National policies vs. context-specific realities: the challenges of halting deforestation across a diverse and dynamic frontier in the Brazilian Amazon

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Abstract

A major national anti-deforestation agenda (PPCDAm) implemented in 2004 played a crucial role in the progress Brazil made towards halting forest loss in the Amazon recently. The deforestation blacklist has been praised as one innovative policy instrument in that context. By targeting monitoring and sanctioning actions at the municipality scale, the blacklist policy triggered cooperation among local actors towards collectively controlling deforestation and geocoding landholdings. Despite promising results, most municipalities remain blacklisted. My study looks at how that regional policy has interacted temporal and spatially with diverse local realities experiencing rapid transformation in the Amazon region. I draw upon a cross-sectional analysis of four case studies across a spatial gradient depicting the deforestation frontier in the state of Pará, northeastern Amazon. By using official data and satellite imagery, as well as local stakeholders' interviews, I examine how the colonization history related to the gradual frontier expansion has shaped municipalities and their ability to cope with one-size-fits-all national policies. I build upon the Ostrom's framework as a conceptual roadmap to organize and identify the context-specific attributes – biophysical, social, economic, and political – mediating local responses towards the blacklist. In a highly dynamic region, I discuss how local actions tackling the blacklist policy have interacted across municipalities, government levels, and parallel initiatives over time that have changed the incentives at stake for collective action in different places. By investigating the response to a national policy at the municipal level, this study builds upon an often-overlooked intermediated analytical scale to detail and highlight the role of local realities and actors in controlling deforestation. Finally, beyond revealing the shortcomings of one-size-fits-all policies implemented over a large and diverse region, the study adds another layer of complexity by also exploring the interaction of such policies in social-ecological systems in rapid transformation.

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Introduction

National policies and programs tackling deforestation in the Brazilian Amazon have been designed and implemented at the regional level. They often frame and define rules for either the entire biome or the geopolitical area of the Legal Amazon. That approach encompasses a vast territory (4-5 million sq.km) characterized by diverse ecosystems overlapping nine states and hundreds of municipalities (530 to 700+) home for 20+ million people.

Besides, anti-deforestation initiatives often target on-the-ground individuals associated with forest clearings. Whether farmers, colonists or companies, they usually represent the weakest chain link driving forest loss. Such strategy has had limited success in a region characterized by pervasive land tenure conflicts (reference) where 617.000+ individual landholders occupy 720.000+ sq.km (IBGE 2017 Table 6710). Only a small proportion[1] of the fines related to environmental crimes ends up collected by the Brazilian federal environmental agency (IBAMA, 2019).

Deforestation in the Amazon has oscillated driven by as many and diverse agents as by direct and indirect factors (references). That is particularly true across expanding frontiers where rapid social and ecological transformations drive high land cover change rates. In the arc of deforestation across the southern and eastern fringes of the Amazon biome, activities and actors driving deforestation have changed both spatially – across states and municipalities – and temporally since development and colonization projects were implemented in the 1960s. In that regard, social groups competing for land and resources have responded differently for particular patterns and rates of deforestation (Fearnside 2008, Godar *et al.* 2014). Large landholders, family farmers, local traditional and indigenous groups, and private companies interact and respond to incentives such as national policies depending on context-specific realities.

In such a context, one-size-fits-all national policies have failed in providing the right incentives for those multitude of agents and local realities. National policies tend to be insensitive to intraregional variability, unable to capture the role of, as well as to address the diverse set of incentives driving land use decisions that impact forestlands (Gibson *et al.* 2000). But novel initiatives have provided successful outcomes in halting deforestation worldwide (Lambin *et al.*

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[1] Payment rate totals 36% of the total number of fines (i.e., 120,012) related to flora and ecosystem crimes applied in the period between 1996-2019. That representes 30% of the total value of fines (R$26 bi) in the same period.

2014). The soybean and beef moratoria in Brazil (references) and the roundtable on sustainable palm oil (references) have narrowed their scope to control deforestation associated with particular sectors, economic activities, or critical territories. Additionally, they have designed monitoring and sanctioning rules, as well as setting commitments that target a broader set of agents embedded in deforestation-related supply chains, from companies to retailers to governments.

In the Brazilian Amazon, another innovative approach to control deforestation refers to the List of Priority Municipalities (a.k.a. blacklist policy) implemented by the Ministry of Environment in 2008. This policy instrument defines a set of criteria to both include municipalities in, as well as to remove them from the "deforestation blacklist." The blacklist policy narrows government monitoring and sanctioning initiatives from the regional scale towards a few municipalities that concentrate forest clearings. Additionally, the policy sets the deforestation blacklist removal criteria at the municipality scale, which triggers the cooperation among local stakeholders towards achieving the collective goals to exit the blacklist (reference).

The blacklist policy has been praised as a successful initiative contributing with the sharp decline in deforestation rates detected in the region recently (Assunção & Rocha 2019). But the blacklist policy has also challenged diverse municipalities and local stakeholders in complying with its uniform set of removal criteria. One decade after its implementation, only 22 out of 62 municipalities found their way out of the deforestation blacklist. In that regard, little has been investigated on how the blacklist policy has interacted with different municipalities across the deforestation frontier. More, in a markedly dynamic region, none has been examined on how municipalities and local stakeholders have coped with the blacklist policy in response to learning experiences from adjacent municipalities, new government policies, and parallel initiatives changing incentives at stake for collective action over time.

This study seeks to fill those gaps by looking at how the List of Priority Municipalities has interacted both temporal and spatially with different municipalities in a region under rapid transformation. This study builds upon case studies framing four municipalities to examine the responses towards compliance with the blacklist policy across a spatial gradient depicting the dynamic deforestation frontier. Second, it looks at how the responses from multiple agents – actors, municipalities, organizations, and local governments – have varied since the blacklist policy implementation. The comprehension of such spatial and temporal nuances, along with the factors underlying the responses emerging from diverse local realities, can inform analysts and policymakers in improving instruments and strategies to tackle the challenge of halting deforestation and governing dynamic social-ecological systems in rapid transformation.

Part 1 of this paper contextualizes the Amazonian deforestation frontier as a diverse and dynamic region in accelerated transformation. It reviews how deforestation patterns have changed over time and across the deforestation frontier, as well as novel initiatives

implemented to curb forest loss in the region recently. Following, Part 2 details the blacklist policy and reviews the studies examining it. Part 3 highlights the shortcomings in current analyses on the blacklist policy that motivate the present study and its research questions. The research design employed in this study for data collection and analysis, as well as the theoretical and conceptual background underlying the institutional analysis performed in the study is presented in Part 4. The findings of the study are presented and discussed in Part 5, following by the reflection and conclusion in Part 6.

Part 1 – Contextualization

The Brazilian Amazon: a region in rapid transformation

The Amazon basin has long attracted attention by its social-cultural and environmental attributes. As the largest continuous tropical forest, the Amazon biome is crucial for the global climate regulation and the provision of a wide array of economic goods and non-market ecosystem services supporting livelihoods from local to global scales. Local governments, however, have struggled to balance pressing social-economic demands and sustainable development in a context of accelerated changes, mirroring challenges that decision-makers have faced worldwide.

Policies inducing positive outcomes in one place may fail drastically when local settings differ (Ostrom 2005), challenging policy-makers governing diverse, dynamic, and increasingly interconnected regions. In Brazilian Amazonia, government development projects and market incentives have prompted unprecedented population growth, infrastructure development, unplanned urbanization, and agricultural expansion over the last 60 years. Those macro-scale incentives have been mediated by diverse social groups struggling for identity, land, and resources' access at the local level (Lima & Pozzobon 2005). Such an interplay has shaped the region as a complex mosaic of juxtaposed social and environmental realities (Becker 2005, Brondizio 2006) from which degradation and forest loss have been salient outcomes impacting local livelihoods and the resilience of Amazonian ecosystems.

Deforestation processes and patterns also shift over time

The Amazon biome has lost roughly 20% (780,000 sq.km) of its original forest cover by 2018 (Almeida *et al.* 2016), whereas it is estimated that logging and fires have degraded even larger areas of remaining natural forestlands (Foley *et al.* 2007, Rappaport *et al.* 2018). Recent studies have alerted the pace of forest conversion and degradation is leading the Amazon biome towards a tipping point that will drastically change its current role in supporting local livelihoods and regulating global warming and regional rainfall patterns (Nobre *et al.* 2016, Lovejoy & Nobre 2018). Similar processes have threatened tropical regions across the globe, challenging national governments to balance social-economic development and environmental sustainability, particularly in the Global South (reference).

Rather than evenly spread, some 75% of the land-cover change in the Amazon takes place in the "arc of deforestation" across its southern and eastern borders (Brasil 2004). Its emergence and shape have gone in tandem with the expansion of roadway axes to develop regional infrastructure connecting the region to national markets (Alves 2002), land reform projects to settle migrants and peasants (Smith 1982, Alston *et al.* 2000), large agricultural ventures (mainly cattle ranching) boosted by generous economic incentives (Hecht 1985), and pervasive land grabbing following the frontier expansion (Fearnside 2005).

As the region develops, so does the actors and patterns of deforestation in response to novel and changing incentives, including public policies, economic shocks, market demand, climate change, and demographic dynamics. If in the early 2000s large polygons 100+ hectares characterized most of the forest clearings in the region, the next decade has seen marked shifts in such a pattern; two in every three clearings represented polygons smaller than 50 hectares in 2009 (Rosa et al. 2012).

Hybrid mechanisms to tackle deforestation

The Forest Code is the primary legislation regulating land use and cover change in Brazil. From its original 1934 version to the most recent law enacted in 2012, the Forest Code limits forest clearings and land-use in private landholdings throughout the country. Land conversion is forbidden in permanent protection areas (APP, the Portuguese acronym) – i.e., sensitive areas in steep terrain, riverbanks, and others. Forest clearings are restricted to a certain proportion of the landholdings according to the biome; in the Amazon, native forests must be preserved in up to 80% of the rural property.

Implementing, monitoring, and enforcing ambitious command-and-control regulations are challenging. Information and state capacity to identify and monitor the processes and agents driving forest loss are crucial for the success of such regulations (reference). That is particularly difficult in a continent-sized country where 5+ million rural properties spread across seven biomes. In the Amazon, satellite monitoring systems detecting real-time deforestation started operating in 2015 only (DETER[2]). Data linking individual actors to land ownership to forest clearings have become available in the last ten years only. More, applying the legislation to ecotones (i.e., natural areas in the transition between biomes) has been particularly tricky for both landowners and state officials in the Amazon-Cerrado transition across the arc of deforestation (Marques *et al.* 2019). Last but not least, political turns restraining the ability of state agencies to operate may harm the limited state capacity to enforce legislation as it has happened in Brazil recently (reference).

In addition to command-and-control policies, novel initiatives have emerged to tackle some of the main activities driving forest loss (Lambin *et al.* 2014). The roundtable on sustainable oil

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[2] http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/deter

palm (RSOP) and the soybean and beef moratoria are pointed out as successful initiatives in tackling the expansion of palm plantations in Asia (reference) and soy and cattle in Brazil over forestlands (Nepstad et al., 2014; Barreto and Gibbs, 2015; Gibbs et al., 2015, 2016; NWF, 2016).

In Brazil, both the moratoria have successfully brought key actors to devise agreements and co-share responsibility in implementing, monitoring, and enforcing their own commitments. The beef and soybean moratoria have strategically narrowed the scope of the problem by targeting a limited set of supply chains agents driving deforestation in specific geographic areas. Instead of pursuing cattle ranchers and soybean farmers, the weaker and numerous actors of the supply chain, the beef and soybean moratoria strategically pressure a small number of powerful players – large meatpacking companies and international retailers – concerned with their institutional image. As these collective agreements develop, pressure builds from within the supply chain towards behavioural changes among participants concerned with their market share.

Differing from command-and-control initiatives relying exclusively on government enforcement, those hybrid initiatives bring together a larger set of stakeholders from both the public and private sector and the civil society. In such a context, communication barriers among decision makers tend to dissolve, reducing the distance — literal and metaphorical — between the interested parts. The participation of multiple stakeholders brings to the table players withholding privileged information whose exchange favors the implementation of rules tailored for particular contexts. Arguably, these hybrid mechanisms result in commitments developed and agreed collectively and based on detailed and reliable information. That favors the co-responsibility among those involved in supporting the tasks of collecting, disclosing and auditing information, increasing the success of such initiatives in tackling deforestation and leveraging government efforts.

Part 2 – The List of Priority Municipalities

The List of Priority Municipalities was designed by the Brazilian Ministry of Environment (MMA) in 2007 (Brasil 2007). Its implementation was part of a broader environmental program by the federal government to curb illegal deforestation and foster sustainable development in Amazonia (Brasil 2004). The innovative aspects of the blacklist policy are three. First, it shifts the focus of monitoring and enforcement efforts from the entire Amazon to a handful of municipalities. Second, it sets its compliance criteria at the municipality level. That prompts vertical decentralization among government levels towards controlling deforestation, and fosters horizontal co-responsibility at the municipality level by requiring both collective and individual actions among local stakeholders (Mello & Artaxo 2017). Finally, the blacklist policy facilitates law enforcement by mandating farmers to geocode landholdings in a public registry,

linking land tenure to agents' identity. Getting out of the deforestation blacklist requires the municipality to keep deforestation rates below 40 sq.km.yr^{-1} and geocode and register at least 80% of the territory privately owned in a public cadaster.

Impacts on blacklisted municipalities

Monitoring efforts centered on a few municipalities allowed the government to raid stronger police operations in the region (Silva 2010). Farmers were sanctioned and farms and facilities engaged in illegal activities were embargoed (Ortiz 2014). The coordinated police operations had strong impacts over a substantial number of individuals and organizations associated with the timber and charcoal activities and agriculture, mainly cattle ranching (Arima *et al.* 2014, Assunção & Rocha 2014).

Besides, the strategy of "naming and shaming" damaged the reputation of blacklisted municipalities (Cisneros *et al.* 2015). Additionally, geocoding farms became mandatory for farmers contracting public agricultural loans (Banco Central do Brasil 2008) and receiving the environmental license for their agricultural activities (MT Legal; Pará?). In a region marked by pervasive land tenure conflicts, geocoding became an obstacle to contract credit loans, further complicating local agricultural activities [highly] dependent on federal credits (reference). These cumulative issues had cascading effects in some municipalities, impacting local economies, increasing unemployment rates, and resulting in violent outcries (Anon 2008, Marconato & Queiroz 2012, Zwick & Calderon 2016).

Responses emerging from the deforestation blacklist

At the regional scale, econometric models have confirmed the role played by the blacklist policy in curbing deforestation among blacklisted municipalities (Arima *et al.* 2014, Assunção & Rocha 2014, Cisneros *et al.* 2015, Sills *et al.* 2015). However, the channels by which that outcome was achieved remain unclear. The ability local stakeholders have to organize themselves towards complying with the blacklist removal criteria may represent a more prominent factor, which in turn may relate to context-specific attributes of the municipalities (Cisneros *et al.* 2015).

In addition to aggregate analyses at the regional scale, case studies have revealed the effect the blacklist policy had at the scale of individual municipalities (Viana *et al.* 2012, 2016, Neves *et al.* 2016). In Paragominas, the emergence of a "novel multi-partner governance arrangement" (Viana *et al.* 2012, 2016) resulted in the first municipality removed from the blacklist in 2010 (Brooks 2011, Zwick & Calderon 2016).

Part 3 – Research questions

Shortcomings in current analyses

Studies at the regional level have been unable to reveal the incentives triggered by the blacklist policy towards deforestation control and farms' geocoding at the local level. Affirming that "blacklisted districts have experienced distinctly larger reductions in deforestation than

comparable non-listed districts" (Cisneros *et al.* 2015, p.2) reveals little about responses arising from different realities. Rules producing incentives leading to productive outcomes in one setting may fail drastically when local realities differ (Ostrom 2005).

In spite of the blacklist policy success at the aggregated level, only one in every three municipalities has complied with it by 2018. And beyond the detailed analysis on what happened in Paragominas, studies examining additional municipalities have not tackled the factors explaining the success or failure of their initiatives (reference). The lack of additional case studies systematically examining the reaction of stakeholders in context-specific realities hinders analysts to learn from how the policy is mediated on the ground.

This is important because as Gibson *et al.* (2000, p.3) advise, the role of local agents and institutions "lay at the heart of explanations of forest use and condition." Becker (2005) also reminds that local actors and governments at the state and municipal levels in the Amazon have assumed an increasing role in the process of setting the directions and strategies driving land use and cover change in the region. It is the struggle for land, identity, resources' access, labor, government support, and economic profit among different actors which defines the institutional arrangements among them and, therefore, their ability to cope with social dilemmas such as that imposed by the deforestation blacklist.

Research rationale

Because the blacklist policy removal criteria are set at the municipality level, actions taken individually by farmers and other stakeholders do not suffice to overcome their collective dilemma. Uncoordinated action among local actors replacing forests by alternative land-uses makes everyone worse off. Landholders are required to both reduce and coordinate forest clearings, besides agreeing in geocoding and providing sensitive information about their farms – a contentious issue across deforestation frontiers where land tenure is unclear and compliance with environmental laws are not the rule. Moreover, decision-makers and governmental agencies must collaborate to support monitoring activities, besides providing required technology and information to allow landholdings' registry – a task eventually requiring the expertise and support from third-party actors. Finally, those activities demand financial resources. Arguably, some scholars state the deforestation blacklist demands the emergence of bottom-up, collective institutional arrangements among various stakeholders in each municipality as a requisite to exit the blacklist (Nepstad 2017).

But the emergence of collective action is also challenging (Ostrom et al.). [expand on the topic to present the challenges imposed by the diversity of local stakeholders (migrants, peasants, ranchers, family farmers, riverine and indigenous groups), their patterns of interaction, power relationship, and other factors affecting trust among those required to cooperate]

Besides, some municipalities may find it more difficult to achieve the blacklist removal criteria because of contextual factors. Since the blacklist policy removal criteria are uniform,

characteristics such as the size of the municipality and its population; the number and area of farms; the remaining area of forest cover; road accessibility (for market connection, police enforcement, and vacant land and timber stocks); the economic dependence of the municipality on forest-related (logging and charcoal) or predatory agricultural activities (extensive cattle ranching), and the lack of political will may prevent or make it harder for some places to find its way out of the blacklist. Those are contextual factors shaped by the colonization history which is linked to the advance of the deforestation frontier in the region.

In addition to the spatial dimension related to the expanding frontier, the rapid regional transformation adds a temporal layer to the puzzle. As local realities change following the natural cycles of expansion and consolidation of the frontier, so do the agents that evolve and adapt to learning experiences and new rules or incentives. An integrated analysis considering the effect of the blacklist policy across different realities both in space and time, therefore, may provide useful information for decision-makers on the processes and responses the anti-deforestation policies can trigger at the mesoscale (i.e., municipalities), complementing both aggregated data from regional studies and more disaggregated information from local analysis.

Research questions

In the context exposed above, this study aims at answering the two following questions:

- How do local municipal realities across a gradient of the expanding deforestation frontier in the Brazilian Amazon affect the responses of municipalities and local actors to the blacklist policy?
- How does the accelerated pace of changes in the region affect the response of diverse municipalities and actors to the blacklist policy?

Part 4 – Research Design

Analytical framework for comparative analysis

The blacklist policy impact may "differ substantially depending on the ability of local stakeholders to organize themselves towards the goal of being removed from a blacklist" (Cisneros *et al.* 2015, p.2). Identifying what triggered the emergence of institutional arrangements as a response to the deforestation blacklist is necessary to understand the different outcomes this policy had at the local scale.

Scholars from the Ostrom Workshop have developed evolving frameworks to guide analysts in understanding how individuals behave and interact to make decisions in specific contexts. The "value of a framework rests in its ability to describe and diagnose the factors that contribute to outcomes in complex socio-ecological systems" (Cole *et al.* 2014, p.11), guiding the systematic collection and analysis of data that favors "the aggregation of knowledge and the generalization of research findings" (Imperial & Yandle 2005, p.501).

Frameworks have been employed in diverse endeavors to (i) improve comparability across socio-ecological system case studies, (ii) ensure the review of key variables influencing particular outcomes, and (iii) provide a basis for establishing causal relationships between observable variables and outcomes (Ostrom 1990, 2011). This paper builds upon the combined IAD-SES framework (Cole *et al.* 2019) to investigate how local stakeholders in each municipality were affected by the blacklist policy and, embedded in particular local realities characterizing each municipality, reacted and responded to that policy producing outcomes as related to the control of deforestation and the geocoding of farms (Figure 1).

Figure 1. Conceptual IAD-SES framework structuring the rationale applied to this study.
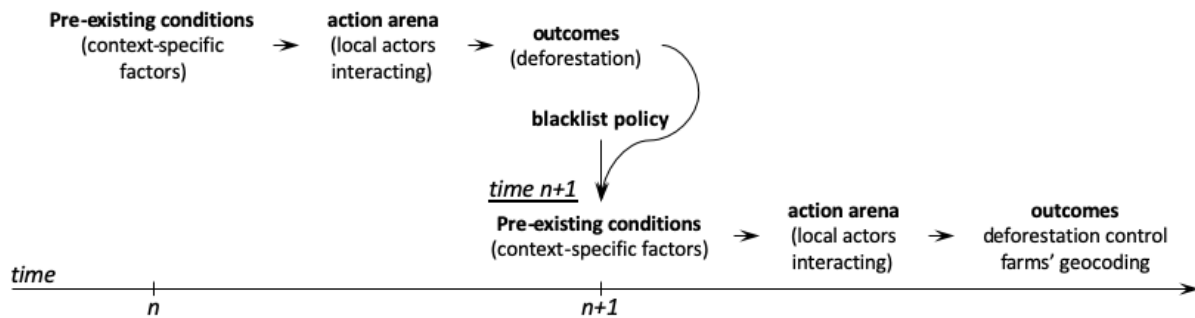
The combined IAD-SES framework focuses their attention to the action arena in which individuals in a given context interact (i.e., the municipality). Ostrom (2005) details the structure of action arenas highlighting the importance to identify the set of participants and their ability to influence one another (e.g., the power relation at stake, the information they bring to the table, the pattern of interactions). As the main focus of analysis, action arenas may be examined either as affected by pre-existing conditions that "structures" the action arena, or as a set of nested action arenas across vertical levels of governance (e.g., federal, state, and municipal levels). The schematic representation depicting the set of links and context-specific factors (pre-existing conditions) across interconnected spatial scales as related to the response of municipalities to the deforestation blacklist is presented in Figure 2.

Figure 2. Schematic representation depicting the set of links and context-specific factors (pre-existing conditions) across interconnected spatial scales as related to the response of municipalities to the deforestation blacklist.
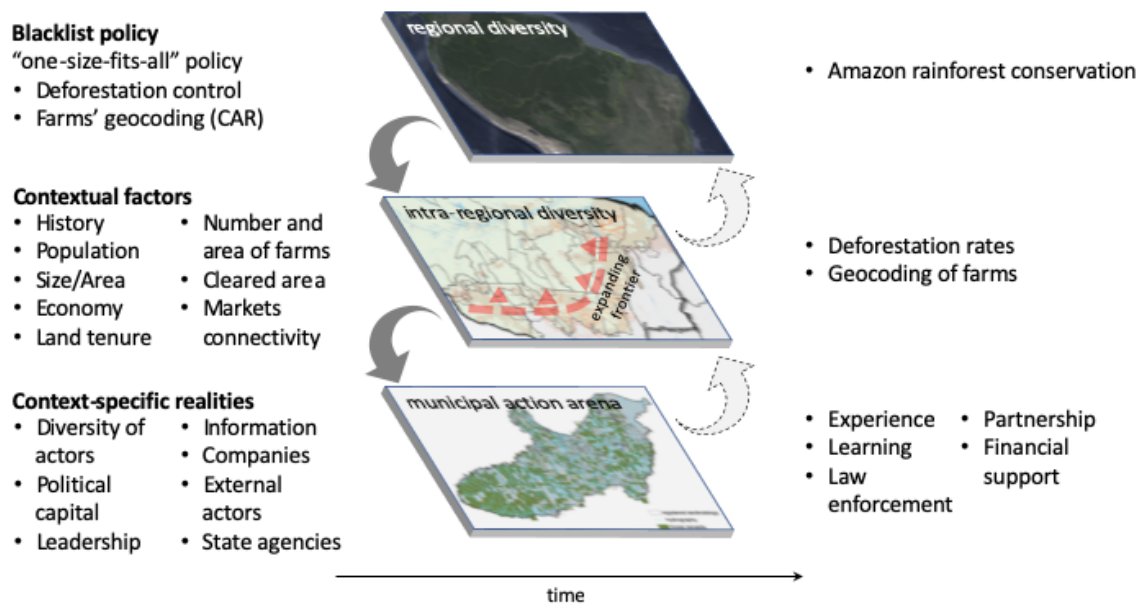
Study areas

This study employs a cross-sectional analysis to examine the responses to the blacklist policy from case-studies framing four municipalities northeastern in the state of Pará. The municipalities of Paragominas, Tailândia, Moju, and Portel (Figure 3) are geographically located across a gradient that illustrates the expanding deforestation frontier in the arc of deforestation and the diversity of colonization histories that have both shaped the Amazon as a mosaic of various social and environmental realities.
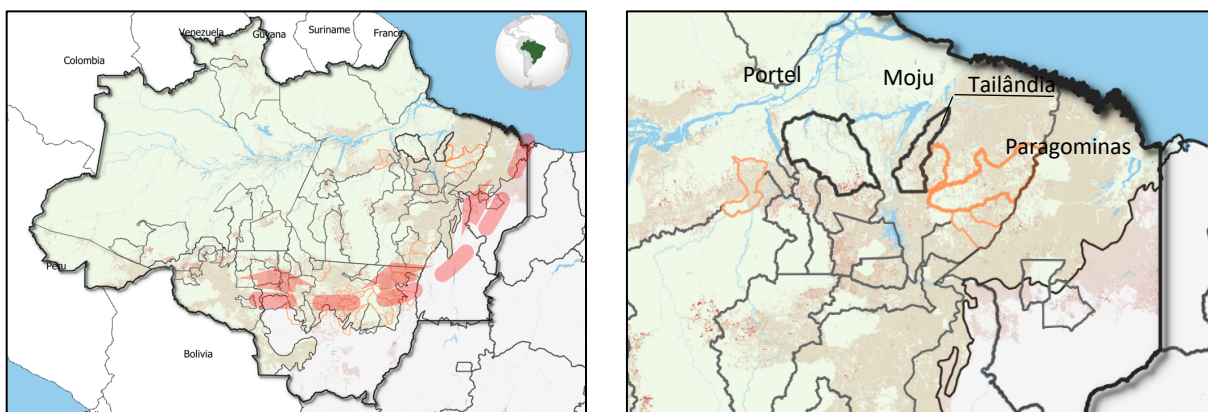
Figure 3. The 62 municipalities included in the MMA deforestation blacklist policy from 2008-2018. The map depicts the social-political boundary of the Legal Amazon (shadowed black line), the ecological zone of the Amazon biome (green color in the background), the area deforested by 2018 (reddish tones), the "arc of deforestation" (dashed red line), the 22 municipalities removed from the MMA blacklist (green polygons) and the 40 municipalities that remain blacklisted (black polygons), as well as the four case studies.

From Paragominas to Portel, municipalities are markedly distinct whether interconnected by roadways or rivers; populated by migrants or traditional riverine populations; economic-dependent on agricultural commodities or traditional extractive and agricultural activities, and so forth. Besides, these municipalities were included in the deforestation blacklist in different periods – Paragominas in 2008, Tailândia in 2009, Moju in 2011, and Portel in 2017. And whereas Paragominas and Tailândia were removed from the blacklist in 2010 and 2013, respectively, Moju and Portel remain.

Data collection and interviews

Official data for the 530 municipalities overlapping the Amazon biome were acquired from government database and organized in a dataset containing information on different attributes. These attributes refer to land cover change (annual deforestation rates), accessibility (roads length), demography (population census), land inequality (land ownership), agricultural production (cattle ranching and crops production), among others. [ongoing analysis; include a table summarizing the data collected]

In addition to secondary data, this study draws on two fieldwork campaigns carried out during May and June 2016, and from December 2017 to May 2018. In addition to the 3-4 weeks field trip to each municipality, I also collected data in Belém (the state's capital) and an additional municipality (Ulianópolis) whose territory was emancipated from Paragominas in 1991. In each municipality, I conducted semi-structured interviews with a broad set of actors, totaling 150+ interviewees. They included government officials and extensionists, practitioners, and researchers involved with initiatives linked to the blacklist policy in the state of Pará and the four case studies. In each municipality, I also conducted interviews with bank managers, priests, local traders, as well as with the directors of unions and cooperatives, local community leaders, ranchers, charcoal producers, farmers, and peasants.

I used two complementary strategies to sample and recruit research subjects. First, I examined both the scholarly literature and the media news to identify organizations and agents pointed out as key actors involved in initiatives related to the blacklist policy. That directed me to Belém, where I visited the headquarters of government agencies, nonprofit organizations, and research centers. Besides meeting state officials and practitioners, those were opportunities to collect official documents and additional information (those not told in official documents and the press coverage). Last, following the snowball sampling strategy, those were occasions from which I started mapping out and identifying new participants and organizations to broaden my research sample, particularly at the municipality level. I followed the same strategy in each municipality, first visiting local government agencies and then expanding my sampling based on information gathered from those interviews.

I defined a different strategy for sampling farmers and other agents in rural areas. Besides relying on information gathered during interviews in the town, I also built upon the annual deforestation data to identify areas in the municipality deforested over different time-periods. In that regard, I stratified my sampling visited farms located in regions presenting different deforestation history. The goal was to learn on the historical and current processes of local land cover change, land concentration, and perceptions on the blacklist policy.

Data analysis [incomplete]

- Secondary data used in clustering analysis to spatially group "similar" municipalities across the region
- Process tracing(?): interviews' coding coupled with secondary data to track what happened in each municipality and derive my narrative and findings

Part 5 – Results and Discussion

### The expanding deforestation frontier shaping local realities

The Brazilian Amazon was mistakenly considered a homogeneous, isolated, and demographically empty region around the 1960s when government incentives and programs triggered significant structural changes in the region. Infrastructure projects such as roadways expansion have shifted historical transportation axes from rivers to roadways. Along with communication improvements, those changes have expanded the local circulation of goods, information, and people across the Amazon, as well as the regional connection and articulation with faraway places.

Financial incentives boosted agricultural and industrial endeavors as opposed to traditional extractive activities, and colonization projects surrounding developing infrastructure (roadways, mining, and energy) reconfigured patterns of territorial occupation. These changes attracted waves of migrants, gave rise to large and often unplanned urban centers, and resulted in varied patterns of socioeconomic, political, and territorial organization (Becker 2005).

Along with those structural changes, alternative land uses have replaced natural forestlands at varying degrees and pace, particularly in the "arc of deforestation" zone characterizing the agricultural frontier in the region. The outcome has been the emergence of contrasting realities among those municipalities located in older and consolidated regions vis-a-vis those located in the fringes of the frontier (Rodrigues *et al.* 2009). In a relatively short time-period (50yrs), these historical conditions have shaped the 530 municipalities in the Amazon biome. They differ sharply in terms of land tenure, political organization, economic basis, market connectivity, diversity of social groups, social capital, and development (Figure 4).

[expand on this?]

Figure 4. Municipalities (n=530) in the Amazon biome grouped (hierarchical clustering on principal components) according to local attributes. Whereas Paragominas, Tailândia, and Moju group belong to the group of municipalities characterizing the expanding frontier in the region, Portel still holds characteristics of municipalities in pre-frontiers conditions.
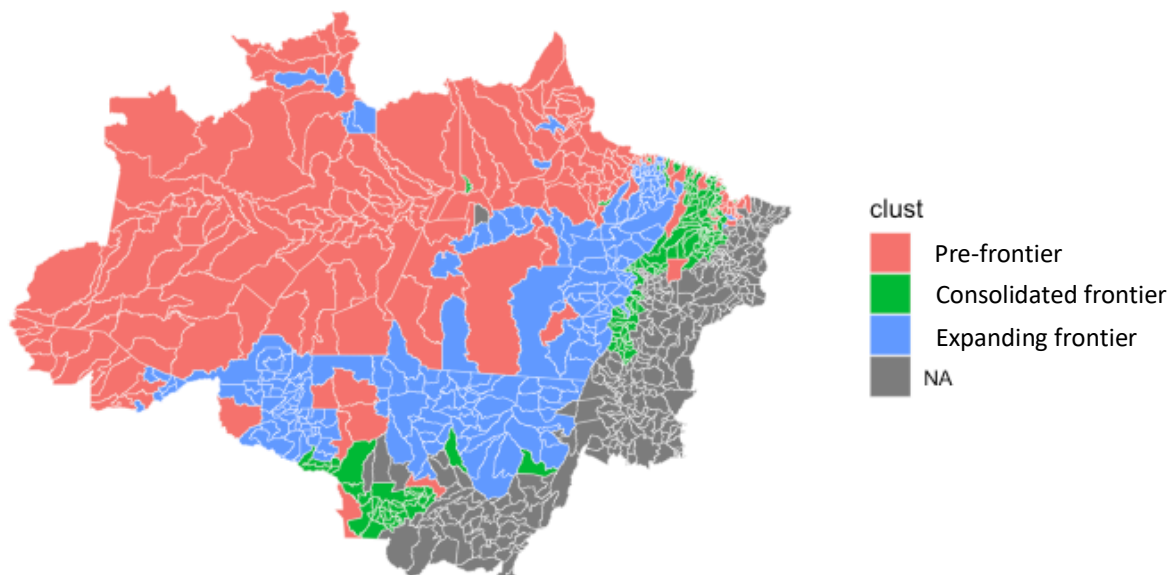
Local attributes relate to land inequality (Gini index on land tenure), road density (km/sq.km), recent deforestation activity (% of original forest cover loss between 2004-2008), remaining forest cover (% of original forest cover loss), migration (% of migrants 40+ age), and year of municipality installation.

That is also true to blacklisted municipalities (Table 1) that exemplify the heterogeneity of biophysical, economic, and demographic attributes of municipalities impacted by the blacklist policy. [prepare a graph – boxplot – to show the variation of the data for each variable used in the cluster analysis]

Table 1. [transpose the table and include other variables as employed in the cluster analysis] Local attributes characterizing the intra-regional variability in Paragominas, Tailândia, Moju, and Portel.

Municipality	Population[1]	GDP (R$1.000)	Area (sq.km)[1]	Protected areas (sq.km)[2]	Land distribution (Gini index)	N. farms	Average farm area (ha)	% territory cleared
Paragominas	95.479	937.220	19.342	418.976	0.67	436	1.316	43.6
Tailândia	69.581	313.598	4.430	93.863	0.79	212	489	47.4
Moju	67.195	326.040	9.094	56.431	0.66	3.633	49	44.8
Portel	47.967	213.380	25.385	11.568	0.71	1.317	91	0.06

1IBGE census; 2IBGE; 3PRODES/IBGE; 4PPM/IBGE;

From going black to getting green: how long does it take to get out of the deforestation blacklist?

In the period between 2008 and 2018, 62 municipalities[3] have been included in the deforestation blacklist by the Ministry of Environment. By 2018, 22 municipalities successfully managed to comply with the removal criteria, thus receiving the "green stamp" and transferred to the list of municipalities with deforestation under control. The average time required for those 22 municipalities to get out of the blacklist was 6 years – ranging from 2-10 years (Figure 5).

Figure 5. Timeline indicating the years in which municipalities were included in and removed from the deforestation blacklist. Red circles indicate the number of municipalities included in the blacklist in a given year; green circles indicate the number of municipalities removed from the blacklist in a given year; and the black lines indicate the municipalities removed from the blacklist with the time when they were blacklisted.
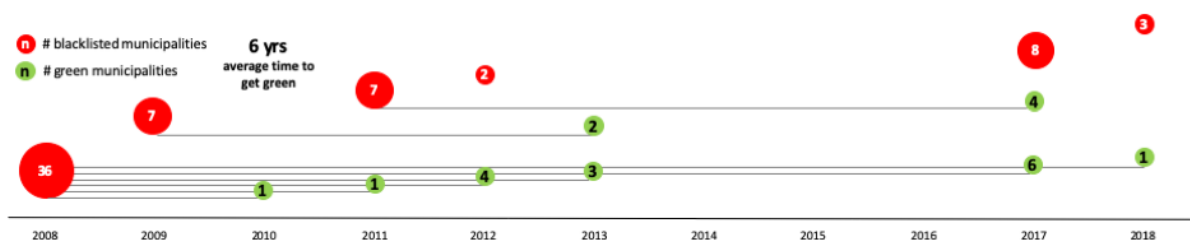

Data on the two main requirements to remove municipalities from the blacklist – i.e., deforestation control and farms' geocoding – indicate that controlling deforestation has been the most challenging goal. By 2017, 30 of the blacklisted municipalities were still struggling to implement practical actions towards managing annual rates of forest loss. On the other hand, just a handful (five) of those municipalities were struggling to geocode farms (Figure 6). In that regard, however, data on farms' geocoding has been criticized by the lack of verification by the state. Since the information provided by landholders is self-declaratory and the system storing that information has been improved continuously, little is known on the reliability of the data provided by farmers (note 1 in Figure 6).

Indeed, it is surprising that most municipalities have geocoded most of the area privately owned in their territories. That is a task whose completion may vary greatly depending on the area of and accessibility in the territory (whether by roads or rivers), the number and diversity of farms and farmers (whether small or large landholdings), the state capacity (personnel, technical, financial) to perform the activities, the cohesion among local stakeholders (willing to register or not their properties), and the partnerships with and support received from other state agencies and organizations.

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[3] In 2018, the municipality of Marcelândia (Mato Grosso state) returned to the deforestation blacklist. The municipality had been originally removed from the blacklist in 2013 following its inclusion in 2008. A new criterion predicts the return of municipalities to the blacklist once annual rates of forest loss surpass 40 sq.km (Brasil 2018).

Figure 6. Status of all municipalities affected by the Ministry of Environment List of Priority Municipalities as related to the two main criteria to exit the deforestation blacklist in the Brazilian Amazon (green shaded area). [indicate the four case studies in the graph]

compliance of municipalities with the MMA deforestation blacklist
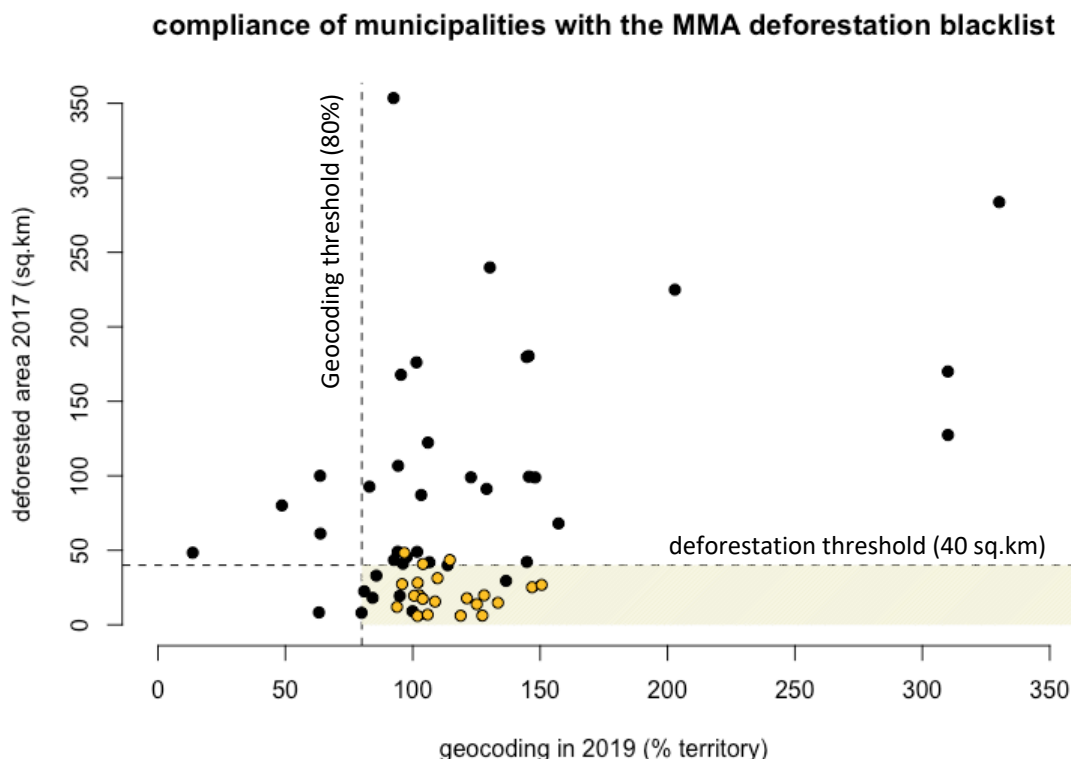
Note 1 – The percentage of the territory geocoded may exceed the total area of the municipality (values > 100% in axis X), revealing the government failure in analyzing the farms geocoded by local actors.

Note 2 – Some municipalities remain blacklisted is spite of having complied with the two removal criteria. Another criterium to remove a municipality from the blacklist requires annual deforestation rates to remain below a specific threshold for the last four years. This criterium has changed annually.

The spatial dimension

The expanding deforestation frontiers and the colonization processes

Understanding what has followed in the four municipalities framed in this study has been intrinsically tied to the pre-existing conditions of the municipality. Those conditions, in turn, have been shaped by the particular history of each municipality following the gradual advance of the deforestation and agricultural frontiers in the region.

Paragominas is an emblematic case characterizing the initial expansion of the frontier in the region. The town that emerged in 1965 developed along the highway (BR-010) created in 1960 to connect Brasília (the recently created capital of Brazil) to Belém (the capital of Pará) – exemplifying the strategy adopted by the government revolving around the infrastructure expansion to integrate the northern region back in the 1960s (Schmink & Wood 1992). Federal programs also attracted migrants through colonization schemes and financial incentives for

agricultural development along the new roadways (Moran 1993), and tax incentives sponsored and supported the conversion of natural forests into pasturelands (Browder 1988).

A similar pathway characterized Tailândia following the gradual advance of the frontier towards the west. Officially installed in the mid-1970s, the first wave of colonists arrived in Tailândia through the roadway opened to connect Belém and the construction site of the Tucuruí hydroelectric dam. Whereas the official colonization schemes failed to distribute lands and organize the settlement of pioneers and colonists arriving in Paragominas, the state agency (ITERPA, the Portuguese acronym) running colonization projects organized, distributed, and granted the first land titles in Tailândia. Small colonists were settled in smaller pieces of land (50 hectares) along the roadway whereas larger areas (500 hectares) were distributed to firms and individuals that never stepped into the region.

Contrary to Paragominas and Tailândia, the first groups of people settling in Moju had done so along the Moju river since the XV century – not to mention indigenous groups still living in the area. In the 1970s, the same roadway connecting Belém and the Tucuruí dam opened up new lands in areas distant from the river in Moju. Similarly, Portel has emerged along one of the many rivers that run into the Amazon delta. The colonization of its territory by traditional riverine families dates back the XVI century. Located in the northern region of Pará, Portel was never reached by government infrastructure projects integrating it to regional markets.

The consolidation of economic activities across the frontier

A severe economic crisis in Brazil by the end of the 1970s refrained the federal government from supporting the planned agricultural (cattle ranching) and infrastructure expansion that had driven the Amazon "integration" (Verissimo *et al.* 1992). At the same time, the collapse of the timber industry in southern Brazil prompted the movement of loggers towards novel frontiers in the Amazon. In Paragominas, logging activities replaced the role of federal agricultural credits to become the primary financial source sustaining the expansion of cattle ranching – the central economic business and the primary driver of deforestation.

The win-win game worked out: timber harvested in forests paved the way for new pasturelands while providing ranchers with money to continue their activity. The timber industry flourished and, early in the 1990s, Paragominas had the largest cattle herd in the state of Pará and became the largest timber producer in Brazil (Verissimo *et al.* 1992). For reasons that include the lack of financial and technical support for colonists, biophysical factors constraining agricultural production, and poor infrastructure and lack of connection to markets, predatory and unsustainable forest-based economic activities moved inwards and consolidated in Tailândia. In the 1980s, sawmills also represented the primary economic activity in Tailândia where the timber industry played a crucial role in constructing new roads – many times requested by colonists isolated in remote lots – and squatting lands throughout the territory.

Whether prompted by the construction of roads or the natural access by rivers, the timber industry has pervaded and played a crucial role in the region harboring the largest tropical forest worldwide. Located in the delta region, Portel's local economy has also revolved around extractive forest activities (timber and non-timber products) – along with traditional familiar agriculture. The fluvial accessibility, in that regard, facilitated the arrival and establishment of the timber industry early on in the region, where industrial timber harvesting has played a substantial role since the 1950s when an American company (Amacol) installed the first industrial sawmill in Portel. Some two thousand direct jobs were generated by the company in its golden days (interviewee X). By the 1990s, the ten sawmills installed in Portel responded for most jobs and the money circulating in town.

Although the timber industry had also stepped in Moju, the favorable climate conditions, river accessibility, and the proximity to Belém favored the arrival of oil palm and coconut companies in the mid-1980s. That industry has held a central role in the local economy still today, employing [the proportion of the workforce] in Moju. Many of the households in Moju – represented by diverse social groups including indigenous and Afro-descendant people, traditional riverine families, and small colonists settled in agrarian reform projects – whose livelihoods are linked to extractive activities and traditional agricultural practices rely on the formal jobs in the oil palm industry.

The boom-and-bust process across the expanding frontiers shaping local realities

The colonization histories of Paragominas and Tailândia were closely shaped by the expansion of the frontier relying on the predatory use of forests and the depletion of soils by cattle ranching, whereas in Moju the oil palm companies replaced large swatches of forests by palm monocultures. That resulted in the loss of some 45% of the original forest cover in those municipalities by 2008. A completely different picture is observed in Portel, a municipality located in the fringes of the frontier. The lowlands characterizing the Amazon delta topography, as well as the thousands of small rivers cutting its territory, have dictated the patterns of occupation and land uses in Portel, limiting the emergence of large human settlements and the conversion of big swathes of forests to alternative land-uses. In a context in which the local economy has been historically based on extractive forest products and familiar agriculture, forestlands remain the predominant land cover in Portel (Table 1).

Beyond the biophysical changes in the landscape, the activities underpinning the local development in these municipalities have left a trail of instability and violence associated with land conflicts and social inequality (Schmink & Wood 1992), political disputes, and economic dependency on predatory activities. Paragominas, in that regard, became nationally known by the shameful epithets of *Paragobalas* (*balas* = bullets), *Paragolama* (*lama* = mud, a reference to the bad conditions of unpaved roads in town during rainfall seasons), or *Parapoeira* (*poeira* =

dust, a reference to the air pollution caused by sawmills and trucks' circulation in unpaved roads during dry seasons in town). In Tailândia, the household turnover in the first lots titled to small farmers gradually took place and resulted in land concentration by capitalized ranchers. Small colonists pushed inwards the territory in that process started grabbing vacant lands, and the unplanned way in which the territory was colonized is in the roots of land conflicts that characterize the region still today. In Moju and Portel, the installation of oil palm and coconut industries and sawmill companies, respectively, revolved around the control of large areas of the territory taken from local families, also a source of persistent, unresolved land conflicts and disputes.

The boom-and-bust development across the frontier has marked the local realities in contrasting ways, and the resolution of economic, political, social, and environmental problems is a legacy that may persist for many decades. It took more than 40 years for Paragominas to transition into a consolidated municipality enjoying a strong political capital, economic stability, and social organization. In there, the same political group has been in office representing the interests of ranchers, farmers, and the timber industry since 1997. The previous mayors of Paragominas in that period include former directors or founders of the farmers' and loggers' unions, as well as state representatives often enjoying prestige among higher ranks of the state and federal governments. These political actors are those who started the transitioning process towards diversifying the local economy after the first signals of collapse in the timber and cattle ranching activities in the 1990s. The consolidation and gradual expansion of croplands (mainly soybean and maize), the attraction of mining companies, and the installation of timber facilities processing timber from forest plantations exemplify the dynamism and diversification of the economy that has happened in Paragominas. The same has not happened in every place. Although the golden period of the timber industry had come to an end in Tailândia early in the 2000s, Tailândia's local economy still relied on illegal activities associated with timber harvesting and charcoal production (demanded by steelwork facilities) until recently.

In Moju, diverse local agents split among associations grouping Afro-descendants population and unions defending either the interests of agricultural family farmers or those of workers of palm oil and coconut industries – sometimes defending conflicting agendas. In that regard, Moju lacks a political cohesion and social organization steering the diverse social groups settled in the territory. For reasons that go beyond the scope of this study, social organizations in the region have struggled to keep their activities running to defend their members' interests, and trust in these organizations has faded away in many places as fieldwork interviews indicate.

Reflecting the lack of cohesion in Moju, the political arena has been marked by a historical dispute between a handful of local families whose goal is to defeat each other. The alternate of power among groups pursuing individual interests rather than a collective one has undermined the advance of programs that benefit the municipality as a whole. In that regard, contrary to

what was observed in Paragominas and Tailândia, political willingness to cope with the deforestation blacklist has found no fertile ground to emerge.

In Portel, the gradual depletion of timber stocks and the rise and consolidation of environmental awareness in the 1990s that put the Amazon on the spot had hindered the business-as-usual model with which the timber industry had historically operated. The growing demand for forest management plans, forest certification, environmental licensing, as well as the enforcement of workers security legislation, summed up with the need to harvest timber in areas far away from the industries, made the operation of industries unfeasible.

In that context, the political and economic elite in Portel that emerged in tandem with the timber industry has more recently moved towards activities related to mining ventures (fluvial sand) and the interregional trading of local extractive goods (açaí fruit and manioc). Local social organizations, on the other hand, have initially emerged to the defend the workers in matters related to the timber industry in the 1980s. More recently, however, diverse associations representing hundreds of traditional riverine communities and villages scattered across Portel have emerged to fight for their land rights over territories they have historically occupied.

The varying responses emerging from municipalities towards the blacklist policy

In February 2008, Tailândia became the first Amazonian town targeted by the joint police operations (*Operação Arco de Fogo*) raided by the federal and state governments to fight illegal activities associated with deforestation in Amazonia – even though Tailândia was not included in the first MMA blacklist disclosed in 2008 (Figure 7). The police operations shut down sawmills and destroyed charcoal production facilities. Besides disrupting the illegal economy associated with those activities, the dark side of those police operations included high rates of unemployment, public outcries, and an economic crisis (Phillips 2009). The inclusion of Tailândia in the deforestation blacklist one year later, in that context, had only a marginal impact on the municipality compared to the outcomes of the police operations in the year before (Phillips 2009). Given the novelty of the policy, the uncertainties regarding its consequences, the repercussion of its impacts, and the mobilization observed in neighbor municipalities, responding to the blacklist became part of the local agenda when the recently elected mayor took office in 2009.

Meanwhile, the first initiatives towards responding to the blacklist policy had already emerged and advanced in Paragominas. In there, led by the mayor and supported by the local rural elite (i.e., the farmers' union), a local pact (a.k.a. Green Municipality Pact) along with two NGOs were designed in 2008 to accomplish the necessary tasks to exit the blacklist. The scholars examining what followed in Paragominas highlight important aspects underlying the emergence of such arrangements. First, the leadership of and the articulation between the mayor and the rural elite gave them the necessary legitimacy to convey among angry and distrustful farmers

the (unpopular) strategy to geocode their landholdings in a public cadaster. Second, the political coalition governing Paragominas had also struggled to recover the image and credibility of the municipality (Marconato & Queiroz 2012). Contrary to the first migrants who arrived in the region 60 years ago, local dwellers and farmers have set deep roots in Paragominas and triggered the emergence of an important social asset: local pride (Nepstad 2017).

Besides that, the technical support and expertise from the environmental NGOs participating in the pact were also instrumental in several aspects, particularly because many actions and strategies to respond to the blacklist were developed from scratch. The NGOS filled important gaps in collecting and organizing social-economic and biophysical information on the municipality to guide and support future actions. They were also essential in the process of designing new cartographic maps to allow the geocoding and monitoring processes at the farm level. More, the NGOs assisted the process of developing methods and tools to geocode and registry landholdings' information in a public cadaster, besides having adapted existing monitoring systems to detect deforestation at the farm level.

The support received from the NGOs in geocoding and registering farms in Paragominas represented a 20-fold reduction in the regular cost the farmers would have paid to perform such activities by their own (Guimarães *et al.* 2011). In that regard, private funds received to support the projects and activities carried out by the NGOs were also crucial. Last but not least, the initiatives put forward in Paragominas received the institutional support from the federal and state governments whose representants attended the meetings and recognized the local commitments set in the Green Municipality Pact, thus giving legitimacy to the process and work carried out in there (interviewee X).

Inspired by the experience of Paragominas, but dispossessed of external assistance from NGOs, Tailândia initiated such activities at a modest pace in parallel with the more crucial mission of restoring the local economy disrupted by the Arc of Fire operations in 2008. To revive the local economy, the mayor and influential political leaders managed to attract an oil palm industry to the municipality in 2011 only. And to remove Tailândia from the blacklist, the secretaries of environment and agriculture were given carte blanche to articulate the strategy towards geocoding farms and controlling deforestation. Indeed, the lack of technical and financial support from third parties in Tailândia resulted that strategies and activities to cope with the blacklist policy were carried out by local government agencies exclusively.

Halting deforestation did not represent the main issue in Tailândia since forest-based activities and economy had broken following the police operations in 2008. But geocoding thousands of farms did. In that regard, achieving the blacklist removal criteria was favored by two aspects in Paragominas. First, the local economy did not depend on further forest clearings since croplands (soybean) had replaced pasturelands, ranchers had invested in intensifying and

modernizing cattle raising activities, and the timber industry now relies on forest plantations rather than natural forests. Second, land concentration resulted in few landholders covering large areas of Paragominas, thus requiring relatively few farms to geocode and achieve the required figure to exit the blacklist.

Despite the examples emerging in nearby municipalities, Moju has not achieved the requirements to exit the blacklist to date. Deforestation in Moju has dropped below 40 sq.km^{-1} right after the municipality entered the blacklist in 2011. Nevertheless, the vast territory and the large number of farms in the municipality represents a big obstacle for Moju towards geocoding the required proportion of its territory. The most recent official census counted 5.800+ rural properties in Moju (IBGE 2019), most of them representing familiar agriculture households associated with diverse social groups.

But other factors have also made things more complicated in Moju. Contrary to Paragominas and Tailândia, few incentives would have prompted the emergence of bottom-up initiatives among local stakeholders to cope with the blacklist policy. Sanctions preventing farmers' access to rural credits had little significance in Moju. Representing most of the population in Moju, small farmers represent a group for whom federal programs and banks have historically neglected agricultural loans for farming activities. Although credit lines for small farmers running familiar agriculture do exist, many bottlenecks hinder the successful implementation of such resources on the ground. Consequently, it is a commonplace to meet small farmers in debt with agricultural loans contracted in previous government programs. In Moju, where most farmers are inapt to contract new bank loans, the 2008 Central Bank decree restricting agricultural loans upon the geocoding of landholdings had no impact (bank manager's interview).

In addition, the local economy revolving around the oil palm and coconut industries has little dependence on the timber industry or other activities associated with forest clearings. In that regard, police operations and stronger monitoring systems in place to curb deforestation have had a negligible impact in Moju. Deforestation has been an issue caused by agents far away from the administrative center of the municipality. Sharing part of its southern territorial limits with Tailândia, a significant proportion of the deforestation in Moju is driven by agents and processes associated with actors and activities in Tailândia. In addition to the large distances that require day-long field trips of environmental agency agents to combat deforestation, that aspect has undermined the readiness of Moju to fight forest clearings.

Similarly, most of the forest clearings in Portel have taken place faraway from town driven by jobless and landless people migrating from the municipality of Altamira. In there, the construction of the Belo Monte hydroelectric dam attracted thousands of workers since 2011 that have recently found their way through the Transamazon highway to settle in municipalities

such as Anapu, Pacajá, and Senador José Porfírio in the southern borders of Portel. That process has leaked deforestation into the southern borders of Portel.

Claiming no responsibility for what has happened in the region, public officials in Portel argue that monitoring land use and cover change in that region is not feasible given its distance to the administrative center of Portel. Indeed, the trip can last some days by the river, the only way to get there from the town. Further complicating things, politicians in Portel have declared no interest in complying with forest and environmental legislation that is assumed to limit the development of activities related to mining and forestry in the territory.

The temporal dimension

Accelerated changes in the region affecting local responses

Uniform policies do not produce similar outcomes when applied over diverse regions. The accelerated pace of changes in regions such as expanding deforestation frontiers makes the matter worse. In addition to the historical factors linked to the spatial expansion of the deforestation frontier shaping local realities, responses emerging from the four municipalities also varied as related to the changing incentives over time.

In that regard, when Paragominas was blacklisted in January 2008, a set of parallel initiatives synergistically impacted local stakeholders in the region (Figure 7). The federal agency in charge of attesting landholders their land regularization changed its protocols. Starting in 2008, INCRA has started requiring landholders to geocode their farms as a requirement to provide the certificate of registry of rural property (CCIR, the Portuguese acronym). It turns out that the CCIR is one of the official documents that banks also started requesting farmers who depend on federal agricultural loans (Banco Central do Brasil 2008).

The high demand to geocode farms coupled with the current lack of demand and means (experts, firms, tools, and adequate cartographic maps) to execute the service became an immense obstacle for farmers to regularize their lands and contract agricultural credits, as bank managers and INCRA officials reported in interviews. Meanwhile, the Federal Public Prosecutor Office in Pará started a crusade against actors participating in the supply-chain of the primary commodities associated with deforestation in Pará in 2008-2009. Instead of persecuting thousands of individual ranchers, the public prosecutor started threatening to sue slaughterhouses and supermarkets trading cattle, beef, and other derived goods. Seeking to avoid sanctions, those agents stopped buying from municipalities blacklisted by the MMA (Figure 7).

The problems arising in dozens of municipalities affected by the blacklist policy, along with the successful initiatives that emerged in Paragominas, prompted the state government to launch the Green Municipality Program (PMV, the Portuguese acronym) in 2011 (Figure 7). The initiative built upon the experience learned from Paragominas to assist other municipalities in

complying with the blacklist removal criteria. Positive outcomes from this initiative would have the potential to benefit the state's image as a whole if Pará succeeded in controlling its historically high rates of forest loss. In that regard, the institutional support put forward by the state government through the PMV had spillovers on the State Environmental Agency (SEMAS, the Portuguese acronym), moving the environmental agenda in the state towards the control of deforestation, geocoding of landholdings, and the support of sustainable alternative economic activities.

Arguably, the consolidation of such priorities started reflecting on municipal environmental agendas. The PMV assisted municipalities in structuring their environmental agencies with resources (cars and motorcycles), tools (GPS devices and GIS software), and personnel training. Regardless of the assistance received from the state after 2011, many municipalities naturally relied upon the tools (cartographic maps, monitoring systems) crafted in Paragominas, as well as developed local collective initiatives inspired in the municipal pact agreed in there.

Another key factor affecting the response of municipalities towards the blacklist policy was the new Forest Code enacted in 2012 – the main legislation regulating land-use and cover change in Brazil. Inspired by the successful experiences in Paragominas and other municipalities, the Forest Code made mandatory the geocoding of rural properties nationwide (Figure 7). The experience with the geocoding requirement in blacklisted municipalities became recognized as a potential source of information for the government to tackle land use and cover changes. In a region where land conflicts are pervasive (particularly across the expanding frontier) and land ownership is poorly defined (some states have three times more area registered in the form of landholdings than their actual territorial size), geocoding farms becomes a tool linking individual agents and land cover changes on the ground. Coupled with the remote sensing system monitoring deforestation in the Amazon, the geocoding and registering of farms in a public database would allow the state to finally identify, enforce and sanction the agents engaged in illegal clearings.

In that regard, the Forest Code overlapped with the requirement of the deforestation blacklist already in place, at the same time it changed rules, conditions, and deadlines for that task. For instance, recognizing that small farmers would face disproportional challenges and hurdles in geocoding their farms, the legislation defined that the state is responsible for providing the means for small farmers to geocode their lands. In municipalities where small landholdings represent substantial proportion of the territory, such as Moju and Portel, achieving the target set by the blacklist policy – geocoding 80% of the territorial area – became harder.

Furthermore, the institutionalization of the geocoding as an official tool and document (CAR, the Portuguese acronym) recognized by the federal government disrupted one of the main incentives for collaboration at the municipal scale. In the absence of means to distinguish between legal and illegal farmers, companies and other organizations relied on the

deforestation blacklist to stop trading with blacklist municipalities. The damage that decision had on local economies was one of the key incentives triggering the successful collective arrangements that emerged in Paragominas. In this regard, the consolidation of the CAR gave the market the correct signal to clear the embargo on blacklisted municipalities, allowing them to trade on an individual basis with farmers whose farms are geocoded. In that regard, an important incentive for collective action at the municipal level was completely lost, fostering farmers to act in their self-interest rather than on the collective one.

After the new Forest Code was enacted, the Ministry of Environment (MMA) stopped disclosing the deforestation blacklist in the period between 2012-2016 (Figure 7). The lack of elucidation by the MMA on the reasons for that remains unclear. In spite of that, many municipalities – as well as the state agencies in Pará – had no clue on whether the blacklist policy was still in place, putting in check the policy instrument itself and the need for keeping actions towards removing municipalities from the blacklist. Portel, as the case study representing a municipality blacklisted in 2017 only, faces now all those mixed incentives (or lack of incentives) to decide on whether and how to cope with the backlist policy.

So far, Portel has not participated in the Green Municipalities Program (PMV), declining to receive the technical and institutional support that has strengthened municipal environmental agencies across the state. Committing with the PMV would require the local environmental agency and government to actively engage in monitoring and enforcement activities, overburdening the limited institutional capacity in Portel, besides opposing some of the local economic interests. Finally, the state environmental agency (SEMAS) has also stepped in to assist municipalities and improving their technical capacity and training their local staff regardless of the adherence to the PMV.

Predominantly covered by forests (Table 1), it is unlikely to expect Portel to take active steps towards getting out of the blacklist and receive a "green" stamp only. Put in perspective, it has become incongruent to praise those municipalities removed from the blacklist and name them as "green municipalities" - even though some have lost almost 50% of their original forest cover. That is even more complicated when deforestation taking place in Portel is not driven by local dwellers, but by the rapid changes taking place elsewhere across the dynamic and evolving frontier in the region.

Final remarks

The strategies and initiatives followed by the four municipalities framed in this study differ on the timing, actors involved, and the particular incentives triggering the actions and changes that took place in each place towards responding to the federal blacklist policy in Brazil. The results and discussion in this paper have detailed the shortcomings of one-size-fits-all policies applied over large regions marked by diverse local realities such as in the Brazilian Amazon. Besides, the

study has revealed the varied ways with which national systems and local realities interact over time in regions experiencing rapid social-environmental transformation. That adds another layer of complexity to policy analysis since the rapid changes that shape the realities structuring and underpinning local responses to national policies are constantly evolving.

The design of policy instruments more flexible and adaptive to the diverse and dynamic characteristics of regions experiencing rapid transformations […].

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Figure 7. The set of key factors and incentives influencing the response of different municipalities (spatial dimension) to the deforestation blacklist over time (temporal dimension).