INSTITUTIONAL SUBVERSION AND DEFORESTATION: LEARNING LESSONS FROM THE SYSTEM FOR THE ENVIRONMENTAL LICENCING OF RURAL PROPERTIES IN MATO GROSSO

RAONI RAJÃO[1]*, ANDREA AZEVEDO[2] AND MARCELO C. C. STABILE[2]

[1]*Universidade Federal de Minas Gerais (UFMG), Brazil*
[2]*Instituto de Pesquisa Ambiental da Amazônia, Brazil*

SUMMARY

This article contributes to the public administration and environmental governance literature by proposing the notion of 'institutional subversion' as a way of describing how the strategies adopted by local actors may change and even go against the initial aims of institutional development initiatives. The article discusses the case of the system for the environmental licencing of rural properties (SLAPR), an institutional development initiative by the state government of Mato Grosso in the south-eastern portion of the Brazilian Amazon. It will be shown that even though this initiative has earned the status of 'best practice' in controlling deforestation, a closer look at SLAPR reveals that it has led to contradictory outcomes. During the first 8 years of SLAPR, it had no significant impact on reducing deforestation and, in some cases, even permitted the increase of total deforestation by providing authorization for this. According to an institutional analysis of the case study, the article draws particular conclusions that could be relevant to public administrators in the region and in other countries. In particular, it is argued that by accepting the possibility of institutional subversion, public administrators may become more attentive to unexpected consequences and be able to take corrective action. Furthermore, in order to avoid institutional subversion, public administrators should integrate institutional initiatives into broader governmental, technological and economical dimensions. Copyright © 2012 John Wiley & Sons, Ltd.

KEY WORDS—institutional frameworks; deforestation; environmental licencing; rural properties; new institutional theory; institutional subversion; determinism

INTRODUCTION

Following the influential Brundtland Report, environmental preservation, social welfare and economic growth ceased to be seen as opposite objectives, but rather, were considered as pillars of what came to be known as 'sustainable development' (WCED, 1987). In order to realise this vision, different multilateral agreements have highlighted the importance of developing institutional frameworks able to tackle environmental issues on a global scale (United Nations, 1992; UNEP, 2011). Nevertheless, despite advances relating to the creation of formal agreements, only a few achievements have been associated with the implementation of environmental institutional frameworks (Zanchetta *et al.*, 2011).

Academic research in public governance has also highlighted the importance of institutional frameworks, as well as the challenges involved in their implementation. According to many authors, the development of a strong institutional framework includes the establishment of clear land rights, an efficient legal system and the use of advanced environmental monitoring systems (Imperial, 1999; Dasgupta *et al.*, 2001; Esty and Porter, 2005). In the case of the conservation of tropical forests, it has been suggested that economic factors (Macedo *et al.*, 2012), the creation of protected areas in public lands (Nepstad *et al.*, 2006), the definition of land use rights and titles in private lands (Wood and Porro, 2002), as well as the use of advanced remote sensing and geographic

---

*Corresondence to: R. Rajão, Departamento de Engenharia de Produção, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6.627, Campus Pampulha 31270-901, Belo Horizonte, MG, Brazil. E-mail: rajao@ufmg.br

information systems are crucial for the development of effective environmental institutional frameworks (Fonseca et al., 2009; Carmenta et al., 2011). Moreover, although the central role of institutional frameworks in attaining good governance is unquestionable, many studies have shown that the establishment of new frameworks is often difficult and unpredictable, challenging the deterministic assumptions of some public administrators and researchers (North, 1990; Blackler and Regan, 2006).

Consequently, this article proposes the notion of 'institutional subversion' as a way of describing how the strategies adopted by local actors may change and even contradict the initial aims of institutional development initiatives. For this purpose, the study draws upon a new institutional theory in economics as well as organisational studies to discuss the challenges relating to the establishment of environmental institutional frameworks. In particular, through using a case study methodology, it evaluates the outcomes of the system for the environmental licencing of rural properties (SLAPR), one of the largest environmental institutional development initiatives ever undertaken in the Amazon region (Stake, 1995; Yin, 2003). For this purpose, both quantitative and qualitative data were collected on the relationship between the formal rules and technologies concerning SLAPR and the behaviour of the farmers in the region. Here, the qualitative data for this study was based on detailed observations and 85 semi-structured interviews collected between 2007 and 2009. The interviewees included scientists at from the National Institute for Space Research (INPE) in São José dos Campos senior officials from the Brazilian Institute of Environment and Natural Renewable Resources (IBAMA) and the Ministry of the Environment in Brasilia, as well as officials, politicians and farmers in Mato Grosso. The quantitative data consisted of georeferenced databases (shapefiles) containing the following: maps of Mato Grosso's deforestation polygons for 1995–1996, 1997–1998, 1999, 2000–2001, 2002, 2003 2004, 2005, 2006 and 2007, as provided by Mato Grosso's Environmental State Agency (SEMA-MT)[1]; shapefiles showing the boundaries as well as the location of legal reserves (areas within private properties that cannot be cleared) and the year when the properties joined SLAPR[2]; and the map showing the locations and boundaries of properties registered by the National Institute of Land Colonization and Agrarian Reform (INCRA) (;)[3] from which the 'control group' was established. This last dataset was used as a basis from which to evaluate the effectiveness of SLAPR, as INCRA's database had properties both in and out of the SLAPR system. Table 1 illustrates the number of properties and the respective total areas for both groups. Here, the final analysis compared the outcomes from the quantitative and qualitative components of the research through a triangulation procedure, resulting in a richer case study of the impact of SLAPR in the region (Jick, 1979; Liverman et al., 1998; Carmenta et al., 2011).

On the basis of the case study, this article argues that in the period under analysis (2000–2007), SLAPR was unable to reduce deforestation and allowed the expansion of the agricultural frontier instead of providing an institutional framework that could ensure the long-term sustainability of the region. Regarding the new institutional theory in economics and organisations, the article concludes that public administrators should go beyond the current deterministic understanding of the implications of institutional frameworks. They are urged to attempt to appreciate how the social contexts in which these frameworks are deployed, shape their outcomes and, in some cases, even subvert their official aims. The rest of the article is organised as follows: the next section provides an outline of the key ideas of the new institutional theory in organisations and economics; the third section shows how new institutional theory has been applied to analyse the Amazon region, while indicating shortcomings in the literature; the fourth section details the case study; and the last section discusses the results and proposes the notion of institutional subversion.

NEW INSTITUTIONAL THEORY AND GOVERNANCE

The origins of the new institutional theory (as discussed today in economics and organisational studies) can be traced back to the debates in the 1970s on how to account for actual human behaviour in a variety of contexts.

---

[1]Pre-processing was carried out to remove duplicate deforestation polygons as well as deforestation polygons smaller than 1 ha.
[2]Even though SLAPR uses georeferenced property records, these presented some problems with geometry because of duplication; duplicated records were therefore removed from the study area.
[3]The INCRA dataset did not show any problems of geometry and, thus, was used without any further pre-processing.

Table 1. Summary of the two analysed groups

	SLAPR (ha)	Control group (ha)	Total (ha)
Sample area (ha)	13 633 020	2 207 034	15 840 054
Number of properties	5806	665	6471

SLARP, system for the environmental licencing of rural properties.

During this period, neoclassical economics and rational choice theory (the dominant theoretical approaches at the time) considered human decision making to be largely a rational process. This meant it conceptualised an actor mainly as a *homo œconomicus*, 'a being who [solely] desires to possess wealth and who is capable of judging the comparative efficacy of means for obtaining that end' (Mill, 1836/1994: 52). However, many scholars became increasingly frustrated with the inability of this perspective to explain matters such as irrational behaviour within organisations and the differences between developed and poor countries. Here, among the different approaches that extended or challenged the rational theories in economics and organisational studies, the new institutional theory has been one of the most vocal (Barley and Tolbert, 1997; Brousseau and Glachant, 2008).

It is possible to identify key differences and similarities between new institutional theory in economics and organisation studies. Empirically, the former tends to emphasise the macro-level, looking mainly at the role of governments in shaping the behaviour of citizens, whereas the latter focuses mainly on the meso-level, analysing how organisations relate to their broader environment and with each other. Theoretically, although economists focus on enforcement as well as formal and informal rules (North, 1990), organisation scholars place particular emphasis on the role of norms and cognition in shaping organisational behaviour (Scott, 2001). Further, many economists still adopt realist assumptions about the world, whereby the phenomena being observed (i.e. efficiency, growth, development) is conceptualised as taking place independent of any individual subjective perceptions. However, most organisational scholars follow the legacy of Berger and Luckmann (1967), highlighting the process of the social construction of reality. Consequently, new institutional theory in organisations proposes that not only economic performance but social reality as a whole should always be considered in relation to specific institutional arrangements (Meyer and Rowan, 1977; DiMaggio and Powell, 1983).

Despite these differences, new institutional theory in economics and organisations are complementary rather than antagonic. Both fields of new institutional theory agree that institutions can be broadly defined as the 'rules of the game', namely, stable social entities that shape and explain human behaviour in ways that take into account broader cultural and historical contexts (Jepperson, 1991: 143; Brousseau and Glachant, 2008: 158). Furthermore, even though institutional economists still adhere to particular aspects of the rational choice theory, they agree with organisational scholars in that the study of institutions 'entails modifying the notion and implications of rationality, incorporating ideas and ideologies into our analysis' (North, 1990: 135).

Finally and most importantly, for the scope of this article, researchers from both fields have pointed out that even though institutions are powerful, they do not govern behaviour in a deterministic way. In organisation studies, this issue has been analysed mainly in the study of change and the related process of institutionalisation. Different studies have indicated that the creation of new formal rules and organisational reforms rarely have an immediate impact on the behaviour of actors. Rather, these new rules and structures need to be institutionalised, that is internalised as taken-for-granted aspects of social life to become effective (Robey and Holmstrom, 2001; Seo and Creed, 2002; Suddaby and Greenwood, 2009). In this context, the relationship between institutions and actual behaviour 'should be analysed as a contested ascent from the abstract to the concrete' which involves the clash between current and envisioned institutional arrangements (Blackler and Regan, 2006: 1858). Institutional economics, in turn, suggests that institutionalised rules rarely have a deterministic impact (Orrnert, 2006; Fischer *et al.*, 2007). To illustrate this, North (1990) made an analogy between economic actors and team players in sports. Even though they have to abide, to some extent, by the 'rules of the game' (e.g. respect contracts, obey property laws), their goals (e.g. to accumulate wealth) lead them to develop strategies that, in some cases, include breaking these rules. Hence, institutional economics suggests that in order to understand the functioning of institutions,

analysts should pay attention not only to formal and informal rules, but also to whether enforcement practices are sufficiently efficient so that breaking the rules is not worthwhile (North, 1990).

A further point, uniting the new institutional theory in economics and organisation studies, is their interest not only in understanding institutions but also in helping promote change. For instance, organisation scholars have highlighted the role of institutional entrepreneurs (i.e. key actors able to foster change) and suggested ways in which organisations could, more effectively, manage the process of institutional change (Dacin *et al.*, 2002; Greenwood and Suddaby, 2006; Hayes, 2008). In this way, economists have emphasised that economic development not only involves the availability of natural resources, technology and capital, but also the building of strong institutions by the creation of a clear set of rules and effective enforcing mechanisms (Harriss *et al.*, 1995; Orrnert, 2006; Brousseau and Glachant, 2008; Thynne, 2008). This last point, in particular, has become very influential in environmental policy-making circles concerning Amazon deforestation. Today, terms such as 'institutional development', 'institutional framework', 'institutional reform' and 'institutional capability' are often used interchangeably to refer, more or less, directly to the notions proposed by institutional theorists (World Bank, 1992; Dasgupta *et al.*, 2001; Esty and Ivanova, 2002; Stern, 2007). The following section critically analyses how the ideas relating to institutional development have been applied to describe and prescribe solutions for deforestation in the Amazon rainforest and to point out the gaps in this literature.

DEFORESTATION AND INSTITUTIONAL FACTORS

Since the beginning of the large-scale colonisation of the Amazon in the 1970s, the issue of deforestation in the region has attracted an increasing number of researchers from different disciplines. It is possible to classify the studies that attempt to explain, predict and prescribe solutions for deforestation into three partially overlapping lines of research. The first and most vocal line of research draws upon statistical analysis, remote sensing and geographic information systems to study the dynamics of deforestation. This literature aimed to measure the total and yearly rate of deforestation in the region (e.g. Tardin *et al.*, 1979; Fearnside, 1982), and as more advanced information technology and detailed datasets became available, researchers began to point out the spatial determinants of deforestation, such as the presence of protected areas and the vicinity of the forest to roads and cities. Hence, these kinds of studies often contain policy suggestions that highlight the need to avoid building roads in the Amazon and stress the importance of creating protected areas in the form of 'barriers' against the expansion of deforestation (e.g. Laurance *et al.*, 2001; Nepstad *et al.*, 2006; Soares-Filho *et al.*, 2010).

The second line of research draws, more or less, directly on neoclassical economics (and related assumptions) to analyse the economical determinants of deforestation. One of the issues raised by these researchers is the role of subsidies and hyperinflation in rendering deforestation profitable. From this, different studies have suggested that if the Brazilian government suspended subsidies to agriculture and provided a more stable economic environment where the land would not be used as a safe investment, then deforestation could be drastically reduced (e.g. Browder, 1988; Repetto and Gillis, 1988; Mahar, 1989; Fearnside, 2008). More recently, other studies have shown that during the 1990s, cattle ranching and other activities fuelling deforestation became profitable and, thus, were financially independent of the government (Fearnside, 2001; Margulis, 2004). Following this conclusion, the focus of the second line of research has changed from government subsidies to agricultural productivity and carbon credits. In particular, and in line with the arguments put forward by the Ministry of Agriculture and agricultural lobbying groups, some authors have shown that it is possible to increase food production without causing further deforestation. To this end, these studies have highlighted the importance of capital investments to facilitate the conversion of low-yielding pastures into areas of intensive cattle ranching and commodity production (Bacha and Rodriguez, 2007; Chomitz, 2007; Sparovek *et al.*, 2010; Bowman *et al.*, 2011). Concomitantly, other studies have emphasised the importance of attributing an economic value to the reductions in carbon emissions from deforestation and forest degradation, a mechanism known as REDD+. According to its supporters, REDD+ would change the balance of the market and render forested areas more profitable than low-yielding activities such as cattle ranching, ensuring the long-term preservation of the Amazon as well as reduction in greenhouse gases emissions on a global scale (e.g. Moutinho *et al.*, 2005; Kaimowitz, 2008; Nepstad *et al.*, 2009).

The third line of research draws directly on the new institutional theory to study the broader social factors behind deforestation. An important difference here is that whereas the second line of research is more focused on the role of markets and economic incentives, here, the emphasis is on the role of the government in controlling deforestation in the Amazon. These studies tend to highlight the importance of the three key dimensions of institutions, namely formal rules, informal rules and enforcement (North, 1990). The first dimension concerns the presence of unclear and, in some cases, even contradictory formal rules. Starting with Hardin (1968), different studies have proposed that the lack of clear land rights and the related shared ownership of resources may give rise to the 'tragedy of the commons', a situation where individuals ultimately cause the depletion of a shared resource by simply following their own self-interest. By expanding on this initial assertion, it has been argued that the lack of secure property rights is one of the main factors behind the rampant deforestation of the Amazon and other tropical forests (Repetto and Gillis, 1988; Peters *et al.*, 1989; Alston *et al.*, 1996; Campari, 2005). Accordingly, Puppim de Oliveira (2008) points out that the Brazilian law has contrasting definitions of lawful land uses. Although the forest code demands that farmers should maintain up to 80% of their property as 'legal reserves', land tenure legislation considers forested areas as 'unproductive'. This is contradictory because these areas are potentially subject to expropriation for agrarian reform purposes, creating a situation where farmers often prefer to deforest their lands as a way of securing their possession, even when this conflicts with the forest code.

In line with the role of enforcement in institutional frameworks, other studies have also indicated that the reasons for the high rates of deforestation in the Amazon are related to the government's inefficiency and high levels of corruption by governmental agencies responsible for law enforcement (e.g. Brito and Barreto, 2006; de Moura, 2006; Chomitz, 2007). Drummond (1999: 145) argued that even though Brazil's environmental legislation is 'one of the most advanced in the world', the persistence of environmental issues, such as deforestation, is closely related to the low capacity of environmental agencies to keep up with their obligations (see also Mueller *et al.*, 1994). Other authors go further and blame the whole government, and specifically the environmental agencies, for not having the 'political will' to enforce the environmental laws as they should (Keck, 2001; Chomitz and Wertz-Kanounnikoff, 2005; Nepstad *et al.*, 2009). More recently, some authors have highlighted that advanced information technologies, such as geographic information systems (GIS), could offer a solution to these problems. Esty (2001, 2004) for instance, argued that a continuous stream of precise real-time data would be the basis of a future global environmental order, which he called 'data-driven' environmentalism, where forests and other natural resources would be protected more efficiently. Focusing on the Amazon, the ability of the GIS to offer real-time monitoring and unambiguous definitions of land ownership and environmental responsibilities was highlighted and praised by many actors. From this, a growing number of studies have suggested that the introduction of this technology will lead to institutional development and a related reduction in deforestation (Fearnside, 2005; Wertz-Kanounnikoff, 2005; Fuller, 2006; Chomitz, 2007; Kintisch, 2007; Fonseca *et al.*, 2009).

Finally, some authors have also indicated the role of informal rules, including norms and worldviews, in the dynamics of deforestation (Andersson, 2004; Lima and Pozzobon, 2005; Schwartzman and Zimmerman, 2005; Lemos and Roberts, 2008). By drawing on institutional economics, Gibson *et al.* (2000) argued that 'local institutions', namely informal rules and patterns of activity, have a strong local presence and may, in many cases, diverge widely from the expectations embedded in formal rules. The authors concluded that informal rules explain why different regions of the Amazon have different rates of deforestation despite the fact that the population lives under the same set of formal rules. Similarly, Rajão and Hayes (2009) showed the relevance of informal rules in organisations by drawing upon the new institutional theory. They proposed that the history of the Amazon in the last four decades could be understood in relation to three conceptions of control (i.e institutionalised ways of seeing the region and attempting to manage it). In particular, although the 1960s to 1980s were dominated by the prevalence of the economic and the military conceptions, from the 1990s onwards, the environmental conception became increasingly important, and the military view lost its strength. From this analysis, the authors argued that the contradictory territorial policies in the Amazon could be understood as the outcome of a tug of war between these divergent institutional conceptions (see also Hayes and Rajão, 2011).

The study of institutions present in the Amazon has provided important insights into the social dynamics behind deforestation and how to tackle it. Thus, it is not surprising that these analyses (especially those relating to formal

rules and enforcement) have been highly influential in policy making in Brazil since the Rio Summit in 1992. In particular, the analysis of policies relating to the plan of controling deforestation in the Amazon (PPCDAm launched in 2004) and the more recent 'Terra Legal' (literally, legal land) suggest that the provision of land titles and the monitoring of land use change through the GIS have become 'taken-for-granted' elements in Amazon policies. Although the benefits of the approaches inspired by institutional analysis are undeniable, it is possible to observe that many studies and policy directives start with the assumption that the improvement of formal rules and enforcement mechanisms will have a direct impact in reducing deforestation in the Amazon. In this sense, the literature on the Amazon has largely ignored the cautionary calls of institutional theorists, such as North (1990) and Blackler and Regan (2006), regarding the unpredictable outcome of institutional development initiatives. Therefore, in order to address this limitation, the next section presents the case study of SLAPR in Mato Grosso and shows how this institutional development initiative facilitated an increase in deforestation rather than its decrease.

ENVIRONMENTAL LICENCING OF RURAL PROPERTIES IN MATO GROSSO

This section provides an account of the trajectory of SLAPR, an institutional development initiative implemented in the southern Brazilian Amazon state of Mato Grosso between the years of 2000–2007. The next subsection provides the historical background and describes how SLAPR was enthusiastically received by a wide range of actors. The second subsection provides evidence of the contradictory effects of SLAPR in the 7-year period following its implementation and shows the ways in which this institutional development initiative was subverted.

From local experiment to global best practice

The SLAPR is the acronym in Portuguese for 'system for the environmental licencing of rural properties'. As the name suggests, the basis of the SLAPR system is a legal instrument called 'environmental licencing', namely the requirement of a formal authorization for the functioning of certain activities. Closely following the prescriptions provided by institutional economics, SLAPR was conceived as a three-stage system (see Figure 1). In the licencing stage, the geographical boundaries and land use of each individual property are brought into the system (GIS). In this process, the farmers who have deforested their legal reserves or who have deforested in places where clearing is prohibited, such as riversides, may have to pay a fine and sign an agreement to reforest those areas. Here, farmers can also obtain an authorization to legally clear up 20% of their properties if they are still able to respect the minimum legal reserve area of 80% for properties located in the rainforest. In the monitoring stage, each property is monitored using satellite-based remote sensing and GIS technology to identify an increase or decrease in forested areas. Finally, in the enforcing stage, farmers within the system who do not obey the law and continue to deforest or who use fire in their properties will have their licences suspended and must pay a fine.

The SLAPR can be regarded as one of the world's biggest institutional development experiments relating to the protection of tropical forests. In the period 2000–2007, SLAPR reached 30.7% of all lands lying outside the state's protected areas (i.e. parks, indigenous lands, extractive reserves). The total registered area amounts to an area
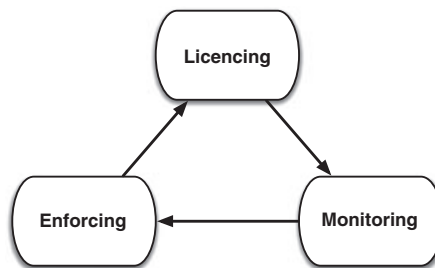

Figure 1. Principle behind the functioning of SLAPR (on the basis of Lima *et al.*, 2005).

approximately four times the size of Costa Rica. For this reason, SLAPR was (and still is) widely acknowledged by researchers, funding agencies and public administrators, as an efficient way to control deforestation in the Amazon (Chomitz and Wertz-Kanounnikoff, 2005; Wertz-Kanounnikoff, 2005). For instance, Fearnside (2003), one of the main scientific authorities in the field, compared the deforestation rates in Mato Grosso to neighbouring states and affirmed that SLAPR contributed to the reductions in deforestation rates. Thus, the author stated that SLAPR represented a new model that showed the government's ability to control deforestation for the first time (see also Chomitz and Wertz-Kanounnikoff, 2005). Funding agencies also provided considerable support to SLAPR. By way of example, the World Bank, in addition to providing non-refundable loans for the creation of the system, also presented SLAPR to different countries as an example of 'best practice' for controlling deforestation. Similarly, the Pilot Program to Conserve the Brazilian Rain Forest (PPG7), a research programme funded by the G7 countries, provided financial support and also cited SLAPR as its main 'success story' (MMA, 2002: 28). Many senior officials from the federal government also openly support SLAPR. During an interview for this research, an ex-minister of the Ministry of the Environment showed clear enthusiasm for the capabilities of the GIS technology and reported that he regretted the fact that during his time in office he was not able to expand the system to other Amazonian states.

Even though some studies indicated problems with SLAPR following the arrival of Blario Maggi as Mato Grosso's governor (Lima et al., 2005; Azevedo, 2009), confidence in its efficiency has remained largely unshaken and even increased since its creation. The Ministry of the Environment of Brazil officially appointed SLAPR as the desired standard for the Amazon and started supporting the development of similar systems in other states. Furthermore, the implementation of systems similar to SLAPR is used as a justification for decreasing environmental restrictions while increasing the provision of benefits to farmers. One example of this is the *MT Legal* (State Law N° 343/2008), a state programme created in Mato Grosso which provides an amnesty on fines and allows farmers to compensate for their shortcomings in terms of legal reserves by paying into a governmental fund. Similarly, the federal government created a programme named *Mais Ambiente* (more environment) in the final months of 2009, expanding the concessions allowed by the *MT Legal* to all regions of Brazil (Decree N° 7029/ 2009). In parallel with the discussions of *Mais Ambiente* and *MT Legal*, Brazil's National Congress also approved a law and created the programme *Terra Legal* (legal land) which allowed the legalisation of individual properties (up to 1500 ha) of public land illegally appropriated in the Amazon. An interview with a senior official involved in this programme suggested that this was carried out under the premise that by monitoring these properties with a system similar to SLAPR, the government would ensure the environmental conservation of these areas.

Moreover, it was possible to observe that many senior officials from the Ministry of the Environment and SEMA-MT still had high expectations regarding SLAPR. They pointed out that in contrast to PRODES, INPE's program for calculating Amazon deforestation, which can only provide the overall deforestation rates in the region, SLAPR was designed to relate specific plots of land to specific landowners. In this way, SLAPR is believed to control the behaviour of individual farmers, remotely. One of the officials from SEMA-MT, directly responsible for creating SLAPR, explained the central role of GIS and satellite images in the new policy:

> 'The environmental law in Brazil is targeted to individual properties. It is not about the Amazon, Mato Grosso or the municipality. It is about ONE property that must have 80% of its area as legal reserve. Now, if Brazilian law states that individual properties must be controlled, I must know where they are located, otherwise I cannot control them.'

The cited excerpt suggests that SLAPR represents a major innovation in the way the environmental law in the Amazon is conceived and enforced. It also indicates that public administrators from different parts of the government have very high expectations regarding the capability of GIS technology to foster institutional development and to control deforestation in the Amazon. In particular, for many senior officials, in identifying the boundaries of individual properties in the GIS, the control of deforestation can be almost automatic. In the words of a senior official from the federal government, '[with GIS], deforestation in these areas is going to have a name and surname. This fact certainly leads to a sensible increase in the governance capability of the environmental agencies in Amazon states'. Although many researchers and senior officials in Brasília, as well as

international funding agencies, often describe SLAPR as an institutional development initiative able to reduce deforestation, a closer look at how SLAPR is used, in addition to its outcomes, reveals a more complex scenario.

Contradictory effects of environmental licencing

Despite the importance of this initiative, our research has found that SLAPR has not had a significant effect in reducing deforestation. This study has assessed the effectiveness of SLAPR by comparing the yearly deforestation rates of properties inside SLAPR and within the control group. The latter group was composed of a georeferenced database of properties registered within INCRA (the federal land agency), which did not join SLAPR until 2007. During the first phase of SLAPR (2000–2001), some campaigns were targeted at specific parts of the state where farmers were actively invited to join the system and had to pay a fine if they refused to do so. From 2003 onwards, the state government changed its strategy, allowing farmers to join the system voluntarily. Because the number of properties within SLAPR increased over the years, we took the status of each property into consideration for the year under analysis, including them in the SLAPR group following their registration into the system.

Here, the deforestation rates of properties within the system were compared to the deforestation rates of the control group on a yearly basis, as opposed to overall deforestation rates over a longer period of time (e.g. Fearnside, 2003). Making this comparison on a yearly basis minimises the interference of external factors, such as fluctuations in commodity prices and whether there is an international crisis. Furthermore, in order to verify whether the groups were directly comparable, histograms of the properties' size distributions and maps of the geographical distributions of both groups were made. The analysis established that both groups had similar frequency size distributions (in terms of the percentage per group size), varying from small properties (<50 ha) to large ones ($>14\,000$ ha). It was also possible to verify whether the properties in both groups followed a geographical distribution and to rule out the presence of any particular spatial clustering (see Figure 2).

Because the geographical and size distribution of the properties showed little difference between the two groups, it was possible to statistically compare the deforestation that occurred within the SLAPR and the control group, as well as the deforestation pre-implementation and post-implementation of SLAPR. This was achieved by fitting generalized linear models with a binomial distribution of errors. The generalized linear models included model parameters to test for the differences in the total cumulative deforestation (cumulative percentage of deforestation within each property) between the groups (SLAPR and the control group)[4] and the differences in the yearly deforestation (percentage of the area within each property) between the groups (SLAPR and control group).[5]

First, it was necessary to determine if there were any interaction effects in the yearly deforestation between the groups and years. When considering the years 1995–1999 (the period of the pre-implementation of SLAPR), there was no interaction effect; hence, the yearly deforestation in the control group and the properties that joined SLAPR had no significant difference. Furthermore, prior to the implementation of the system (1995–1999), deforestation occurred yearly in 30–40 per cent of properties in both groups. Because deforestation rates in both groups were similar prior to the implementation of the system, it could be expected that after the implementation of SLAPR, the properties within the system would have significantly lower deforestation rates than the ones outside it (in the control group). However, it was observed that with the exception of 2003, the yearly deforestation rates showed no significant difference between SLAPR and the control group ($p < 0.01$). Furthermore, the proportion of properties that were deforested was also similar in the two groups. For 2001 and 2003–2005, yearly deforestation larger than 1 ha occurred in 35 to 45 per cent of the properties in both groups, wehreas in 2002 and 2006–2007, yearly deforestation occurred in 15 to 23 per cent of properties. This suggests that in the years 2001, 2002 and 2004–2007, SLAPR, as an institutional initiative, failed to change the behaviour of farmers in relation to deforestation. Furthermore, when examining the year 2003, it was observed that the deforestation of the properties inside and outside SLAPR were significantly different because of the high rate of deforestation that took place within SLAPR properties. During this year, the properties inside the SLAPR were deforested at more than twice the rate

---

[4]Where the model was: cumulative % of deforested area – group (SLAPR, control group).
[5]Where the model was: yearly % of deforested area – group × year of deforestation.

Figure 2. Geographical distribution of the control group and the SLAPR properties.

(in relative terms) of the properties in the control group. Regarding the deforestation that occurred inside the SLAPR properties in 2003, 40 per cent of this was carried out illegally (i.e. inside legal reserves) and 60 per cent legally (i.e. with the authorization issued by the state government). This suggests that SLAPR was not only unable to offer a significant reduction in deforestation, but, in some cases, also stimulated its increase by facilitating the obtention of authorization for legal deforestation. This data is corroborated and clearly illustrated in Figure 3. Although the overall deforestation rates are quite similar before 2000, the annual deforestation rates appear to be higher in the SLAPR properties post-implementation of the system; however, it was only in 2003 that this difference was statistically significant ($p < 0.01$).

The SLAPR also failed, as a system, to control illegal deforestation within licenced properties. In the period between 2000 and 2007, 344 000 ha of forest was cleared within the legal reserves of SLAPR properties. Furthermore, whereas the total deforestation inside the control group remained stable (9.33% of the area was deforested pre-implementation and 9.37% of the area was deforested post-implementation), within the SLAPR, it increased from 8.01 to 10.4 per cent of the area, this being a relative increase of 30 per cent. Here, the short-comings relating to the monitoring and law enforcement of SLAPR have technical and political roots. On the technical side, the remote sensing technology used by SLAPR during that period did not have a high enough spatial resolution to allow the detection of small deforestation plots. In addition to this, different forest rangers reported that the current legislation requires on-site inspections of deforestation plots to establish its legal liability. On the political side, various officials from SEMA-MT reported that the agency was lenient with

---

[4]Where the model was: cumulative % of deforested area − group (SLAPR, control group).
[5]Where the model was: yearly % of deforested area − Group × year of deforestation.
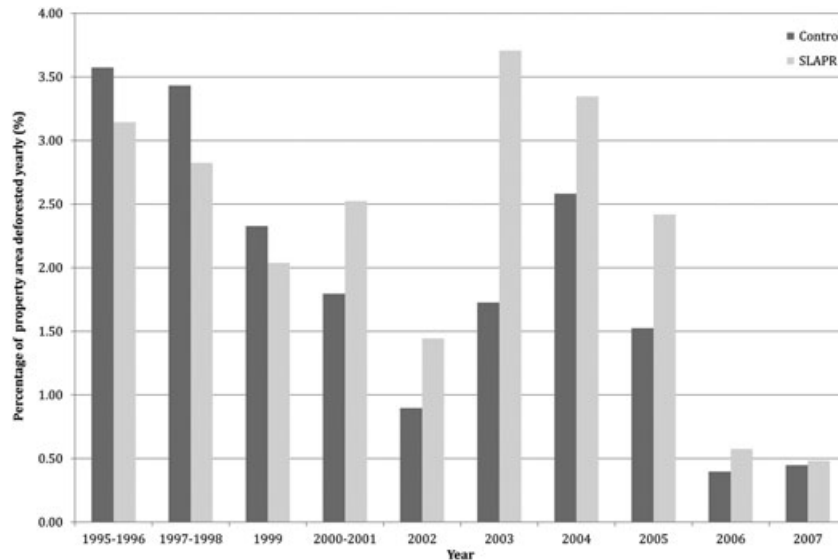
Figure 3. Percentage of property deforested yearly within SLAPR and the control group.

farmers inside the system so as to not scare them off and convince more people to join SLAPR. Additionally, given the economic and political importance of the rural sector in the state of Mato Grosso, there is an implication that in some periods the application of heavy fines to properties within SLAPR is problematic and consequently avoided.

This suggests that despite the assumption that SLAPR would decrease the transaction costs relating to law enforcement, the practices adopted by Mato Grosso's environmental agency did not lead to 'zero illegal deforestation', as promised by the proponents of the system. Thus, in the years with higher deforestation rates throughout the region, possibly caused by high commodity prices and other exogenous factors, the system contributed to its increment by providing an instrument able to legalise deforestation while not being sufficiently strong to control illegal deforestation within the system.

DISCUSSION

It is understandable why so many researchers and public administrators still praise SLAPR as a success story. In line with the suggestions of institutional theorists, the system is able to provide clearer land rights by forcing farmers to solve pending legal issues (such as the registration of legal reserves) and can clearly inform the government of the geographical location and limits of individual properties. Furthermore, following the suggestions of the current literature, SLAPR (theoretically at least) also contributes to the institutional development of the Amazon by radically reducing the transaction costs involved in checking the compliance of farms within the system, facilitating law enforcement activities. Moreover, given the large number of properties that joined SLAPR and the total area they constitute, the fact that this initiative has so far been one of the most encompassing initiatives ever carried out in tropical countries cannot be denied.

If SLAPR was so successful when analysed from the perspectives provided by the new institutional theory, how was it possible that this initiative was not effective or, even in some cases, that it allowed for an increase in deforestation rather than its reduction? In this section, we will define some conceptual tools to analyse this contradiction and propose particular pragmatic actions that may enable public administrators to improve environmental governance in the Amazon and in other regions.

Analysing institutional intiatives

The new institutional theory in organisations and economics has provided some conceptual tools with which to analyse the contradictory effects of institutional initiatives that have been largely overlooked by the current literature on the Amazon. First, many studies so far have ignored the full extent of the challenges involved in changing not only the formal, but also the informal dimension of institutions. Although rules such as environmental regulations and enforcement mechanisms (e.g. monitoring systems) can be changed 'by decree' and through heavy investment, the transformation of the informal rules, as manifested through cultural tendencies and conceptions, tends to be a much slower process. As indicated by Blackler and Regan (2006), the internalisation of new rules into practices is often a frustrating process, full of false starts and contradictions. Returning to our case study, it is evident that public administrators should not underestimate the time and effort necessary to change the current attitudes of farmers. Although SLAPR undoubtedly provides a very advanced set of formal rules and technologies, the transformation of current destructive practices into sustainable farming is likely to take more than the 7 years under analysis and requires negotiations and concessions from both environmentalists and farmers.

Secondly, while working towards the slow change of informal rules and the acceptance of institutional reform, public administrators should recognise the existence of a gap between the interests of the actors that create institutional frameworks and of those that mobilise them in their economic activities. As shown by Rajão and Hayes (2009), the history of the Amazon has been marked by a conflict between groups with contrasting views of what development is and how it can be achieved. Although environmental public administrators envisage the Amazon as a provider of environmental services and deforestation as a crime, most local farmers see deforestation as means of development and food production. This dual view of development resulted in what North (1990) has identified as the distance between rules and game strategies.

This distance was evident in the reasons why most farmers decided to join SLAPR. Although many farmers have embraced the rules set out by SLAPR for joining the system, they have done so as part of a broader strategy in which the main object is not to become environment friendly,but to maintain and even expand their productive areas. Thus, it was possible to observe that the underlying logic of land use was not altered significantly with the implementation of SLAPR. Producers merely adopted the rules that allowed them to keep deforesting and, in this way, maintained their businesses as usual. Of course, there have been exceptions and some farmers have chosen to adhere to the rules of SLAPR and restrain from deforesting. However, not only was the impact of these actions statistically insignificant (as shown previously), but it was also governed by an economic logic. In particular, it was possible to observe that these farmers did not decide to join SLAPR and respect the environmental law as a result of a profound institutional change, but rather, as a way of obtaining a type of 'proof of legality' that is valued by many large agribusiness companies and enable access to bank loans. These examples suggest that many farmers used SLAPR in ways that are consistent with their own economic interests and cultural values, rather than the principles of sustainable development defended by the Ministry of Environment (Azevedo, 2009).

The two points mentioned lead us to the third and final point: the non-deterministic character of institutional development initiatives and the possibility of having the opposite effect, a situation we call 'institutional subversion'. One of the factors that explains the praise and expansion of SLAPR with similar initiatives was the underlying belief of some key actors, such as funding agencies and the Ministry of Environment, that this institutional development initiative could only contribute to a reduction in deforestation in the Amazon. In other words, different actors have suggested that institutional development initiatives involving the clarification of land rights and monitoring capabilities in the Amazon would deterministically lead to a more protected environment. However, it has been observed that SLAPR did not contribute to the reduction of illegal deforestation, but rather, facilitated an increase in the total amount of deforestation by authorising legal clearings on a large scale. This strategy, along with others, adopted by farmers in association with local political actors indicates an act of 'institutional subversion', whereby SLAPR's outcomes were contrary to the expectations of the funding agencies and other actors who supported the project.

In summary, the example shown in the case study suggests that some public administrators and researchers in the Amazon were able to go beyond the *homo œconomicus* by focusing on the role of the government only to

replace him by the *homo juridicus* (del Vecchio, 1937). Hence, although many have correctly taken on board the ideas of the new institutional theory in relation to the limits of the rational choice theory and neoclassical economics, they wrongly assumed that actors deterministically abide by the intentions behind the formal rules established by the state. By proposing the concept of 'institutional subversion', we hope to highlight the impossibility of the deterministic assumptions present in some studies and policies, while suggesting a more subtle understanding of the relationship between institutional frameworks and environmental governance.

From institutional determinism to institutional integration

The recognition of the complexity and non-deterministic character of institutional initiatives is an important first step but is insufficient to improve environmental governance. Furthermore, because farmers constitute the largest group of natural resource managers globally (FAO, 2007), adopting a *laissez-faire* policy that allows the maintenance of business as usual is not a valid option for public administrators today. In order to deal with the challenges mentioned previously and to increase the chances of the success of institutional development initiatives, we suggest that public administrators should make a shift from institutional determinism towards an emphasis on institutional integration. In particular, we propose that institutional development initiatives should attempt to integrate three key dimensions in their design and implementation, namely governmental, economic and technological ones.

The first dimension of institutional integration is related to the alignment of different sectorial policies within national governments. One of the problems found in the case of SLAPR (and more generally, in the Amazon) is that although a sector of the government created policies to push farmers towards environmental conservations, other policies (i.e. rural, fiscal, land tenure) pushed them in the opposite direction (Puppim de Oliveira, 2008). This integration could take place in the creation of policies whereby farmers obtain fiscal incentives, such as lower taxes and access to special lines of credit, should they comply with the environmental legislation. For instance, the Ministries of Agriculture, Land Reform and the cabinet of the Chief of Staff (Casa Civil) recently launched 'Programa ABC', which provides financial credit in order to stimulate low carbon development through a change in productive practices (recuperation of degraded pasture, no-till agriculture, among others). So far, the plan is being implemented without any explicit connection to initiatives from the environmental sector, such as SLAPR. Here, if 'Programa ABC' and other initiatives from the productive sector were to be integrated into environmental institutional development initiatives, it would result in stronger and more coherent forms of environmental governance.

The second dimension of institutional integration concerns the development and adoption of technologies that provide a closer fit with the needs of institutional development initiatives. One of the aims of SLAPR was to monitor the land use near water bodies and springs, as required by the forest code. However, the satellite images used by the government during the period under analysis did not have a sufficient spatial resolution for this to happen. Similarly, different studies have shown that the monitoring of carbon stocks required for the payment of environmental services (see more on this in the next sections) demand the development of more advanced monitoring systems (Kintisch, 2007; Bond *et al.*, 2009). In addition to technological development, public administrators should also be willing to create regulations that accept the data provided by systems such as SLAPR to aid the remote enforcement of the law. As already mentioned, the current legislation requires rangers to visit the deforestation site. Since an inspection of all deforestation plots is unfeasible in practice, due to of the size of the region and the costs involved, many farmers have been left with a sense of impunity. If scientists, forest rangers and legislators reached an agreement in relation to the validity of remote-sensing data as evidence for deforestation, initiatives such as SLAPR would become more effective.

Finally, the third and most important dimension that institutional development initiatives should attempt to integrate is the economic one. The principle behind this integration is that producers should not only be punished when they break the rules, but also rewarded economically when they fully embrace the aims of environmental institutional development initiatives. In this way, the governments would not only stimulate the (slow) construction of a *homo juridicus*, but also become a channel for the presence of some aspects of the *homo œconomicus* by providing financial incentives. There could be various types of reward. For instance, institutional development initiatives such as SLAPR could serve as issuers of green certificates, which allow farmers access to markets with

higher profit margins (Hamilton and Zilberman, 2006; Nepstad, 2011). Related to this, institutional development initiatives should not only attempt to control access to natural resources, but should also increase the productivity of the resources currently in use. This could be achieved, for instance, by coupling law enforcement and technical assistance to stimulate an increase in productivity (Gouvello, 2010; Sparovek *et al.*, 2010). It is important to recognise, however, that the market is not always willing to pay the opportunity cost related to avoiding deforestation and other types of environmental degradation (Chomitz, 2007). For this reason, it is also important to attribute a financial value to the provision of environmental services in the form of schemes such as REDD+, a carbon credit mechanism created to reduce emissions from deforestation and forest degradation in developing countries (Hall, 2008; Kaimowitz, 2008; Nepstad *et al.*, 2009).

It is clear that the integration between institutional development initiatives and the three dimensions outlined previously is unlikely to be easy. Nonetheless, public administrators should realise that institutional change not only involves the enforcement of laws, but also the construction of pathways that would allow the gradual internalisation of the informal aspects of institutions.

CONCLUSION

On the basis of the case study and the previous discussion, some conclusions that are relevant to both the new institutional theory and the challenges involving sustainable development have been reached. In relation to the academic debate, this article has shown that new institutional theories in organisations and economics have many common ideas. In particular, both theories concur on the non-deterministic character of institutions and the importance of not merely analysing formal but also informal rules, as well as their related cultural attitudes, logic and practices. Although this point has been embraced by many studies, some researchers in the field of public administration and environmental policy still overlook this key issue. Therefore, it can be argued that an analysis of institutional development initiatives would benefit from a more sophisticated theoretical stance on the basis of a dialogue between organisational studies and economics at multiple levels of analysis.

Furthermore, this case study of SLAPR also emphasises the importance of moving from a view of institutions as deterministic, towards an emphasis on integration. In particular, it suggests that institutional development initiatives have a much higher chance of success if they are conceived as components of broader schemes that go beyond an enforcement of the environmental law. By integrating institutional development initiatives into governmental initiatives in other sectors, as well as creating suitable technologies and providing economic incentives, public administrators would not only be able to pose legal threats, but could also offer economically attractive alternatives to current unsustainable practices.

In relation to the aims of sustainable development and the issue of deforestation specifically, it is also possible to learn some lessons from the case study. Here, we do not intend to suggest that institutional development initiatives, in general, and SLAPR, in particular, should be abandoned. On the contrary, a position such as this would lead to the same kind of determinism that this article sets out to criticise. Instead, what emerges from this study is the importance of being more attentive to how institutional development initiatives evolve and are put into practice. Hence, by proposing the notion of institutional subversion, this article intends to highlight the fact that there is no quick fix to the problems of deforestation, greenhouse gas emissions, water pollution and so on. This suggests that even very promising schemes such as REDD+ could be subverted in the same way as SLAPR. The subversion of REDD+ may take place, for instance, through the action of 'carbon cowboys', these being actors who are able to obtain financial benefits in unethical or illegal ways (Lederer, 2011). It may also occur through the leakage of deforestation to neighbouring countries or biomes currently outside REDD+ schemes, such as the *cerrado* (wooded savanna) in Brazil (Santilli *et al.*, 2005) or through the lack of REDD+ jurisdictions which could result in double accounting (Agrawal *et al.*, 2011). Every set of formal rules and technologies that constitute present and future institutional frameworks are due to be shaped and re-interpreted by local actors in new and sometimes unexpected ways. Therefore, the detailed and constant monitoring of the outcomes of institutional initiatives is as important as their correct design and implementation.

REFERENCES

Agrawal A, Nepstad D, Chhatre A. 2011. Reducing emissions from deforestation and forest degradation. *Annual Review of Environment and Resources* **36**: 373–396.

Alston LJ, Libecap GD, Schneider aRR. 1996. The determinants and impact of property rights: land titles on the Brazilian frontier. *The Journal of Law, Economics and Organization* **12**: 26–61.

Andersson KP. 2004. Who talks with whom? the role of repeated interactions in decentralized forest governance. *World Development* **32**: 233–249.

Azevedo A. 2009. Legitimação da insustentabilidade? análise do sistema de licenciamento ambiental de propriedades rurais - SLAPR (Mato Grosso), Centro de Desenvolvimento Sustentável. Universidade de Brasília, Brasília.

Bacha CJC, Rodriguez LCE. 2007. Profitability and social impacts of reduced impact logging in the Tapajós National Forest, Brazil: a case study. *Ecological Economics* **63**: 70–77.

Barley SR, Tolbert PS. 1997. Institutionalization and structuration: studying the links between action and institution. *Organization Studies* **18**: 93–117.

Berger PL, Berger B, Kellner H. 1974. *The homeless mind: modernization and consciousness*, Penguin: Harmondsworth.

Berger PL, Luckmann T. 1967. *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Penguin.

Blackler F, Regan S. 2006. Institutional reform and the reorganization of family support services. *Organization Studies* **27**: 1843–1861.

Bond I, Grieg-Gran M, Wertz-Kanounnikoff S, Hazlewood P, Wunder S, Angelsen A. 2009. Incentives to sustain forest ecosystem services: review and lessons for REDD. International Institute for Environment and Development, London.

Bowman MS, Soares-Filho BS, Merry FD, Nepstad D, Rodrigues H, Almeida OT. 2011. Persistence of cattle ranching in the Brazilian Amazon: a spatial analysis of the rationale for beef production. *Land Use Policy* **29**: 558–568.

Brito B, Barreto P. 2006. A eficácia da aplicação da lei de crimes ambientais pelo Ibama para proteção de florestas no Pará. *Revista de Direito Ambiental* **43**: 35–65.

Browder JO. 1988. Public policy and deforestation in the Brazilian Amazon. In *Public Policies and the Misuse of Forest Resource*, Repetto RC, Gillis M (eds). World Resources Institute: Washington, DC; 247–297.

Campari JS. 2005. *The Economics of Deforestation in the Amazon: Dispelling the Myths*. Edward Elgar: Cheltenham.

Carmenta R, Parry L, Blackburn A, Vermeylen S, Barlow J. 2011. Understanding human-fire interactions in tropical forest regions: a case for interdisciplinary research across the natural and social sciences. *Ecology and Society* **16**: 1–22.

Gouvello Cd. 2010. Brazil low carbon: country case study. World Bank Washington, DC.

Chomitz KM. 2007. *At Loggerheads? Agricultural Expansion, Poverty Reduction, and Environment in the Topical Forest*. World Bank Publications: Washington, DC.

Chomitz KM, Wertz-Kanounnikoff S. 2005. Measuring the initial impacts on deforestation of Mato Grosso's program for environmental control. *World Bank Policy Research Working Paper*, no. **3762**.

Dacin MT, Goodstein J, Scott WR. 2002. Institutional theory and institutional change: introduction to the special research forum. *Academy of Management Journal* **45**: 45–57.

Dasgupta S, Mody A, Roy S, Wheeler D. 2001. Environmental regulation and development: a cross-country empirical analysis. *Oxford Development Studies* **29**: 173–187.

DiMaggio PJ, Powel WW. 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* **48**(2): 147–160.

Drummond JA. 1999. A legislação ambiental brasileira de 1934 a 1988: comentários de um cientista ambiental simpático ao conservacionismo. *Ambiente & Sociedade* **3–4**: 127–149.

Brousseau Er, Glachant J-M. 2008. *New Institutional Economics: A Guidebook*. Cambridge University Press: Cambridge.

Esty D. 2001. Toward data-driven environmentalism: the environmental sustainability index. *The Environmental Law Reporter* **26**: 10603–10612.

Esty D. 2004. Environmental protection in the Information Age. *New York University Law Review* **79**: 115–211.

Esty D, Ivanova MH. 2002. Global environmental governance options & opportunities. Yale School of Forestry & Environmental Studies, New Haven, CO.

Esty D, Porter M. 2005. National environmental performance: an empirical analysis of policy results and determinants. *Environment and Development Economics* **10**: 391–434.

FAO. 2007. The state of food and agriculture: paying farmers for environmental services. Food and Agriculture Organization of the United Nations, Rome.

Fearnside PM. 1982. Deforestation in the Brazilian Amazon: how fast is it occurring? *Interciencia* **7**: 82–85.

Fearnside PM. 2001. Soybean cultivation as a threat to the environment in Brazil. *Environmental Conservation* **28**: 23–38.

Fearnside PM. 2003. Deforestation control in Mato Grosso: a new model for slowing the loss of Brazil's Amazon forest. *Ambio* **32**: 343–345.

Fearnside PM. 2005. Deforestation in Brazilian Amazonia: history, rates, and consequences. *Conservation Biology* **19**: 680–688.

Fearnside PM. 2008. The roles and movements of actors in the deforestation of Brazilian Amazonia. *Ecology and Society* **13**: 23.

Fischer A, Petersen L, Feldkötter C, Huppert W. 2007. Sustainable governance of natural resources and institutional change—an analytical framework. *Public Administration and Development* **27**: 123–137.

Fonseca F, Davis CA, Câmara G. 2009. Spatial data infrastructures for the Amazon: a first step towards a global forest information system [Special Issue]. *Earth Science Informatics* **2**: 189–313.

Fuller DO. 2006. Tropical forest monitoring and remote sensing: a new era of transparency in forest governance? *Singapore Journal of Tropical Geography* **27**: 15–29.

Gibson C, McKean MA, Ostrom E. 2000. Explaining deforestation: the role of local institutions. In *People and Forests: Communities, Institutions, and Governance*, Gibson C, McKean MA, Ostrom E (eds). MIT Press: Cambridge; 1–26.

Greenwood R, Suddaby R. 2006. Institutional entrepreneurship in mature fields: the big five accounting firms. *Academy of Management Journal* **59**: 27–48.

Hall A. 2008. Paying for environmental services: the case of Brazilian Amazonia. *Journal of International Development* **20**: 965–981.

Hamilton SF, Zilberman D. 2006. Green markets, eco-certification, and equilibrium fraud. *Journal of Environmental Economics and Management* **52**: 627–644.

Hardin G. 1968. The tragedy of the commons. *Science* **162**: 1243–1248.

Harriss J, Hunter J, Lewis CM. 1995. *The New Institutional Economics and Third World Development*. Routledge: London.

Hayes N. 2008. Institutionalizing change in a high-technology optronics company: the role of information and communication technologies. *Human Relations* **61**: 245–271.

Hayes N, Rajão R. 2011. Competing institutional logics and sustainable development: the case of geographic information systems in Brazil's Amazon region. *Journal of Information Technology for Development* **17**: 4–23.

Imperial M. 1999. Institutional analysis and ecosystem-based management: the institutional analysis and development framework. *Environmental Management* **24**: 449–465.

Jepperson RL. 1991. Institutions, institutional effects, and institutionalism. In *The New Institutionalism in Organizational Analysis*, Powell WW, DiMaggio PJ (eds). Chicago Press: Chicago, IL; 143–163.

Jick TD. 1979. Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly* **24**: 602–611.

Kaimowitz D. 2008. The prospects for Reduced Emissions from Deforestation and Degradation (REDD) in Mesoamerica. *International Forestry Review* **10**: 485–495.

Keck ME. 2001. Dilemmas for conservation in the Brazilian Amazon. *Environmental Change and Security Program Report* **7**: 32–46.

Kintisch E. 2007. Carbon emissions: improved monitoring of rainforests helps pierce haze of deforestation. *Science* **316**: 536–537.

Laurance WF, Cochrane MA, Bergen S, Fearnside PM, Delamônica P, Barber C, D'Angelo S, Fernandes T. 2001. The future of the Brazilian Amazon. *Science* **291**: 438–439.

Lederer M. 2011. From CDM to REDD+—what do we know for setting up effective and legitimate carbon governance? *Ecological Economics* **70**: 1900–1907.

Lemos MC, Roberts T. 2008. Environmental policy-making networks and the future of the Amazon. *Philosophical Transactions of The Royal Society B* **363**: 1897–1902.

Lima D, Pozzobon J. 2005. Amazônia socioambiental: sustentabilidade ecológica e diversidade social. *Estudos Avançados* **19**: 45–76.

Lima A, Irigaray CT, Figueira JC, da Silva RT, Guimarães S, Araújo S. 2005. Sistema de licenciamento ambiental em propriedades rurais do estado de Mato Grosso: análise de lições na sua implementação. Ministério do Meio Ambiente: Brasília.

Liverman D, Morian EF, Rindfuss RR, Stern PC. 1998. *People and Pixels: Linking Remote Sensing and Social Science*. National Academy Press: Washington, DC.

Macedo MN, DeFries RS, Morton DC, Stickler CM, Galford GL, Shimabukuro YE. 2012. Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. *PNAS* **24**: 1341–1346.

Mahar DJ. 1989. Government policies and deforestation in Brazil's Amazon region. World Bank, Washington, DC.

Margulis S. 2004. Causes of deforestation of the Brazilian Amazon. The World Bank: Washington, DC.

Meyer JW, Rowan B. 1977. Institutionalized organizations: formal structure as myth and ceremony. *American Journal of Sociology* **83**(2): 340–363.

Mill JS. 1836/1994. On the definition and method of political economy. In *The Philosophy of Economics: An Anthology* (2nd edn), Hausman DM (ed.). Cambridge University Press: Cambridge; 52–68.

MMA. 2002. Lessons from the rain forest: experiences of the pilot program to conserve the Amazon and Atlantic Forests of Brazil. Ministério do Meio Ambiente, Brasília.

de Moura DG. 2006. Mídia e corrupção: a operação Curupira na Amazônia. Centro de Desenvolvimento Sustentável. Universidade de Brasília, Brasília.

Moutinho P, Santilli M, Schwartzman S, Rodrigues L. 2005. Why ignore tropical deforestation? a proposal for including forest conservation in the Kyoto Protocol. *Unasylva* **222**: 27–30.

Mueller B, Alston LJ, Libecap GD, Schneider R. 1994. Land property rights and privatization in Brazil. *The Quarterly Review of Economics and Finance* **34**: 261–280.

Nepstad D. 2011. Recognizing and managing the tropical agricultural revolution in Latin America and the Caribbean, Inter American Development Bank. Inter American Development Bank Techinical notes, Washington.

Nepstad D, Schwartzman S, Bamberger B, Santilli M, Ray D, Schlesinger P, Lefebvre P, Alencar A, Prinz E, Fiske G, Rolla A. 2006. Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology* **20**: 65–73.

Nepstad D, Soares-Filho BS, Merry F, Lima A, Moutinho P, Carter J, Bowman M, Cattaneo A, Rodrigues H, Schwarz S, McGrath D, Stickler CM, Lubowski R, Pris-Cabezas P, Rivero S, Alencar A, Almeida O, Stella O. 2009. The end of deforestation in the Brazilian Amazon. *Science* **326**: 1350–1351.

North DC. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press: Cambridge.

Orrnert A. 2006. Missing pieces: an overview of the institutional puzzle. *Public Administration and Development* **26**: 449–455.

Peters CM, Gentry AH, Mendelsohn RO. 1989. Valuation of an Amazonian rainforest. *Nature* **339**: 655–656.

Puppim de Oliveira JA. 2008. Property rights, land conflicts and deforestation in the Eastern Amazon. *Forest Policy and Economics* **10**: 303–315.

Rajão R, Hayes N. 2009. Conceptions of control and IT artifacts: an institutional account of the Amazon rainforest monitoring system. *Journal of Information Technology* **24**: 320–331.

Repetto RC, Gillis M. 1988. Public policies and the misuse of forest resource. World Resources Institute, Washington, DC.

Robey D, Holmstrom J. 2001. Transforming municipal governance in global context: a case study of the dialectics of social change. *Journal of Global Information Technology Management* **4**(4): 19–32.

Santilli M, Moutinho P, Schwartzman S, Nepstad D, Curran L, Nobre C. 2005. Tropical deforestation and the Kyoto protocol: an editorial essay. *Climatic Change* **71**: 267–276.

Schwartzman S, Zimmerman B. 2005. Conservation alliances with Indigenous peoples of the Amazon. *Conservation Biology* **19**: 721–727.

Scott WR. 2001. *Institutions and Organizations*. Sage Publications: Thousand Oak, CA.

Seo M-G, Creed WED. 2002. Institutional contradictions, praxis, and institutional change: a dialectical perspective. *Academy of Management Review* **27**(2): 222–247.

Soares-Filho BS, Moutinho P, Nepstad D, Anderson A, Rodrigues H, Garcia RA, Dietzsch L, Merry F, Bowman M, Hissa L, Silvestrini R, Maretti C. 2010. Role of Brazilian Amazon protected areas in climate change mitigation. *Proceedings of the National Academy of Sciences* **107**: 10821–10826.

Sparovek G, Berndes Gr, Klug ILF, Barretto AGOP. 2010. Brazilian agriculture and environmental legislation: status and future challenges. *Environmental Science & Technology* **44**: 6046–6053.

Stake RE. 1995. *The Art of Case Study Research*. Sage: Thousand Oaks, CA.

Stern N. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University Press: Cambridge.

Tardin AT, dos Santos AP, Lee DCL, Maia FCS, Mendonça FJ, Assunção GV, Rodrigues JE, Abdon MdM, Novaes RA, Chen SC, Duarte V, Shimabukuro YE. 1979. *Levantamento de areas de desmatamento na Amazônia legal atraves de imagens do satelite Landsat*. Institutio Nacional de Pesquisas Espaciais: São José dos Campos.

Thynne I. 2008. Symposium introduction—climate change, governance and environmental services: Institutional perspectives, issues and challenges. *Public Administration and Development* **28**: 327–339.

UNEP. 2011. Keeping track of our changing environment: from Rio to Rio + 20 (1992–2012). Division of Early Warning and Assessment, United Nations Environment Programme, Nairobi.

United Nations. 1992. Agenda 21: Rio declaration: forest principles. United Nations, New York.

del Vecchio G. 1937. Homo juridicus and the inadequacy of law as a norm of life. *Tulane Law Review* **11**(4).

WCED. 1987. Our common future: Report of the World Commission on Environment and Development. United Nations, New York.

Wertz-Kanounnikoff SA. 2005. Forest policy enforcement at the Amazon frontier: the case of Mato Grosso, Brazil. Universität Heidelberg, Heidelberg.

Wood CH, Porro R. 2002. *Deforestation and Land Use in the Amazon*. University Press of Florida: Miami, FL.

World Bank. 1992. World bank approaches to the environment in Brazil: a review of selected projects, country specific sector review. World Bank, Independent Evaluation Group, Washington, DC.

Yin RK. 2003. *Case Study Research: Design and Methods*. Sage Publications: CA.

Zanchetta MIs, Telles P, Barretto R. 2011. Radar Rio + 20: por dentro da Conferencia das Nacoes Unidas sobre Desenvolvimento Sustentavel. FGV, ISA, Vitae Civillis, São Paulo.