of and plantation over former pasture lands, or even deforestation. In a culturally rich and biodiverse region as the Amazon, especially the later could have dramatic effects for the preservation of the environment, the balance of the climate, and the reproduction of distinct ways of life. For that reason, this study attempts to point out the areas in the Amazon which have been under the most pressure since the boom of soy exports to China, leading both to an increase in total output production and planted area, convergent with increased rates of deforestation.

Four axes of soybean frontier expansion in the Amazon

The states that comprise the Legal Amazon[9] are responsible for more than 50% of all the soy exported from Brazil. Most of this production is consolidated in the state of Mato Grosso, and it has been so even before the booming Chinese demand. Nevertheless, even in Mato Grosso, soy production continues growing be it through intensification, or crop substitution, or even the inception of new technological improvements. Beyond this consolidated area, other Amazonian states witness rapid soy culture expansion, including Pará, Mato Grosso do Sul, Tocantins, Maranhão, Rondônia and Roraima (Figures 5 and 6).

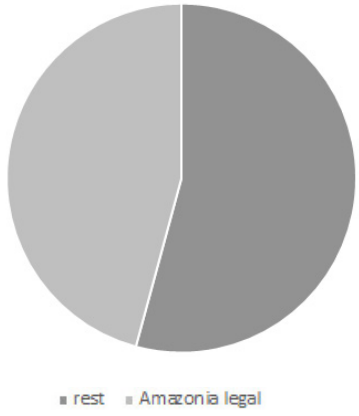
[9] Legal Amazon is a socio-political unit established by law (1.806/1953) for the purposes of state- planning and environmental protection, and it comprises the states of: Acre, Amapá, Amazonas, Mato Grosso, Pará, Roraima, Rondônia, Tocantins and parts of Maranhão.

Figure 5 – Amazonian increased production



Data source: IBGE databases

Figure 6 – Exports share legal amazon



Data source: IBGE database

Productivity in those states has a direct connection with the incorporation of more lands by the soy business. The planted area dedicated to soy cultivation has also expanded in order to accommodate for a higher soy demand. Soy producers are indeed taking over areas previously dedicated to other crops, cattle or forest. Pará is the state that has seen the largest increase in planted area between 2007 and 2017, with the area being multiplied by almost 10. Rondonia, Roraima and Tocantins have tripled the area dedicated to soy cultivation. Maranhão has doubled its soy area, while Mato Grosso witnessed an 83% increase. It is undeniable that the soy frontier is, indeed, expanding.

When attempting to collect data regarding an alleged expansion of this frontier towards the Amazon, one is faced with conflicting and passionate arguments condemning soy producers for deforestation or defending the business by relating this soy expansion to the claiming of formerly degraded pasture land, not forest. In order to design strategies to protect the socio-bio-diversity of the region, one needs to understand the phenomenon and look beyond those arguments. Previous studies carried out between 2000-2006, have already hinted at the hypothesis of "displacement deforestation" at least in the north of Mato Grosso, where soy plantation was replacing cattle ranching and this last was being indirectly pushed further north, causing for deforestation (Barona et al. 2010).

Accordingly, as a first step, this research project analyzed data that could confirm (or discredit) the argument of the soy frontier expansion and, as a second step, attempt to identify present day hotspots of soy-driven pressures. This is not merely an intellectual data crunching exercise, but an indispensable step to further on the ground research necessary to understand where and how soybean expansion may be causing environmental and socio-economic changes and the multi-layered impacts of overlapping economic activities, including soy production but also others that exert pressure at the frontier such as dams, roads, logging and mining projects (Moran 2016). Accordingly, we needed to identify the hotspots where more research attention should be turned to; therefore, this study cross referenced data from the Brazilian Institute of Geography and Statistics (IBGE)[10] and satellite data monitoring compiled by the Brazilian Deforestation Monitoring System of the Legal Amazon (Inpe-Prodes).

We focused on the impact of soy expansion in the Legal Amazon, but because we want next to observe the changes in the socio-economic profile and ways of life of people living in the areas of soy frontier expansion, we've selected the lowest possible level of analysis according to the available datasets: the municipal level. We've identified the timeframe, as already mentioned earlier in this paper, during which Chinese demand for soy boomed and the corresponding Brazilian production increased as well as the exports share to China (2007-2017). This timeframe also coincides with the implementation of the Soy Moratorium.

We've narrowed down the municipalities in the Amazon that produced soybean over this 10-year period. For the sake of comparison, we've eliminated those municipalities for which there were not at least 8 years of observations by IBGE. We have also excluded the municipalities which total areas (by square kilometers) were diverging by a margin of more than 3% between IBGE's and Prodes' databases. Finally, we have also excluded from the sample all those which had merged or been obliterated as distinct political units. The final sample comprises 136 soy producing municipalities in the states of Maranhão, Mato Grosso, Pará, Rondônia, Roraima and Tocantins.

IBGE datasets allowed us to calculate how production rates and planted areas have changed over time. For the practicalities of future fieldwork, we've decided to further single out the top 20 municipalities in terms of: (a) relative increase in soybean production, and (b) expansion of the soybean frontier (planted area) during the same 10-year period. Both lists converge almost identically, with the exception of one municipality that appears in only one of the lists. Thus, a sub-sample of 21 municipalities was finally selected: Araguacema (TO), Porto Velho (RO), Novo Progresso (PA), Serra Nova Dourada (MT), Caseara (TO), Marcelândia (MT), Peixoto de Azevedo (MT), Matupá (MT), Ulianópolis (PA), São Felix do Araguaia (MT), Paragominas (PA), Dom Eliseu (PA), Alto Boa Vista (MT), Rio Crespo (RO), Rondon do Pará (PA), Guarantã do Norte (MT), Ariquemes (RO), Colíder (MT), Rosário Oeste (MT), Nova Brasilândia (MT), Planalto da Serra (MT).

This preliminary result confirms that wherever there has been a substantial increase in soybean production, this trend has been accompanied by a parallel expansion of the planted areas. The mere correlation does not (yet) speak for a direct cause-effect impact between soy plated areas and a corresponding increase in deforestation rates; however, the data show a strong indicator of the complex pressures exerted in those key-areas. For that reason, we've also cross-referenced the Landsat data on deforestation collected by Prodes on those municipalities. Not surprisingly, all of the 21 municipalities figured amongst the top 50 in terms of percentual increase of deforested area.

[10] Instituto Brasileiro de Geografia e Estatística (IBGE). Accessed on: August 14, 2019. https://www.ibge.gov.br/.

Figure 7 – Sub-sample of municipalities

Municipality	Increase in planted area	Increase in production	Increase in deforestation (%)
Rio Crespo (RO)	629 x	732	6%
Rondon do Pará (PA)	320	384	6%
Caseara (TO)	65	72	18%
Planalto da Serra (MT)	57	61	0%
Colíder (MT)	55	58	1%
Guarantã do Norte (MT)	34	34	5%
Nova Brasilândia (MT)	32	34	1%
Porto Velho (RO)	30	38	34%
Ulianópolis (PA)	29	35	10%
Matupá (MT)	27	30	12%
Araguacema (TO)	23	30	37%
São Félix do Araguaia (MT)	21	25	8%
Serra Nova Dourada (MT)	21	21	28%
Paragominas (PA)	20	21	5%
Peixoto de Azevedo (MT)	18	20	13%
Novo Progresso (PA)	17	19	29%
Rosário Oeste (MT)	17	19	1%
Dom Eliseu (PA)	17	17	7%
Marcelândia (MT)	17	17	14%
Alto Boa Vista (MT)	16	16	6%
Ariquemes (RO)	14	18	4%

Data source: IBGE and Prodes databases

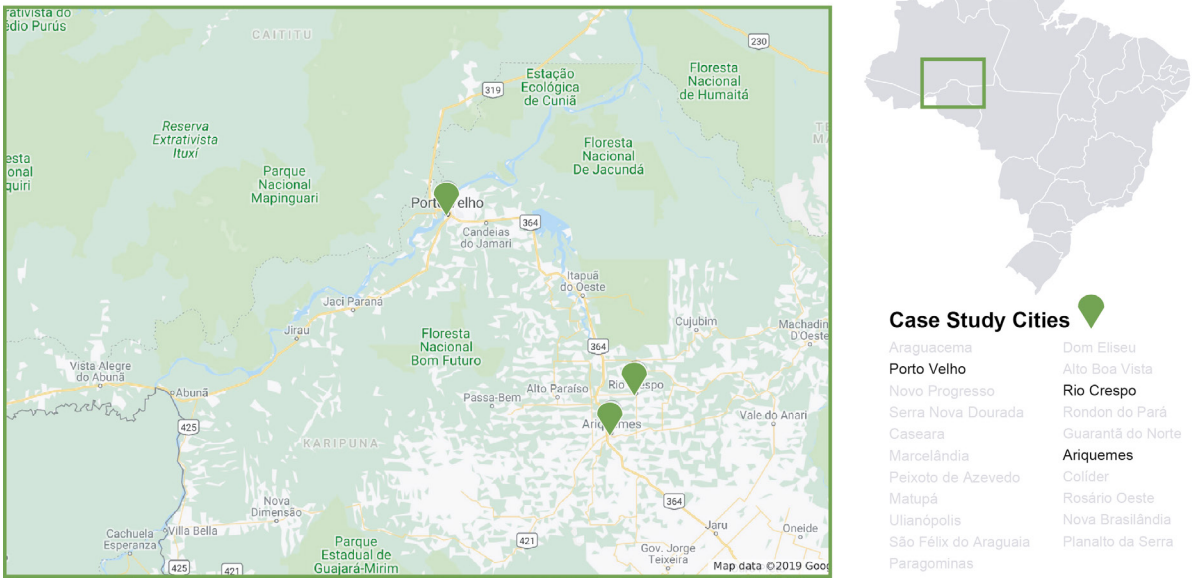
By connecting the geographical reference points that represent the selected municipalities on a map, one may observe that those areas also overlap with hotspots of the arc of deforestation and with a certain level of infrastructure provision (energy, roads, ports) which allows for better connectivity and logistical opportunities for the soybean value chain. Those connections form patterns that we have identified as the four axes of soybean frontier expansion in the Amazon: Paragominas Axis, Araguaia Axis, Upper Mato Grosso Axis, Lower Mato Grosso (see Figures 8 to 12).

In each one of those axes there is one major exporting municipality highlighted in red as a hub on the Figure below. Some of those hubs export more than they produce, suggesting that the surrounding municipalities are somehow already connected to them, through the availability of road infrastructure as shown on the Figures below. The surrounding municipalities, granted infrastructure conditions for logistics and access to credit, are the ones to be on the lookout for in terms of becoming the departure points for the further agricultural frontier expansion.

Figure 8 – Four axes of pressures caused by soycrop expansion

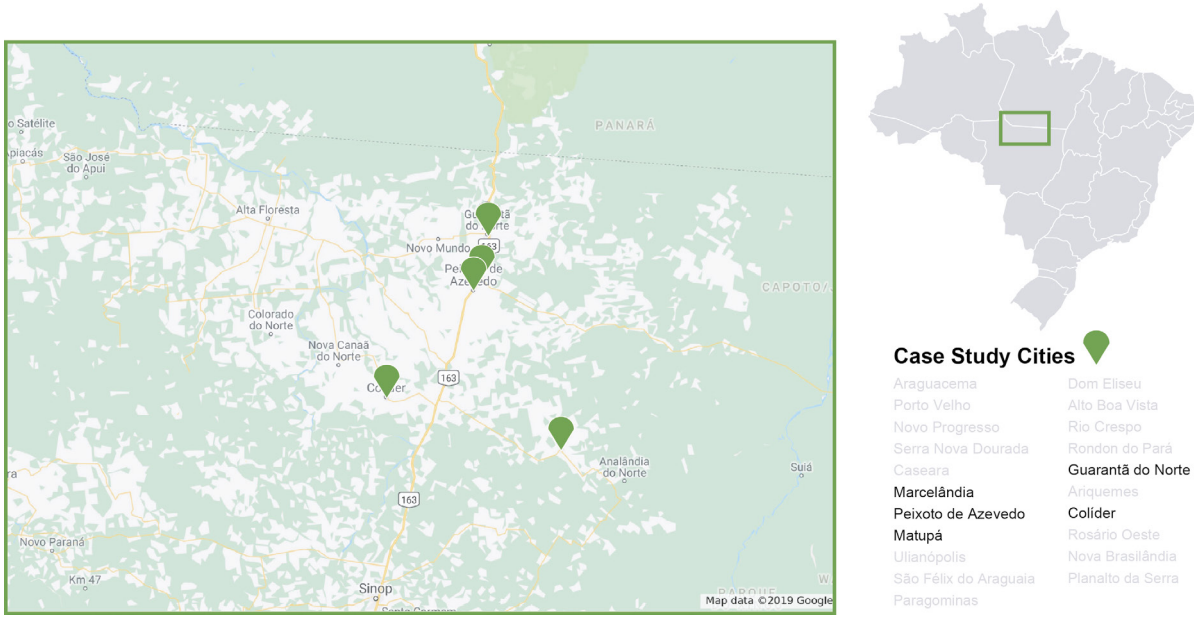
Fonte: Figura obtida no *Google maps* e tratada pela autora.

Figure 9 – Porto Velho-Ariquemes Axis



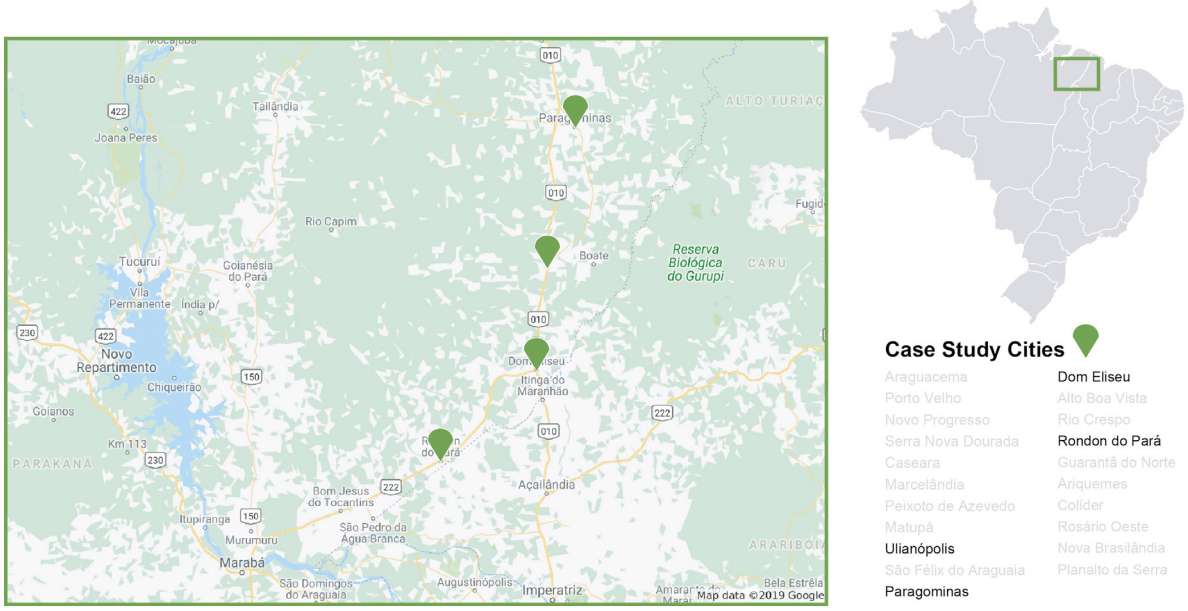
Fonte: Figura obtida no *Google maps* e tratada pela autora.

Figure 10 – Upper Mato Grosso Axis



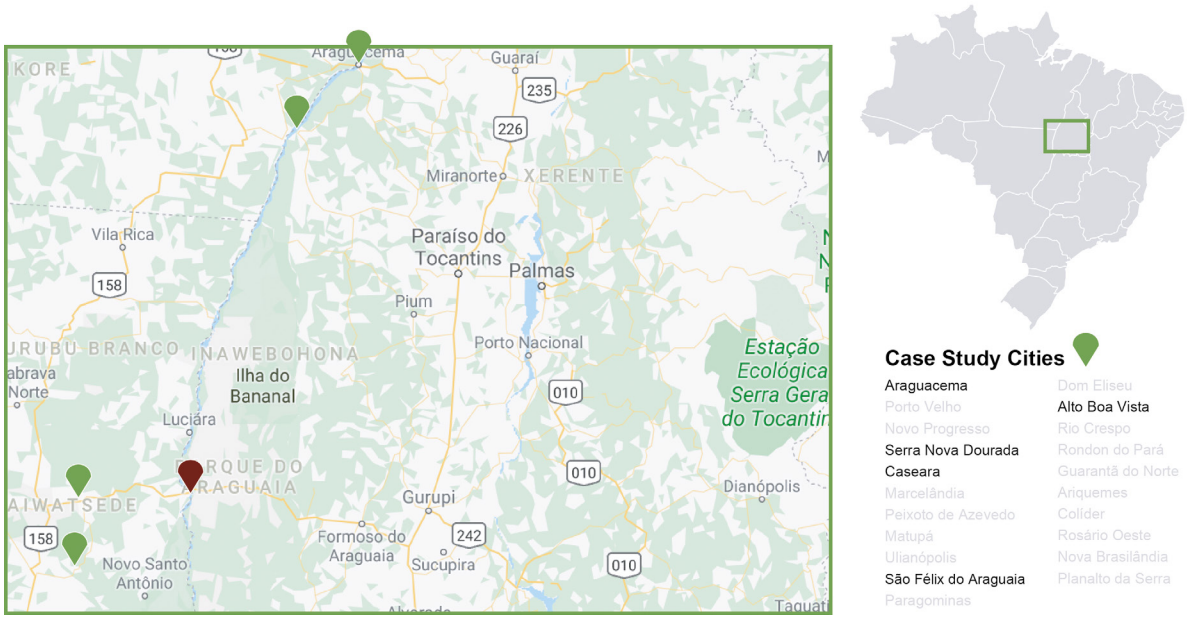
Fonte: Figura obtida no *Google maps* e tratada pela autora.

Figure 11 – Paragominas Axis



Fonte: Figura obtida no *Google maps* e tratada pela autora.

Figure 12 – Araguaia Axis



Fonte: Figura obtida no *Google maps* e tratada pela autora.

On the other hand, resisting green pockets of forest conservation surrounded by said municipalities, coincide with protected areas. Indigenous demarcated territories and areas of environmental preservation have, so far, worked as deterrents to the frontier expansion. Any revision or weakening of environmental policies and monitoring, blurring demarcation and protection shall result in permanent land cover changes and irreversible social and environmental impacts. This preliminary research conservatively establishes that even if soycrops may not be expanding directly over forest area, it is certainly (and at least) indirectly pushing the frontier forward through the displacement of other economic activities. If soy expands over former degraded pasture-lands, further investigation is needed to establish if cattle becomes a more intensive business in Brazil or if it keeps expanding over forest area, as it traditionally has. What about crop substitution? If other activities are not being pushed by the pressures caused by the expansion of the soy frontier, then what is causing for the growing rates of deforestation in the selected municipalities?

Finally, further investigation on the ground should attempt to identify what those transformations mean to the socio-economic profile of the regions under pressure and how the ways of life of the local populations are being impacted? In order to answer to those questions, we need to collect and evaluate fieldwork observations at the above mentioned four identified axes.

Conclusion

One commonly hears the argument that soybean crops have expanded over pastures and are not, at least directly, causing for the deforestation of the rainforest. Nevertheless, more than pointing fingers at farmers for deforestation, one should take into consideration the whole value chain and the pressures caused by the growing external demand for soybeans.

This preliminary study confirms that Chinese demand has indeed impacted the prices of soybean in the international market, granting external incentives to Brazilian farmers to expand their production by intensifying productivity but also by means of incorporating new land. Four axes of frontier expansion in the Amazon have been identified as driven by the growth of soybean planted areas following datasets provided by IBGE and Inpe-Prodes at the municipal level between 2007 and 2017, a period that coincides

with the Soy Moratorium timeframe. Since the Moratorium does not exclude the possibility of crop expansion over lands already cleared by other economic activities, soycrops have coincidentally expanded in municipalities where deforestation has also occurred, suggesting the hypothesis of displacement deforestation. Nevertheless, further analysis is needed to triangulate the relationship between the beef and soy industries with land use and cover change. If that is the case, even if soycrops may not be advancing over native forest, it is certainly occupying larger areas causing for additional pressures on the agricultural frontier. Displacement of related activities certainly bypasses the ideal of a zero deforestation moratorium and deviates from commitments for the conservation and recovery of the forest.

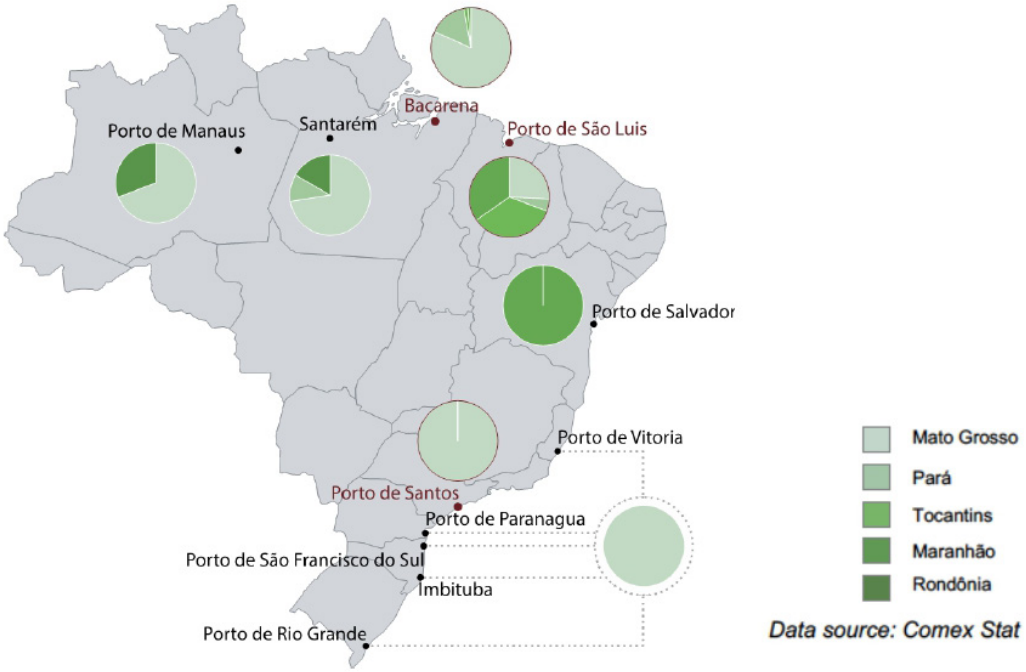
Anticipating the consequences of a potential expansion of the soy business further into Amazonian territories and taking into consideration displacement deforestation are of urgent concern given the socio-bio-diversity of this region and the role that the largest tropical forest has in self-regulating its micro-climate (50% of the regions' precipitations is evaporation from the forest itself) and influencing the climate of other regions of the continent (Salati e Vose 1984). There is a clear and delicate co-dependency between climate and vegetation cover. Rainfall patterns in the Amazon have already been impacted by the conversion of forest area into degraded pastures or soy plantations. Several studies report that the changed climate goes hand in hand with the deforestation rates. In the dryer season, an average loss of 16% in rainfall can be expected where forest is converted to pasture and 24% when converted to soy plantations (Cavalcanti 2016).

Whereas attention has been given to the impacts of deforestation on global climate change, recent studies have also started looking into the coupling between climatic events and vegetation change in the Amazon. In that vein, the abovementioned precipitation changes combined with increased deforestation may lead to more structural transformations, including vegetation change, in the region (Hutyra et al. 2005; Salazar Nobre and Oyama 2007). The scenario is one of snowball effects of deforestation impacting climate change, and this change in turn transforming vegetation which reduces the evapotranspiration of the region and so on. The impacts can go beyond the Amazon. Recently draughts in the southeast parts of the country have also been attributed to deforestation and the changing precipitation patterns in the Amazon (Fearnside 2004; Nobre 2014).

One should not forget the human dimensions of the impacts of climate change in the Amazon which especially impacts the farmers themselves (Brondizio et al. 2008). Furthermore, the economy of mechanized soybean expansion itself introduces changes to work, land access, contributing to ensuing social disputes (Assis 2010; Cabral 2013; Sauer 2013). Further research is needed to evaluate the local socio-economic and environmental consequences of this expansion, granting especial attention to the combined and overlapping impacts of infrastructure projects taking place in the Amazon (such as roads, energy plants, ports, storage facilities), many of which are of interest to the Chinese as they facilitate connections between the soybean value chain from the fields to the table.

Additionally, for future research, a crucial aspect for understanding the soy supply-chain are the routes soybeans take from Brazil to China, in particular which intermediaries deal with it in the process, the Brazilian ports it reaches, and the infrastructure available in between them. Chinese intermediary companies already operate in Brazil; Cofco International is present in 9 and Cofco Brazil in 8 out of the 21 sampled municipalities of the four identified axes. At present, most of the soy exported leave from the port of Santos carrying the production from the consolidated area of Mato Grosso. However, the production of other frontier areas are mostly leaving the country through the ports of Bacarena and Sao Luis (Figure 13).

Figure 13 – Soy exports routes per port



Fonte: Elaboração da autora com dados do portal Comex Stat.

Consistent with the Chinese national development and international strategies of improving access to commodities while creating overseas investments opportunities, the Chinese have already negotiated agreements to expand the port of Sao Luis and also discussed participation in the railroad sector.[11]Scaling down the production is unlikely to happen in the short term, considering the history of soy production in Brazil, the present day driving role of the Chinese as a mega-consumer market, trader and infrastructure investor, pushing and facilitating access to Amazonian commodities.

Regardless of the trade disputes between the Unites States and China, which fueled an increased demand for Brazilian soy during the months in which this article was being written, the Chinese long-term strategy is consistently seeking alternative routes and commercial partners to bypass dependency of any given single trade-partner. Brazil's inception into the international commercial scheme was commodity-driven. The colonial Portuguese empire sought alternative routes to the Indies in order to bypass tariff disputes in the commerce of goods dominated by tradesmen of what came to be later known as Italy. By doing so they've navigated around the African continent establishing trading posts along the way, and inaugurated modern colonial business by crossing over to the Americas to expand the frontiers of their dominium. Some say, globalization started then. International commodity prices have, ever since, dictated many of the phases of economic boom especially in the Amazon.

At present, the Chinese seek their own alternative commercial routes and embrace globalization. Commercial and physical frontiers are being expanded again towards the Amazon; how Brazil prepares for and engages with these new routes, balancing its own domestic interests and disputes, will define if History will inscribe the country as a (large) Chinese trade post or as an equal-footing partner. Informed research can help in projecting this expansion, overlapping with other infrastructure developments, assisting policy makers in preparing for expected pressures in socio-environmentally sensitive and geopolitically strategic areas such as the Amazon.

[11] Fernandes, Anaïs. 2018. Chinesa investe em porto no Maranhão e estuda ferrovias. *Folha de São Paulo*. March 19, 2018. https://www1.folha.uol.com.br/mercado/2018/03/chinesa-investe-em-porto-no-maranhao-e-estuda-ferrovias.shtml.

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