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Challenges of Governing Second-Growth Forests: A Case Study from the Brazilian Amazonian State of Pará

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Abstract: Despite the growing ecological and social importance of second-growth and regenerating forests across much of the world, significant inconsistencies remain in the legal framework governing these forests in many tropical countries and elsewhere. Such inconsistencies and uncertainties undermine attempts to improve both the transparency and sustainability of management regimes. Here, we present a case-study overview of some of the main challenges facing the governance of second-growth forests and the forest restoration process in the Brazilian Amazon, with a focus on the state of Pará, which is both the most populous state in the Amazon and the state with the highest rates of deforestation in recent years. First, we briefly review the history of environmental governance in Brazil that has led to the current system of legislation governing second-growth forests and the forest restoration process in Pará. Next, we draw on this review to examine the kinds of legislative and operational impediments that stand in the way of the development and implementation of a more effective governance system. In particular, we highlight problems created by significant ambiguities in legal terminology and

inconsistencies in guidance given across different levels of government. We also outline some persistent problems with the implementation of legal guidance, including the need to understand local biophysical factors in order to guide an effective restoration program, as well as difficulties presented by access to technical assistance, institutional support and financial resources for the establishment and monitoring of both existing secondary forests and newly regenerating areas of forest. Whilst we focus here on a Brazilian case study, we suggest that these kinds of impediments to the good governance of second-growth forests are commonplace and require more concerted attention from researchers, managers and policy makers.

Keywords: forest governance; restoration; secondary forests; Amazon

1. Introduction

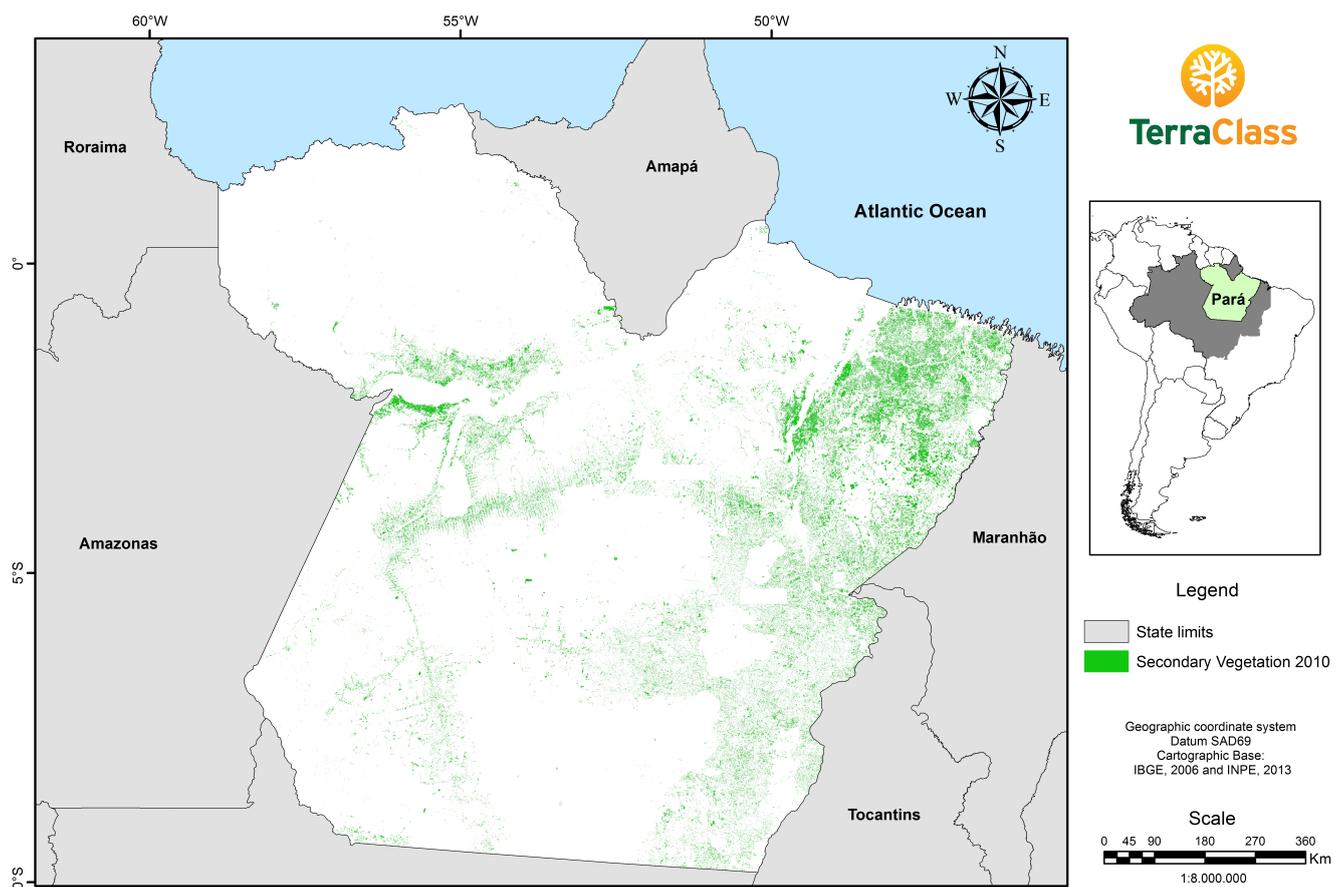
Second-growth forests (*i.e.*, forests regenerating on areas that have previously been clear-cut) are an increasingly ubiquitous element of human-modified landscapes and currently account for more than half of the world's remaining tropical moist forests [1,2]. These forests can provide critically important habitat for safeguarding biodiversity, especially in parts of the world where native vegetation is highly fragmented or where there is little old-growth forest remaining [3–5]. Second-growth forests can also provide significant ecosystem services, including the recovery of soil fertility in fallow farming systems [6,7], the provision of natural resources to support local livelihoods [8] and carbon sequestration and conservation [9–12].

Yet, second-growth forests can often be highly ephemeral components of a landscape [13]. Many human-modified landscapes in agricultural frontier regions are comprised of complex and dynamic patchworks of agricultural areas and fragments of regenerating forest [14]. The fate of a given patch of second-growth forest is determined by the interplay between economic incentives for returning the land to production, the value of the forest to local people (including as fallow land for farmers who lack access to external sources of nutrients) and the legal framework governing the management and clearance of such forests [15]. Yet, the legal framework governing second-growth forests in many countries and especially in those with active deforestation frontiers is frequently marked by high levels of uncertainty and controversy. This is for at least two main reasons. First, the fact that such landscapes are highly dynamic, with shifting patterns of active agricultural production, fallow and land abandonment, makes it hard to design, implement and monitor any regulations on second-growth management and clearance practices. Second, the value of second-growth forests to society is often poorly appreciated, and they are commonly viewed as areas of degraded land with little or no economic value. This perception is exacerbated by considerable uncertainty and disagreement regarding the point at which a forest regenerating on once-cleared land can legally be classified as a “forest”.

Here, we present an overview of some of the particular challenges facing the governance of second-growth forests. We use the state of Pará, in the eastern Brazilian Amazon, as a case study, as it is typical of many agricultural frontier regions across the tropics. Significant agricultural land

abandonment has been observed in this region since 1940 [16], and about 25% of the deforested area was under some form of second-growth forest in 2010 [17]. Forty percent of this was in the state of Pará, where the Brazilian government's TerraClass mapping program identified over 165,000 km² of second-growth vegetation in 2010 (Figure 1). Although some regenerating stands in older landscapes, such as in the northeast of Pará, can be over 50 years old, most second-growth forests in the Brazilian Amazon, as elsewhere, are relatively short-lived components of a landscape, with an average age of only five years in 2002 [18].

Figure 1. Distribution of secondary forests in Pará state, Brazil. Source: Instituto Nacional de Pesquisas Espaciais—Centro Regional da Amazônia (CRA/INPE).



To provide context, we first briefly examine the legal framework governing environmental resources and second-growth forests across Brazil, before focusing on evolving governance structures of the state of Pará. We then analyse some of the key impediments, including both legal and implementation aspects, facing the development of a system of good governance for second-growth forests. In discussing second-growth forests, we are concerned with both the governance of established areas of second-growth forest, as well as the governance, whether through passive or active approaches to restoration, of forests regenerating on cleared land. Forest restoration is of particular prominence in Brazil following the recent revision and renewed enforcement of the Forest Code (Código Florestal)—the central piece of legislation regulating land use and management on private properties.

We end the paper with a brief discussion on how many of these issues are generic to agricultural regions across the world.

2. A Historical Perspective of the Governance of Second-Growth Forests and Forest Restoration in Brazil and the State of Pará

Across Brazil, many aspects of the legal framework governing second-growth forests and the regeneration of degraded land remain both poorly clarified and understood [19,20]. Persistent ambiguities and uncertainties in the legal framework governing second-growth forests in Brazil has led to a lack of consistency and coherence between different levels of environmental governance, as well as negatively affecting the perception of their importance to society by both the agricultural sector and legislators alike. Part of the confusion relates to the distinctly hierarchical nature of Brazil's federal governance system, where regulations imposed by states and municipalities cannot be seen to undermine federal directives (*i.e.*, they can only be more, not less, environmentally conservative). However, in practice, the state level, through the actions of state environmental secretaries, often emerges as the dominant player in legislating, regulating and controlling environmental impacts.

To better understand these complexities, it is necessary to evaluate the history of second-growth forests (and regenerating areas of other, non-forest ecosystems) that have been recognized by Brazilian law. In 1981, the National Environment Policy of Brazil (Law No. 6938) highlighted the “restoration of degraded areas” as a national priority, including for mitigation and compensation activities related to development impacts (e.g., infrastructure, mining and oil and gas). Subsequent to this, the Environmental Criminal Law (1998, Law No. 9605) gave further legal weight to the importance of restoration and the value of second-growth forests, by stipulating that the restoration of degraded areas should form an obligatory part of environmental mitigation strategies.

However, despite the recognition given to second-growth forests in these early pieces of environmental legislation, their significance in the eyes of many legislators and environmental implementing agencies continued to remain limited, especially in the agricultural sector. This situation changed abruptly following the revision of the Forest Code in 2012 (Law No. 12651/2012), which attracted enormous national and international attention and heralded the start of a new phase in the development and implementation of forest policy in Brazil [20]. After multiple vetoes and revisions, the revised law finally came into force in October of the same year (Presidential Decree 12727/12).

The revised Forest Code introduced new mechanisms and criteria to determine the areas that need to be conserved and/or regenerated, depending on property size and the length of time since the original forest was cleared. A central pillar to its implementation is the Cadastro Ambiental Rural (CAR) (Table 1), an electronic land registration system, where landowners declare the current legal status of each rural property in terms of legal reserves (LR), areas of permanent protection (APP) and production areas.

Considering the entire country, the new law identified some 21 million hectares of illegally cleared land that must be restored, of which 78% is in private legal reserves and the remainder in areas of permanent protection, including areas of riparian vegetation and other environmentally sensitive areas, such as steep slopes and hilltops [21]. With respect to LRs in properties, where the CAR system shows a reserve deficit (which is less than 80% in forested areas of the legal Amazon) prior to July 22, 2008,

the deficit area must be restored within 20 years. By contrast, properties with a deficit created after July 22, 2008, are obliged to immediately suspend all production activities, and regeneration strategies must be put in place by 2014. In the case of APPs, areas that were already consolidated for agriculture prior to July 22, 2008, are “allowed to continue in production, provided that, and depending on property size and other factors, minimum-sized areas are regenerated”. Under the revised Forest Code, the total area of environmental deficit, *i.e.*, areas deforested prior to 2008 that must now be restored, has been reduced by 58% compared to the original law, mostly due to an amnesty given to smaller properties, permitting the inclusion of APPs in the calculation of the total LR area, a reduction in the LR restoration requirement to 50% in municipalities dominated by protected areas and relaxing of the restoration requirements in APPs on smaller properties and those designated for agricultural production [20].

The changes and adaptations to the federal Forest Code generated an enormous legislative and implementation burden for individual states, which were passed the responsibility of prescribing specific laws and regulations for enforcing forest governance at the regional level. For example, properties with a deficit of legal reserve or APP must adopt regeneration strategies in agreement with the relevant state’s Program for Environmental Regularization (Programa de Regularização Ambiental, PRA) (Table 1). For the majority of states, this is underpinned by the Rural Activities License (LAR), which acts as the main regulatory mechanism for the overall organization of land use, including any areas set aside for restoration. The LAR sets a legal obligation to bring the property into compliance with environmental regulation, including the restoration of or compensation of LRs and APPs (Table 1). Beyond the establishment of state-level PRAs to guide the restoration process for illegally deforested areas, state-level regulations are also needed to prescribe the governance of existing second-growth forests and whether they should be classified as either forest or fallow land. For example, in many states, there is no legal definition on when a regenerating area becomes classified as “forest” compared to “fallow” and qualifies for legal protection. There is also a lack of guidance on the ways in which fallow areas can be cleared, as well as the restoration techniques that should be used, whether active or passive, to restore land that was illegally deforested in the past, despite an emerging body of literature on the subject [22]. In combination, such legislative shortcomings often open the door for *ad hoc* and inconsistent decision-making that, in the long-run, is likely to severely undermine this undervalued environmental resource.

Currently, Pará is the only state of the Brazilian Amazon that has adopted an explicit definition of second-growth forests, *i.e.*, forests that have regenerated from previously cleared land and that can no longer be considered as fallow (and, hence, cannot be cleared). For now, the state has defined a lag time of three years before any active restoration activity is initiated in order to evaluate the potential for passive restoration (thereby reducing costs). This delay period was established in recognition of the natural propensity for the regeneration in the Amazon region if the previous land use had not been excessively intense [22]. The regulations proposed in the PRA further stipulate that any necessary active restoration activities must be completed within nine years for APPs and 20 years for LRs, with frequent periods of monitoring for each.

Table 1. Legal instruments associated with the Brazilian Forest Code (Law 12651/2012) and its relation to the governance of second-growth forests and the forest restoration process in Brazil.

Legal Instruments	Definition	Role in the Restoration Process	
Permanent Protection Areas (APPs)	Environmentally sensitive areas that must be legally protected to conserve water resources, geological stability, biodiversity, facilitate gene flow of fauna and flora, afford soil protection and support the well-being of local human populations. APPs include both riparian areas that protect riverside forest, hilltops and steep slopes.	The amount of APP that must be restored is proportional to the size of the property, as well as the water body in question in the case of riparian areas.	Property size (fiscal module) Width of APP to be restored (m)
		Up to 1	5, for all water courses
		1 to 2	8, for all water courses
		2 to 4	15, for all water courses
		4 to 10	20 to 100, depending on water course width
		Above 10	30 to 100, depending on water course width
		All	15, for all perennial springs.
Legal Reserves (LRs)	Legal reserves are fixed minimum percentages of properties that must be left as native vegetation, the size of which varies by biome. Some sustainable use is allowed (such as selective logging), but the areas must assist in the conservation and rehabilitation of ecological processes and promote biodiversity conservation.	Following the revised Forest Code, restoration of LRs must take place in 20 years or less. This can be achieved passively through natural regeneration or by planting different native species. The use of fruit, ornamental or exotic cultivated species is also allowed in small (family) farms, when intercropped with native tree species.	
SICAR (Sistema de Cadastro Ambiental Rural)	The SICAR is a nationwide electronic system for the management of environmental information of rural properties	SICAR permits the federal government to more effectively oversee land use planning and environmental conservation initiatives nationwide, as well as allowing individual property owners to assess their own compliance with the revised Forest Code. From 2017, financial institutions will only grant credit to CAR-registered rural landowners.	

Table 1. Cont.

Legal Instruments	Definition	Role in the Restoration Process
Rural Activities License: LAR	The main regulatory mechanism for the overall organization of land use, including the restoration process established by Pará state decree (857, January 30, 2004, and subsequently edited (Decree 216, September 22, 2011).	Determines what agricultural activities can be conducted in areas where native vegetation has already been modified/cleared and represents the main instrument for controlling, monitoring and demonstrating the environmental compliance of private properties in Pará, especially regarding the management of legal reserves and permanent protection areas.
Program for Environmental Regularization (PRA)	The Programa de Regularização Ambiental (PRA) is the state-level instrument used to implement the Presidential Decree 8235 with a set of actions or initiatives to be undertaken by rural landowners and leaseholders in order to achieve environmental compliance.	Deals with the regularization of APPs and LRs and restricted use (RU) upon recovery, restoration, regeneration or compensation. The owners or occupiers of rural properties should hold the PRA after completing the Rural Environmental Registry (CAR). The decree complements the rules necessary for the implementation of the CAR, which will start the process of rural environmental restoration planned in the current Forest Code.

In February, 2014, Pará established the first legislation defining successional stages of second-growth forests for any Amazonian state (Instrução Normativa, IN 02 February 26 2014). Prior to establishing this law, the management of different types of second-growth forests and their clearance for agriculture represented something of a legal vacuum, preventing the implementation of state zoning legislation (State Decree 7398, 2010), which stipulates that intermediate and advanced-stage second-growth forests should be conserved. Following the passing of IN 02 February 26 2014, licenses for the clearance of second-growth forest in a given private property must be based on a combination of age, the basal area of large trees and the percentage of primary forest in the municipality where it is located. Stands of second-growth forest shown through inspection of satellite images to be older than 20 years are recommended for protection without requiring any field assessment, while stands between five and 20 years old are recommended for protection, depending on the total stand basal area of native trees and palms equal to or larger than 10 cm in diameter. The threshold to authorise the clearance for agriculture is less than $10 \text{ m}^2 \text{ ha}^{-1}$ for municipalities with higher than 50% primary forest cover and less than $5 \text{ m}^2 \text{ ha}^{-1}$ for those municipalities with less than 50% primary forests.

The above criteria, developed through a scientific advisory working group (including the authors of this article) under the auspices of the state environmental department, SEMA and the Programa Municípios Verdes (a state-wide program to reduce deforestation and promote the adoption of more sustainable land-use systems), took into consideration the recovery of biodiversity and ecosystem service provision using field information from 140 forest plots across the state.

The definition of second-growth successional stages also informs how these areas can be used for achieving environmental compliance. For example, according to the current proposal for the state PRA, areas can only be traded if they are in an intermediate or advanced stage of regeneration (although areas in an initial stage of regeneration can be rented to a third party through a strictly bilateral arrangement). This focus on the older second-growth forests helps avoid inundating the market for the trading of legal reserve credits to achieve compliance with the Forest Code with vast areas of very young second-growth forest.

3. Impediments and Challenges to the Good Governance of Second-Growth Forests and the Restoration Process in the State of Pará

Despite the advances made by the Brazilian federal- and state-level environmental legislation outlined above, there are many challenges involved in ensuring that these changes result in the good governance of second-growth forests, *i.e.*, safeguarding the long-term protection of the environmental services provided by these forests, whilst ensuring the fair and sustainable development of the agricultural sector, including the need for adequate resources and technical assistance to support the regeneration of degraded and illegally deforested areas. We outline some of these challenges using the state of Pará as our case study, first assessing some of the key legal impediments to good governance and then examining the operational challenges, highlighting four key issues that complicate translating legal prescriptions into practice. Our assessment is far from exhaustive and reflects our own experiences of some of the key barriers to the effective conservation of existing second-growth forests and the large-scale restoration of degraded areas in Pará. However, we believe that many of these issues are generic to the conservation and restoration of second-growth forests in other Brazilian states

and other nations that host tropical forests. By highlighting these persistent problems, we hope to contribute towards efforts to develop more clear, consistent and fair regulatory frameworks for second-growth forests across the tropics.

3.1. Legal Impediments to Achieving Good Governance of Second-Growth Forests

The legislative frameworks governing second-growth forests and the process of restoring forest on illegally cleared land in the state of Pará have a wide range of short-comings that are not limited to this state and are symptomatic of widespread difficulties in developing clear, consistent and fair rules for the management of second-growth forests, and indeed, environmental resources in general, in many parts of the world. Here, we briefly discuss four types of impediment that can be observed in Pará today and exemplify some of the problems that they generate, including a lack of clarity in key definitions; inconsistencies in legal frameworks between different levels of governance and over time; and the potential for abuse or “loopholes” in how regulations are enforced.

3.1.1. Unclear or Poorly Founded Definitions and Concepts

An important conceptual challenge facing the governance of second-growth forests in Brazil in general is the diversity of scientific and technical terms used to describe key issues, such as the process of forest restoration itself, and a lack of consensus regarding the use of these terms amongst different actors. For example, the revised Forest Code refers to the obligation to restore native vegetation where private properties are not compliant with the law, but uses a variety of terms to describe this, including forest recovery, restoration and recuperation. Restoration is considered by this law to be the “recovery of a degraded ecosystem or a wild population to a state as close as possible to its original condition”, while recuperation is the “recovery of a degraded ecosystem or a wild population to a non-degraded condition, which may be different from its original condition”, while the term recovery refers more broadly to land, soil, vegetation and the environment generally. The use of these contrasting terms often interchangeably can generate confusion as to the overarching aims of a given piece of legislation.

In addition, regulations that prescribe how second-growth forests should be protected, cleared and managed are often made without any clear justification or supporting evidence. For example, prior to the approval of the new law (IN 02/2014), the interim legislation decreed that second-growth forests could be cleared for agriculture wherever there was a density of less than 50 trees larger than 10 cm DBH (diameter at breast height) per hectare. However, it has been impossible to find any documentation or evidence supporting why this “50 trees per hectare” rule was chosen.

3.1.2. Inconsistencies between Different Levels of the Legal Framework

The responsibility for the environmental governance of private land in Brazil is distributed across federal, state and municipal levels. However, delays in the specification of general frameworks provided by the federal government at state and municipal levels, as well as differences in priorities between different levels of government can commonly result in uncertainty and contradictions regarding the interpretation of the law at the local level. For example, there is a lack of specific guidance on the techniques that should be used to facilitate regeneration in areas that must be restored

by law (e.g., deforested riparian zones), such as the type (e.g., native or non-native) and number of species that should be used, resulting in the potential for varying interpretations and possible development-conservation conflicts [23]. A wider problem in aligning the requirements imposed by federal legislation with implementation at the local level is the need for political continuity in the state government, which is primarily responsible for managing this process. This is especially problematic in the case of long-term environmental problems, such as the regeneration of second-growth forests that play out over multiple election periods. The failure of the “1 billion trees” restoration program initiated by the previous Pará state government provides a clear example of this. This program developed the first technical guidance for restoration projects in Pará (State Decree 1848, August 21, 2009), but despite its political importance, it suffered from significant strategic and operational problems and was discontinued two years after implementation.

3.1.3. Frequent Revisions to Legal Documents over Time

A key requirement for a given piece of legislation to be regulated and implemented in practice is that it remains stable for a minimum period of time. However, in practice, Brazilian environmental legislation is commonly characterized by frequent revisions and alterations. The federal Forest Code is perhaps the most famous example of this, which was subject to a very large number of provisional amendments before the current version was finally agreed upon in October, 2012. In the state of Pará, the main piece of legislation governing the conservation and restoration of forests in private properties was altered three times in four years (State Decrees, 2141 in March, 2006, 1848 in August, 2009, and 2099 in January, 2010), with each new revision revoking the authority of the previous version. These changes generated significant controversy and uncertainty and prevented the finalization of specific regulations (e.g., the size of legal reserves in areas with state zoning legislation) that are needed to implement any new law once it has been approved. The personal experience of the authors is that extremely few individuals, whether legislators, enforcers or landowners, have a strong command of the full set of legal prescriptions for the management and clearance of second-growth forests at any given point in time. This situation is further exacerbated by the frequent turn-over of key individuals in state- and municipality-level government.

3.1.4. Potential for Abuse and the Inequitable Application of Regulations

A common complaint regarding environmental legislation in Brazil, as elsewhere, is the existence of possible loopholes that open the door to abuse and differentiated responsibilities. Second-growth forests are perhaps particularly susceptible to this problem owing to their highly dynamic nature and the sensitivities of imposing clearance restrictions in places where some farmers rely on rotation-fallow systems in order to maintain their livelihoods.

An example of this potential problem is in the recent regulation, IN 02/2014, to determine the clearance of second-growth forest. The law states that areas younger than five years can be cleared irrespective of their physical structure, whilst areas older than 20 years must be conserved. Areas between five and 20 years can be licensed for clearance if the total basal area of the forest is less than $10 \text{ m}^2 \text{ ha}^{-1}$. However, in the absence of highly prescriptive guidance on how field surveys (to determine if the basal area of a site is above or below the threshold) should be conducted, landholders are able to

position vegetation plots such that they avoid the largest and densest areas of trees. Moreover, if the area is subject to selective logging or allowed to burn prior to conducting the field surveys, it is possible that the average basal area could be reduced just beneath the critical threshold, thus deceiving the regulators. Indeed, there is some anecdotal evidence that this is already happening.

3.2. Operational Impediments to Achieving Good Governance of Second-Growth Forests

In addition to problems of clarity and consistency associated with the legal framework itself, there are significant operational impediments to the implementation of effective legislation governing existing and regenerating second-growth forests. Here, we consider some of the practical difficulties associated with restoration forestry regarding: (i) an understanding of the historical, geographical and ecological aspects that influence the likely success of any restoration project; (ii) access to technical and institutional support for restoration activities; (iii) the availability of and access to resources for monitoring; and (iv) access to adequate financial resources.

3.2.1. Understanding of Historical, Geographical and Ecological Aspects That Influence the Likely Success of any Restoration Project

As is the case across many parts of the tropics, there is limited knowledge on many of the ecological factors that could influence the success of restoration in different areas of a highly heterogeneous region, such as Pará. Some previous research has addressed how past land uses [24] and natural conditions influence forest regeneration, such as climate factors [25] and soil fertility [26]. However, further research is needed to help elucidate the positive or negative influence of factors, such as previous land-use intensity, the availability of nearby forests to act as a source for seeds, the use of different species of nurse trees and how to adapt restoration to suit particular ecological contexts, such as forests on white-sand soils, steep slopes and in riparian areas.

3.2.2. Access to Technical Guidance and Institutional Support for Restoration Activities

The success of a given restoration project is often determined by technical and institutional factors. Landowners commonly report that the lack of technical guidance to advise on planting and management techniques is more of a barrier to restoration than problems in accessing credit. This is particularly the case in designing restoration projects for areas where natural succession may be inhibited or to ensure that regenerating stands include economically valuable species, such as fruit and timber trees. There are major knowledge gaps regarding the species of seeds or seedlings that are likely to be established under different environmental conditions and levels of degradation. Although some federal institutions (Empresa Brasileira de Pesquisa Agropecuária and the Universidade Federal Rural do Pará) participate in the National Network of Seeds and have protocols for collecting the seeds of native forests species, the availability of these seeds remains limited by a lack of qualified collectors. Similarly, access to sufficient seedlings can often be a critical factor limiting the restoration of large areas with native trees. Problems related to technical assistance are often exacerbated by a lack of clarity in technical guidelines as to what is permissible, as well as inconsistencies in prescriptions given by different levels of government. An example here is the lack of clarity in what defines a native

versus a non-native species, despite the fact that this distinction is often invoked in regulations governing forest restoration. Moreover, there are a number of provisions for using mixed plantings of native and non-native species, including in both the restoration of legal reserves, but also riparian habitat (where non-native species can be used temporarily to aid regeneration), without the necessary detail on the number and type of native species that should be used or the extent to which non-native trees are permissible.

Another important technical limitation is the number of trained personnel who are able to conduct both desk and field assessments to appropriately map, sample and classify regenerating forests into different stages (*i.e.*, in accordance with the prescriptions given by IN 02/2014).

Of course, the full set of challenges and opportunities linked to restoration in developing countries go far beyond technical concerns related to the restoration process, but also relate fundamentally to the social dimensions of forest restoration, including opportunities for improving livelihoods and food security in rural communities [27,28].

3.2.3. Resources for Monitoring Second-Growth Forests

Although Brazil is one of the few countries to publish spatially explicit deforestation information every year, comparable information on second-growth forests is not yet available. In 2008, Brazil launched a new land-use monitoring project for the Amazon, called TerraClass, that provides biannual data on different production systems, early- and late-stage second-growth and primary forest. This is a useful contribution, but in order to guide fair and consistent decision-making regarding which areas of forest should be conserved and which can be licensed for clearance, a full time series analysis is needed to generate a map of the age of different second-growth stands for the whole state.

3.2.4. Access to Adequate Financial Resources

The revised Forest Code calls for the establishment and promotion of credit lines and extension services to support forest restoration work. Great expectations have been associated with the Programa de Regularização Ambiental (PRA, Table 1) in this regard, but as of yet, no specific incentives or support for restoration have been offered. Whilst access to credit for restoration has improved in the past five years, there is still relatively little awareness as to what opportunities exist and what criteria need to be satisfied in order to access this credit. After the revision of the Forest Code, new credit lines were launched, such as within the smallholder-dedicated Plano Safra dedicated to smallholders, which provided resources specifically designated for forest restoration in LRs and APPs. The barriers to accessing credit are often related to uncertainty and disputes over land titles, and the costs and technical resources needed to resolve tenure problems in the dynamic frontier landscapes that characterise much of Pará, as other areas of the tropics, can be enormous.

4. The Challenge of Governing Second-Growth Forests in the Tropics

As discussed at the start of this paper, second-growth forests present a particular governance challenge, both because they represent what are often highly dynamic components of complex mosaic landscapes, but also because their value for conservation and society is often poorly appreciated by

many key actors. In many ways, second-growth forests epitomize the tensions that commonly exist between environmental and agricultural sectors. On the one hand, the fact that second-growth forests represent a critical component of fallow-based agricultural systems, including millions of traditional smallholder farmers throughout the world, means a strict “fences and fines” conservation agenda is not appropriate. Yet, on the other hand, the fact that these forests are critical to the provision of local and regional ecosystem services, including pollination, soil conservation and the maintenance of hydrological systems, as well as the protection of globally important biodiversity, demands that the restoration of degraded areas is made a major environmental policy, as indeed, it has been in Brazil under the revised Forest Code. Integrating these priorities with trajectories of agricultural development is particularly challenging in highly biodiverse frontier regions, such as Pará, that host a highly diverse array of actors, including millions of poor and vulnerable smallholder farmers.

In seeking to overcome this challenge, we have highlighted the importance of legal and operational impediments that are typical of secondary forest governance worldwide [27–29]. One overarching recommendation that emerges from our analysis and that is echoed by studies elsewhere is the need for much greater clarity, consistency and transparency in the rules that govern the conservation and restoration of second-growth forests, recognizing that the dynamic and uncertain nature of these forests makes this particularly challenging compared to other areas of environmental governance. We argue that achieving this is only possible through careful dialogue between researchers, policy makers and societal representatives involved in both the environmental and agricultural sectors. Second-growth forests, perhaps more than any other area of land management, require a landscape approach that places the costs and benefits of the full land use mosaic at the heart of decision-making. We also recognize the importance of actors and institutions capable of bridging sectors and levels of governance and ensuring that possible contradictions, inconsistencies and flaws are identified and resolved openly. Brazil and, in particular, the state of Pará have made significant progress towards this with the nation-wide consultation process that underpinned the revision of the Forest Code and the establishment of cross-sectoral agencies, such as Pará’s Green County Program. Significant work still remains in Pará, as elsewhere, to ensure that this process gains sufficient momentum to establish a system that links forest conservation and agricultural agendas. This needs to be done by bringing together the regulations, incentives, technical support and monitoring instruments capable of fostering a lasting and fair approach to the management of second-growth forests for the benefit of future generations. Moreover, it is vital that second-growth forests are ultimately recognized as being a benefit, rather than impediment, to the development of sustainable agricultural and forestry systems, ensuring the maintenance of critical ecosystem services, the conservation of biodiversity and the provision of a large and poorly developed job market in restoration ecology and forest management [27–29]. With this in mind, the assessment of second-growth forest conservation and restoration programs should not be made based on technical indicators of forest condition alone, but should incorporate an understanding of the drivers of success, encompassing the suite of inter-related biophysical, socioeconomic and political-institutional factors that will ultimately determine the success or failure of a given project [27].

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Author Contributions

All authors contributed to the planning, research and writing of this paper.

Conflicts of Interest

The authors declare no conflict of interest.

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