

Environmental compliance in the Brazilian Amazon: exploring motivations and institutional conditions

Authors : EMILIE COUDEL¹; MARIE-GABRIELLE PIKETTY²; TOBY ALAN GARDNER^{3,5,6};
CECILIA VIANA³; JOICE NUNES FERREIRA⁴; THIAGO MORELLO⁷ ; LUKE PARRY⁶; JOS
BARLOW⁶ ; MARTINE ANTONA²

Institutions :

1.GREEN, CIRAD - EMBRAPA, BELEM - PA - BRASIL

2.GREEN, CIRAD, MONTPELLIER - FRANCE ;

3.MUSEU PARAENSE EMILIO GOELDI, BELEM - PA - BRASIL;

4.EMBRAPA, BELEM - PA - BRASIL

*5.DEPARTMENT OF ZOOLOGY, DOWNING STREET, UNIVERSITY OF CAMBRIDGE, CB23
7DY, UNITED KINGDOM*

*6.LANCASTER UNIVERSITY - MUSEU PARAENSE EMILIO GOELDI, LANCASTER - UNITED
KINGDOM*

7. USP – UNIVERSIDADE DE SÃO PAULO

1. Introduction

Deforestation in the Amazon has decreased from 23.901 km² in 2004-2005 to 6.348 km² in 2009-2010 (INPE, 2012) suggesting that the region may be at a turning point (Davidson et al., 2012; Nepstad et al., 2011; Nepstad et al., 2009). In 2008, the Brazilian government set a target to reduce deforestation rates in 2020 to 20% of the 1996-2005 level. Whilst it is still too early to claim victory (Nepstad et al., 2011), recent successes

have been attributed to a combination of: several innovative governance measures, such as quasi-instant satellite monitoring (Brito et al., 2010), strong demonstrations of force by regulatory authorities, market sanctions (i.e. soy moratorium, beef embargo) (Barreto and Araujo, 2012; Nepstad et al., 2009), emergence of local governance arrangements (Brannstrom et al., 2011), the decentralization of governance, and creation of conservation units (Soares-Filho et al., 2010; Toni, 2011). Designed at different governance levels, and across different sectors, these initiatives can be seen as part of a “governance of transition” (Kemp and Loorbach, 2006; Kemp et al., 2007; Voss and Bornemann, 2011).

Transitions can be defined as fundamental changes in society's structure, culture and practices (Loorbach, 2010). Bringing about transitions has become a world-wide concern, as many current socio-ecosystems are under pressure and need to find a way to achieve sustainable development regimes (Voss and Bornemann, 2011). Current regimes are shaped by structural determinants, which may lead to lock-in situations. Transition towards sustainable regimes can occur through the progressive dismantling of unsustainable structures and the building of new structures according to the chosen conception of sustainability, in a creative destruction process. Concomitant changes are necessary within technological, economic, ecological, sociocultural and institutional sectors, each change reinforcing changes in the other sectors. Managing to revert historical trends, structural barriers and path-dependency is quite challenging (North, 1997). It requires a reflexive governance process, based on interaction arenas, experimentation, adaptation programs and continuous monitoring (Kemp and Loorbach, 2006; Kemp et al., 2007).

In Brazil, one of the spearheads of this “governance of transition” is the Action Plan for Prevention and Control of Deforestation in the Brazilian Legal Amazon (PPCDAm),

which was launched in 2004, as part of the Sustainable Amazon Plan. It structures a set of policies around three main goals: (i) regulating land tenure and zoning land use, (ii) monitoring land conversion, and iii) providing incentives for sustainable land-use activities (Barreto and Araujo, 2012). Its underlying motivation is to slow and stop activities linked to deforestation through strong command-and-control measures, and simultaneously to promote a new institutional culture that stimulates legal activities through market-based incentives, social control and capacity building.

Given that the history of Amazonian colonization has been largely devoid of legal rules (Araújo and Léna, 2010; Fernandes, 1999; Taravella and de Sartre), the effective implementation of new policy instruments is challenging to decision makers and stakeholders alike, and requires greater understanding of the factors which would bring about a change in land-use practices. Although case studies (Boyd, 2008; Brannstrom et al., 2011) and macro assessments (Nepstad et al., 2009; Sparovek et al., 2010) take a positive view of the impact of recent initiatives, they rarely single out the effects of such policies on different types of Amazonian landowner¹. Any assessment of the effectiveness of new policy measures needs to take into account the motives, constraints and perspectives of different types of landowner. Efforts to improve legal compliance of Amazonian landowners have focused largely on the medium to large-sized farms who are more sensitive to market influences, and while accounting for only 10% of all landowners are responsible for almost 80% of land². Nevertheless, the remaining 90% of landholders are responsible for approximately 650 000 properties, including the most impoverished inhabitants of the region. The motivations and ability of these

¹ Although traditional populations have a great importance in the Amazon region, in this paper, we focus on private landholders.

² In the IBGE Census for 2006, in the Legal Amazon region, there were 642 127 properties of less than 200 ha (amounting to 23 million ha), and 72 882 properties with more than 200 ha (amounting to 87 million ha)

smallholders to comply or not with rules are very different from those of larger landowners and need urgent attention as part of the broader transition process.

The overall aim of the foregoing analysis is to improve understanding the extent to which different policies are capable of exerting different influences on levels of environmental compliance across different groups of actors. In particular we focus on trying to understand those policy levels that are capable of motivating change within smallholder communities. We will thus first present why a better understanding of compliance motivations is required and why they may differ for large and small landholders. Then, we will analyze differing levels and perceptions of environmental compliance across a broad spectrum of landowners in two regions of the eastern Brazilian Amazon where recent governance initiatives have attempted to influence private land management. We consider three transition goals: limiting deforestation, improving legal compliance within private properties, and encouraging sustainable activities.

2. Environmental policies and compliance

2.1. Understanding compliance

Environmental regulations are varyingly interpreted, modified and ignored by actors at different levels of social organization, leading to differences in “rules in use” (Farber, 1999; Ostrom, 1990). The behavior of people to conform to the rules that are intended to regulate their actions is defined as compliance (Hauck, 2007). The efficiency of a set of regulations depends critically on achieving a high level of compliance. Understanding differences in compliance and the potential for improvements to existing policies requires an understanding of differences in motivations and rule interpretation among different actors.

Previous work indicates that motivations for compliance include fear of the law, economic incentives, established social norms, personal consciousness, and differences in the ability to comply (Gezelius and Hauck, 2011; May, 2004; Winter and May, 2001). Gezelius and Hauck (2011) suggested that compliance is influenced by both the wider institutional context and its interaction with individual or group conditions. For example, deterrence (fear of being caught) is a compliance motivation which depends on the level of enforcement of the state (level of control and size of penalty).

2.2. Compliance motivations regarding different policies

One of the central challenges of transition politics is to encourage a progressive change in norms that results in an increased acceptability of new regulations. First it is necessary to identify the institutional conditions set by different types of policies, and how may they influence levels of compliance.

Command-and-control policies have long been seen as a major policy instrument. They can act through increased monitoring and control, increases in the size of penalties and changes to the style of inspections (May, 2004). The efficiency of command-and-control policies depends upon the risks perceived by actors of being caught and punished, the benefits of not complying with the law, as well as on levels of respect for law and the State (Gezelius and Hauck, 2011). However, the effectiveness of command-and-control policies is questionable for areas where the capacity for state enforcement is lacking, where policy making is greatly biased by political interests and/or conducted out of context of the practical realities of regions where laws are intended to be applied.

Market-based instruments have been viewed as a possible alternative to command-and-control policies. They appeal to an actors' rational economic interest to achieve compliance through taxes or incentives, or may also place conditions on the production process to have access to certain markets (certification). Payments for Environmental Services (PES) have been proposed as a way of securing the production of positive environmental externalities (Engel et al., 2008), though success depends not only on the market incentives, but also on a series of other institutional factors (e.g. land rights, degree of social organization) (Muradian et al., 2010).

Institutional arrangements and social regulations, including trust, the need for recognition within a group, and moral beliefs have gained increased importance in analyses of compliance motivations (Ostrom, 2005). Policies to promote such arrangements are generally based on efforts to decentralize power and control (Agrawal and Ostrom, 2001; Ostrom, 1998). Decentralization is intended to give greater legitimacy to rules, as they become better adapted to local contexts, and thus ought to

encourage higher levels of compliance. Nevertheless, local enforcement capacity remains an important precondition (Gibson et al., 2005) and local power dynamics may still lead to rule deviation or concentration of control within special interest groups, thus undermining the motivation for others to comply (Ribot, 2005).

One of the criticisms made of command-and-control, market-incentive and decentralization policies is that they generally work best under constant conditions and do little to promote learning dynamics which are fundamental to bring about change (Boyd, 2008; Voss and Bornemann, 2011). By contrast pro-active policies for empowerment, capacity building and innovation can help create the space for new knowledge and perceptions to emerge, for social interaction, and social learning (Leeuwis and Pyburn, 2002). Whilst nobody can be “compelled to learn” there are motivations linked to an awareness of a need to change, willingness and ability to participate in this change (Marshall and Marshall, 2007).

The ability to change and adapt depends not only on individual characteristics but also on the opportunities offered by the institutional context and the capacity of the actor to benefit from these opportunities, as determined by differing power relations, networks, knowledge and education, and resources (Sen, 1989). Capacity is also linked to an awareness of regulations and incentives (Winter and May, 2001), with awareness acting as an important precondition for all other compliance motivations to be activated.

2.3. Environmental policies for transition in the Brazilian Amazon

Transition in the Amazon is manifest primarily as command-and-control measures to control deforestation. The creation of conservation reserves has reduced the rate of

forest conversion to agriculture (Toni, 2011), but, because a large area of land is under private ownership, control of this land has remained at the centre of attention (Ferreira and al. 2012). Even before the settlement of the Amazon in the 1960s, the Federal government had put in place measures to control changes in land cover (especially deforestation) through a Forest Act dating back to 1936. Currently under reform (Sparovek et al., 2012), this Forest Act requires the set aside of a Legal Reserve – LR - of native vegetation on each property. In the tropical forest zone of the Amazon region³, the LR was initially set to 50% of the property (1965), and subsequently increased to 80% in 1996. This change meant that landowners who had been compliant with the law became non-compliant (Sparovek et al., 2012). A number of subsequent measures attempted to provide a level of flexibility in compliance, including a reduction in the size of LRs to 50% of properties in “consolidated agricultural regions”, as defined by Ecological Economic Zoning (ZEE) plans.

A precondition to improving the control of deforestation and law enforcement of private properties was to regularize the land registry of property boundaries and rights. The “Terra Legal” program was launched by the Federal government in 2008 to achieve this, but rapidly encountered serious bureaucratic complications in verifying documents supplied as proof of ownership. A pragmatic compromise solution was suggested whereby land “owners” could self-declare their property limits⁴ and areas dedicated to production and conservation under an instrument known as CAR – the Rural Environmental Land Registry. CAR does not ensure land tenure; it assigns ownership

³ In the Amazon region, the Forest Act distinguishes tropical forest zones, dry forest zones (cerrado) and natural pasture zones.

⁴ through GPS references

only for monitoring purposes (specifically regarding compliance to environmental legislation).

To encourage adoption of CAR, public-private partnerships have emerged to exclude landowners who have not yet registered, including mechanisms to limit access to credit or control the sale of agricultural commodities. The CAR provides only a first step in monitoring and controlling deforestation. The second step for private landowners is to secure a LAR (the Rural Environmental Licence), which regulates all activities within the property and identifies necessary steps to ensure full compliance with the Forest Act.

2.4 Possible effectiveness of these policies to bring about environmental compliance

Command-and-control policies in the Amazon are limited because of the remoteness of many regions and the limited capacity and centralization of agencies responsible for control. Estimated costs for regulatory enforcement are still very high (Börner et al., 2011). Low levels of effective enforcement have led to a low level of perceived risk of being caught, especially for small areas of deforestation.

Market-based incentives for compliance have been used by a number of public-private initiatives (Brannstrom et al., 2011), enabling a more focused control on specific chains of production (e.g. soy, beef, wood). Sanctions on credit and market access have been particularly effective, especially regarding larger producers. Positive-incentive based policies such as certification or PES are still relatively rare.

Social regulations and local controls of deforestation may be strong in some traditional communities, but in land settlements and colonies (which have progressively turned into townships), norms are often still oriented by the behavior of original colonists which are often not oriented towards forest conservation (Taravella and de Sartre). A

certain level of awareness is emerging regarding new knowledge networks (Boyd, 2008) and soft governance initiatives (Brannstrom et al., 2011), but examples are largely limited to places with strong leaders, who often happen to be the bigger landowners (Araújo and Léna, 2010).

For all these policies, property size seems to be an important factor in influencing the motivations for environmental compliance (Table 1).

Table 1. Hypotheses regarding the conditioning effect of property size on different policy approaches to achieving environmental compliance

Depends on...		Probable influence of property size on compliance	
		Small properties	Large properties
Government enforcement	Probability of detection of illegal behavior	Weak or no effect as too small and numerous	Higher probability of being monitored and controlled
Market control	Size and location of market, size of production and dependence on credit	Weak as rarely exposed to export markets unless full chain of custody is required (e.g. for cattle certification)	Strong incentive to become legalized to ensure market access
Social regulation	Strength of existing social norms	Stronger in traditional community and older settlements, but often weak in young colonies	Historically low due to early incentives to deforest
Capacity to change	Access to technology, technical knowledge and costs of	Weak due to lack of access to and knowledge of	Potentially high, especially among properties with more

	implementation	alternatives, though some good examples of change exist	resources
Consciousness/awareness	Level of information and education	Can have high environmental consciousness but accompanied by a low awareness of rules	Environmental consciousness variable but often accompanied by a high awareness of rules

The susceptibility of different actor groups to different policies aimed at improving environmental compliance therefore depends strongly on levels of wealth and education, as well as historical and cultural determinants of rural livelihoods and the incentives for original colonization.

3. Methodology

3.1 Focusing on “deforested Amazonia”

The study is focused on two regions in eastern Pará: Santarém-Belterra and Paragominas. The recent history and agricultural development of these regions is closely associated with the development of two major federal highways, the BR-163 and BR-010 respectively. Between 2001 and 2010, Paragominas is 2nd of the deforestation list (over the Legal Amazon 773 municipalities), and Santarem is between 16th and 24th, depending on the year (Prodes)⁵. Both regions host important pilot initiatives regarding land-use sustainability in the Amazon. In the municipalities of Santarém and Belterra a partnership between *The Nature Conservancy* (TNC) (an international conservation NGO), and the multinational Cargill resulted in 2006 from a moratorium on soybean

⁵ <http://www.dpi.inpe.br/prodesdigital/prodesmunicipal.php>

production from deforested areas. In Paragominas, the *Município Verde* project was initiated in 2008 to bring the municipality out of the federal governments' list of most deforesting municipalities. Through collaboration between the local government, the local farmers union and leading environmental NGOs (TNC and Instituto do Homem e Meio Ambiente da Amazonia, IMAZON) a strong commitment was made to achieve zero-deforestation and promote sustainable land practices.

This work was conducted as part of the Rede Amazônia Sustentável⁶. The RAS network emerged shortly after the start of both of these initiatives and is working as a research partner with the coordinating organizations to help provide guidance on the environmental and socio-economic implications of different land-use and land-management options.

3.2. Information and data collection

Analysis of environmental compliance was conducted using two complementary sources of information for both study regions: a literature review of recent policies and laws; and a quantitative survey of landowners collected by the RAS network.

The quantitative survey was conducted in 2010 in Santarém and 2011 in Paragominas. In each region, 18 catchments were selected along a gradient of past deforestation, ranging from extensively cleared landscapes with less than 20% forest cover to landscapes with 100% forest remaining. In each catchment interviews were carried out with a sample of landowners. Qualifying properties had to be > 1 hectare in size, and have agricultural production in the year of 2009 (reference year of the survey). Urban or

⁶ RAS is a collaborative research initiative focused on the study of land-use sustainability in eastern Amazonia, involving more than 30 institutional partners from Brazil, the UK and Australia. Coordinating institutions are the Goeldi Museum and Embrapa Amazônia Oriental (Belém), and the Universities of Cambridge and Lancaster in the United Kingdom. The overall aim of RAS is to contribute towards an improved understanding of the long-term environmental and socio-economic consequences of current land-use and land-use change processes in the eastern Brazilian Amazon

peri-urban areas were excluded from the exhaustive sampling of households. Two types of rural property were selected for the survey. Firstly, we interviewed farmers from properties in which RAS had study transects for biophysical data collection contributing between 5-11 transects per catchment. These properties are representative geographically of the landscape though tend to be located in the larger properties and are thus not representative of rural producers as a whole. Consequently we complemented these socioeconomic surveys with a random sample of up to 20 interviews (in areas with a sufficient rural population) from among all rural producers in the catchment.

The total survey accounts for 475 interviews, 165 from Paragominas and 310 in Santarém. 12 surveys were conducted in the FLONA, the Tapajos National Forest and are excluded from this analysis as they represent a distinct arrangement of property rights. The difference in the number of interviews between Santarém-Belterra and Paragominas highlights an important distinction between the two regions, with large areas of Paragominas having a low population density and being dominated by large properties.

3.3. Assessing environmental compliance

Table 2 illustrates the variables chosen to analyze compliance levels, according to each of the three broad policy goal, as well as possible motivations for compliance.

Table 2. Variables selected for analyzing compliance and underlying motivations

Objective	Variables
Reducing deforestation	<ul style="list-style-type: none"> • Percentage of the property with primary and secondary forest • Type of land cover cleared for production, in 2000, 2005 and 2009
Improving legality	<ul style="list-style-type: none"> • Existence of Legal Reserves, CAR, and LAR • Time and cost to obtain these legal documents • Awareness of CAR and LAR
Encouraging sustainable production	<ul style="list-style-type: none"> • Participation in reforestation projects • Reasons for not reforesting • Willingness to participate in reforestation • Participation in sustainable production programs • Awareness of sustainable production programs or compensation programs • Familiarity with debate over revisions to Forest Act

The dynamics of deforestation and current forest cover are evaluated here on a declarative basis. Although they can be considered subjective and subject to misinformation, the advantage is that they include small-scale deforestation in small properties which cannot be detected easily by satellite images.

Regarding compliance motivations, other than awareness indicators (e.g. “have you heard about this regulation?” “have you never heard about it?”), simple indicators are not available. An understanding of social norms, environmental consciousness, level of deterrence require a deeper qualitative analysis.

To test our hypotheses regarding differences in compliance according to the size of properties, we have distinguished 5 categories of property size:

1. 0 to 25 ha: very small properties, mainly corresponding to traditional subsistence farmers in the Amazon (since periurban properties were not part of the sample).
2. 25 to 100 ha: these will generally be land settlements, 100 ha is the largest possible size of an individual resettlement farm under Brazil's agrarian reform program (INCRA).
3. 100 to 300 ha: one important legal distinction in farm size in Brazil corresponds to 4 tax modules (TM), with legal authorizations⁷ being required above this limit. In Paragominas, 1 TM is 55 ha (4TM=220 ha); in Santarem, 1 TM is 75 ha (4TM=300 ha). We chose to have the same limit for both municipalities to simplify analyses.
4. 300 to 1000 ha: medium to large size properties
5. over 1000 ha: large size properties

⁷ Licences are required for any activity related to agriculture, forest management, fish breeding or silviculture. Clearing any natural vegetation (such as deforesting) is thus subject to licensing.

3.4. Sample representativeness and characteristics

Table 3. Total sample size according to number of properties and spatial extent

	Paragominas		Santarem and Belterra	
	Sample (no. properties)	Total area (ha)	Sample (no. properties)	Total area (ha)
<20ha	11	936	120	1648
20 - 100 ha	80	3030	138	7491
100 - 200 ha	15	3577	11	3689
200 - 1000 ha	20	8702	28	11747
> 1000 ha	39	215612	13	52725
Total	165	231857	310	77300

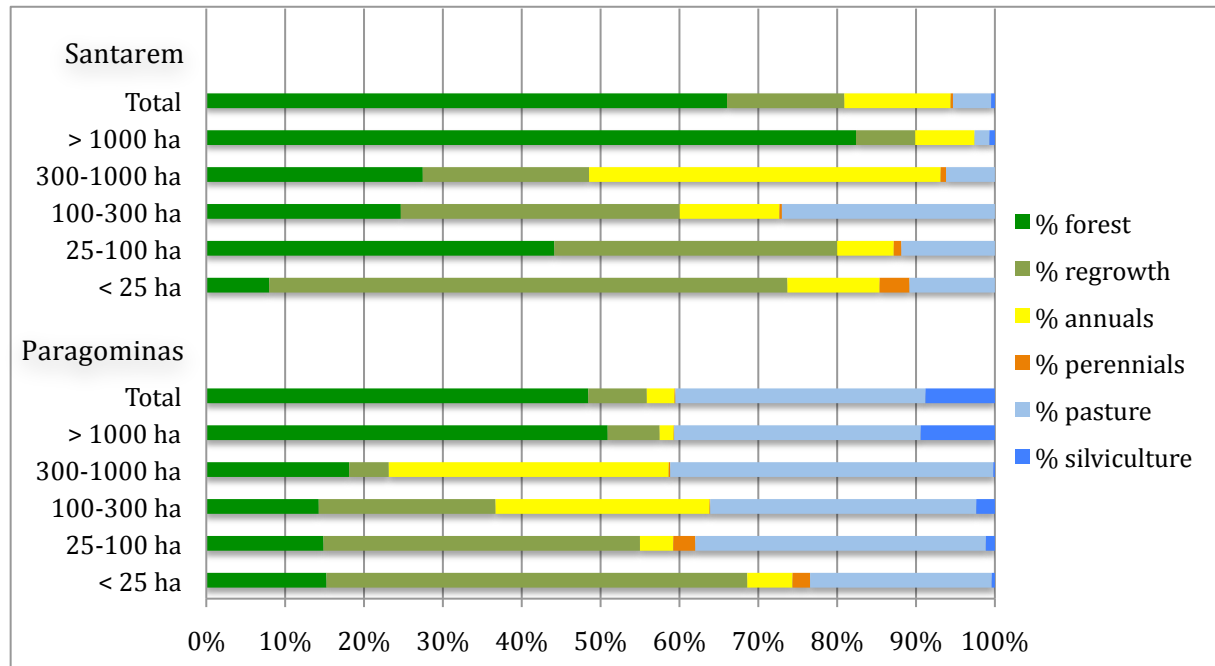
Comparing our sample to IBGE data (2006, see Table A1 in appendix)⁸, in Paragominas, we would have interviewed 36% of the total number of registered land tenures, and amongst them almost 89% of tenures between 20 and 100 ha, probably indicating the huge proportion of small properties that are excluded from the national census. In Santarem, the IBGE survey identified many more smallholders (7325 property <100 ha see Table A1 in Appendix). Although our sample clearly favors smallholders (258 properties out of 310), representativeness is low but sufficient for analysis.

Representativeness of production types (annuals, perennials, pasture and silviculture) was estimated with respect to the dominant land use of each property. Proportions of production in our sample are close to the IBGE data (see Table A2, in Appendix).

Paragominas is clearly dominated by cattle ranching, as well as having a recent increase in silviculture. Santarem, with a higher density of small properties has many more properties with annual crops. However, beyond these general patterns dominant production type varies considerably according to size (see Figure 1; and Table A3).

⁸ To match IBGE categories, we had to modify our usual categories (limits are 20 ha, 100 ha, 200 ha and 1000 ha, instead of 25 ha, 100 ha, 300 ha and 1000 ha).

Figure 1. Distribution of land use (percentage of total area of all properties per size category)



In Paragominas, almost all property size categories have 20% more pasture than in Santarem. Silviculture is mainly restricted to larger properties (more than 1000 ha). In Santarem, properties between 300 and 1000 ha (few are larger than this) are often dominated by annuals, including soy, rice and corn cultures among this category. Perennials are mostly cultivated by small holders and restricted to a small number of localities.

4. Results and Discussion

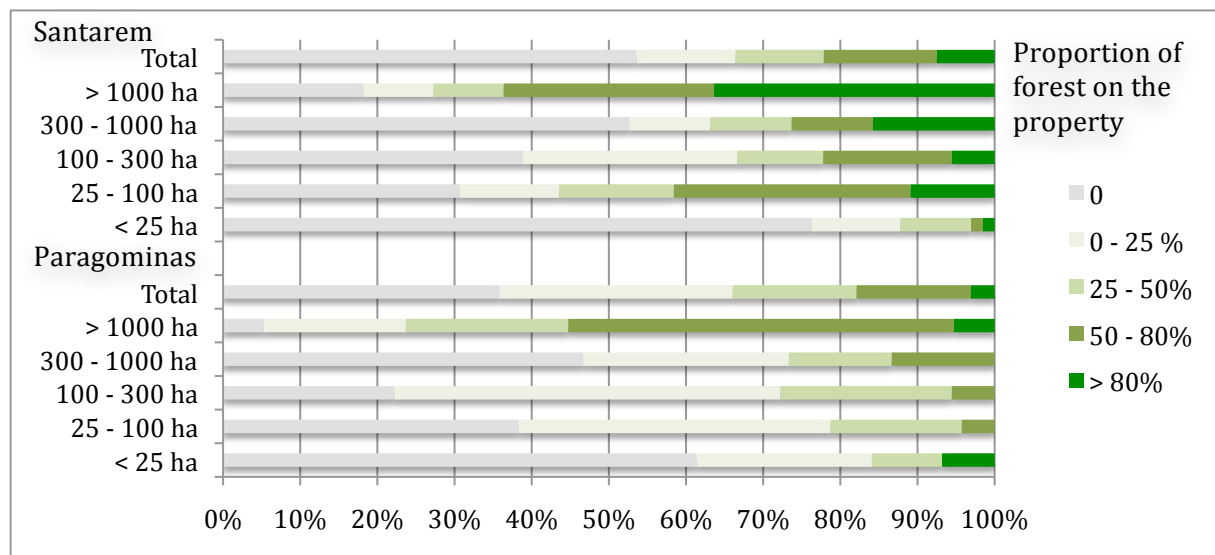
We present results with respect to the three broad policy goals for transition: reducing deforestation; improving legality; and moving towards more sustainable production. For each of these goals, we will develop what are the governance conditions, what is the level of compliance observed in our sample, and give some assumptions concerning motivations of compliance, mainly in relation to the awareness of rules.

4.1 Deforestation

The size of legal reserves in Paragominas and Santarem is dependent upon regional zoning regulations. The ZEE (Ecological and Economical Zoning) of BR-163 was approved in 2009, defining regions of consolidated production activities, where the reserve size is 50%, and preservation regions, where the limit is 80%. The zoning process is still being conducted in Paragominas.

Very few properties are compliant with the 80% limit with only 7% in Santarem and 3% in Paragominas. In Santarem, bigger properties are more likely to have 80% forest remaining though the same patterns does not hold for Paragominas. When considering a LR of 50%, the majority of largest properties (> 1000 ha) are compliant (54% of properties in both Santarem and Paragominas). By contrast the majority of very small properties have no forest at all (more than 60% in both regions).

Figure 2. Extent of forest in properties of different size class in Santarem and Paragominas

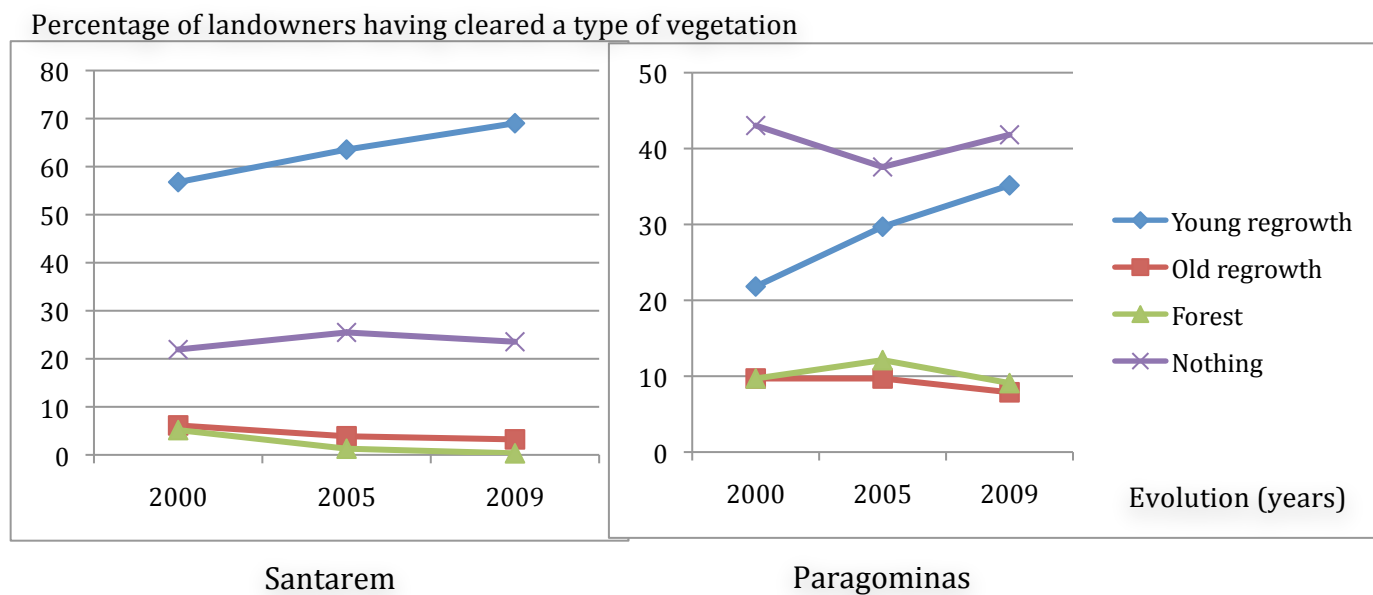


The new Forest Act provides for an amnesty to non-compliant properties larger than 4 tax modules (approximately 300 ha) on the condition that they meet the Legal Reserve

requirement within a given time period. However, such a change will be difficult to achieve for properties between 300 and 1000 ha (in Santarem and Paragominas, 50% of these have no forest, and many others less than 25%).

Given their current “environmental deficit” (the amount of additional forest needed to achieve legal compliance), very few properties may legally clear any additional forest (this includes any vegetation regrowth of more than 5 years, which also needs a separate authorization to be cleared). Figure 3 summarises the types of forest that are reported to have been cleared in the last ten years.

Figure 3. Type of land cover cleared according to year and municipality



In both regions, deforestation of old secondary and primary forest has been consistently low since 2000, matching overall deforestation trends for these two municipalities in general (Figure A1). In both cases, decreases in deforestation activity can be observed before conservation initiatives were started (in Santarem, before the 2006 soy moratorium; in Paragominas, before the 2008 Red List), suggesting that both regions are reaching a stage of consolidation and are no longer part of the active deforestation frontier.

Behind this general trend a number of interesting patterns emerge when comparing deforestation activity across property size categories (see Figure A2 in Appendix). Very large properties (>1000 ha) have exhibited a continuous decrease in clearing for all types of forest in both Santarem and Paragominas. Intermediate landholders in Santarem increased clearance of regrowth (both young and old) in 2005, but in 2009 came back to the 2000 level of clearance (25% of them). Intermediate landholders have stopped deforestation, but compensated through clearance of young and old regrowth. Small properties in Santarem appear to have decreased (and almost stopped) clearance of both forest and old regrowth, though have increased the clearance of young regrowth which makes up a large proportion of many of these properties. Small properties in Paragominas appear to have increased clearance of both forest (15% of them still clear forest in 2009) and regrowth.

A large number of respondents did not answer to the question of land clearance (see figure A2 in appendix), which may be because they have forgotten or because they are reluctant to admit deforestation. Response rates were higher amongst small farmers who have less to lose from not engaging.

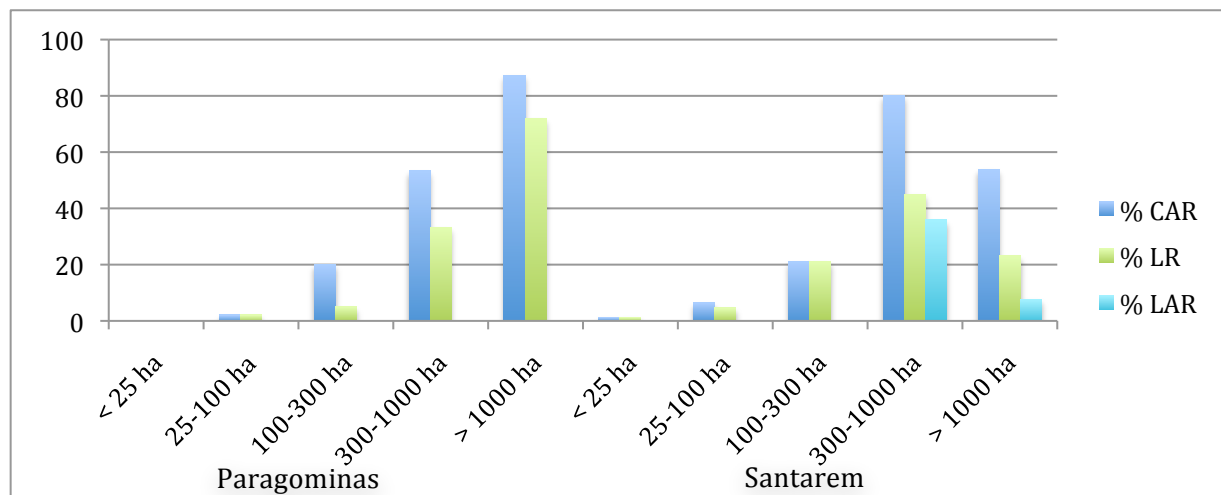
4.2 Improving legalization and compliance

Environmental legalization of private properties depends on acquiring three documents: CAR (Rural Environmental Land Registry), LR (Legal Forest Reserve) and LAR (Rural Environmental Licence). Since 2008, in the state of Pará, selling to slaughterhouses⁹ is officially conditional on having CAR, and demonstrating engagement in the process

⁹ Requirements for the Legal Beef: <http://www.carnelegal.mpf.gov.br/compromissos/pecuaristas>

towards acquiring LAR. Municipalities which are part of the Red List of deforestation¹⁰ can exit the list only if they achieve 80% of their surface as CAR, which Paragominas achieved in April 2010. Individual legalization can be relatively costly, though partnership with TNC has mitigated these costs in both Santarem and Paragominas. In Santarem, there is no formal market requirement for legalization beyond a need to demonstrate that soybean crops do not come from deforested areas when selling to the main buyer (Cargill). According to our data (Figure 2), the majority of properties over 300 ha in both regions have CAR.

Figure 2. Percentage of properties that have legal documents, according to size and municipality



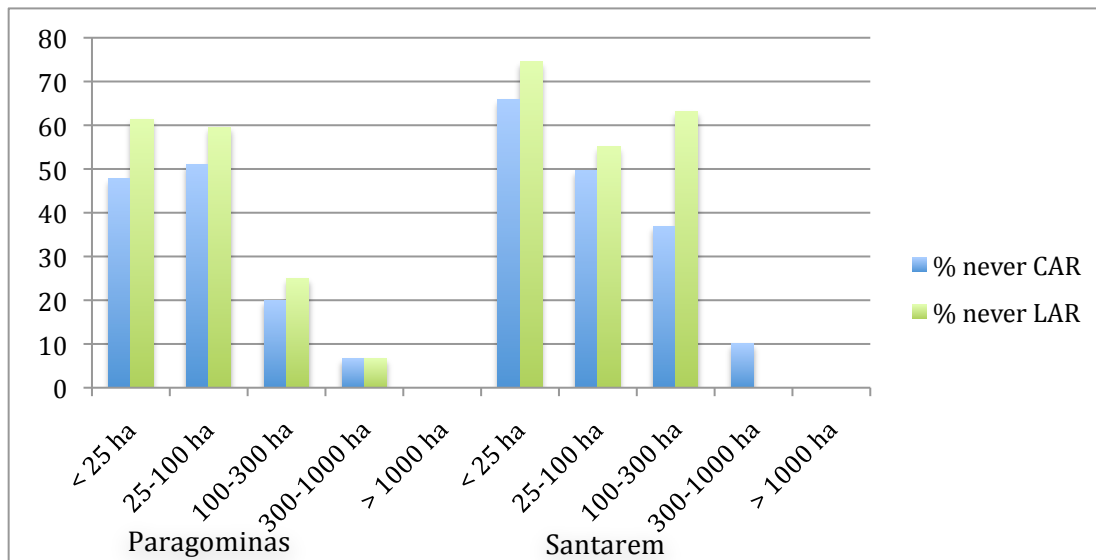
In our sample, only properties in Santarem have LAR and mainly among the intermediate landowners (300 to 1000 ha), which are predominantly annual crop farmers (soy, rice, corn). Although LAR is compulsory for the Legal Beef Program there is a certain level of flexibility insofar as producers must only prove they started the process before 2010, and have LAR by 2011. Although the survey was carried out in

¹⁰ The Red List was first published by the Ministry of Environment in 2008, listing municipalities critically responsible for deforestation, thus becoming a priority for anti-deforestation policies

2011, it is surprising that we found no evidence for LAR in cattle farms. What is more surprising is the low proportion of LAR documents compared to owners of CAR.

Smallholders are notably excluded from the process of property legalization. Virtually no farms with less than 100 ha have CAR, and only 20% of those between 100 and 300 ha. In agrarian reform settlements (up to 100 ha), the federal agency INCRA is responsible for organizing the CAR. Given costs of securing a CAR individually (between 1000 and 5000 reais, according to data collected) smallholders are unable to achieve this on their own, and have little incentive to do so given weak or no exposure to markets. However, our data also indicate that 60% of smallholders (properties less than 100 ha) have never heard of CAR and LAR (Figure 3). This can be partly explained by low levels of literacy, widespread confusion about legal status and lower access to information source.

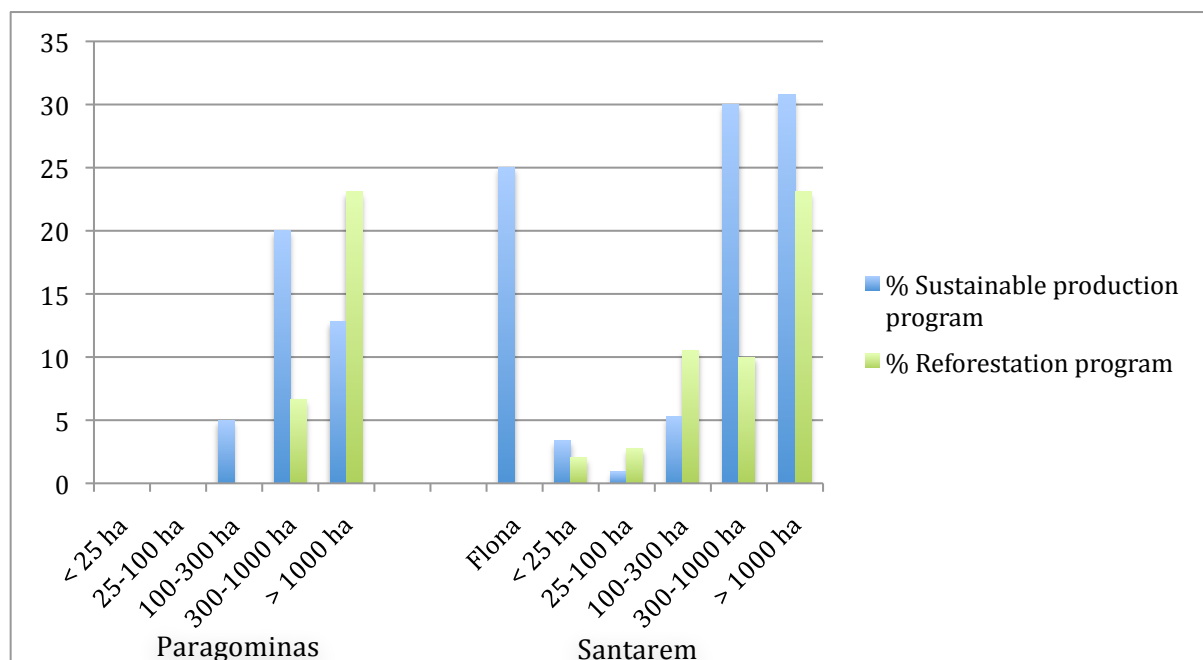
Figure 3. Awareness of regulations



4.3 Towards sustainable production

A number of different options are available to improve on farm income without requiring further deforestation, including sustainable intensification, reforestation and forest management. The RAS data gives some information on the level of participation to sustainable production programs and reforestation projects.

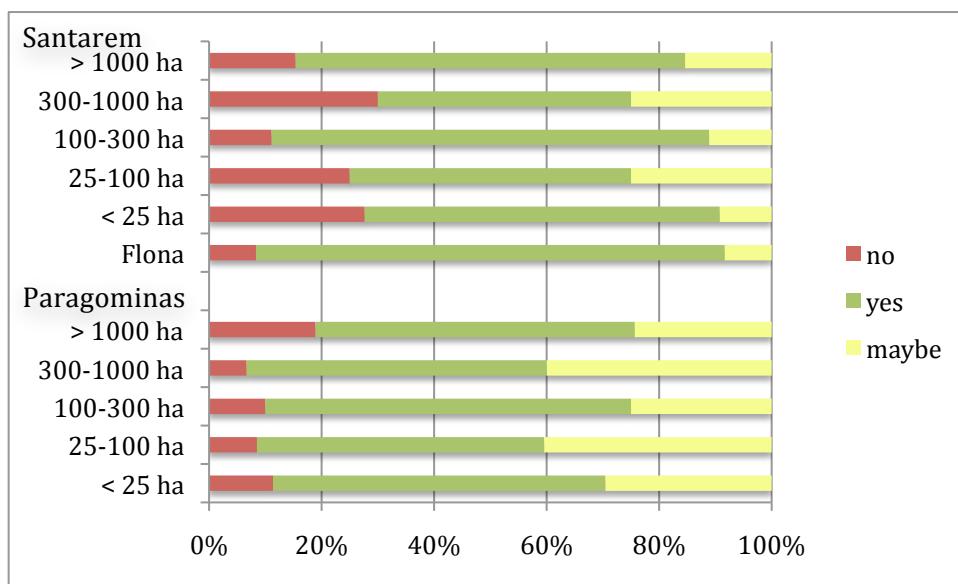
Figure 4. Percentage of properties with sustainable production or reforestation projects



Few properties in our sample are involved in sustainable production programs (such as the TNC-Cargill initiative or a best practice initiative for cattle farmers recently initiated with support from Vale in Paragominas) to guarantee compliance and environmentally responsible practices, or restoration programs (Figure 4). In Paragominas, there are 10 reforestation projects (out of 165 properties), and in Santarem, 13 (out of 310), with no participation from smallholders.

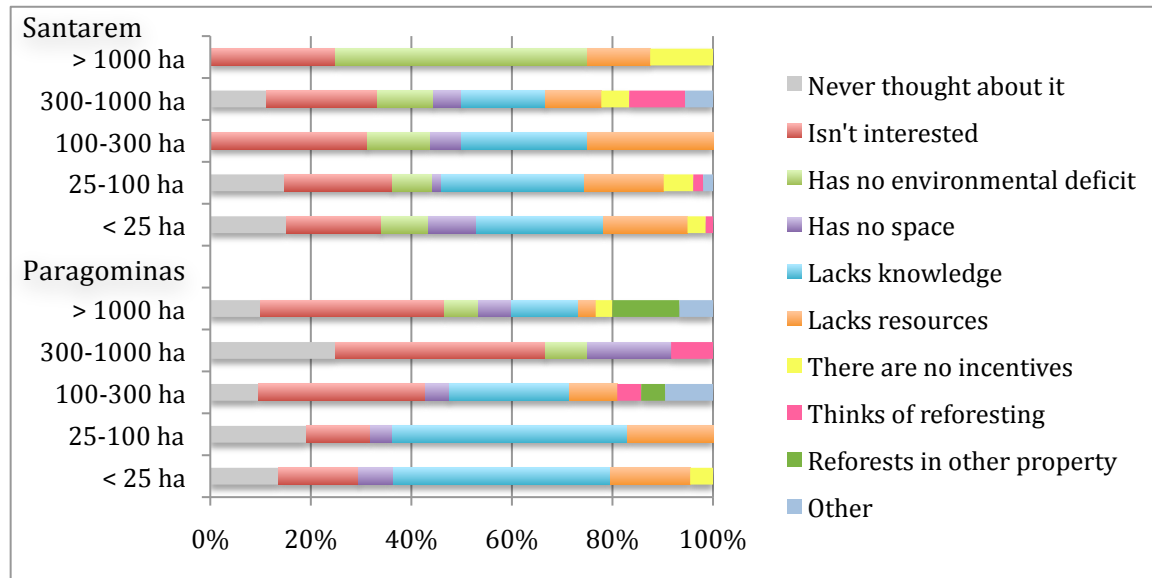
Although most properties have a legal reserve deficit few landholders have chosen to achieve legal compliance through reforestation. Nevertheless, more than 60% of landowners reported that they would be willing to participate in a reforestation project, with more interest in Santarem than in Paragominas (Figure 5).

Figure 5. Landowners who are willing (or not) to participate in a reforestation project (percentages per category)



Considering the reasons why individuals have not yet engaged in reforestation efforts different patterns appear between property size categories (Figure 6). Intermediate and large (over 100 ha) landholders demonstrated little interest whilst smaller farmers often lack appropriate knowledge and resources.

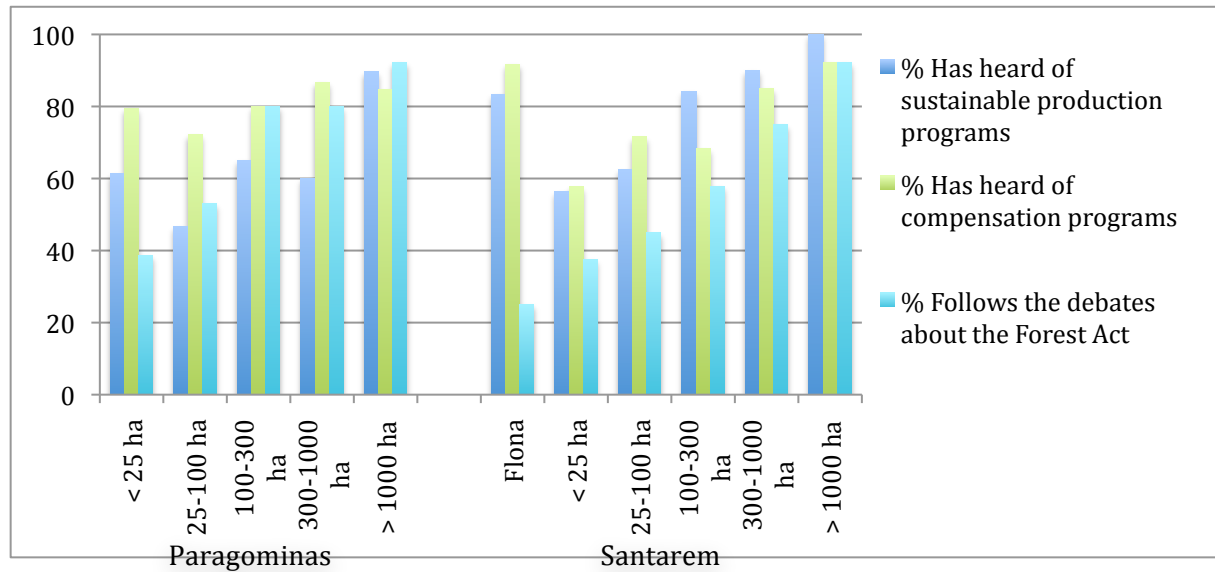
Figure 6. Reasons for not engaging in reforestation (one answer only, percentage according to property size and municipality)¹¹



Several landholders in Santarem indicated that there was a lack of government incentives (not only financial, but also technical support) for reforestation and also that bureaucracy remains an important barrier. Awareness of different sustainability initiatives (such as sustainable production programs or compensation for not deforesting) is relatively high, even among smaller holders (Figure 7).

¹¹ The answers « has no space », « there are no incentives », « thinks of reforesting », « reforests in other property » have been disaggregated from the « other » option.

Figure 7. Awareness of sustainable production programs, compensation programs or the Forest Act modifications (percentages per category)



For all categories, awareness of sustainable production initiatives is greater in Santarem, which is unsurprising given impact of the soy moratorium in this region. Awareness of changes in the Forest Act is greater in Paragominas and landholders cite that one important source of information is the government, which is not at all mentioned by landholders in Santarem.

5. Conclusion

What can we learn from differences in levels of compliance levels illustrated by our study? At the scale of individual properties deforestation on primary or old secondary forest has been decreasing since 2000, indicating that these regions are becoming consolidated. A large number of properties have already experienced significant deforestation. Whilst the majority of larger landowners have ceased deforesting altogether, many remain with a legal reserve deficit (i.e. less than 50 or 80% forest cover

depending on the region), indicating that the main policy challenge is now to improve legalization of farms and no longer in reducing deforestation.

Substantial progress has already been achieved in the legalization process with regards to CAR especially amongst larger properties. The strongest motivations for acquiring CAR may be linked to market access and credit sanctions and not always due to legal requirements (e.g. as in the case of the Legal Beef initiative). In Santarem, although CAR is not required to sell soy, as part of efforts to counter the negative image from the 2006 Greenpeace campaign, the main exporter, Cargill, in partnership with TNC has actively promoted CAR and LAR amongst its suppliers. Adoption of LAR remains very low, highlighting doubts regarding the true efficiency of CAR. As pointed out by Rajão *et al.* (Forthcoming), the mere possession of CAR may do very little to change land-use practices, and may even legitimize deforestation (Rajão *et al.*, Forthcoming). As such the process of legalization alone is evidently not sufficient to encourage a transition towards more sustainable farming practices.

Perhaps counter intuitively, awareness of incentive programs (compensation for not deforesting, sustainable production) is higher than awareness of reforms to the Forest Act, which regulates native vegetation cover on private properties - suggesting that soft laws and market pressures can have a stronger effect on producer behavior than the law itself (Branstromm *et al.* 2011). High levels of awareness and interest in voluntary sustainability programs raise the risk of widespread disappointment if benefits (e.g. through compensation or preferential market access) are not forthcoming (Nepstad *et al.* 2011). Reforestation is viewed relatively positively, but many barriers still have to be addressed including technical capacity and capital costs.

The most striking result of our survey is that small farmers (less than 100 ha) are essentially excluded from the legalization process. Approximately half of them do not have any forest remaining on their land at all. In Paragominas, 20% of landowners from our sample are still clearing forest or old regrowth. Virtually no smallholders have CAR (which for many, depends on INCRA), nor are they aware of its necessity and none currently participate in any sustainable production or reforestation initiative. Clearance of young regrowth appears to have increased in many places. Whilst these young secondary forests can be part of a well-managed alternative system (Denich et al., 2005) if poorly managed they can also precipitate more rapid degradation of the wider landscape, e.g. through the impacts of fire.

These findings identify serious shortcomings of existing efforts to legalize rural properties in the Brazilian Amazon, especially considering that Paragominas and Santarém are at the forefront of political efforts and investment in capacity building by NGOs. Many smallholders currently feel that they have very few alternatives available to them. Whilst the new Forest Act will probably not expect them to comply with strict environmental regulation, understanding their motivations and capacities to change (Marshall and Marshall, 2007), remains an essential challenge in any effort to address this current policy gap.

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Appendix. Extra tables and figures

Table A1. Representativeness of sample, according to size (percentage of properties represented in each category)

	Paragominas			Santarem		
	Total (IBGE 2006)	Sample (nb properties)	Representativeness	Total (IBGE 2006)	Sample (nb properties)	Representativeness
<20ha	98	11	11%	5461	120	2%
20 - 100 ha	90	80	89%	1864	138	7%
100 - 200 ha	19	15	79%	858	11	1%
200 - 1000 ha	98	20	20%	113	28	25%
> 1000 ha	155	39	25%	20	13	65%
Total	460	165	36%	8316	310	4%

Table A2. Dominant production, in percentage of properties

	Annuals	Perennials	Pasture	Silviculture	Total properties
Paragominas (IBGE 2006)	19%	7%	61%	1%	461
Paragominas (sample)	25%	2%	62%	7%	165
Santarem (IBGE 2006)	57%	6%	23%	0%	9242
Santarem (sample)	51%	11%	30%	1%	310

Table A3. Dominant production in land use (percentages per category and municipality)

Area (cat)	Mun.	Annuals	Perennials	Pasture	Silvi.	Mixed	Other	NA	NB
< 25 ha	PGM	43	5	43	2	2	5	0	44
< 25 ha	STM	57	17	17	0	1	5	3	149
25 -100 ha	PGM	19	2	74	2	2	0	0	47
25 -100 ha	STM	43	5	44	1	1	4	3	109
100 -300 ha	PGM	30	0	60	0	5	5	0	20
100 -300 ha	STM	32	11	53	0	0	5	0	19
300 -1000 ha	PGM	40	0	60	0	0	0	0	15
300 -1000 ha	STM	80	0	20	0	0	0	0	20
> 1000 ha	PGM	5	0	69	23	0	0	3	39
> 1000 ha	STM	38	0	31	8	8	8	8	13
Total		41	7	40	3	1	3	4	487

Figure A1. Deforestation dynamic in Paragominas and Santarem, between 2001 and 2009

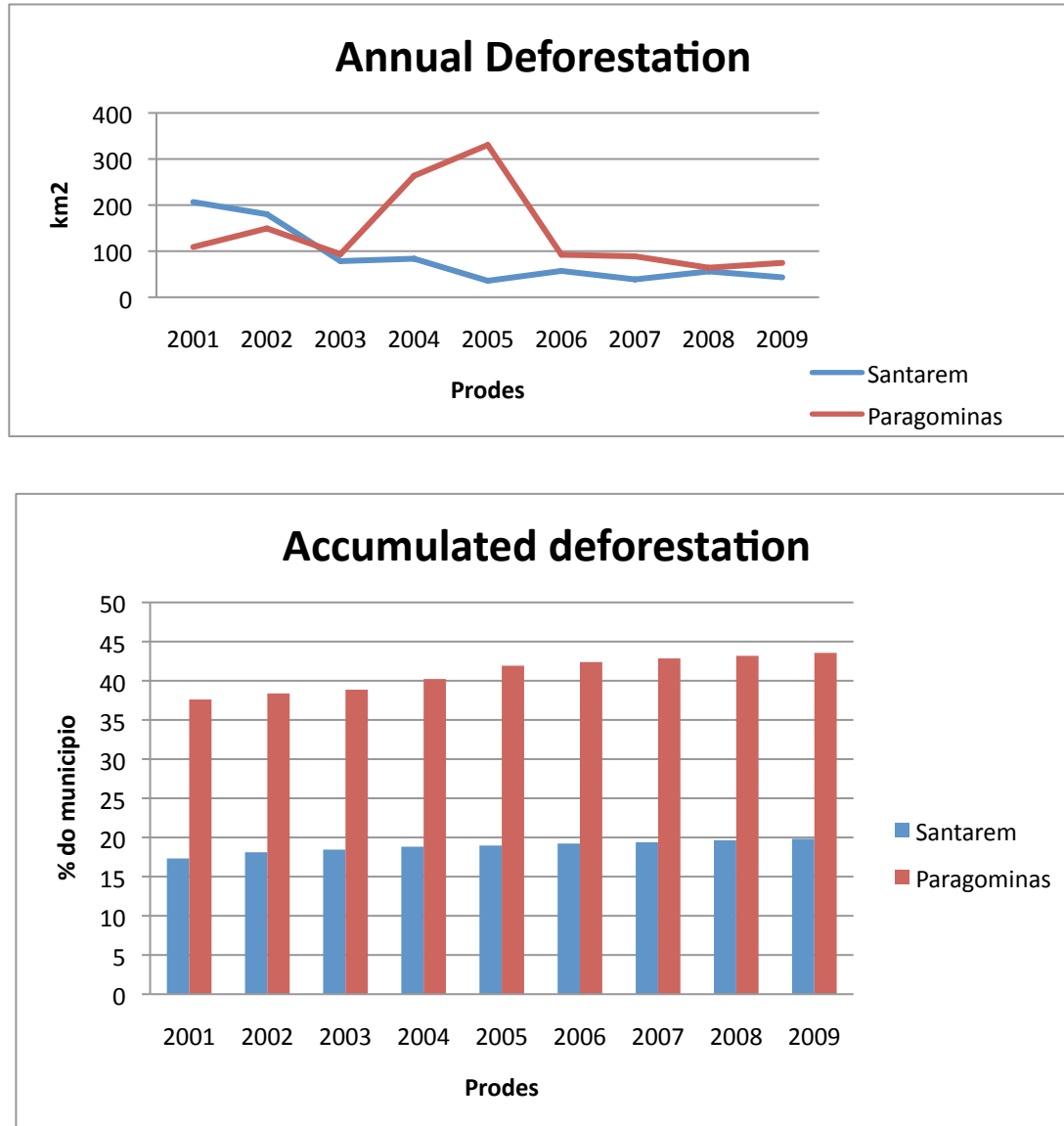


Figure A2. Type of land cover cleared, according to size of property (percentage of landowners in size category having cleared a type of land)

