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Payment for Environment Services to Promote Compliance with Brazil's Forest Code: The Case of "Produtores de Água e Floresta"

Ana Carolina Oliveira Fiorini [1,*], Marilyn Swisher [2] and Francis E. Putz [3,*]

[1] School of Natural Resources and Environment, University of Florida, Gainesville, FL 32611, USA
[2] Family, Youth and Community Sciences Department, University of Florida, Gainesville, FL 32611, USA; mesw@ufl.edu
[3] Department of Biology, University of Florida, Gainesville, FL 32611, USA
* Correspondence: anacarolinfiorini@gmail.com (A.C.O.F.); fep@ufl.edu (F.E.P.)

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Abstract: Payments for ecosystems services (PES) can promote natural resource conservation by increasing compliance with environmental laws. Law enforcement and PES proponents assume that individuals make decisions about compliance based on expectations of gains, likelihood of being caught in non-compliance, and magnitude of sanctions. Brazil's Forest Code, characterized by low levels of compliance, includes incentive and disincentive mechanisms. We interviewed landowners in the Atlantic Forest to understand their motivations to participate (or not) in a PES project, the effects of knowledge and perceptions of environmental regulations on compliance, and how both environmental regulations and PES affect land management decision-making. We found that neither expectations of financial gains nor PES payments drive behavioral change and that the perception of systemic corruption reduced compliance with environment regulations. There were important behavioral differences between long-term residents for whom the land is their main source of income and recent residents with little dependence on land-generated income.

Keywords: conservation behavior; illegality; informality; land-use decisions; law enforcement; PES; qualitative research

1. Introduction

Natural conservation can be promoted both by compulsory (laws) and voluntary-mixed tools like payments for ecosystems services (PES) (e.g., [1]). PES are administered in places already subject to other environmental policies, and in many places PES provide incentives to comply with existing policies [2,3]. Regulations and incentives are important elements to signalize societal norms and expectations [4]. Mixing compulsory regulatory disincentives with voluntary incentive-based instruments can potentially improve ecosystem services and increase incomes [5]. Policy mixes or combinations can improve the quantity and quality of ecosystem services provided [6]. Evidence of the efficacy of policy mixes of PES with existing regulations has grown [7–9]. Most analyses are theoretical, based on little empirical evidence [10]. This study contributes to this literature using qualitative data that reveal facets of landowner decision-making about compliance with existing environmental laws and participation in PES programs. We used a case-study to investigate how forest conservation instruments using incentives and disincentives influence land use decisions.

Environmental behaviors may result from interactions between emotions, attitudes, beliefs, identities, knowledge, worldviews, and values embedded in social and cultural contexts combined with skills and opportunities to act [11,12]. Environmental behaviors are all types of behavior that change

the structure, composition, function, or dynamics of ecosystems [13], therefore, pro-environmental behaviors refers to behaviors that harms the ecosystems as little as possible, or even benefits the environment [14]. Three broad approaches characterize our understanding of behavior change. Value-belief-norm theory attributes behavior change to an individual's underlying beliefs, norms, and values [13]. The theory of planned behavior examines the influences of attitudes about a behavior, perceived judgement of behavior to people important to the actor, and perceived control over the behavior [15]. Rational choice theories treat behavior as an outcome of the individual's effort to maximize benefits from the behavior [16].

PES programs assume that monetary benefits encourage environmental behaviors but need to recognize that non-financial incentives can exert great influence on participating in PES programs [17]. Demographic factors are predictors of participation. Higher income and educational levels [18,19], older heads of households [20], and land characteristics like size and proximity to the project headquarters [21] predict increased PES participation. Motivations for PES participation include intrinsic motivations for ecosystem protection [22], prosocial considerations like procedural fairness, equity and legitimacy [23], and a form of land tenure and food security [19,24]. Contract design, program flexibility, social and human capital reserves, and personal values also affect participation [19,20,25]. In contrast, participation declines if many changes in land management are required [21] and when property owners depend heavily on the land for income [26].

Like PES, public law enforcement theory assumes that individuals are likely to commit non-legal acts if the action's expected utility exceeds the utility of acting within the law, taking into account the chance of being caught and the magnitude of likely sanctions [27]. Therefore, enforcement could shape compliance by affecting the likelihood of detection and sanctions and the severity of sanctions, which [28] call calculated motivations to comply with environmental regulations. They distinguish between normative motivations, an individual's feeling that compliance is a civic duty, and social motivations when there is social pressure to comply. Their findings imply that normative and social motivations affect an individuals' assessment of the utility of an act although they are often ignored in utility-based explanations of behavior.

Knowledge of what drives legal compliance and participation in PES contracts is critical to understanding how combined incentive and disincentive, voluntary and compulsory, approaches can achieve desired conservation outcomes, but the combination generates potential contradictions. For example, PES cost-effectiveness is thought to be greatest in regions with high deforestation rates or in most need of restoration [29]. However, PES payments to promote compliance in these regions could go to the worst violators of regulations and could reduce other motivations to comply [2]. Few PES studies have employed qualitative methods that provide an in-depth understanding of landowner perceptions [23,30,31] and few explore how combined incentive and disincentive instruments affect pro-environmental behaviors.

Brazil has a robust system of environmental laws and regulations (ELR) that employ disincentives for non-compliance (fines and jail terms) and incentives for compliance (e.g., PES), a combination of compulsory and voluntary tools. The Forest Code (FC), Brazilian federal law 12651 [32], is the main legal instrument dealing with protection and recovery of native vegetation on private lands [33,34]. The 1934 FC was enacted to protect riparian forest and last updated in 2012 when PES was incorporated, and amnesty granted for deforestation that occurred before 2008 [32]. The FC requires landowners to maintain natural vegetation in ecological buffer zones near springs and rivers, on steep slopes, and on hilltops (Permanent Protected Areas or PPAs). They must establish natural vegetation set-asides (Legal Reserves—LR) on a predetermined minimum percentage of their land, 20% in our study area. The FC is a potentially powerful conservation tool but has modest impacts on forest conservation due to poor compliance [35,36].

The relationships between PES and compliance with existing environmental protection laws are complex. A key goal of this research was to understand how law enforcement and PES individually and together influence environmental decision-making. We used a case study to examine (1) motivations to enroll in a PES project, (2) the role and importance of knowledge and perceptions of environmental regulations in compliance, and (3) how ELR and PES affect land management decision-making.

2. Materials and Methods

2.1. Study Area

Rio Claro Municipality in Rio de Janeiro State, one of the most deforested states of the Atlantic Forest Biome in Brazil, created the PES analyzed here in 2010. Produtores de Agua e Floresta (PAF) started as a partnership of an international NGO and four Brazilian organizations [37]. Rio Claro's population is about 18,000 [38] and the service sector and agriculture dominate the economy. It is near Brazil's two biggest cities, 139 km from Rio de Janeiro and 270 km from Sao Paulo. Beginning in 2009, with additional public announcements to join issued in 2009, 2011, 2012 and 2015, PAF offered landowners the opportunity to participate in PAF's program to maintain and restore riparian forests to reduce soil erosion and sustain water supplies. PAF requires participants to restore riparian forests as required by the FC, e.g., PAF pays participants to increase FC compliance.

People learned about PAF mostly when its managers visited properties and when landowners visited Rio Claro's rural labor union or consulted with the rural extension company. A PAF local manager visited any landowner who expressed interest in joining in order to geo-reference the property and explain the requirements of PAF and the FC. PAF then mapped land use on the properties and established FC-based reforestation targets. Participation in PAF required property owners to reforest at least 25% of the area suitable for riparian forest, with an incentive to those who agreed to reforest more than the minimum. PAF payments were USD 7–29 per year per forest-covered hectare and were increased in 2013 [37]. The payments were calculated based on milk production, because a dominant land-use in the municipality is pasture for cow breeding [37]. The expansion of pasture is an important deforestation driver in the region.

Property owners who signed PAF contracts pledged to suspend current use of areas allocated to reforestation and PAF assumed the costs of reforestation. PAF's managers designated areas for active restoration by preventing fires, excluding cattle and planting trees or passive restoration by protecting existing forest. Contracts were valid for two years without penalty for early withdrawal. As of July 2017, 67 participants owning 78 properties collectively agreed to maintain 4134 ha of forest and to reforest an additional 520 ha ([39]; Figure A1—Appendix A). In 2017, the total number of landowners in Rio Claro was 499 [40], and PAF included about 14% of landowners in the municipality.

2.2. Methodology

We compared perceptions of landowners who participated in PAF with those who did not. We investigated perceptions regarding connections between PAF participation and compliance with environmental regulations, particularly the FC. Figure 1 illustrates the conceptual connections between the theoretical assumptions of PAF and those of law enforcement and incorporates a concept that the utility of a behavior goes beyond purely financial motivations. We define behavior decisions as the environmental management practices reflecting on land-use; and behavior change as the changes in behavior related to the existence of a regulation or a PES that result in land-cover change.

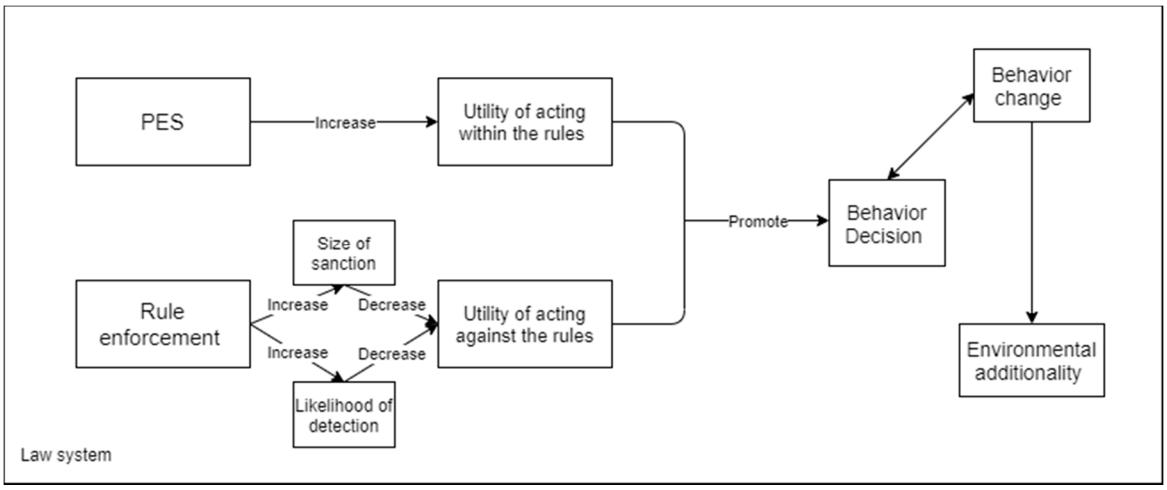

Figure 1. Rule enforcement and payments for ecosystems services (PES) joint theoretical model.

Guandu Watershed agency (AGEVAP) provided a geo-referenced database showing property boundaries of PAF participants and areas designated for reforestation and provided descriptive information about the participants. We contacted all but six of 67 PAF participants, two of whom were unwilling to respond. Six were unresponsive to ten phone calls and two visits to their properties on different times and days. We sampled to match participants and non-participants on socio-economic traits and opportunity cost proxies (land characteristics). Owners were not in residence on many properties and we therefore used intercept sampling at other locations frequented by landowners, the local rural labor union and the local technical assistance and rural extension office (EMATER). We interviewed 19 landowners who chose not to participate in PAF and two who enrolled but dropped out of the project before receiving any payment (Table 1 provides demographic traits of the respondents in the two comparison groups).

Table 1. Sample demographics.

	Gender			Age	Education Level
	M	F	M + F		
PAF (Produtores de Água e Floresta) participant	41 (69%)	9 (15%)	9 (18%)	Average 62 Min: 36 Max: 91	- never attended school: 3 (5%) - studied in elementary school: 13 (22%) - incomplete high-school: 2 (3%) - completed high school: 9 (15%) - technical degrees: 6 (10%) - college: 32 (37%) - post-graduate degrees: 6 (10%)
Non-participant	15 (79%)	2 (11%)	2 (11%)	Average 58 Min: 32 Max: 84	- never attended school: 2 (11%) - elementary school: 11 (58%) - high school: 4 (21%) - technical school: 1 (5%) - college: 1 (5%)

We conducted semi-structured interviews (34–150 min, Table A1 provides summary of interview questions) to explore why participants chose to join or not join PAF and why people complied or not with the FC (University of Florida IRB201701354). The interviews covered four topics: (1) general information about properties and socio-economic characteristics of the landowners; (2) perceptions about forests and ecosystem services, including explanations of the distribution of forest and regrowth areas on the land; (3) perceptions of and knowledge about environmental regulations; and (4) knowledge about the project and their motivations for joining or not joining PAF [41]. Procedures were used to develop the protocol, which was reviewed by three researchers with experience in conservation and sustainable

agriculture. We revised the interview guide to accommodate local language and culture after testing the interview instrument with five Rio Claro landowners of various socio-economic backgrounds.

Data analysis involved four steps (Figure A2). Steps 1 and 2 are commonly used in many types of qualitative data analysis [42,43]. Step 1, topical coding, identifies specific ideas in the individual responses and captures each respondent's comments based on transcripts of the interviews and the researchers' notes and case summaries [44,45]. In Step 2, thematic coding, we grouped similar concepts generated in Step 1 into themes and identified relationships among them [46,47]. These larger frames helped us understand respondents' more global views about relevant topics and to identify broader commonalities among participants than the specific concepts in Step 1. In Step 3, analytic coding created mental models of respondents' representations of a condition or process and the relationships among the concepts [48]. We identified components in the respondents' mental models that help explain how participants think about participation in PAF and to understand commonalities and differences among respondents' views of the roles of the FC and PAF in their lives. We printed statements of the themes and arranged them into representations that reflect thought processes and interactions among themes. In Step 4, we assessed the degree of model agreement or "fit" with the majority of cases [46,49] and created explanatory models. Finally, we re-examined our theoretical model and modified it based on our results [50,51], creating a model that contributes to the theoretical understanding of socio-environmental systems.

3. Results

The interviews produced 267 first-level (Step 1) codes for the 59 participants and 158 for the 21 non-participants. We modified our initial theoretical model of the relationships between law enforcement, participation in PAF, and environmental additionality of PAF to reflect our findings. The explanatory models of decision-making (Figure 2) highlight (1) important distinctions between outsider and insider groups; (2) the impacts of corruption and lack of trust in government on decision-making processes; and (3) pathways that reflect added constructs in decision-making among insiders and outsiders and between PAF participants and non-participants.

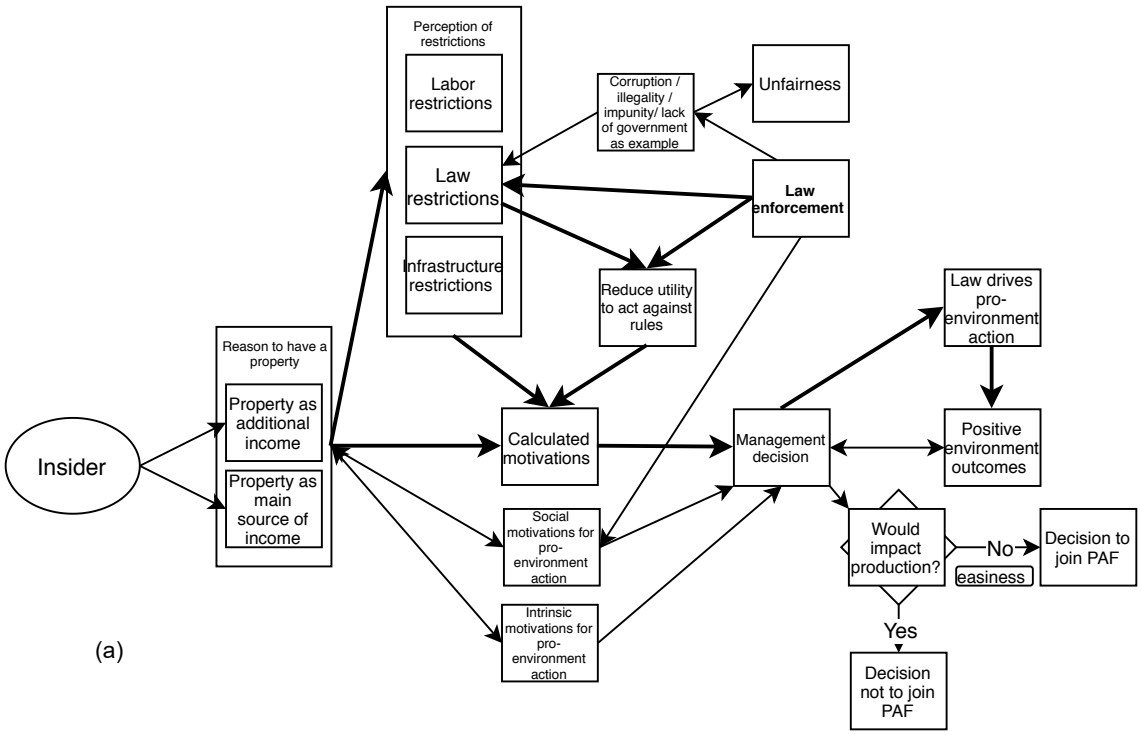

Figure 2. *Cont.*

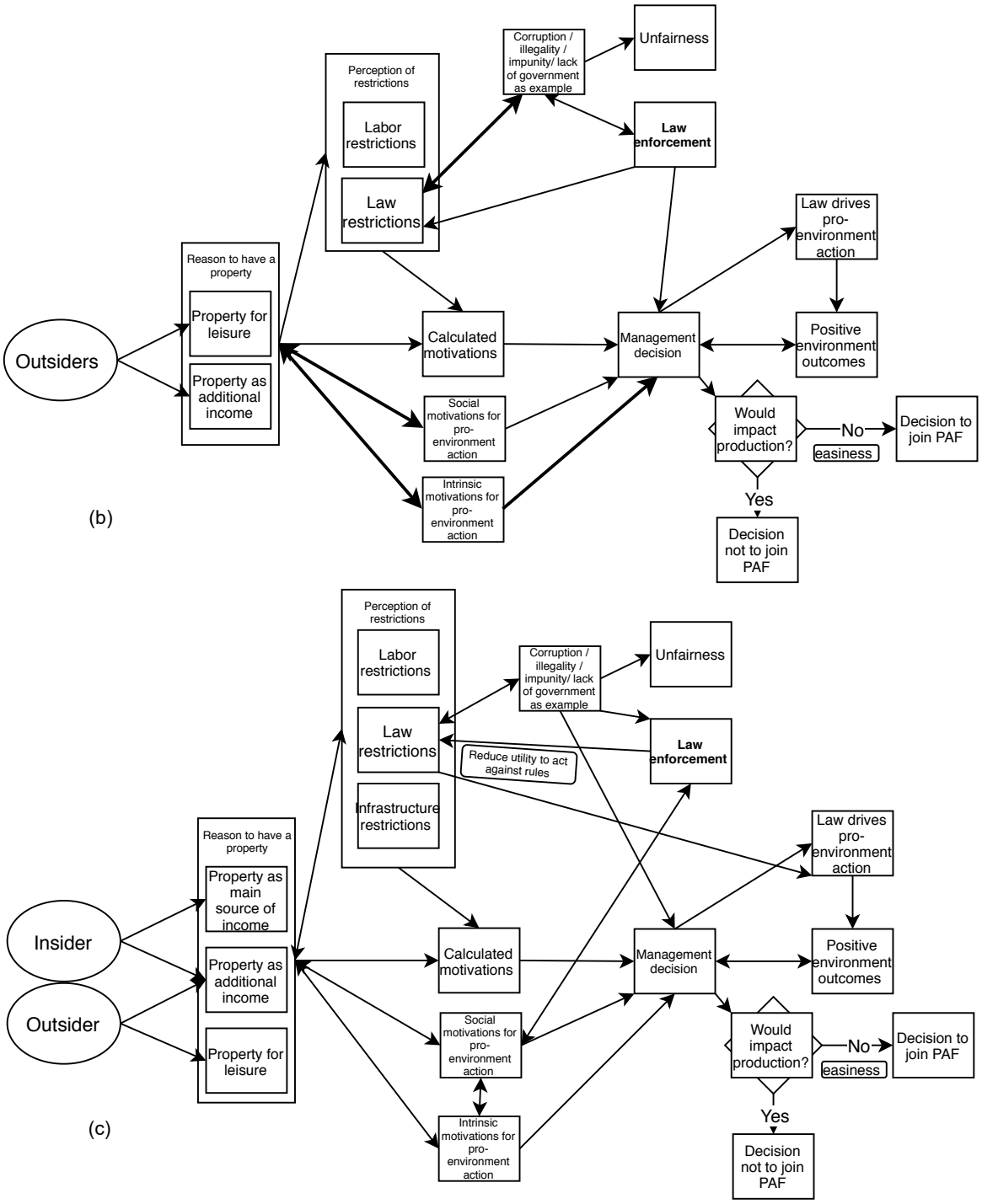

Figure 2. Behavior models in Rio Claro. Models summarizing the data analysis of participants and non-participants in PAF payment for environment services project, Rio Claro, Brazil, 2017. Thicker lines indicate most important pathways for the groups. (**a**) Behavior model summarizing the data analysis of insiders. (**b**) Behavior model summarizing the data analysis of outsiders. (**c**) All behavior models represented together.

Among both participants and non-participants there are two broad groups with divergent approaches to land-use decision-making. We labelled one group "insiders," referring to landowners born in the area and raised as farmers, and the other "outsiders," property owners with non-agricultural backgrounds. An individual's background affects land use decision-making and objectives for property management. We henceforth distinguish between insiders and outsiders because it was

the most consistent distinction among respondents, including differences between PAF participants and non-participants. There were more outsiders among the sample of participants (61%) than that of non-participants (29%). Many PAF participants were relatively wealthy and well-educated, and included large landholders who lived in urban areas and did not rely on farm income. We built models for insider participants, outsider participants, insider non-participants, and outsider non-participants (Figure 2a–c).

The insider–outsider groups differ fundamentally in their reasons for owning property in the area. Insiders, both participants and non-participants, use their property mainly for income whereas outsiders use it for leisure or supplementary income. Several PAF participants' comments capture the importance of income: "We already worked in the rural area, then there was an opportunity to buy a property and we did it . . . We want to keep using the property for our family livelihood" (PAF11, male, 79-year-old insider). Insider non-participants shared similar ideas. For example, one said: "All that we obtained (could buy) in life came from this property" (N1, female, 49-year-old insider). Another said: "I like to do what I do, the necessity made me like it. I was born in a rural area and do not know how to do anything else" (N3, male, 50-year-old insider). Outsiders, in contrast, sometimes justified the way they thought about their property by emphasizing their non-rural backgrounds: "I do not perceive any drawback from having forest in my land because I do not depend on my property [for a living]" (PAF22, male, 65-year-old outsider). Another participant bought the land to conserve forest (PAF64, male 90-year-old outsider). Outsiders often mentioned that their family histories were not related to the rural lifestyle. "My father was an intellectual, not a farmer. I was raised in an apartment, but I always desired a rural life so I moved to the countryside" (PAF68, female, 67-year-old outsider). Another said: "My goal is to have a property that pays for itself because now I have to use resources from other sources of income to keep the farm" (PAF79 male 54-year-old outsider). Insiders typically used their land to generate income, whereas outsiders used it for leisure but were not averse to using it to generate income.

3.1. Motivations

Intrinsic pro-environmental motivations and the ease of joining largely drove individual landowners' decisions to join PAF and economic motivations and barriers to joining were the main reasons non-participants did not join. Financial gain was not the main reason for joining for most PAF participants. Over 80% of participants said that they would participate without the money although they commented that: "Any extra money is always good" (PAF50, Male, 54-year-old outsider). For outsider non-participants, an emerging theme was "heard about it but nobody offered it directly" and some said they might join if asked. Non-participant N11 (Male 52-year-old outsider) gave a typical explanation: "We found out about the program on TV but did not look for details. We do not intend to deforest anyway, so we do not need the incentive [to conserve forest]. But if the project directly asked us to join the program, we could join." Many non-participants outsiders said that PAF looked like a good opportunity, but that they did not trust the government. They thought that the government might stop payments once the forest grows back because forest land is legally protected. This justification was also provided by some insider non-participants when we asked about the minimum level of economic incentives that would make them join a conservation program and increase their pro-environmental behavior.

Economic motivations revealed in the interviews clearly included the opportunity costs discussed in the PES literature. For example: "Decision-making is based on what improves our situation, but we always focus on cattle because it seems to provide us more profit" (N22, male 32-year-old insider). Another said: "if I had more forest it would affect my income" (N26, male 56-year-old insider). The perception of restrictions on land use influenced economic motivations on land use decisions. Participant PAF68 (Female 67-year-old outsider) stated: "In the 1980s everyone started to plant *brachiaria* grass when rural laborers started to migrate to nearby cities . . . *brachiaria* spreads because it does not require much labor." The high opportunity cost of allowing the pasture to become

forest was the most common reason non-participants gave for not participating. Non-participants went so far as to describe their individual "opportunity cost math" to show that the payments were not enough and said that they would not participate because pastures are more useful than forests. Participant NP17 (male 58-year-old insider) said: "I heard PAF's proposal, but I thought it [the payment] was too little . . . I could get more planting yams. And in the future, what will I leave for my children and grandchildren if I sign? It is permanent."

Diverse ideas emerged along with these common themes. Two non-participants pointed out that the effort and cost to society to restore forest to increase water quality and availability would have no impact compared to the addressing lack of sewage treatment facilities in cities. This implies that they believed reforestation would require a major individual effort but produce little benefit for society. One respondent indicated that he would join PAF if everybody in the region did so, suggesting that a collective effort would justify the individual cost.

Enrolment of communal land by quilombolas, slave descendants, deserves special attention because community-owned and private owned land are often treated differently in PES projects. The quilombola community in Rio Claro includes about 240 people in 55 families, 85% of whom depend entirely on their land for their livelihoods. The community association decided to join PAF because they had once made and sold charcoal to the steel industry, which resulted in extensive forest degradation, and they believed that participation in an environmental project would improve their public image. When the community joined the project, its members were not aware that the project would provide payments. By the time of this study, PAF had become the main source of financial income for the association and provided members with jobs in reforestation on private properties.

ELR compliance was another motivation for PAF participation. Many participants indicated their awareness of FC requirements and believed that most landowners could comply without compromising their livelihoods. Participants expressed different perceptions of the likelihood of enforcement of environmental laws in general, even though most knew someone who had been sanctioned for non-compliance. Many perceived increased environmental awareness and law enforcement over the previous two decades.

The theoretical approach in Figure 1 suggests that sanction size and likelihood of detection would be the most important factors in reducing the utility of acting against the law. This was true in Rio Claro where many people had been jailed for deforestation and the perceived probability of getting caught was high. These conditions decreased motivation to violate this legal requirement, showing that laws can drive pro-environmental action. Nonetheless, fines were perceived as less effective than jail terms in reducing illegal actions and there is a perception that the restoration required by the FC is not enforced. Landowners understood that authorization was required to change land-use if they allowed trees to regrow. In consequence some landowners voiced the idea of a "negative opportunity cost," willingness to pay to suppress forest regrowth even if they do not plan to use the pasture in the near future.

Corruption of environmental enforcement officers and "the government" as an institution was a predominant emergent theme that greatly affected perceptions of the fairness of environment laws. Many landowners remarked that their decision to comply with environmental regulations included consideration of the inequitable enforcement of sanctions. Many did not believe that enforcement was equal for small and large landowners, saying that the latter could bribe officers or even influence the creation of laws.

3.2. Relationships between Themes

PAF's modest fiscal incentives did not appear to reduce other motivations for FC compliance. One reason cited for compliance was the importance of forest, especially the hydrological benefits it provides. Participants learned about these benefits from the project, which could have increased motivations to conserve. We did not investigate changes in perception due to the project, but many

landowners said that they traditionally conserved forest near springs suggesting that information from the project only reinforced their prior knowledge.

The reason for owning property influences how landowners perceive FC restrictions on land uses. Increased restrictions were widely perceived as negative because they reduce landowners' sense of self-determination. Many insiders perceive FC compliance primarily as a restriction, one saying, "The forest is untouchable" (PAF 78, male, 65-year-old insider) and many felt that part of their property was "not really theirs to manage." PAF does not include landowners in choosing species for reforestation. Some argued for change because some landowners prefer species for aesthetic value or potential income generation.

Labor constraints influenced land-use decisions. One non-participant insider said that: "There are not enough people to work the land. Our children grew up and left and we can't afford to hire other people" (N10, male, 78-year-old insider). Some outsiders who initially planned to use the property as a source of income pointed out that labor availability limited this option: "In the beginning I was thinking about raising cattle, but since it is hard to find labor in the region, I gave up" (PAF51, male 66-year-old outsider). Other limitations also emerged: "The worst here are the roads. It's hard to maintain production or any other activity" (PAF05, male 73-year-old outsider). In contrast, some landowners who valued their land for leisure did not want paved roads "because it would make me lose my privacy" (PAF40, male 73-year-old outsider).

Intrinsic and social motivations for conservation indicate reasons for owning property which influences motivations for conserving forest. Conserving forest and its aesthetic value and a desire to fulfil a family dream were motivations for owning land. Owning property seemed to strengthen intrinsic and social motivations for pro-environmental action. Respondents frequently mentioned beauty and tranquility as forest ecosystem services, discussed their desire to maintain forest for future generations or for wildlife, and indicated that maintaining forest was a lesson that their family had learned. Intrinsic motivations prevailed among outsiders whereas insiders were more driven by perceived economic benefits.

Use of PES in a policy-mix context may be problematic. Most of PAF's money went to a minority of landowners with large properties [52] even though most PAF participants have small holdings by Brazilian standards. This bias has implications for project effects on real and perceived equity. Some participants said that they received meagre benefits from PAF while other people received substantial benefits to protect forest that law requires them to preserve. PAF sometimes describes its accomplishments by the number of participating properties, but care is needed when using this measure because PAF does not have a minimum property size requirement. Four participants owned < 1 ha and three < 5 ha. Further, in addition to PAF payments, five landowners received a second and much larger PES payment as an incentive to transform part of their land into a Private Reserve of Natural Heritage (RPPN from Portuguese acronym), a category in the national protected area system.

We modified our theoretical model to reflect findings (Figure 3). For the Rio Claro context, the type (fines or jail) of sanction resulted in different decreases in utility of acting within the rule, where jail reduced illegality, but fines seems to have no or small implications in the decreased motivation to violate legal requirements. The perception of corruption is important to explain this and also how people perceive the fairness, size of sanctions and likelihood of detection, therefore influencing causal path of rule enforcement to reduce utility of acting against the rules. Furthermore, in Rio Claro PES enrolment was not mainly motivated by increasing compliance with the rules. So, although it does increase the utility of acting within rules, we removed this box from the model. Finally, we highlighted the feedback loops between behavior decision, behavior change and environmental additionality.

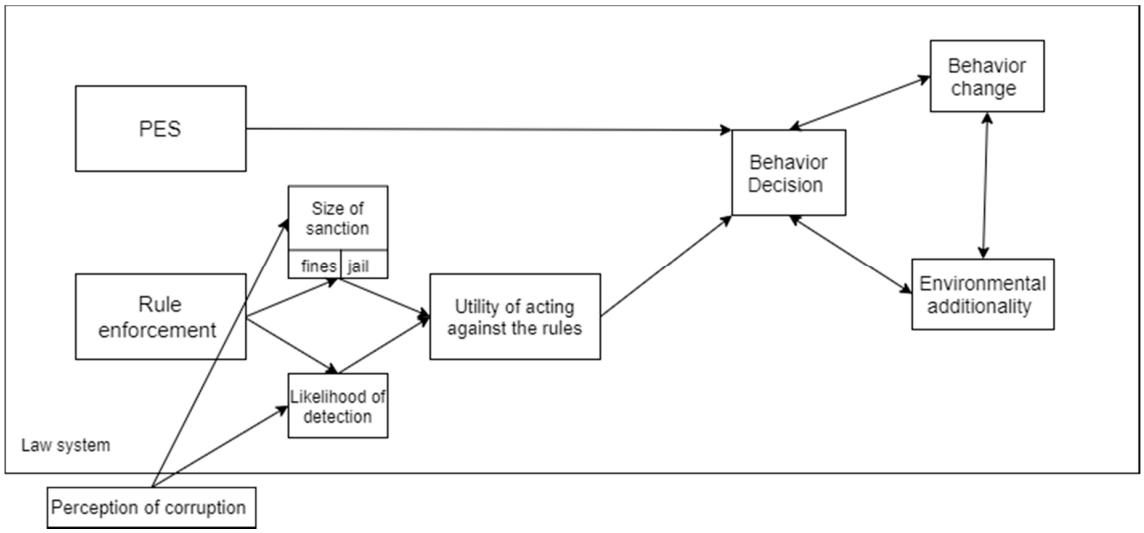

Figure 3. Modified law enforcement and PES joint theoretical model based for Rio Claro, RJ, Brazil, 2017.

4. Discussion

4.1. Contributions to the PES Literature

Although transaction costs accrue substantially when PES projects include numerous smallholders [53], PAF was accessible to landowners large and small, poor and wealthy. In contrast to some PES projects [19,54,55], property size did not seem to influence the likelihood of participation in PAF. Our finding that outsiders were prevalent among PAF participants is similar to [17] findings for Costa Rica. Compared to non-participants, smallholders and larger landowners enrolled in a PES tended to be older and wealthier, had access to non-farm salaries, and participated only marginally in agriculture. In contrast, PAF participants included some insiders who depend on farm income and had limited formal education. Our interviews reflect findings by [56] that willingness to participate was negatively associated with availability of family labor and with the fear of changing production patterns characteristic of low-income, farm-dependent landowners.

The data we collected support findings that perceptions toward conservation and intrinsic environmental motivations drive participation in PES [19,23,57–59]. Other researchers [60,61] who question the rational choice theories that underlie many PES schemes report that the opportunity cost principle is often only loosely relevant. Nevertheless, similar to findings by [62] in Mexico, many PES participants "like forest but also like cash" and the payments provided an important additional incentive. PAF participants' recognition of the importance of forest for essential environmental services, especially hydrological, could stimulate long-term behavioral changes and promote more conservation [63].

Monitoring and enforcing conditionalities of pro-environmental behavior that were agreed upon in exchange for enrolment in PES are necessary incentives for effective conservation [64]. PAF monitors compliance but lacks clear protocols for dealing with non-compliance. PAF's contracts state that non-compliant landowners can receive only partial payments or be excluded from the program, but as of 2018 no PAF participants were penalized for non-compliance (AGEVAP, personal communication). PES implementers often tolerate some non-compliance and only one-fourth of PES projects described in the literature report sanctions for non-compliance [64]. The authors in [64] point out that local politics and budgetary constraints often have greater influence on PES enforcement than budgetary constraints. This appears true for PAF, which tolerates some non-compliance in recognition of the time needed to build trust with participants.

4.2. Insights from ELR

Landowners' personal financial gains can compensate for their potential financial losses from illegal actions, which influences the behavior decision of whether to deforest or suppress forest regrowth in ecological buffer zones. This situation reveals an inherent tension between individual and social assessments of ecosystem service value. Many factors affect the likelihood of collective action when faced with such social dilemmas [65], but enforcing regulations is often critical insofar as it influences individual perceptions of costs [66,67]. PAF participants and non-participants were aware of people being fined or jailed for deforesting, but perceived differences in the sanctions. People feared jail and would avoid deforesting but did not fear sanctions for failure to reforest. A study in the Amazon Biome found that only 6% of the Rural Environmental Registry (CAR) registered producers were taking steps to restore illegally cleared areas on their properties; and suggested that full compliance with the FC offered few economic benefits from the landowner's perspective [68].

Rio Claro property owners who depend on land for their livelihood value cleared land more than forest. As noted earlier, some landowners pay the "negative opportunity cost" to suppress forest regrowth to protect their descendants' ability to make decisions about how to use the land in the context of tough enforcement of prohibitions on deforestation. This example shows how policies may intersect with behaviors and norms to result in unanticipated outcomes [69]. This viewpoint may also reflect the higher selling price of cleared land, which could be a vestige of decades of governmental incentives to clear land in Brazil [70]. Cleared land in Rio Claro sells for two to five times more than forested land despite its out-of-compliance status. Riparian cleared land would sell for less than forested land if the FC were enforced because the purchaser would have to pay for reforestation. The value of cleared land could also reflect a cultural tendency of Latin Americans to value pasture over forest [71].

The nature and magnitude of the effects of political corruption on compliance with environment regulations remains understudied [72] but corruption was an important theme in many interviews. Perceived corruption and unfairness, such as large landowners having fewer "real" obligations for legal compliance, are recognized as faults in the Brazilian legal system. Perceptions of corruption, unfairness, and impunity help explain low levels of compliance with environmental law in Rio Claro. Similarly, [68] highlighted that the perception of impunity severely weakens environmental policies to control deforestation in the Amazon. We therefore concur with [3] that incentive instruments cannot offset weak governance resulting from limited state capacity to enforce or corruption. Loss of respect for and confidence in environmental laws generated by perceived corruption deserves more attention.

4.3. Implications Emerging from the Empirical Findings

Brazil has extensive experience with diverse approaches to environment protection, PES being among the most recent. As in many regions where PES interventions are implemented, our study occurred in an area characterized by weakly enforced environmental regulations [73] but that is of tremendous importance to conservation [74]. The authors of [75] hypothesize that landowners often burn or cut early successional growth even when they do not need the area for production to avoid restrictions in the future. In this setting, PES could help tip the balance toward allowing natural forest regeneration. It would be useful to examine how price differences between cleared and forested land in Brazil have evolved in response to perceptions of enforcement of the FC.

Debates about the relative benefits of disincentive and incentive policies seem to be moving toward policy mixes [75]. It is crucial to understand how actors, who can alter the services provided, perceive the instruments and their interactions. The use of a pragmatic carrot-and-stick approach can promote pro-environmental behaviors in the context of weakly enforced laws [76], help reduce the perception that regulations are unfair, and increase compliance. A clear assessment of the time needed to transition from response to incentives to voluntary legal compliance is important because PES cannot compensate indefinitely for regulatory insufficiencies [2]. Furthermore, PES interventions could exacerbate inequalities, especially where income from land use is highly asymmetrical [77].

Enforcement is important for any regulation to be effective and FC enforcement should apply to restrictions on land use and to the conditionality of PES. Calculated and normative motivations as described by [28] seem to explain compliance intentions in Rio Claro, but lack of trust in the government and perceptions of corruption affect landowner decisions. Regulations like the FC can reduce landowners' sense of self-determination and diminish their intrinsic motivation to protect the environment [78]. Similarly, funds provided by PES can both reduce intrinsic and increase extrinsic motivations for conservation [22]. Moreover, other researchers [79] argue that the focus on rewards and punishments has led to neglecting other ways of supporting smallholders to achieve conservation objectives in the longer term. They suggest focusing on local heterogeneities and capacities and the need to promote trust, altruism and responsibility towards others and future generations.

PES and ELR approaches can be justified to the extent that landowners generate positive externalities through conservation practices that deserve rewards and generate negative externalities through deforestation that justify penalties. However, the approaches differ fundamentally with regard to who pays the costs of conservation. The limited funds for conservation could exacerbate inequities if the incentive approach primarily benefits a few large landowners. It is important to understand how PES influences the cost-effectiveness of achieving desired conservation outcomes in diverse contexts. In Rio Claro, PAF did bring environmental additionality but at a relatively high cost [80]. If law enforcement is stringent and the legal system perceived to be just, enforcement alone will motivate pro-environmental behavior, and PES payments are unnecessary. If these conditions do not hold, PES payments should cover opportunity costs and sanctions should be harsh enough to deter non-compliance. PES substitutes for environmental regulation and should target areas with the highest potential service values with high PES payments and enforced conditionality. Using PES to achieve environmental goals where legal restrictions are enforced is inefficient at best. An alternative would be to use PES to increase equity by PES payments sufficient to offset costs for poor people who could not otherwise comply. It may be fruitful to treat PES as a transitional mechanism to generate behavioral change when the primary objective of payment is to promote compliance with environmental regulations, but PES is likely not a permanent solution to non-compliance. The authors of [4] argued that environmental benefits that arise as a result of compensation or regulations require an on-going flow of payments or compliance checks and, if removed, there is a risk that these benefits will disappear.

5. Conclusions

Three major conclusions emerged from our study. First, the differences between insiders (farmers, mostly born in the area) and outsiders (non-farmers) are more important than the distinction between participants and non-participants regarding compliance with the Forest Code and willingness to conserve forest or reforest. Second, cost–benefit calculations are not the primary driver of decisions about PES participation. Most PAF participants were outsiders whose pro-forest decisions were largely based on perceived intrinsic values. Insiders, in contrast, were more likely to invoke financial considerations in their decision-making. Third, perceptions of systemic corruption in the enforcement process contributes to respondents' not treating environmental regulations as important in decision-making. PAF's design does not generate the maximum potential benefit from interactions between the incentive and disincentive instruments within the FC because of failure to recognize these three factors. Instead, PAF serves more as compensation for prior pro-environmental behaviors than as an incentive for behavior change.

Perception of the probable stability and longevity of any existing set of regulations, particularly those that limit landowners' ability to make land management decisions, have a critical effect on compliance. Landowners often do not allow forests to regrow and refuse to participate in projects that require reforestation when they expect that reforested areas can never be cleared. Worse yet is when perceptions of in perpetuity loss of the right to clear forest provokes aggressive anticipatory deforestation.

Efforts to save and restore ecosystems require a deep understanding of the efficacy of the tools employed to encourage pro-environmental behaviors. Many instruments are potentially useful and can sometimes be combined beneficially. Nonetheless, limited funds for conservation require decisions about which instruments to employ. These decisions should be based on an analysis of likely interactions between context and the underlying assumptions needed for each type, design, and implementation of instrument to produce the desired results.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Detailed Coding Procedure

We created a case file for each interview. A field assistant transcribed the interviews. The researcher paid close attention to the respondent during the interview and noted change in tone, pauses or other signs of hesitation, emotion-laden responses and other non-verbal cues to meaning. Case files were comprised of both the transcriptions and the notes taken by the researcher. The data analysis process began with coding the open response sections of the interviews. A code assigns a summative or evocative phrase that captures the essence of a respondent's comments to a question [81]. The objective of coding is to allow the researcher to identify patterns in an individual's responses and across cases, in this case patterns that may explain why landowners participated or did not participate in PAF and complied or did not comply with Forest Code.

Data analysis involved four steps, three levels of coding (Figure A2) (1) topical, (2) thematic and (3) analytic, followed by (4) development of an overall conceptual model. The analysis process commenced with identification of specific ideas or themes that emerged from the data in response to each question and topics in the interviews. We used both the transcription and case summaries to capture the information provided by participants, a commonly used procedure to ensure reliability in coding [44,45,82,83]. We then grouped the themes identified into larger conceptual frames that reflect similar themes and relationships among themes that emerged from the interviews [46,47]. These larger frames helped us understand respondents' views about multiple topics. Even if subconsciously, human beings create these larger mental models or scaffolds in many aspects of their lives [48,84,85]. This part of the data analysis process allowed us to identify at least a portion of the participants' mental models as they considered participating in PAF and to understand the commonalities among respondents' views of the roles of the Forest Code and PAF in their lives. Our main goal was not to provide statistical generalizations, but to characterize different perspectives among the landowners. Our final step in data analysis was to develop a model, based on an analysis of the individual codes, the emerging themes, and the interactions between them. We printed all themes and emerging themes and manually arranged them into a model that reflects the learning process. After we checked for agreement of models with the majority of cases (as per [46]), we also highlighted potential findings from outliers.

Topical or descriptive (Level 1) coding assigns a code to the specific comments made by each respondent ([81]: pp. 83–92). Coding proceeded topic by topic or question by question for each respondent, and codes were developed independently for each comparison group, participants and non-participants in PAF. However, topical codes do not necessarily include only the specific subjects posed in the researcher's questions. It is common for respondents to make comments that are only tangentially related to a question or are seemingly not related at all. These emergent topics are also coded and often provide insights into the respondent's ways of thinking about a topic or the associations a topic brings to his/her mind. Topical codes are highly specific. For example, several participants commented on problems associated with labor. Some commented that their children leave the farm while others commented that there are few people willing to work as agricultural laborers for hire in the region due to low wages. These comments illustrate two aspects of the topical coding process. First, we did not ask specifically about labor. These comments were made in response to questions about other topics and hence they were emergent comments. Second, the comments varied, some were concerned with out-migration and others lack of local labor.

Thematic (Level 2) coding groups the specific comments that emerge in topical coding into broader associated categories or themes ([81]: pp. 218–223). Thematic coding typically reduces the number of codes substantially because the comments made are grouped by the broad topics included in the interview. Emergent topical codes are also grouped when possible. For example, a thematic code that emerged in this study had to do with the effort involved in meeting bureaucratic requirements. Three topical codes were identified in the first level of coding: (1) the effort associated with land registration, (2) the wasted time spent dealing with fines related to inappropriate land use, and (3) anticipated time and effort required to join PAF. Comments of the first two types were made by all respondents whereas comments about joining PAF were made only by non-participants in PAF. The overarching thematic code for all three of these specific topical comments is bureaucratic efforts for land management. Thematic coding initiates the process of analyzing the data, moving beyond description to understand how respondents organize experiences and concepts into individual mental models.

Analytic (Level 3) coding ([81]: pp. 223–234) develops specific models of the components included based on both the topical conceptualization of the researcher and emergent patterns that group the specific mental models expressed by respondents. These models include both abstract concepts and proposed explanatory relationships between those concepts. The proposed relationships, typically indicated by flow lines between concepts, are referred to as "propositions" because they are proposed explanations of the relationships among complex concepts. These models focus on specific components of the overall theoretical basis of the research. We developed four of these specific models in this study. For example, we based one model on the socio-economic concepts related to participation in PES described in the literature [86–88] and emergent concepts such as "insiders and outsiders" in our study.

The overall conceptual model we developed draws upon the individual models developed in Level 3 analytic coding to create a model that we offer as a proposed theory-based explanation of how the participants in PAF and non-participants perceive the connection between payments for ecosystems services and legal compliance. Like most explanatory models, this model contributes to theory by incorporating the mental models of respondents to create a more robust understanding of a complex decision-making process. Table A2 provides first-level participant codes, Table A3 shows first-level non-participant codes, Table A4 displays themes from participants and non-participants in PAF; and Table A5 presents themes decision process, i.e., the process of combining themes together to be included in the models.

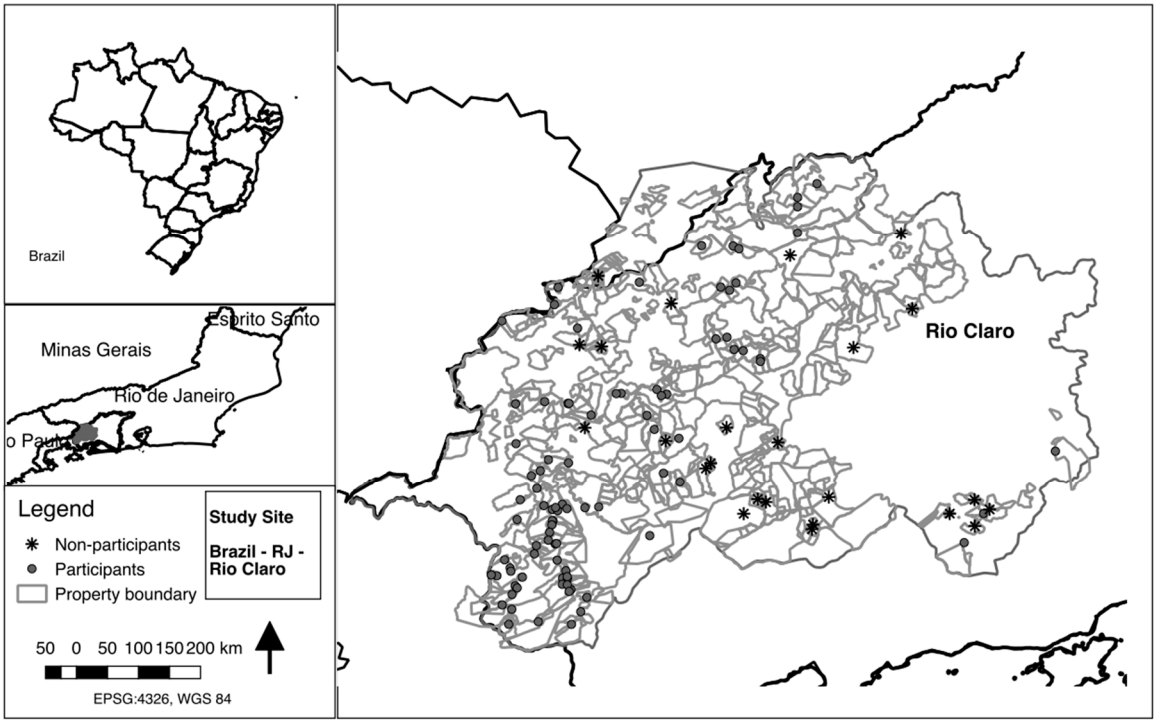

Figure A1. Map of properties registered in CAR in Rio Claro, 2017.

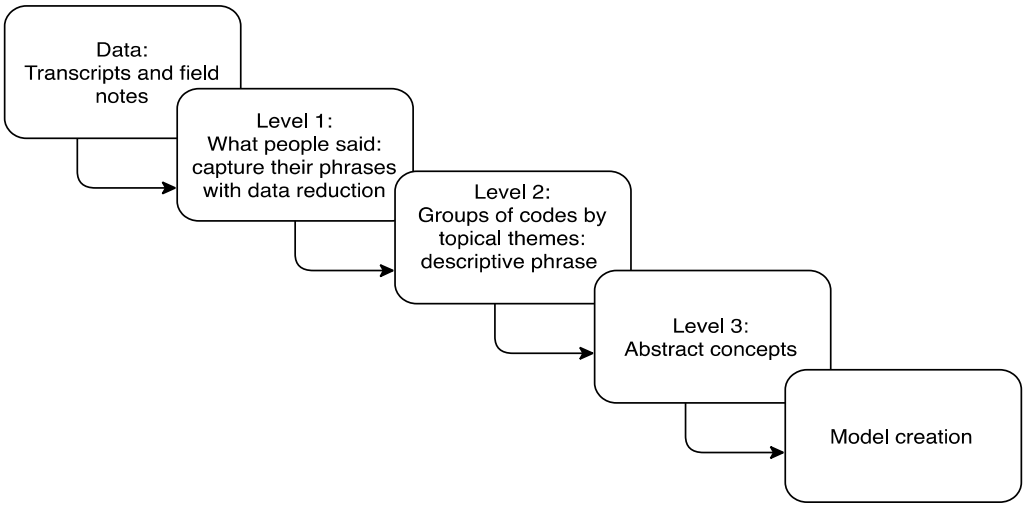

Figure A2. Qualitative methods summary. Summary of quantitative data analysis process. The data acquired were organized into transcripts and field notes, first-level coding created condensed, descriptive phrases that summarized the ideas expressed, level two coding grouped the individual level one codes into themes, and level three coding produced abstract concepts to allow creation of models summarizing the findings.

Table A1. Summary of interview questions.

Objective	Open-Response Questions
1. General information about property(ies) management	- Why do you have this land? - What are your main aims for this land?
2. Landowners' perception about forests, ecosystems services and reasons for the distribution of forest and regrowth areas on their land	- Do you reserve any part of your property(ies) for forest conservation? Why do you do that? - Do you reserve any part of your property(ies) for forest restoration? Why do you do that? - What benefits do you perceive from having forest on your property(ies)? - What drawbacks do you perceive from having forest on your property? - How did your management practices change the forest areas over time? - What services do you obtain from forest?
3. Landowners' motivations for joining or not PAF	- How did you find out about PAF? - Why did you decide to (not) participate in PAF? - How did PAF change the management of your property? (Participants) - Would you be willing to reforest the PPA areas? What would be needed to make you willing to do so?
4. Landowners' perception and knowledge about environmental legislation	- What environment regulations are you aware of that affect managing your property(ies)? (Probe: check PPA and legal reserve) - What is your opinion of these regulations? - How do you perceive the enforcement of environment regulations in the region? - Why do people comply (or not) with the regulations? - How did the environment cadastral dataset (CAR) change your perception of the environment regulation and its enforcement?

Table A2. First-level participant codes, by topic for a sample of 59 respondents in Rio Claro, Brazil, 2017.

Topic	First-Level Code	Idea It Refers	Codes
1. Reasons for having the land	Property for leisure	Uses the property for leisure activities	PAF82, PAF71, PAF33, PAF18, PAF45, PAF12, PAF77, PAF21, PAF17, PAF61, PAF22, PAF23
	Property to share with friends	Wanted the property to have a place to enjoy with friends	PAF51
	Desire to pursue a rural lifestyle	Identifies with rural life	PAF82, PAF23, PAF05
	Property as investment	Property is a way of creating savings to meet future necessities in a period of instability in the country	PAF82, PAF68, PAF56, PAF17, PAF25, PAF68, PAF42, PAF81
	Family had the property for leisure	Family had this property before the current owner and used it for leisure	PAF40, PAF56, PAF50, PAF42, PAF45, PAF08, PAF29, PAF32, PAF79, PAF70
	Family livelihood related to property	Property accounts for a big part of family's income	PAF71, PAF33, PAF50, PAF11, PAF16, PAF47, PAF59, PAF72, PAF78
	Property for cattle ranching,	Has the property to raise cattle	PAF78, PAF86, PAF01
	Family already managed the property	Plans to keep the activity the family had before	PAF78, PAF86, PAF66, PAF10, PAF04, PAF72
	Looking for escape from the city	Wanted to have an alternative to the busy city lifestyle	PAF86, PAF36, PAF89, PAF37, PAF28, PAF18, PAF88, PAF12, PAF68, PAF36, PAF44, PAF61
	Family likes the region and property	Family demonstrates affection for the place	PAF56, PAF54, PAF19, PAF05, PAF12
	Property as inheritance	Leave something for the family	PAF88, PAF12, PAF68, PAF36, PAF63
	Property as additional income source in hard times	Can sell cattle when the family needs money	PAF56
	Family dream	Family member always wanted a property	PAF37, PAF54
	Retirement plan	Bought it thinking about using it when retired	PAF17, PAF81,
	Raise horses	Desired to have an income from horses	PAF73
	Housing	Family uses mainly for residency	PAF32, PAF31, PAF14, PAF34
	Inspiration	Bought to have inspiration and creativity to write	PAF67
	Forest conservation	Bought already thinking about forest conservation	PAF64, PAF51

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
2. Aims for the land	Property for forest conservation	Wants to maintain the property for forest conservation	PAF40, PAF88, PAF66, PAF64, PAF51, PAF54, PAF31, PAF67
	Property in a park area	Acknowledges the limit use of the property because it is within a protected area	PAF78
	Property for family livelihood	Aims to provide for the family with property	PAF78, PAF16, PAF72, PAF78
	Aims to improve the property	Wants to get more profitability from the property	PAF78, PAF86
	Labor restriction changed the aim of the property	Had to change the aim due high labor cost	PAF68, PAF36, PAF55, PAF01, PAF58, PAF21
	Cattle	Desire to have cattle related activities	PAF56, PAF42, PAF54, PAF57
	Use for leisure	Use the property for leisure	PAF33, PAF77, PAF21, PAF45, PAF12, PAF04, PAF08, PAF74, PAF70, PAF61
	Use for leisure because cannot change it	The law does not allow to change the land cover, so uses for leisure	PAF58
	Aging	Getting older and reducing the work load	PAF37, PAF58, PAF11
	Difficulty in access	Moved from other property to be closer to the city/school	PAF03
	Additional income	Aims to use the property to contribute in the income	PAF18, PAF45, PAF10, PAF73, PAF63, PAF14, PAF05, PAF81
	"Rents" for maintenance	Let people use the property in exchange for work in maintenance of the property	PAF21, PAF08
	Tourism	Aims to implement a tourism related business	PAF06, PAF54, PAF25, PAF61, PAF05, PAF57
	Corruption prevented to implement economic activity	To implement the desire activity would have to "buy" license	PAF42
	Tried activities that did not work	Gave up of activity in consequence of perceived failure in generating income	PAF42, PAF73, PAF81, PAF23
	Bar in the property	Has a bar to complement income	PAF34

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
3. Reason for maintaining forest	Maintain forest because it is not allowed to cut	Clearing forest is not allowed	PAF82
	Maintain forest because of water	Believes forest is important for water resources	PAF82, PAF56, PAF89, PAF33, PAF50, PAF03, PAF17, PAF10, PAF54, PAF23, PAF57, PAF81, PAF72
	Maintain forest because of animals	Maintain forest for the sake of animals	PAF82, PAF37, PAF50, PAF51, PAF10, PAF04, PAF08, PAF22, PAF81, PAF72
	Maintain forest because of future generations	Maintain forest for the sake of future generations	PAF82, PAF89, PAF66, PAF51, PAF31, PAF34, PAF67
	Environmental awareness	Maintain the forest because s/he considers her/himself to be an environmentally conscious person	PAF71, PAF68, PAF36, PAF50, PAF18, PAF17, PAF12, PAF51, PAF10, PAF57, PAF31, PAF63, PAF81
	Enjoys the forest	Maintain forest because s/he likes the forest	PAF68, PAF36, PAF40, PAF56, PAF33, PAF50, PAF18, PAF42, PAF10, PAF22
	Obligation as a citizen	Protecting forest is a moral requirement, wanted to be an example for society	PAF40, PAF51, PAF54, PAF57, PAF31
	Wood source	Uses wood extracted from the forest	PAF86, PAF89, PAF03, PAF17, PAF72
	Law required	The law requires forest maintenance	PAF78, PAF86, PAF12, PAF25
	Too small almost does not have forest		PAF28
	Religion	God thinks it is important to conserve, nature is God	PAF68, PAF18
	Labor expenses	It is too expensive to pay labor to deforest	PAF10
	Family teaching	The family already conserved the forest and wants to pass on this lesson	PAF31
4. Reasons to restore forest	Trees are beautiful	Planted Ipes (*Handroanthus*) because believes they are beautiful or other trees	PAF82, PAF57
	Recover a degraded area	Wants to reforest to recover a degraded area	PAF71, PAF56, PAF66, PAF10, PAF63
	Areas around spring	Reforestation is allowed because was around springs, or recover a spring	PAF78, PAF56, PAF89, PAF33, PAF18, PAF63
	Land abandonment and areas that were not being used	Was not using some areas and the forest grew back	PAF86, PAF12
	Changed production for tourism	The forest grew back when changed focus of the property	PAF86, PAF36
	Trees in the fence line with neighbors	Planted trees in the fence line with neighboring property for more privacy and/or not moving the fence	PAF89
	Off-site mitigation	Received money from a company to perform an off-site mitigation to compensate and environment damage	PAF50, PAF54
	Reduce the problem with fire	Believed that the forest existence could reduce the problem and fear of having fires too close	PAF25
	Shade for cattle	Allowed tree regrowth in some spots to provide shade for the cattle	PAF72

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
5. Perceived benefits of forest	Believes forest in important for water	Relates forest to water availability and provision and to high humidity	PAF82, PAF56, PAF37, PAF33, PAF50, PAF03, PAF28, PAF18, PAF88, PAF77, PAF21, PAF17, PAF06, PAF42, PAF45, PAF66, PAF12, PAF10, PAF04, PAF08, PAF25, PAF22, PAF57, PAF31, PAF19, PAF63, PAF67, PAF81, PAF72
	Reforestation does not increase water availability	People normally think reforestation increases water availability, but reforestation does not increase water availability	PAF64
	Erosion control	Forest reduces the impact of rain on the soil	PAF28, PAF42, PAF45, PAF64, PAF04
	Believes forest in important for conservation	Believes forest conservation and biodiversity are benefits	PAF82, PAF50, PAF40, PAF03, PAF18, PAF88, PAF42, PAF51, PAF08, PAF25, PAF22, PAF14, PAF31, PAF63, PAF81
	Clear Air	The air is cleaner, "purer," near forest	PAF86, PAF50, PAF17, PAF45, PAF12, PAF55, PAF25, PAF22, PAF14, PAF31, PAF63, PAF34, PAF81, PAF72
	Breeze	Temperature and breezes are nicer near forest	PAF86, PAF37, PAF42, PAF45
	Peace and beauty, stress relief	The forest provides a feeling of peace and encourages contemplation	PAF50, PAF12, PAF42, PAF51, PAF08, PAF57, PAF31, PAF19, PAF67, PAF81, PAF72
	Society collaboration	Feels that s/he is collaborating in the society	PAF17, PAF51, PAF23, PAF67
	Climate more stable near forest	The forest reduces variations in temperature and humidity	PAF77, PAF17, PAF21, PAF45, PAF66, PAF51, PAF55, PAF10, PAF04, PAF25, PAF34
	Tourism	The forest brings tourism to the region	PAF45
	Firewood	The forest provides firewood	PAF10, PAF22, PAF57
	Payment	The PAF payment is a benefit from forest	PAF08
	Work inspiration	The forest inspires composing music	PAF67
	Better soil close to the forest		PAF72, PAF40

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
6. Perceived drawbacks from forest	Nothing for heirs	Not drawback, but if they only left the forest to grow back, the heirs would have less land value	PAF64
	Not at all	Interviewee demonstrated a strong denial of drawbacks of forest presence	PAF82, PAF56, PAF21, PAF12, PAF51
	No drawbacks, but fencing incurs costs	Interviewee specifically mentioned no drawbacks but	PAF40
	Lost is land for production	The forest occupies an area that could be used for production	PAF78, PAF86
	Problems with hunters or palm extractors	The forest attracts people to hunt and extract palm	PAF36, PAF86, PAF56, PAF42, PAF45, PAF10, PAF54, PAF01, PAF31, PAF19, PAF67, PAF81
	Conflict with neighbors	Neighbor allows cattle to cross into others' property, which generated conflicts	PAF23
	Too many restrictions on use of forest land	The law places too many restrictions on forest land use, reduces the options for landowners	PAF23
	The landowner incurs more responsibilities with forested land than with pasture	If the pasture burns, nobody says anything, but if the forest burns the landowner is fined	PAF40
	Humidity	Does not want forest near the house because it makes it too humid	PAF25
7. Land management resulting in land use changes	Deforested in the past for cattle	Deforested to increase area for cattle	PAF78, PAF86, PAF89, PAF72
	Let forest regrow	Forest grew back after abandonment of production	PAF68, PAF36, PAF37, PAF18, PAF66, PAF45, PAF12, PAF64
	Was pasture when arrived	Reported that when arrived in the property everything was pasture and now there is a lot of forest	PAF50, PAF51, PAF67
	Transformed property in condominium	Divided and included many houses	PAF25, PAF55

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
8. Learned about PAF	Neighbors participating	Found out about the project because neighbors were participating	PAF82, PAF71, PAF56, PAF03, PAF77, PAF57, PAF67
	Surprised to be accepted in PAF	Has a lot of forest, so did not understand why they would be accepted in a PES project	PAF71
	Part of COMDEMA	Member of the municipality environment committee	PAF40, PAF50
	TV	Saw information about the program on television	PAF78
	Local institution	EMATER Rio Claro (Rio Claro's technical assistance and rural extension company), rural labor organizations and/or environment secretariat provided information	PAF86
	Created the project	Was part of the group that created the project	PAF68, PAF50
	Project went until property	The project staff visited the property to provide information	PAF89, PAF03, PAF21, PAF45, PAF51, PAF10, PAF04, PAF01, PAF73, PAF08, PAF22, PAF34
	Friend or family	A friend of the family informed him/her about the project	PAF66, PAF12, PAF31, PAF63, PAF81
	Looked for help to restore to fulfil environment regulation	Was informed about PAF while looking for ways to fulfil an environment requirement for building a condominium	PAF55
9. Motivation to participate	Everybody around was participating, so joined too	Joined the project because the neighbors were also participating	PAF82, PAF56, PAF89
	To protect springs	Joined the project to protect or increase protection for springs	PAF82, PAF56, PAF03, PAF21, PAF06, PAF66, PAF12, PAF57, PAF81
	For help with fencing	Joined the project for the help with fencing	PAF82, PAF56, PAF37, PAF21, PAF51, PAF73
	Would have joined without the money	Would have joined without the money	PAF82, PAF56, PAF89, PAF03, PAF77, PAF21, PAF51, PAF73, PAF57
	Already was doing what was needed and would get money for it	Joined the project because already had forest and would get money by joining	PAF82, PAF33, PAF50, PAF67
	No reason not to join	Did not see any reason not to join; was already doing required practices	PAF50, PAF45, PAF51, PAF57
	Sponsorship of increase in protection	The program provides sponsorship to increase the protected area on the property	PAF40, PAF77, PAF21
	Money	Joined because of payment	PAF78, PAF89, PAF33, PAF10, PAF23, PAF19, PAF67
	No negative impact	Joined because the areas that would go into reforestation would not reduce agricultural production	PAF78, PAF21, PAF06

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
	Desire to restore areas	Desire to protect areas around river because believes the rivers in the world are drying out; protect areas experiencing erosion	PAF86, PAF42, PAF66, PAF25, PAF63, PAF34, PAF81
	Money attracts corruption	Almost did not join because money attracts corruption	PAF56
	Project people were nice	Joined because the people that were recruiting for the project were very nice; wanted to help the project staff	PAF56, PAF89, PAF14
	Avoid criminal fires and hunt	Joined because other people get to know you are in the program and then do not start fires or hunt on your property	PAF89
	Avoid land invasion	Joined because of concern about land invasion and believed the project's presence would avoid it	PAF89
	Increase local environment awareness	Joined because wanted to help to increase local environment awareness	PAF33, PAF21, PAF31
	Believes in the PES logic	Believes that the forest is providing a service to society and that landowners should therefore be compensated and that payment is a good incentive for those that depend on the land	PAF50, PAF21, PAF22
	The project sounded important	Project staff explained what the project entailed and it sounded important for the environment	PAF03, PAF45, PAF08, PAF72
	Likes forest	Decided to participate because always liked forest	PAF18, PAF77, PAF21, PAF66, PAF08
	Wanted to restore and could not do it alone	Joined because wanted to restore part of the property and could not do it alone	PAF88, PAF45, PAF66, PAF73, PAF81
	Used the term rent for PAF	Mentioned that s/he "rented" a small area for PAF	PAF28, PAF45, PAF32
	Legislation	Thought about the legislation because would have to do it eventually anyway	PAF45, PAF22
	Contract flexibility	The contract is renewed every two years, allows maintenance of rights	PAF51, PAF73
	Reduce cost of required reforestation	The legislation requires a forest reserve in order to allow property to be divided into a condominium	PAF55
	Help to avoid tax fine	Had a tax fine because the auditor did not believe the amount of production declared in relation to the size of land	PAF54
	Be able to produce something in the forest area	Aimed to use the forest area, to get benefit from it.	PAF23
	Wanted to restore and could not do it alone	Joined because wanted to restore part of the property and could not do it alone	PAF88, PAF45, PAF66, PAF73, PAF81

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
	Used the term rent for PAF	Mentioned that s/he "rented" a small area for PAF	PAF28, PAF45, PAF32
	Legislation	Thought about the legislation because would have to do it eventually anyway	PAF45, PAF22
	Contract flexibility	The contract is renewed every two years, allows maintenance of rights	PAF51, PAF73
	Reduce cost of required reforestation	The legislation requires a forest reserve in order to allow property to be divided into a condominium	PAF55
	Help to avoid tax fine	Had a tax fine because the auditor did not believe the amount of production declared in relation to the size of land	PAF54
	Produce something in the forest area	Aimed to use the forest area, to get benefit from it.	PAF23
	Guilt for past deforestation	Realized that past deforestation activities could negatively affect downstream water users	PAF01
	Recognition	Recognition by society that they were doing an important thing by preserving their forest	PAF19, PAF40
	Perception of outcome	Saw the forest growing in some properties with the project	PAF67
	Benefit for others	Joined because would be helping to provide water for the city	PAF72
10. Behavior changes required	No behavior change	Reported not have changed any behavior due to the project nor received any environmental benefit because of the project	PAF82, PAF40, PAF78, PAF86, PAF56, PAF33, PAF03, PAF21, PAF06, PAF12, PAF64, PAF51, PAF55, PAF04, PAF22, PAF57, PAF31, PAF19, PAF63, PAF34, PAF67
	Nothing was done in the property	Reported that the project had not yet completed do the reforestation activities	PAF71, PAF78, PAF86, PAF89, PAF73, PAF67, PAF81
	Became aware of the importance of forest and stopped deforesting	The project increased environment awareness and led stopping deforestation	PAF89
	The change in the property did not impact production	The project protects reforested land and therefore did not have an impact on the productivity of the property	PAF42, PAF66, PAF10, PAF08
	Stopped people from taking wood from the forest	The project would prevent taking wood from the forest	PAF14

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
11. Perception of outcomes	Increase in water availability	Sees an increase in water availability	PAF21, PAF42
	Erosion reduced	Perceive erosion reduction affecting the river	PAF45, PAF04
	Needed more audits	The project should have more audits by the state environmental institutions to guarantee that the reforestation was done properly.	PAF54
	Needed more rigor in program execution	Program execution required more generate more results in the reforested areas.	PAF54
	Reduced the problem with fire	The reforestation helped control fires originating on neighbors' land	PAF14
	Worked in the project	Someone in the landowner family worked on the project	PAF34, PAF14
12. Knowledge of environmental regulations	Never worried too much because believes conservation is important	Did not try to find information about environment regulations because they do not want take actions that hurt the environment	PAF82, PAF64
	Is aware of PPA and RL	Mentioned the PPA and the RL requirements	PAF82, PAF71, PAF78, PAF89, PAF03, PAF88, PAF06, PAF45, PAF64, PAF01, PAF73, PAF08, PAF25, PAF22, PAF57, PAF63, PAF67
	Increase in environment awareness in the country	Perceives an increase in environmental awareness in the country	PAF71, PAF40, PAF78, PAF36, PAF68, PAF73
	Not allowed to touch anything	The law does not allow changing, extracting, or, removing trees on forest land	PAF78, PAF10, PAF23
	Does not know anything	Claims not to know anything about environmental regulation	PAF86
	Deforestation is not allowed	Deforestation is not allowed	PAF86, PAF89, PAF33, PAF37, PAF21, PAF12, PAF73, PAF08, PAF57, PAF14, PAF34, PAF67
	Fire is not allowed	Using fire for land management is not allowed	PAF33, PAF37, PAF21, PAF22, PAF57, PAF14, PAF34
	Bad chemicals not allowed	Toxic agricultural chemicals cannot be applied near th rivers	PAF06, PAF42, PAF45, PAF14
	Aware of rules	Mentioned many rules including Forest Code requirements	PAF40, PAF56, PAF68, PAF71, PAF50, PAF66, PAF51, PAF55, PAF54, PAF14, PAF31
	Not allowed to extract river sand	The law does not allow to removal of sand from rivers	PAF37
	Not allowed to extract river sand	The law does not allow to removal of sand from rivers	PAF37

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
13. Opinion about environmental regulations	Conservation is important	Thinks the regulations are important because conservation is important	PAF82, PAF40, PAF86, PAF68, PAF36, PAF56, PAF89, PAF33, PAF37, PAF50, PAF03, PAF17, PAF45, PAF66, PAF12, PAF64, PAF51, PAF10, PAF04, PAF54, PAF73, PAF32, PAF22, PAF31, PAF63, PAF34, PAF67, PAF81, PAF72
	Some regulations are overdue	Believes there is an excess in some environment regulations, that some go beyond what is necessary	PAF71, PAF40, PAF37, PAF18, PAF42, PAF73, PAF25, PAF19
	Corruption creates difference in actions between big and small landowners	The law is applied differently to rich and poor landowners	PAF71, PAF86, PAF33, PAF21, PAF45, PAF54, PAF23, PAF14, PAF67, PAF72
	Law is not considered for decision-making	The landowners do not consider the law for decision making	PAF71, PAF56, PAF89, PAF33, PAF37, PAF12, PAF51, PAF55, PAF04, PAF34
	In favor of the landowners' responsibilities	Believes the landowner as a citizen should be responsible for forest on their land	PAF40, PAF88, PAF66
	Any law must be respected	If it is a law, it should be respected	PAF78, PAF03
	People would deforest if it did not exist	If the law did not exist people would cut everything down to plant pasture	PAF78, PAF86, PAF03, PAF18, PAF17, PAF06, PAF45, PAF10, PAF08, PAF25, PAF32, PAF14, PAF63, PAF67, PAF81, PAF72
	Was informed about PPA requirements by the project	When the project was trying to enroll people, the staff informed them that what they were proposing was required in the law	PAF04
	Prevents profiting from the property	The environment regulation restricts the producer too much, it makes the forest of little use	PAF23
	The government itself does not do anything	The government creates all the laws but does not do anything to improve environment awareness	PAF57
	Overlap of legislation	There are so many overlapping environment regulations that it is hard to keep track	PAF19

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
14. Perceived enforcement of environmental regulations	The places with bad roads do not get any enforcement	The places with bad roads do not get any enforcement	PAF56, PAF03, PAF18, PAF67
	Never saw law enforcement	Reported that never saw or heard about law enforcement actions	PAF82, PAF03, PAF66, PAF12, PAF23, PAF73, PAF08, PAF63, PAF81
	Rigor in enforcement in relation to deforestation	Reported that the legislation enforcement has been strict or knows people who were fined	PAF71, PAF40, PAF86, PAF36, PAF68, PAF37, PAF50, PAF21, PAF10, PAF04, PAF01, PAF32
	Fine is too high	If environmental enforcement includes fines, the fines are too high	PAF01
	Rigor in the enforcement in relation to hunting	Reported that the legislated enforcement has been strict	PAF40
	Corruption of the enforcement agent	Reported that the enforcement agent may be corrupt	PAF40, PAF68, PAF36, PAF42, PAF45, PAF22, PAF19
	Fine is not paid	The landowners that get fined do not pay the fines	PAF68, PAF36, PAF14
	Was previously fined	Mentioned incurring an environment fine	PAF78, PAF19
	Park area	Property is within the protected area and therefore sees more enforcement	PAF78, PAF21
	Some rigor in environment regulation enforcement	Does not seem to perceive strong rigor, but saw environmental agents or knows people that were fined	PAF89, PAF33, PAF06, PAF42, PAF45, PAF64, PAF54, PAF22, PAF57, PAF34, PAF67, PAF72
	The enforcement agents do not know how to communicate with the landowner	The enforcement agents do not know how to communicate with the landowner, they arrive in the property without explaining the reasoning behind the legislation and give people fines	PAF37, PAF19, PAF67
	Changed behavior because of increased perception of enforcement	Used to deforest, but learned that it was illegal and liable to sanctions	PAF01
	Overlap of enforcement in different levels of government	The overlap of environment regulations in different levels of government leads to excess bureaucracy and confusion	PAF19
	Overlap of enforcement in different levels of government	The overlap of environment regulations in different levels of government leads to excess bureaucracy and confusion	PAF19

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
15. Perceived motivations to comply (or not) with environment legislation	Normative motivations—agrees with the law or believes it is the right thing to do	Complies with environment law because s/he believes it is the right thing to do	PAF82, PAF40, PAF56, PAF17, PAF66, PAF12, PAF55, PAF10, PAF54, PAF23, PAF73, PAF22, PAF14, PAF19, PAF63, PAF34, PAF81
	Lack of knowledge about environmental legislation	Believes people do not have knowledge about the legislation	PAF71, PAF77
	Calculated motivations	Believes that the financial utility (money and enforcement) is the most important reason for people to comply or not with environmental regulations	PAF71, PAF78, PAF68, PAF56, PAF89, PAF50, PAF03, PAF18, PAF77, PAF06, PAF45, PAF66, PAF51, PAF55, PAF10, PAF54, PAF01, PAF73, PAF08, PAF22, PAF57, PAF31, PAF19, PAF34, PAF72
	People believe that there will not be sanctions	People are aware of the law, but do not think they will be sanctioned	PAF78, PAF68, PAF56, PAF89, PAF33, PAF50, PAF88, PAF77, PAF25, PAF45, PAF51, PAF10, PAF54, PAF23, PAF08, PAF14, PAF31, PAF34, PAF81
	Cost of bureaucracy	The biggest cost associated with the law if you do not follow regulations is to have to deal with the bureaucracy	PAF68, PAF36, PAF03, PAF18
	Sanctions are not complete and corrupts the citizenry	People do not worry about sanctions because they serve as a way of instituting corruption and bribery	PAF50, PAF77, PAF42, PAF45, PAF51, PAF55, PAF54, PAF23, PAF22, PAF67
	It is necessary to understand the reasoning	People are convinced to conserve forest if they understand the importance of it.	PAF50, PAF77, PAF06, PAF64, PAF31, PAF81
	People live today and do not worry about tomorrow	People make decisions thinking about what they need today, people live today and do not worry about tomorrow, they do not think about the long term	PAF64
16. CAR perceived change in environmental regulation and enforcement	Pays someone to deal with bureaucracy	Does not know about CAR, because pays someone to deal with bureaucracy	PAF64
	Has not done it	Did not remember to do it or lives in urban area	PAF82, PAF71, PAF28, PAF25, PAF34
	Depends on political will	CAR seems to be a good instrument but its application will depend on the will of politicians; corruption is instituted	PAF40, PAF66, PAF54, PAF23, PAF73, PAF22
	Nothing will change	CAR will not change anything in terms of land management or enforcement	PAF78, PAF86, PAF88, PAF42, PAF66, PAF57
	Only bureaucracy	Nothing will change, it is just another bureaucracy	PAF86, PAF23, PAF57, PAF81
	Is increasing real restrictions	This is a movement to increase real restrictions and enforcement of environmental regulation	PAF68, PAF03, PAF01, PAF72
	Is increasing perception of restrictions	CAR is making people think they will have to comply	PAF77
	Made people more aware of environmental legislation	The registration process in CAR made people more aware of what was required in the Forest Code	PAF56, PAF68, PAF33, PAF50, PAF03, PAF18, PAF88, PAF77, PAF17, PAF66, PAF64, PAF55
	Was too much information, already forgot	While registering in CAR advisors gave too much information and the interviewee even forgot it	PAF89
	Did because goes together with everybody	Everybody did it, so the landowner did it too	PAF18, PAF63
	CAR can help legalization	CAR has instruments to help to legalize the property	PAF31

Table A2. *Cont.*

Topic	First-Level Code	Idea It Refers	Codes
17. Emergent	Necessity drives decision-making process	Necessity is the main driver of decision-making process	PAF82
	Does not use the forest	I never walk in the forest	PAF82
	Television as a source of environmental information	Television teaches about environment and environmental regulations	PAF82
	Lack of sewage treatment in the municipality	Sewage treatment has an important impact water and the municipality does not take care of it	PAF71
	People need to understand for themselves	The environmental campaigns have led to people to think and to understand the reasoning for conservation	PAF71
	Participates in the rural labor union because s/he has employees	Main reason to participate in the labor union is that the individual has employees	PAF78
	Criminal fires set	People always make fires in the road, and nobody knows who did it	PAF78, PAF03, PAF10
	Used network to obtain public benefits	Used the network to obtain benefits	PAF56
	Property is the first place to release animals in Rio de Janeiro	Private Reserve of Natural Heritage (RPPN) within property is the first place to release animals in Rio de Janeiro	PAF50
	"Biodigestor" as a reason to join the project	Another reason to participate not related to land use was the inclusion of biodigestors in the project	PAF28
	Water availability reduced	Remembers when the river had more water	PAF18
	Government should invest in policies to keep the people in rural areas	People are leaving the rural areas because there are no options there	PAF06
	RPPN	Created a protected area within property	PAF40, PAF50, PAF64, PAF54
	Created an environmental NGO	Created an environmental NGO	PAF50, PAF51
	Was harder was to convince the family to participate	The family did not want to participate because they believed it was unnecessary	PAF04
	River is very dirty	There is a chicken producer that seems to pollute the river intensely	PAF73, PAF14
	Birds are coming back with the prohibitions of cages	Perceived increase in bird population and believes this is due to the increased prohibition of cages	PAF08, PAF34
	Expansion of the cities, land division into condominium	It is necessary to think how to stop the expansion of the cities, and land division into condominiums. The division is resulting in deforestation	PAF08
	Absence of government	Does not work to report bad actions because the government does not do anything	PAF81
	Bureaucracy in excess to obtain license	There is too much bureaucracy required to obtain a license to make a lake for raising fish.	PAF81, PAF72

Table A3. First-level non-participant codes, by topic, for a sample of 21 respondents in Rio Claro, Brazil, 2017.

Topic	First-Level Code	Idea It Captures	Codes
1. Reasons for owning the land	Property for livelihood	Family depends on the property for livelihood, main source of family income	N1, N3, N7, N8, N10, N16, N19, N17, N20, N23, N26, N30
	Property was already in the family	When they started managing the property it already had the current use	N4, N22, N21
	Property as additional source of family income	Property helps family income	N4
	Property for leisure uses	Has the property for leisure purposes	N18, N19, EX70
	Property as an investment	Bought property as a safe investment	N16, EX92
	Property as a retirement Plan	Bought the property thinking about using it in retirement	N11, N19
	Housing	Has the property only for family residence	N12
2. Aims for the land	Property for family livelihood	Aims to provide for the family with property	N17, N1, N3, N7, N8, N30, N18, N19, N20, N22, N26, N23
	Bar on the property	Has a bar to complement income	EX70
	Improve income from the property	The aim is to improve income for the property	N3, N4, N10
	Limited labor changed the aim for the property	Had to change the aim due to restricted availability of labor	N10, EX70
	Cattle drives decision making in the property	Sees cattle as a best source of investment and wants to keep cattle, which drives decision making	N16, N26
	Use for leisure	Uses the property for leisure and wants to keep doing so	N11, N9
	Property for housing	Property for housing purposes only	N18, N12, N9
	Future income	Aims to get some income from the property in the future	N11
	Additional income	Wants to keep the additional income from the property	N20
	Condominium	Wants to transform the property in a condominium	N20
	Property to leave something for the kids	Property to leave something for the kids	EX92
	The bad roads are a problem for production	The bad roads are a problem for production	EX92

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
3. Reason to maintain forest	Was already there	When landowner started managing the property the forest was already there	N17, N30, N18, N16, N10, N8, N19
	Needs forest because of law	The law requires having forest	N17, N3, N7, N12
	Hunt	Likes to hunt, so maintained forest for hunting	N17
	Likes the animals	Likes the animals, so maintained forest for animal life	N17, N21
	Forest gives better environment	Forest gives a better environment on the farm, it is better to work more closely with the environment	N17, N7
	Family teaching	The family already conserved forest and passed on this legacy	EX70
	Acknowledges the law	Meet legal requirements	N1, N7, N30, N18, N10
	Wood source	Maintain forest for wood source	N1
	Water source	Maintain forest for water source	N1, N4, N7, N22, N20, N19, N16, N12, N11, N10, EX70
	Likes the forest	Likes the forest	N4, N9, N19
	Without the law would have the same amount of forest	The environmental law did not increase the amount of forest that the landowner has	N1
	Stopped deforesting because of the law	When they heard the law was created, they stopped deforesting	N3
	Produces banana within the forest	Maintains forest because s/he believes that banana productivity is higher within the forest	N23
	Collaborate with society	Maintains forest because/he believes this is a way to collaborate with society	N26
	Environmental awareness	Maintains forest because s/he considers him/herself to be an environmentally aware person and sees it importance	N21, N19, N11
	Religious TV shows importance of nature	The religious TV stations talk about how forest is important for life	EX70

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
4. Reason to restore forest	Shade for cattle	Allowed tree regrowth in some spots to provide shade for the cattle	N17
	Banana trees near the river	Aims to plant bananas to accumulate water	N1
	No need to restore	Believes already has enough forest so they do not need to reforest	N3, N30, N8, N18
	Wants to restore around springs	Wants to restore forest around springs to maintain water quality and availability	N7, N21, N22, N12
	Pit areas	Allowed forest to grow back in pit areas	N26, N19
	Animals	Planted because believed the animals needed more forest	N21
	Lack of labor	Forest grew back in some areas due to lack of labor force	N23
	Went to prison for deforestation	Was jailed because the employees were deforesting	N23
	Recover degraded area	Let the forest grow back to recover a degraded area	N19, N19
	Land abandonment	Forest grew back in areas are no longer in use	N9
5. Perceived benefits of forest	Believes forest is important for water	Relates forest to water (provision and/or availability) and humidity	N17, N1, N3, N4, N23, N30, N21, N23, N22, N11, N9, N8, N10, N19, N12, N18, N20, EX70, EX92
	Believes forest does not increase water availability	People normally say that it is necessary to keep forest around springs, but the landowner does not believe that this is true	N26
	Climate	The forest is important for lower temperatures and climate stability	N17, N4, N30, N20, N10, EX92
	Hunting and leisure	Uses the forest to hunt, a source of recreation	N17
	Wood	Used the forest as a wood source	N1, N21, N11, N9, N8
	Air quality	Believes the forest is important for air quality purposes	N3, N4M N30, N21, N26, N22, N12, EX92
	Erosion control	Believes the forest is important for erosion control purposes	N19
	Forest conservation	Believes the forest is important for forest conservation purposes and sees this as a benefit	N30
	Beauty and peace	Mentioned the beauty and the peace that forest provide as benefits	N26, N10, EX70
	Palm/food	Eats palm from forest	N20
	Plants within forest	Plants within forest to increase productivity	N23

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
6. Perceived drawbacks of forest	Problems with hunters or palm extractors	The forest attracts people who hunt and extract palm	N17, N10, EX92
	No drawbacks at all	The forest does not produce any drawbacks, demonstrated strong denial of any drawback	N1, N23
	Forest increase would impact livelihood	If I had to increase the forest area in my land, it would impact my family's livelihood	N26
	Forest around all rivers	Does not make sense to have forest around all rivers	N30
7. Land management resulting in land use changes	Deforested in the past for cattle	Deforested to increase area for cattle	N9
	Changed the native pasture for bracquiaria to improve pasture	Change the native pasture for bracquiaria to increase productivity, invested in improving pasture	N1, N11
8. Discovery of PAF	Project visited the property	Project staff has been to the property to offer PAF	N17, N3
	EMATER	Heard about it at the technical institute	N1, N4
	Neighbors participating	Found out about the project because neighbors were participating	N19, N9
	Part of COMDEMA	Member of the municipality environment committee	N26
	TV	Saw a program on television	N11
	Local institution	Heard something about it in one of the local institutions (EMATER Rio Claro), or the rural labor or environmental secretariats	N22, N20, N16, N12, N30
	Project	Follows the project since the beginning	N21
	Project went until property	The project staff visited the property to explain the project	N10

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
9. Motivation not to participate	Not convenient	PAF was not convenient	N17, N4
	Low payment	PAF does not cover opportunity costs of reforesting	N17, N26, N16, N20
	Uncertainty about future of the project	They pay now, but who guarantees that the project will keep paying in the future	N17
	Heard about it but nobody offered it	Heard about it, but did not want to follow up to see if it a good deal	N1, N10
	Would reduce agricultural production	The reforestation would reduce production	N3, N26, N16, N20, N22, N8
	If reforestation were mandatory s/he might participate	Would participate if reforest if was mandatory	N22, N26
	If could decide the places to be reforest would join	Could join the project if s/he could choose the places to reforest	N30
	Could consider increasing the % missing from the LR	Might consider participating to increase the % of forest needed to be in compliance with the LR	N26
	Was not directly offered to join	Was not directly offered opportunity to join so did not think much about joining, but from the description provided, might have joined	N30, N19, N12
	Does not want to reforest	Does not want to reforest	N18
	Was already doing	Was already doing what the project is supposed to do so did not see any reason to join; sees it as doing his/her part.	N11
	Would participate if needed to add to participation	If people asked individual to participate s/he would join to contribute with the people	N30, N11
	Does not believe in the project	Does not believe in the project because people only "give the worse part of the property to the project"	N21
	It would be like selling a part of the land	Believes that participating on PAF would be like selling a part of the land	N10
	Small property	Property is too small to reforest part of it	N11, N9, N8
	Contract time	The contracts are for less than 5 years and reforestation is forever	N20, N8
	Does not trust the government	Does not trust the government and believes they would not keep their word and would stop paying whenever	N16, N20
	Left the project because the project wanted to plant in the riparian forest	Family decided left the project because the project wanted to plant riparian forest and they thought they already had too much forest, cancelled enrolment when found out about the reforestation requirement	EX70, EX92
	Wanted to participate for the money	Money drove participation	EX70, EX92
	Land already retains a lot of water and owner should be paid for that	S/he believes the property already produces a lot of water, and s/he should be paid for that	EX92

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
10. What would you require to reforest	Nothing, farm is too small	Would not reforest because farm is too small	N17
	Higher and payment in perpetuity	The payments would have to be higher and paid in perpetuity	N17
	Only if was mandatory	Would only reforest if was mandatory	N22, N26
11. Perception of outcomes	**Not Applicable to Non-Participant Group**		
12. Knowledge of environmental regulations	Deforestation is prohibited	Deforestation is not allowed	N17, N8, N9, N10, N12, N16, N18, N22
	Need riparian forest	It is necessary to have forest around rivers	N17
	Fire is prohibited	It is not allowed to use fire to manage the land	N17, N1, N4, N22, N12, N8
	Hunting is prohibited	Hunting is not allowed	N23
	Chemicals are prohibited	Using chemicals near the river is not allowed	N22
	Knows that small landowners have fewer requirements	Small landowners have fewer obligations than big ones in the Forest Code	N17, N30
	Knows about PPA and LR	Is aware of PPA and LR requirements	N17, N1, N3, N4, N22, N26, N30, N18, N16, N12, N11, N10, N8, EX70
	Palm extraction is prohibited	It is prohibited to extract palm	N4, N23
	Aware of law	Mentioned following and knowing about the environmental law	N21, EX92
	Not allowed to touch anything	The law does not allow to the landowner to extract or deforest anything in the forested land	N26, N23, N12
	Never worried too much because believes conservation is important	Did not look to find out about environmental regulations because do not want to act against the environment	N19
	Changes too much	The environmental law changes too much, so it is hard to follow	N30

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
13. Opinion of environmental regulations	Conservation is important	Thinks the regulations are important because conservation is important	N1, N3, N4, N21, N12
	Good, but inefficient	Believes that the legislation is good, but most people do not follow the rules	N17
	Differences between small and large landowners	The big landowners deforested around rivers more; there is a difference in the way agents enforce the regulations in big vs. small properties	N17, N12, N11
	Important for environment	Believes environmental regulation is important for the environment	N1
	Much more deforestation would occur without regulation	Without the law would exist much more deforestation	N3, N4, N7, EX70
	What exists is enough	It is not necessary to ask landowners to reforest more if the producer already has 20% of land in forest	N7
	The regulations are not in line with the rural reality	The law does not match the rural reality	N30
	Some regulations are excessively demanding	Believes that some environmental regulations are excessive and go beyond what is necessary	N23, N16, N12
	The legal regulations are not a factor in decision-making	The landowners do not consider the law for decision making	N22
	People would deforest if the regulations did not exist	If the law did not exist, people would cut everything down to put pasture	N12, N9
	It is important for protecting water	Forested land is important in retaining water and therefore the regulation is important	N26, N22, N8
	Corruption	The state is the first to not follow the rules	N16
	Small landowners incapable to comply	Small landowners cannot maintain forest because compliance would mean that would be no land for production	N18
	Protecting hilly lands makes no sense	The Atlantic forest occupies hilly terrain and it makes no sense to protect all of the hill terrain	N18, N20

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
14. Perceived enforcement of environmental regulations	Some enforcement	Sees the enforcement car pass, but does not know anyone that was fined	N17, N1, N26, N20, N12, N11
	Only for the small	Big landowners are often unpunished	N3
	Corruption of the agent	Mentioned that knows about enforcement agencies being corrupt, the corruption allows the bribers to get away with environmental crimes	N7, EX70
	Park area	Is within protected area so gets to see more enforcement	N10
	Rigor in enforcement in relation to deforestation	Reported that enforcement of the legislation has been strict or knows people that were fined	N16, N10
	Never saw law enforcement	Reported that never saw or heard about law enforcement actions	N18, N19, N8
	The places with bad roads do not get any enforcement	The places with bad roads do not get any enforcement	N9
	Fines do not affect behavior	Does not think fines affects the behavior of people, because they know people who were fined and did not change their behavior at all	N12
	Does not worry about it	Agrees with it and does not worry about it	N19
	Was jailed before	Was jailed for environmental crimes (deforestation)	N23
	Believes does not see enforcement in the region because the deforestation is over	Believes does not see enforcement in the region because the deforestation is over in the region	N30
	Enforcement in bird caging has increased and know there are more birds	The enforcement of people that practice bird caging has increased and knows there are more birds now	EX70
	Contributed to people leaving rural areas	Believes the rigor in the environmental law contributed to people moving away from rural areas	EX70
	The law is important because otherwise there would be more deforestation	Believes the law has slowed or prevented more deforestation	EX70

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
15. Perceived motivations to comply (or not) with environmental legislation	Normative motivations. Agrees with the law or believes is the right thing to do	Complies with environmental law because believes is the right thing to do	N17, N3, N7, N30, N26, N19, N18, N12, N10, N9, N8, N22
	Fear of enforcement	Believes people conserve because they fear enforcement will show up	N1,
	Normative motivations	Believe all citizens must follow any rule	N1
	Calculated motivations	People do not comply because there is not enough enforcement	N3, N7, N22, N30, N21, N19, N18, N12, N11, EX70
	People believe that will not be sanction	People are aware of the law, but do not think there will be sanctions	N21, N18, N22
	Bad example of the government	People do not comply because they have a bad example of the government	N18
	People do not know why is important to have forest	People do not know why is important to have forest, so they do not comply	N26
	Necessity of each family	The decision over the land is independent from the legislation and change with the necessity of each family	N30
16. CAR perception of change in environmental regulations and in enforcement	Nothing will change	CAR will not change anything in terms of land management or enforcement	N17, N21, N 18, N16, N11
	Made people more aware of environmental legislation	The registration process in CAR made people more aware of what was required in the FC and of their rights	N17, N3
	Did the Car because had too	Did the Car because had too, did not learn anything with it	N1, N19, N18, N10, N9, N8. N20, N22, N23
	Will increase real requirements	Believes the government will later start asking landowners to reforest	N3, N30, N26, EX92
	Diagnostic	Believes is a good way to the government to find out about rural areas	N7
	Only bureaucracy	Nothing will change it is just another bureaucracy	N21, N10
	Depends on political will	CAR seems to be a good instrument, but its application will depend on the will of politicians, and corruption is institutional	N12, N16

Table A3. *Cont.*

Topic	First-Level Code	Idea It Captures	Codes
17. Emergent	Participates in Rio Rural	Participates in a World Bank project that requires "an environmental" action	N1
	Fire is normally a crime	Someone has set a fire and the fire entered the property	N1
	Heard about the RPPN project, and did not participate because of the family	Mentioned PES from RPPN and only did not join because property was in family name	N3
	"Clear" land is necessary	It is necessary to clean the land every two years, otherwise you lose the right of using it	N22
	Sewage from the property goes to the river	Property owner reported that the sewage from the property goes to the river	N8
	Have cows to maintain the pasture	Cows avoid forest to grow back, and help to maintain the pasture	EX70
	Corruption with bureaucracy to legalize water extraction	The producer gave up of a project because it had Corruption with bureaucracy to legalize water extraction	EX92

Table A4. Themes from participants and non-participants in PAF, Rio Claro, Brazil, 2017.

Theme	First-Level Code	Topic
Property for leisure		
	Property for leisure	1
	Property to share with friends	1
	Desire to pursue a rural way of life	1
	Family had the property for leisure use	1
	Family likes the region and the property	1
	Looking for escape from the city	1
	Family dream	1
	Housing	1
	Inspiration	1
	Identifies with indigenous culture	1
	Forest conservation	1
	Property for forest conservation	2
	Use for leisure	2
	"Arrenda" for maintenance	2
	Enjoys the forest	3
	Land abandoned in areas that were not being used	4
	Let forest regrow	7
	Was pasture when arrived	7
Property as additional income		
	Property as investment	1
	Property as inheritance	1
	Property as additional income in hard time	1
	Retirement plan	1
	Raise horses	1
	Family already managed the property before current owner	1
	Cattle	2
	Additional income	2
	Tourism	2
	Bar on the property	2
	Changed from agricultural production to tourism	4
	Forest as additional source of income (subtheme)	
	Off-site mitigation	4
	Desire to own something in a forested area	9

Table A4. *Cont.*

Theme	First-Level Code	Topic
Property as main source of income		
	Property for cattle ranching	1
	Family livelihood is related to the property	1
	Family already managed the property	1
	Property provides family livelihood	2
	Aims to improve the property	2
	Cattle	2
	Deforested in the past for cattle	7
	Transformed property into a condominium	7
Perception of restrictions and limitations reduces property profitability Labor limitations		
	Labor limitations changed the aim for the property	2
	Aging	2
	Labor expenses	3
Legal restrictions		
	Property in a park area	2
	Use property for leisure because cannot alter it	2
	Too many restrictions on use of forest land	6
	The landowner has more responsibility over forest land than over pasture	6
	Not allowed to alter anything in forested areas	12
	Law prevents owner from profiting from the property	13
	Park area	14
Infrastructure restrictions		
	Difficult access	2
	Tried activities that did not work	2
	Legal restrictions are not enforced in areas with bad roads	14

Table A4. *Cont.*

Theme	First-Level Code	Topic
Corruption causes ineffectiveness		
	Corruption prevented implementing economic activity	2
	Money attracts corruption	9
	NGO responsible for reforestation needs to be audited	10
	More rigor by the executor of the program is necessary	10
	Some additional regulations are overdue	13
	Sanctions are not complete and corrupts citizens	15
	Corruption differs between big and small landholders	13
	Corruption of enforcement agents	14
	Individuals use the network to obtain public benefits	17
Water		
	Maintain forest because of water	3
	Areas around spring	4
	Believes forest in important for water	5
	Conservation is important	13
	Water availability is reduced over time	18
	To protect springs	9
Social motivations for pro-environmental action		
	Obligation as a citizen	3
	Maintain forest for benefit of future generations	3
	Societal collaboration	5
	Everybody around was participating, so joined too	9
	Project people were nice	9
	The project sounded important	9
	Recognition	9
	Benefit for others	9
	Worked in the project	10
	Any law must be respected	13
	Did because it brings together everybody	16

Table A4. *Cont.*

Theme	First-Level Code	Topic
Laws promote pro-environmental action		
	Maintain forest because is cutting is not allowed	3
	Law is required	3
	Looked for help to restore land in order to fulfill environmental regulation	8
	Joined PAF because of legislation	9
Direct use of the forest/forest utilities		
	Water	
	Wood source	3
	Firewood	5
	Reduce the problems with fire	4
	Erosion control	5
	Clear air	5
	Desire to restore areas	9
Environmental awareness and biospheric values		
	Environmental awareness	3
	Maintain forest because of animals	3
	Believes forest is important for conservation	5
	Would have joined without the money	9
	Increase local environmental awareness	9
	Forest conservation	1
	Never worried much because s/he believes conservation is important	12
	Conservation is important	12
	Normative motivations: Agrees with the law or believes compliance is the right thing to do	13
	It is necessary to understand the reasoning behind environmental laws	15
Intrinsic motivation for pro-environmental action		
	Religion	3
	Trees are beautiful	4
	Sponsorship for increases in protection	9
	Increases local environmental awareness	9
	Likes forest	9
	Forest conservation	1
	Forest provides peace and beauty, stress relief	5
	Forest provides inspiration for work	5
	People need to understand for themselves	17

Table A4. *Cont.*

Theme	First-Level Code	Topic
Recover previous damage to the land		
	Recovered a degraded area	4
	Relieved guilt for past deforestation	9
Positive environmental outcomes		
	Land was abandoned areas that were not being used	4
	Changed agricultural production to tourism	4
	Wanted to restore and could not do it alone	9
	Perception of positive outcomes	9
	Became aware of the importance of forest and stopped deforesting	10
	Stopped harvesting wood from the forest because of PAF	10
	Increased water availability	10
	Reduced erosion	10
	Reduced the problems with fire	10
	People would deforest if it did not exist	13
	Changed behavior because increase the perception of enforcement	14
Illegality/impunity and lack of government as example		
	Problems with hunters or palm extractors	6
	Avoid criminal fire and hunting	9
	Avoid land invasion	9
	People believe that there will not be any sanction	15
	Sanctions are not complete and corrupts the citizenry	15
	The government itself does not do anything	13
	Corruption of the enforcement agents	14
	Fines are not paid	14
	Nothing will change	16
	Depends on political will	16
	Sewage treatment is lacking in the municipality	17
	Criminal fires occur (arson)	17
	Absence of government	17

Table A4. *Cont.*

Theme	First-Level Code	Topic
No required behavior change		
	Already was complying with the law and would get money for it as well	9
	No reason not to join	9
	No negative impact	9
	No behavior change	10
	Nothing was done by PAF in the property	10
	The change in the property did not impact production	10
Calculated motivations		
	Money	9
	Believes in the PES logic	9
	Used the term rent for PAF	9
	Calculated motivations	15
	People believe that there will not be sanctions	15
	People would deforest the law did not exist	13
	Fine is too high	14
	People live today and do not worry about tomorrow	15
	Necessity is critical in the decision-making process	17
(subtheme) Autonomy		
	Contract flexibility	9
	RPPN immobilizes the land	17
(subtheme) Costs related to land management		
	For help with fencing	9
	Reduce cost of required reforestation	9
	Not drawbacks, but costs with fencing is costly	6
Reduced utility in acting against the law		
	Rigor in the enforcement in relation to hunting	14
	Rigor in the enforcement in relation to deforestation	14
	Fine is too high	14
	Changed behavior because of increased perception of enforcement	14
	Is increasing real restrictions	16
	Is increasing perception of restrictions	16
	CAR can help legalization	16

Table A4. *Cont.*

Theme	First-Level Code	Topic
Bureaucracy	* moved to be facility easiness	dropped
	Help to avoid tax fine	9
	Bureaucracy cost of compliance with environmental regulation	15
	Overlap of legislation	13
	Overlap of enforcement in different levels of government	14
	Only bureaucracy (effort associated with land registration)	16
	Bureaucracy in excess to obtain license	17
Land value as a reason not to conserve		
	Nothing for heirs	6
	Expansion of the cities, land division into condominium	17
Unfairness		
	The enforcement agents do not know how to communicate with landowners	14
	Corruption: Difference in enforcement actions taken with small and large landowners	13
Awareness (dropped)		
	Made people more aware of environmental legislation	16
	Is aware of PPA and RL	12
	Increased environmental awareness in the country	12
	Not allowed to touch anything	12
	Does not know anything	12
	Deforestation is not allowed	12
	Fire is not allowed	12
	Toxic chemicals are not allowed	12
	Aware of rules	12
	Not allowed to extract river sand	12

Table A5. Themes decision process. Process of combining themes together to be included in the models.

Theme	Action
Property for leisure	Rational to have a property
Property as additional income	Rational to have a property
Property as main source of income	Rational to have a property
Perception of restrictions reduces property profitability	Keep
Labor restrictions	
Law restrictions	
Infrastructure restrictions	
Corruption causes ineffectiveness	Joined into illegality
Water	It is part of intrinsic calculations and social motivations
Social motivations for pro-environmental action	Keep
Laws promote pro-environmental action	Keep
Direct use of the forest/forest utilities	Part of calculated motivations
Environmental awareness/biospheric values	Part of intrinsic motivations and of how law restrictions are perceived
Intrinsic motivation for pro-environmental action	Keep
Recover previous damage to the land	Reflects change in intrinsic and/or social motivations to act
Positive environmental outcomes	Keep
Illegality/impunity and lack of government as example	Joined with corruption
No required behavior change	Keep
Calculated motivations	Keep
(subtheme) Autonomy	
(subtheme) Costs related to land management	
Reduced utility in acting against the law	Keep
Bureaucracy	Included in calculated motivations and in the perception of corruption and Illegality
Land value as a reason not to conserve	Included in calculated motivations
Unfairness	Keep
Awareness	Dropped once the change in awareness about the law does not reflect in the change in behavior
Easiness	Keep

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