

Overlapping and Conflicting Property Rights and Duties in the Xingu River Basin

Martin Delaroche¹

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****NOTE:** I could not fully complete the paper in time, but I hope the participant in the WINIR Symposium will find the essential parts of the argument I will develop during my presentation on Monday. If possible, I will upload an updated version on Sunday**

Abstract: The increasing pressure of human activities in many parts of the world leads to the growing connectivity of spaces and natural resources, generating conflicts in resource use. However, different property rights regimes often govern distinct aspects of a same geographical area, i.e. the property regime covering the use of trees or commodities (resource units) differ from the property regimes governing forests, lands, or rivers (resource systems). In addition, these resource-specific property rights are usually administered independently from one another. In the Xingu river-basin region in Mato Grosso (Brazil), the expansion and intensification of agriculture in the watershed area have led activities that yesterday had only local impacts to now have impacts at the regional scale, significantly disturbing the way other resources are governed. Existing property regimes on land, both for agricultural and indigenous lands are unable to account for the adverse impacts of agriculture on water quality at the watershed scale. As rivers flow through areas under different governance regimes and connect spaces with one another, they overlap with and create mismatches between property rights owned by different actors for various resources. This sheds light on critical but overlooked design issues of property rights in the context of multi-resource governance. I argue that cross-level and cross-scale interactions between overlapping property rights regimes call for a different type of governance as different efficiency considerations apply to the local and regional scales. Critical design issues include 1) adopting a different approach to property depending on whether resources are units or flows; and 2) taking into account that distinct administrative and informal organizations administer these property regimes. Finding property arrangements that can ensure multi-level resource governance and cope with environmental change therefore depends upon overcoming the obstacles of institutional fragmentation.

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Introduction

In spite of decades of environmental policies, environmental degradation in the Amazon region of Brazil is still ongoing at a worrisome pace. As the agricultural frontier gets pushed back, landscapes of past colonization are stabilizing and urbanization is developing. This evolving situation brings new challenges to the implementation of environmental policies. In the Northern part of the state of Mato Grosso, the agricultural colonization starting off in the 1970s has profoundly transformed the area into one of the major crop and meat producing regions of Brazil. At the same time agricultural expansion was driving deforestation, conservation areas and indigenous parks were created in various places, helping avoid further environmental degradation. The Xingu Indigenous Park² (PIX), located in the northeast region of Mato Grosso is one of those. Created in 1961 following the orders of President Jânio Quadros, the park covers an area of 2.6 million hectares (ha) and is inhabited by around 5,500 indigenous people forming 16 different indigenous groups. Importantly, the park has a unique geographical location as many of the tributaries forming the Xingu river meet within the boundaries of the park.

Indigenous peoples of the PIX have successfully preserved their forests for more than forty years in spite of the intense deforestation occurring in the surroundings. As of 2009, around 37% of the Xingu river-basin area was deforested, while the area deforested in the PIX was only 1.7% of its original forest cover (Instituto Socioambiental, 2011). Large-scale deforestation outside the park's boundaries has resulted in an "*abraço da morte*" ("death hug") that is gradually tightening its hold over the PIX (see Figure 1). In spite of being remarkable environmental stewards, indigenous peoples are powerless faced with the decrease in water quantity and quality caused by agricultural activities located upstream of the Xingu river basin. Loss in forest cover outside the PIX translated into increased sedimentation, water turbidity and temperature, affecting in turn fish size and reproduction rates, threatening indigenous peoples' livelihoods. In addition, the intensive use of pesticides and fertilizers by agriculture further reduces water quality. Recent research conducted by indigenous and researchers have evidenced the presence of a wide

² Hereafter referred to as the 'PIX' or simply 'the park'

range of chemicals in fishes at concentration unsuitable to human health (Instituto Socioambiental, 2011). Finally, the increased frequency of forest fires for land clearing outside the park bears consequences in terms of air pollution for all inhabitants of the Xingu river basin.

The current situation in the Xingu river basin is not uncommon and illustrates the multi-scale and multi-level dimensions of natural resources use and environmental externalities in other places in the world (Cash et al., 2006). The intensification of human activities in the Xingu river basin has led to the growing connectivity of natural resources such that simultaneous use of various resources increasingly affect, or are affected by, each other. Activities that were yesterday relatively insulated from each other (e.g. agriculture outside the PIX and fishing or water consumption within the PIX) are now significantly impacting one another. In such cases, the successful management of environmental problems at one scale (e.g. within the park) increasingly depends on the success of management of environmental problems at another scale (e.g. at the river-basin scale) (Brondizio et al., 2009). Environmental policies thus arguably require some degree of coordination and linkages between those scales to be effective.

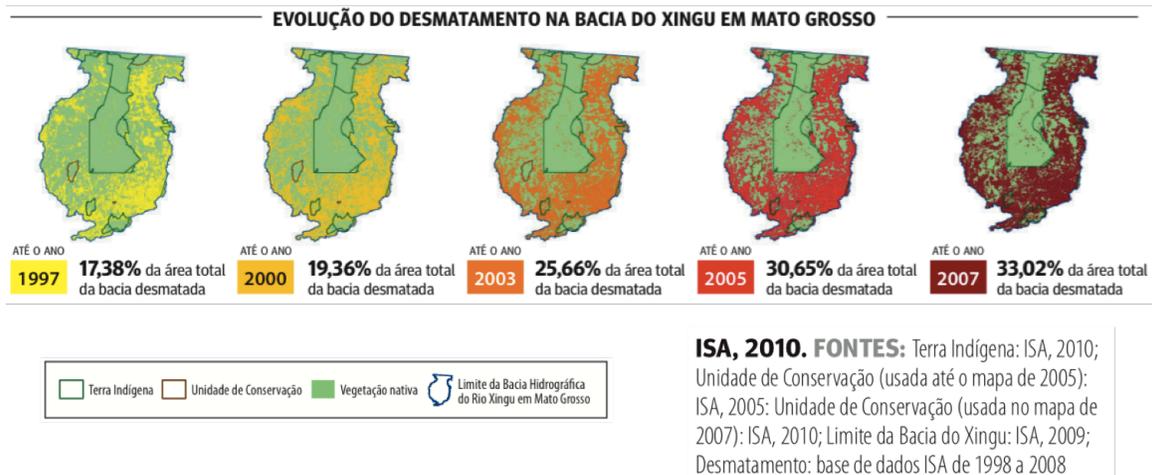


Figure 1: Evolution of deforestation in the Xingu river basin in Mato Grosso, 1997-2007.

Source: (Velasquez et al., 2010)

Property rights hold a key place in natural resource management by defining a variety of rights and correlated duties with respect to access and use of natural resources. However, different property rights regimes often govern distinct aspects of a same geographical area, i.e. the property regime covering the use of trees or commodities (resource units) differ from the property regimes governing forests, lands, or rivers (resource systems). If not already the case at the stage of their definition, these property rights regimes inevitably start to overlap and/or to conflict as natural resources uses get increasingly connected with one another. For instance, the rights of farmers to cultivate their land³ now directly conflicts with the rights of indigenous peoples to enjoy clean water in the PIX, which was not the case at the time property rights over the park were defined by the state in the 1960s.

Although part of this problem is due to the existing gap between the mandate of environmental policies and their implementation on the ground (Fearnside, 2013), I argue that this problem goes beyond a lack of monitoring and enforcement of rights. The institutional situation in the Xingu river basin highlights the practical and theoretical challenges of multi-resource governance. In this paper, I first extend the logic of current property rights theory to multi-resource governance to point out inconsistencies created by the definition of single-resource property rights regimes. As argued elsewhere, it appears evident that “property theory has not kept pace with the growth of empirical and historical data on property systems” (Cole & Ostrom, 2012, p. 37). Second, still applying current theory, I analyze what are the transaction costs to solving interferences between interdependent natural resources use. Third, I analyze two practical obstacles to the redefinition of property rights regime in the context of multi-resource governance: (1) the absence of a mechanism to determine the priority of one resource use over another; (2) the existence of multiple independent state agencies in charge of defining important aspects of property regimes.

³ This right is never absolute and always subject to particular limitations imposed by laws and public policies. As Demsetz remarked: “*An owner of property rights possesses the consent of fellowmen to allow him to act in particular ways*” (Demsetz, 1967, p. 347)

1. Multi-resource governance and property theory

a. The definition of property rights

Property rights are usually defined as a right to a benefit stream from a given resource. It defines a *triadic* relationship between (a) one particular asset (e.g. a natural resource); (b) rights of the ‘owner’ to benefit stream; (c) correlated duties of all other people not to interfere with the owners’ rights (Bromley, 1991; Hohfeld, 1913). Property rights are thus functional only insofar as there exist duties from other people ensuring that the owner can safely enjoy the benefit stream attached to a resource.

This definition calls for a few remarks. First, directly flowing from this definition is the idea that property is not the resource itself, but rather the benefits that are attached to it. Indeed, authors traditionally make a distinction between the biophysical characteristics of resources and the humanly-devised property rights system to govern them (Cole & Ostrom, 2012; Gibson et al., 2000). The use of a forest can indifferently be governed by private, public, or common-property regimes, although each regime may entail different management outcomes. Second, this definition only covers the use of one category of resources at a time. In practice, it is increasingly difficult to discuss the management of natural resources without considering other affected resources or underlying ecosystem services (Sandberg, 2007).

Multi-resource governance refers to the situation in which an institutional arrangement needs to be found for accommodating the interactions or interferences between users resulting from the simultaneous use of *various interdependent resources*. It resembles “multi-level resource governance” but differs from it to the extent that it examines not one but multiple interdependent resources use, at different scales.

b. The challenge posed by multi-resource governance

In many places in the world, as in the Xingu river basin, human activities expand in geographical scope or intensity and start impacting each other, creating interactions and conflicts in resource-use. Although such interactions can be beneficial, they are harmful in most cases. In the Xingu river basin, the expansion of agriculture relying on extensive monoculture and intensive chemical inputs use has led to increased water pollution and air pollution (e.g. fire smokes) for most inhabitants of the area, including indigenous peoples. Agricultural land-use conflicts with others' use of water for drinking or fishing, and deforestation driven by this expansion may modify the overall ecosystem equilibrium by depleting carbon stocks and modifying hydrological cycles (Panday et al., 2015).

The intensification of human-environment interactions creates increasing connectivity between different resource-uses and underlines the functional interdependence of management regimes. The growing connectivity of natural resources occurs not only between different resource-uses (e.g. agricultural water pollution and fishing) but also between each resource-use and underlying ecosystem services (e.g. water availability and recycling, hydrological variation, etc.) (Duraiappah et al., 2014; Sandberg, 2007). In the Xingu example, it can be illustrated by how agricultural and cattle-ranching expansion in the headwaters area reached a point at which these activities cause not only environmental damage at the local level but also inside the PIX and beyond, by putting significant pressure on water quality for drinking and fishing.

Such connectivity has been facilitated by human interactions at many different levels: expansion of a regional agriculture turned towards global markets and supported by export policies; raising commodity prices; public policies for agricultural production; building of infrastructures and roads all around the park easing the arrival of new migrants attracted by agricultural opportunities (Brondizio et al., 2009). In practice it also means that one's actions at a given location may have impacts much farther locations than previously assumed.

This increasing connectivity creates growing problems of interdependence and interferences in resource-use. Social and ecological systems become increasingly linked and functionally interdependent, as one resource-use at one level may now impact another resource-use at another level. An example in the U.S. is how agricultural practices in the Midwest (i.e. intensive reliance on pesticides and fertilizers) result in the dead zone of the Gulf of Mexico although they are located thousands of miles away (Brondizio et al., 2009). Furthermore, it indicates that the way a management regime is designed for one resource will likely bear important consequences over how well other management regimes function for other resources.

c. Increasingly contradictory duties

The issues of growing connectivity and functional interdependence of natural resources pose serious challenges to property rights theory. At least in theory, each person holding a right over a resource can expect *all others* to have correlated duties not to interfere with this right. Although such an assumption seems relatively reasonable and practical in the case of single-resource use, it is widely inapplicable once we move the focus from single to multi-resource use. This can be seen through a fictional example.

As a landowner, I do enjoy a right to cultivate land and carry out all the operations necessary for a successful harvest while all others should have duties not to invade my land or impose any guidelines on my management practices. As a fisher using a river downstream of that piece of land, I have a right to fish that matches with others' duties' not to dump anything toxic or harmful for fish populations. This example looks familiar to most readers of property rights theory as it can be analyzed in terms of a single resource-use (i.e. water) that links the use of land and the use of a fishery. However, as we expand the analysis to additional resource-uses in the area, such as a right to clean air which might be harmed by agricultural fires or a right to drinking water that concerns all inhabitants, in particular as concentrated in urban areas, such analytical framework loses analytical power. Interferences between resource uses occur at too many levels and

through different avenues (e.g. through water or underground water, through air, etc.), or concern too many parties (e.g. farmers, fishers, indigenous peoples, urban dwellers, etc.).

Property rights theory is unable to deal with such situations because it assumes something overly ambitious: that for each property right, all other individuals have a duty to respect that right. Duties associated to various resources might not necessarily conflict in the first place as resource-uses themselves do not conflict to a large extent. This is, in essence, what was the case when property rights were defined on the boundaries of the PIX in the 1960s. There were no major interferences created by agriculture that had not yet expanded up to the very boundaries of the PIX. Furthermore, at the time, this type of agriculture relied on different technologies as we were in the early stages of the agricultural colonization of Mato Grosso, whereas it relies now heavily on chemical inputs (Jepson, 2006). Somehow, in the past, all users of various resources in the region could live without having to “fulfill” their duties with respect to remotely-located others, because most of them did not encroach on others’ resource-uses. Following agricultural and urban expansion however, each resource user should have been increasingly required to follow their duties toward each other, but quite evidently none of this happened.

d. A problem of incomplete or overlapping property rights?

This last example shows how duties have been the most overlooked aspect of property rights theory, especially as applied to natural resources: “In natural resource management policy formulation and implementation, formal property rights are enacted or reformed with the underlying assumption that rights will be realized at the operational level; that is, the duties and powers inherent in those rights will be recognized and internalized by the resource users” (Galik & Jagger, 2015, p. 82). If in theory, duties concern all others with no rights to a resource, the number of persons that are in practice ‘reasonably expected’ to respect duties is much less important. This is because different resources and their associated rights define duties with different spatial scope. For instance, the number of persons that concretely have to respect rights I have on land will likely be lower than the

number of persons that have to respect rights I have on water, because the spatial boundaries of a land plot are span over a significantly smaller geographical area than a water stream.

The literature has characterized this issue as one of mismatches, i.e. “a problem of fit involving human institutions that do not map coherently on the biogeophysical scale of the resource, either in space or time (Cash et al., 2006, p. 4). There are usually three types of mismatches: temporal (e.g. rights holders with different time horizons), spatial (i.e. poorly defined or overlapping spatial boundaries creating competing incentives), or jurisdictional (e.g. when different property regimes govern the same resources or sector) (Cash et al., 2006; Wilson, 2006; Yandle, 2007).

One might now remark that the problem of mismatches is therefore one of under-specification or overlapping of property rights. Perhaps the problem indeed is that the state (i.e. the central authority supposed to define property rights in most property theory⁴) has not yet defined “missing” rights that would clarify the role of all actors affected by specific resource-uses. However, taking back the example of water use, that would basically mean that every person should have its own legal relationship to water use specified, and as many would probably have varying degrees of use rights to water (e.g. some for consumption, some for consumption and fishing, some for agricultural irrigation, etc.), as many correlated duties would need to be consistent together. If this is to some extent possible to solve contradictions in the duties of actors for a single-resource, it might not be as simple for the use of multiple interdependent resources, where there are simply too many duties in too many directions for too many actors.

Another possibility is that property rights regimes overlap with one another. The issue of overlapping property regimes has mainly been explored for cases of singular resources rather than cases of multiple resources use. For instance, Yandle analyzes the overlapping property rights over New Zealand’s marine resources where the “differing temporal qualities of individual transferable quotas (ITQs) and the annual catch entitlement (ACE)

⁴ Although this can also be done by a community

appear to have created a fishery in which two key components have distinctly different time horizons and goals for fishery management” (Yandle, 2007, pp. 13-14). Too few papers have tried to address cases of cross-scale interactions resulting from the overlap of property regimes attached to different natural resources.

Furthermore, the fact that a number of these interdependent natural resources are ecosystem services that support and ensure the functioning of other resources adds a layer of complexity. While Wilson (2006) remarks that institutions designed for managing a single set of resources tend to ignore ecosystem services and degrade them over time, it has proven extremely difficult to assign property rights to ecosystem services so far (Sandberg, 2007).

2. Solutions to address multi-resource governance issues

a. The structure of rights and entitlements

Is governance and property rights theory “epistemologically unprepared” for current understanding of ecosystems interactions as some authors wonder (Sandberg, 2007)? It is interesting to review what tools the existing literature on property rights has to help address the challenge of multi-resource governance.

One way to explore potential solutions to the puzzle created by multi-resource governance is to analyze property as a bundle of rights, composed of (a) access and use rights; (b) management rights; (c) exclusion rights; and (d) alienation rights (Schlager & Ostrom, 1992).⁵ This conceptual framework however applies to the analysis of a single sector or type of resources. In an attempt to overcome this conceptual limitation, Galik & Jagger (2015) propose adding a fifth ‘stick’ to the bundle of property rights: the *right of alteration*, i.e. the right to change the goods or services provided by the resource. The

⁵ define each right

authors thus hopes providing a better analytical framework to examine situations in which resources (e.g. land) can be broken down in multiple resources, or a flow of goods and resources (e.g. forest, carbon, etc.). The typical example is that of a reforestation or forest conservation project under the REDD+ mechanism.⁶ This new framework, albeit useful in some applications, suffer limitations for examining cases where there are more than two resources or two parties under consideration.

A much more welcomed contribution of the authors is to re-emphasize the role of duties and liabilities associated with property rights: “In natural resource management policy formulation and implementation, formal property rights are enacted or reformed with the underlying assumption that rights will be realized at the operational level; that is, the duties and powers inherent in those rights will be recognized and internalized by the resource users” (Galik & Jagger, 2015, p. 82).

I argue that the reason why such duties and liabilities are not internalized is because they are overwhelming. A quick look at the transaction costs implications of considering seriously duties and liabilities in situations of multi-resource interferences can give an idea of how the problem looks like.

b. Transaction costs implication of different rights structure

The economic theory of property rights has examined the problem of interferences between two resource-uses under the lens of externalities. It has explained the emergence of property rights based on transaction costs: when the costs of keeping two activities under separate regime becomes greater than internalizing them under a single rights regime, property rights can be re-arranged to encompass both uses or possibly eliminating the less profitable one (Demsetz, 1967). In the case of multi-resource governance, externalities are going in all directions, and there are many different types of actors holding different types of property rights over various natural resources. It

⁶ explain what REDD+ is here

intuitively means that the externalities may impose costs so great that they would ideally be internalized within a single property regime. Does it mean that natural resource management policy should structure entitlements under a single property regime for all resources, potentially held by the state? Theoretically speaking, this should not be the case unless the transactions costs of bargaining to solve the interdependencies between various resource-uses are low enough for private actors to conduct them. The bargaining costs might well be too great to allow for any internalization of externalities, in which case we reach a theoretical dead-end: it is too costly to keep separated property regimes, but it is too costly for private actors to re-arrange rights under a single regime.

In 1991, Bromley tackled part of the issue with a deeper discussion of entitlements. He remarked that there are multiple ways of protecting someone's rights, and this helps "gaining a more complete understanding of the myriad ways we impose costs on each other" (Bromley, 1991, p. 42). He distinguishes between different types of entitlements: (1) entitlements protected by property rules; (2) entitlements protected by liability rules; (3) inalienable entitlements (Calabresi & Melamed, 1972). The distinction between property rules and liability rules is the following. If I hold property rights over some asset, no other individuals can take any action over that asset *without my prior consent*. On the contrary, if I am protected by a liability rule, other individuals may undertake actions that have an impact on my asset, but I must be compensated for it. Of course, these legal relations go both ways: if others have property rights or are protected by liability rules, I have to either ask for their consent or compensate them before I take any actions interfering with their assets. Finally, an inalienable entitlement refers to a previous stage at which "collective decisions must be taken regarding who is to own something, the nature of that ownership (a property rule or liability rule) and what price is to be paid if it is used, taken or destroyed" (Bromley, 1991, p. 45).⁷

Transaction costs vary greatly depending on one type of entitlements to the other, and who has the entitlement (Bromley, 1991). If protected by a property rule, the demonstration that some action will not interfere significantly with my resource-use is on

⁷ For a longer discussion of entitlements type, please refer to Bromley 1991

others who require my prior consent. Conversely, if I want to prevent the owner of a resource to take an action that would be detrimental to me, I have to go meet and negotiate with that person, possibly offering her compensation for not undertaking that action. If protected by a liability rule, others can take actions that will interfere with my resource use but they need to be prepared to offer compensation for any damage I shall incur. In this case, however, I must be the one raising the issue and claim for compensation based on the demonstration that some undertaken action had an impact on me. Inversely, if others are protected by liability rules, I can take actions that will undermine their resource-use but should offer compensation, if and only if I am asked for it.

There might be cases in which such two-party transactions may entail significant effects for third parties. Then, the transaction costs of representing those third-party interests might simply be too great for two-party bargaining to occur. In such cases, it may be preferable to have an inalienable entitlement precluding either parties to take any action before a collective decision has defined how use rights should be structured to minimize interferences between the parties. In other cases, third-party effects might simply be difficult or impossible to evaluate and, under such uncertainty, it may be necessary to have an inalienable entitlement. For instance, it is very difficult to know with precision the impacts of agricultural land-use expansion on local and regional ecosystem services such as climate regulation, although it may in the future entail several adverse effects for others such as rainfall diminution (e.g. in the case of massive deforestation).

c. Two policy-relevant questions for multi-resource governance

Two theoretical and practical questions emerge from this discussion: who should handle the re-arranging of property rights regimes to accommodate different uses and, more importantly perhaps, what resource use should be given priority (including ecosystem services) (Sandberg, 2007)?

What resource use should be given priority?

[Section to be completed later]

The respective value (and costs) of each resource traditionally serves as the guide for determining which uses should be prioritized.

In addition to the structure of entitlements, Bromley (1991) also examined the nature of different interdependence relations between natural resources use in the hope of gaining further insights for natural resource management policy-making. He analyzes for each type of interdependence whether the degree/severity of the following elements: (1) nature of impact; (2) frequency of impact; (3) presence of third-party effects; (4) transaction costs; (5) unique damage function; (6) irreversibilities. As we already covered elements (3), (4) and (5), we will concentrate on the remaining ones. Sometimes, the nature (1) of conflicts in resource-use can be at most ‘irritating’ but do not represent a serious health or ecological threat, or does not impose severe economic costs. Also, the frequency (6) with which interferences occur matters: the noise from a railroad might be varying on a daily basis or be seasonal, but the dumping of chemicals into a river has potentially constant effects. Finally, interferences can sometimes be irreversible while others can be fixed.

Who should re-arrange rights?

Can actors within multi-resource governance contexts negotiate and re-arrange bundles of rights (and duties) so as to minimize (or compensate for) the externalities? Although in case of small-scale settings, particular contexts and very specific actors, we can see bargaining occur over ecosystem services (Depres et al., 2008), this is unlikely to happen in a situation like the one illustrated by the Xingu river basin case. Although the property/liability distinction can help us structure property rights in various natural resources in ways that minimize interferences, not all interactions are strictly between two parties. Due to the growing connectivity between social activities and ecological resources, much of the interferences occurring in the Xingu river basin for instance now concern more than one type of resources and two types of actors.

Using this set of criteria, it appears that a good number of interactions occurring in the Xingu river basin are too serious to be subject to any two-party bargaining.

Property rights theory bestows the state with the role of defining property rights regime. However, in practical terms, it is sometimes difficult to determine *who* is the state in the context of multi-resource governance. Multiple laws and various state agencies are in charge of different aspects of resource use in the Xingu river basin for instance. As in many other places, Brazilian public and environmental policies are widely inconsistent in their objectives and have different degrees of implementation and enforcement (Fearnside, 2013).

To give just a flavor of these contradictions, one can use the example of the Brazilian Forest Code (BFC). According to this legislation, landowners have an obligation to maintain and protect the forest cover on their property over a share of land area defined by Legal Reserves (LRs) and in all riparian areas under Areas of Permanent Protection (APPs). Depending on the biome in which the land is located, this forest-cover requirement can range from 30% to 80% in the Amazon. At the same time, the Brazilian Constitution defines the social function based on the *uti possidetis*, i.e. the land should be owned by who exploits it. In areas where land property is ill-defined, the easiest way to claim property is then to clear it (Aldrich et al., 2012; Araujo et al., 2009). Furthermore, landowners owning large tracts of land left idle will also tend to deforest their land in fear of being expropriated following occupation of their land by landless peasants who put it at use. The issue comes partly from the fact that two distinct state agencies enforce these two property rights regime over land. The Environment Agency (IBAMA) is in charge of implementing the provisions of the BFC and does it with the help of the Environmental Military Police. However, the authority in charge of legalizing land occupation is the National Institute for Agrarian Reform (INCRA). As they do not necessarily have the practical means of controlling whether land is put at productive use before assigning land rights to colonize, the easiest way to know that land occupants effectively cultivate land is to observe that no standing trees might hinder cultivation (Fearnside, 2001; Le Tourneau & Bursztyn, 2011).

If we are to examine other natural resources rights regime in the area, one can only take measure of the institutional fragmentation: property rights regimes tend to be administered separately by various groups and state agencies. Hence the theoretical redefinition of those rights in order to balance the interferences existing between various natural resources use is practically complex, if not impossible.

[Complete this part later - implications for governance]

CONCLUSION

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