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Community enforcement and tenure security: A fuzzy-set qualitative Comparative analysis of twelve community forest management initiatives in the Peruvian Amazon

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ABSTRACT

The interest of policymakers in community management of tropical forests is ever growing. Yet, a large research body shows varied levels of success of community conservation initiatives. While policymakers often prioritize legal forest ownership, mostly land titles, consensus exists that success rather depends on a broader set of local institutional arrangements and their fit with the forest context. In this paper, we contribute to building theory on these institutional arrangements and their interaction. We apply a fuzzy set Qualitative Comparative Analysis to case study data on 12 voluntary community conservation initiatives in northern Peru to explore the relationship between local enforcement, legal and alternative property rights, and conservation effectiveness. As recommended for QCA our case selection was intentional and the cases exhibit diverse conservation successes, geographic characteristics, legal and customary property rights, and enforcement mechanisms. We conclude that strong community enforcement mechanisms are indispensable for effective conservation in voluntary initiatives. Furthermore, we find for cases with strong enforcement mechanisms, that some government back-up, i.e., local government support for enforcement and/or legal rights to conserve the forest, significantly increases conservation effectiveness. Strong conservation enforcement tends to be present in communities with strong forest rules, leaders, and pre-existing community institutions. Our findings suggest the importance of paying close attention to community characteristics during project design and refraining from one-size-fits-all-solutions, such as focusing mainly on the presence of legal ownership rights over the forest. Instead, more focus needs to be placed on understanding existing community institutions and supporting communities to strengthen and adapt these for conservation enforcement, rather than imposing new arrangements. Finally, policymakers can help community enforcement institutions become even more effective, by providing them with legal rights to conserve the forest and by strengthening their relationship with local governments so that they receive support in situations they struggle to handle alone.

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1. Introduction

Local and indigenous communities possess an estimated 52% of total land in Latin America, even though much of that area is legally classified as public land (Alden Wily, 2011). Community forests are often relatively small (Chhatre & Agrawal, 2009), but all together cover large areas (Shanee, et al., 2014). They are important as carbon repositories, for biodiversity conservation and water regulation, and for timber and non-timber forest products (NTFPs). A large research body shows varied levels of success of community forest management and conservation initiatives. Specific outcomes

depend largely on the fit between social and institutional arrangements, and the biophysical, ecological, and social-political context of the forest (Robinson, et al., 2014; Larson, et al., 2010). To improve results of conservation and forest management projects, it is important to build theory on what components of these arrangements, individually and combined, impact positively on conservation effectiveness (Brechin, et al., 2002; Waylen, et al., 2010; Cambell, et al., 2001). In this context, we explore the relationship between local enforcement, legal and customary property rights, and conservation effectiveness.

Granting private or common land titles remains a leading mechanism to promote community conservation, particularly in Latin America (Blackman, et al., 2017). Many projects only consider communities with such land titles or focus on helping to obtain

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those. Yet, a vast body of research indicates that government granted legal forest ownership may contribute to successful forest management but is no guarantee for conservation success (Ostrom & Nagendra, 2006; Deininger & Feder, 2009; Robinson, et al., 2014; Larson, et al., 2010). Especially if governments do not help communities to protect these legal rights, these might not provide them with the assurance that they will be the ones benefiting from the outcomes of their investments. Such assurance is generally referred to as tenure security (Sjaastad & Bromley, 2000). In addition, tenure security, whether enforced by legal or customary rules, does not necessarily incentivize communities to better protect their forests (Charnley & Poe, 2007).

Scholars have argued that conservation effectiveness depends on the existence of local enforcement mechanisms, rather than on legal ownership rights (Gibson, et al., 2005; Padgee, et al., 2006; Coleman, 2008; Chhatre & Agrawal, 2009; Agrawal & Chhatre, 2006; Yadav, et al., 2003; Chhatre & Agrawal, 2008; Coleman & Steed, 2009). Cronkleton & Larson (2015) demonstrated among communities in the Peruvian and Ecuadorian Amazon that when state presence is weak, individuals rely on collective behavior to assure that their rights are upheld. Such collective behavior includes customary and alternative rights over the forest, with different levels of legal strength and often with strong local recognition (Kerekes & Williamson, 2010). In forest areas in Peru, the government is rarely involved in conservation enforcement in communities and community institutions are thus the central enforcement mechanisms. Few communities manage to obtain some assistance from local government authorities to sanction rule-breakers in situations they cannot handle alone. The importance of local enforcement mechanisms and of the support of local government for local enforcement have received little attention. In this paper we address this knowledge gap.

Community forest management and conservation initiatives in the Amazon have enormously increased in the last decades (Shanee, et al., 2014; Monteferri & Coll, 2009). The interest of governments and development agencies in such initiatives is ever growing, because of the potential of win-win opportunities: carbon storage, biodiversity conservation and improved livelihood conditions (Arts & de Koning, 2017; Adams & Hulme, 2001; Shanee, et al., 2014). Yet, it is less known that many communities voluntarily conserve their forests, independent of policies and external finance. Their motivation is often linked to certain services, such as water supply, timber, and NTFPs, but also the intrinsic value of nature (Klooster, 2000; Wilson et al., 2019; Shanee, 2013; Reyes-García, et al., 2018, V. Fairhaid & Leach, 1995). Here, we present the results of our study on 12 voluntary community conservation initiatives located in diverse forest landscapes in the Loreto, San Martín, and Amazonas regions of the northern Peruvian Amazon.

The central research question of this paper is as follows: What combinations of legal and alternative forest ownership, community enforcement initiatives, and local government support result in effective forest conservation by local communities (Blackman, et al., 2017; Robinson, et al., 2014; Dietz, et al., 2003; Agrawal & Chhatre, 2006; Coleman & Steed, 2009; Ostrom & Nagendra, 2006; Larson, et al., 2010; Chhatre & Agrawal, 2009)? To answer this question, we analyze data using Qualitative Comparative Analysis (QCA) (Ragin, 1987). QCA is a research method that uses analysis grounded in Boolean set logic to compare case studies, thereby allowing for (modest) generalizations without losing detailed case knowledge. It draws on intensive knowledge of cases to identify causal conditions and *multi-causal pathways* of these conditions that alone or together lead to a specific outcome (in our study effective forest conservation). We formulate the following hypotheses (to be elaborated upon in the theoretical section below):

H1: Strong community enforcement is a necessary condition for effective conservation in voluntary community initiatives under different tenure arrangements.

H2: Local government support for sanctioning contributes to effective conservation in voluntary community initiatives that have strong community enforcement.

H3: Legal forest ownership does not contribute to effective conservation in voluntary community initiatives.

The paper is structured as follows. In the next section, we present the concepts and theoretical issues related to our research question. Next, we describe the research area, the case selection process, and the QCA research and analysis method. We then report the results of the analysis and decide whether to conduct a second QCA to obtain increased insights in possible *necessary* conditions for effective conservation. Following, we discuss our findings in the context of existing literature. Finally, we present conclusions and recommendations for follow-up research and practice.

2. Theoretical considerations

2.1. Legal forest ownership

The causal relationship between private property rights and land use decisions was first discussed in the economic history literature (Alchian & Demsetz, 1973). It was theorized that private land ownership resulted almost automatically in an increased sense of tenure security of the owners, because government services protected exclusive rights associated with private property vis-à-vis third parties (Buntaine, et al., 2015; Feder & Feeny, 1991). Increased tenure security would motivate farmers to intensify investments, and, for instance, enhance the fertility of agricultural land (Feder & Feeny, 1991; Besley, 1995; De Soto, 2001). In the 1970s and 1980s, these principles were applied in large-scale land administration projects mostly in Latin America in which the land rights of owners were strengthened through clarification and formalization of these rights. The same ideas also gained traction among forest management scholars and practitioners, who considered legal forest ownership as indispensable for effective conservation (Padgee, et al., 2006; Charnley & Poe, 2007; Wynberg & Laird, 2007; Sandbrook, et al., 2010).

Unfortunately, land administration projects have led to disappointing results (Bennett, 2007, p. 21). World Bank (2017) estimations indicate that “only 30 % of the world’s population has a legally registered title to their land”, with most untitled land being in the global South. In the Peruvian Amazon, the regularization of legal property of around 20 million ha of land lacks completion (RRI, 2015). In addition, land regularization efforts have often failed to improve socio-economic conditions of the poor, suggesting a misunderstanding of the causal links between legal land property and economic development (Cousins, et al., 2005; Holden & Ghebru, 2016). Legal private or common property rights only improve tenure security if third parties respect and the government effectively protects these rights (Cronkleton & Larson, 2015). In the global South, where many governments are weak, patchworks of legal, semi-legal and customary property rights arrangements can be found, that have local acceptance and enforcement and result in vibrant informal ownership exchange (Kerekes & Williamson, 2010).

The relationship between legal property rights and conservation outcomes is also ambiguous. According to Ostrom (2009, p. 419), “theoretical predictions of the destruction of natural resources due to the lack of recognized property systems have led to one-size-fits-all recommendations to impose particular policy solutions that frequently fail”. Studies on community initiatives

with and without legal property rights show varied levels of sustainable forest management and concurring conservation success (Ostrom & Nagendra, 2006; Chhatre & Agrawal, 2009). Several meta-studies indicate that legally titled communities do not necessarily have lower deforestation rates than untitled communities (Larson, et al., 2010; Robinson, et al., 2014).

2.2. Community enforcement

Community enforced forest conservation was long considered impossible, at least in the eyes of leading scholars and practitioners in Europe and North America. Government intervention or private ownership were considered the best solutions for sustainable management of common pool resources (Demsetz, 1967; Hardin, 1968; Smith, 1981). No rational individual in a community would be willing to enforce forest management rules, as personal costs of such efforts are high and benefits low, while the entire community, and to some extent even the entire world population, benefits (Cambell, et al., 2001; Ostrom, et al., 2002).

Yet, institutionalists have found evidence that some common pool resources, including forest resources, can be managed effectively relying on local institutions, and that communities around the world had been doing so for centuries (Ostrom, 1990; Ostrom, 1998). Empirical findings in laboratory setting with students also show willingness to sanction those who deviate from rules (Coleman & Steed, 2009). Ostrom & Nagendra (2006), for example, conducted laboratory experiments of behavior in common-pool resource situations with undergraduate students. They find that, when given the opportunity, some groups of participants, design and execute their own sanctioning system, even when these come at a cost, and that those groups achieve the highest payoffs. Field research in locations around the world also demonstrates that communities may enforce local natural resources rules, even in cases in which the investment costs are higher than the benefits (Ostrom, 2010; Henrich, et al., 2006; Tang, 1992; Gibson, et al., 2005). Participating community members are motivated by material gains, but also by altruism, fairness, reciprocity, and reputation (Cardenas, 2004; Fehr & Rockenbach, 2003; Carpenter, 2007).

In more remote locations where public administration and law enforcement are largely absent, like the Peruvian Amazon, communities rely on their own enforcement mechanisms (Cronkleton & Larson, 2015; Kerekes & Williamson, 2010; Gibson et al., 2000a). We define such mechanisms as the institutions in a community that promote physical forest occupation (e.g., create paths and place milestones and guard houses), monitor the forest condition and its authorized and non-authorized users (Ostrom, 1990), and sanction rule-breakers. There is an almost infinite variety of community forestry rule enforcement mechanisms that can exist (Charnley & Poe, 2007), many of which are complex social constructions with their own logic, based on historically built social capital (Katz, 2000; Klooster, 2000), traditions and habits, government promoted social structures (Leach, et al., 1999), and adaptations to the biophysical and ecological context and the wider social system (Cleaver & De Koning, 2015; Ojha, et al., 2016, Antorini & Bray, 2005).

2.3. Local government support for sanctioning

Interactions between communities that require assistance with forest governance and government officials are becoming more common in developing countries (Gupta & Koontz, 2019). The effects of government enforcement on community forest management can be both positive and negative (Coleman & Steed, 2009;

Gupta & Koontz, 2019). Government enforcement can crowd out local efforts and be counterproductive (Cardenas, et al., 2000; Cardenas, 2004). Agrawal & Chhatre (2006) provide three possible explanations. First, a powerful external actor might hinder the adoption of governance rules that are best suited for the local situation. Second, comanagement might introduce large amounts of external funds into the local context, which may exacerbate the negative influence of powerful external actors. And third, forest designated to comanagement are often not in a good condition. Yet, government enforcement can also complement community efforts. As institutional arrangements for conservation are necessarily complex and nested (Dietz, et al., 2003), local actors might need to combine their limited resources to be successful (Larson, 2002; Pacheco & Kaimowitz, 1998, p. 469; Andersson, 2004; Ostrom, 1990, pp. 100–102).

3. Data and methods

We use Qualitative Comparative Analysis (Ragin, 1987) to structure our data analysis. QCA is particularly useful as it bridges the gap between qualitative, case-study-oriented, and quantitative, variables-oriented, research. As such, it allows the researcher to draw conclusions that go beyond each single case study and to present more general explanatory factors and lessons, without losing in-depth case knowledge (Arts & De Koning, 2017). Standard statistical techniques are useful to understand the specific effect of independent (quantitative) variables on a dependent (quantitative) variable (*correlational causality*). QCA, on the other hand, makes it possible to determine the effect of configurations of (qualitative) conditions on a single (qualitative) outcome (*conjunctural causality*) (Rihoux, 2006; Grofman & Schneider, 2009; Fainshmidt, et al., 2020). In addition, QCA is powerful at analyzing multiple causal pathways (*equifinality*), which consist of scenarios in which alternative configurations of conditions produce a similar outcome. Given these characteristics of QCA, the unit that is key to the analysis is thus *not* the case, but the configuration(s) *as such*. Hence, QCA researchers are less concerned with examining many cases than with exploring combinations of relevant conditions. This makes QCA suitable for small-N research, where ample knowledge is available about each case (see for example Arts & de Koning, 2017). Such is the case in this research.

In QCA, the conditions and the outcome are presented as sets, as collections of items with something in common (i.e., indigenous communities). The values that the conditions and the outcome take are based on their membership score for a specific set. Some conditions have all set characteristics and are full set members (score = 1), while others only partially fit in the set. For example, a community with indigenous people and migrants has only partial membership in the set 'indigenous communities' (score < 1). In QCA, a threshold is defined to determine whether a case is a set member or not. It can for example be decided that cases with a score of > 0.6 are considered set members and cases with a lower score non-set members.

Causality is determined based on overlapping memberships of cases in the outcome and condition sets, as well as on a rigorous choice of causal conditions. QCA also makes the distinction between *sufficient* and *necessary* conditions for an outcome to occur. For condition X to be *necessary*, all members of the outcome set Y must also be members of the condition set X. Thus, X must always be present for outcome Y to occur, although it can also produce other outcomes than Y. For condition X to be *sufficient*, all members of the condition set X must also be members of the outcome set Y. *Sufficient* conditions thus always produce outcome Y, although other conditions can also produce Y.

3.1. Case selection

We assess 12 initiatives (cases) in the northern Peruvian Amazon, in which local communities voluntarily conserve forests (Fig 1). As recommended for QCA, our case selection was *intentional*, rather than random. As the focus in QCA is on *configurations of conditions*, it is important for the internal validity of the analysis that most of such *configurations* are represented by real cases. Thus, to minimize the *configurations* not represented by the empirical data, we attempted for our cases to be as diverse as possible. We identified the initiatives in collaboration with local conservation experts. As minimum requirements, community members must have made an active decision to assign a specific area for nature conservation, halt all potentially destructive activities in this area, and actively protect it. Initiatives also must have existed for at least two years, be initiated and managed without structural external support, and still be running. In addition, we selected cases that had diverse geographic characteristics, tenure arrangements, and enforcement mechanisms (Devers, 2013). We did not select the communities based on performance, and only identified conservation success during data analysis.

The 12 cases are located in the northern Peruvian Amazon, across diverse geographic regions. Four (*Chapís, Amaya, Puerto Díaz, and Puerto Industrial*) are in the Datem del Marañón province (~150 msl). The vegetation in this remote province, located at the base of the Andean foothills in the Loreto region, consists of carbon rich *Mauritia flexuosa* L. palm swamps, low-land forest,

and some hill forests. The human population density is low (1.4 inhabitants/km²). Still, while 95 % of forest currently stands (Cornejo, 2016, unpublished results), deforestation is rising, mostly near communities (GCF, 2015), as households depend on shifting cultivation agriculture, and harvesting of forest resources for cash income (De Oñate-Calvín, et al., 2018; Cruz-Burga, et al., 2017). Two cases (*Ojos de Agua, Valle del Biavo*) are dry forests in lowlands of the San Martín region (~200–350 msl), and six (*Pampa del Burro, Ronsoco Cocha, Jungla de los Monos, El Arenal, El Hocicón, Jardines Ángel del Sol*) are cloud forests in the mountains of the San Martín and Amazonas regions (~800–1500 msl). The dry lowland and mountain areas of San Martín and Amazonas are agriculture dominated mosaic landscapes, with patches of forests. The population density has risen rapidly since the 1980 s (INEI, 2017). Deforestation is high, due to road projects, migrant influx, shifting cultivation agriculture, and an agrobusiness land rush. Between 2001 and 2016, 402,635 ha were deforested in the two regions, 8 % of the 2000 forest cover (MINAM - Geobosques, 2017). However, since 2007, annual deforestation decreased, partially due to community conservation (Agudo, 2019).

The 12 cases can be categorized within seven kinds of forest ownership, listed here with decreasing levels of legal strength. The first (1) and legally strongest consists of 'private conservation areas in titled indigenous communities' (*Pampa del Burro, Ronsoco Cocha*). There are two types of land titles for indigenous communities, both granted by one of Perú's twenty-five regional governments and registered in the national public registry.

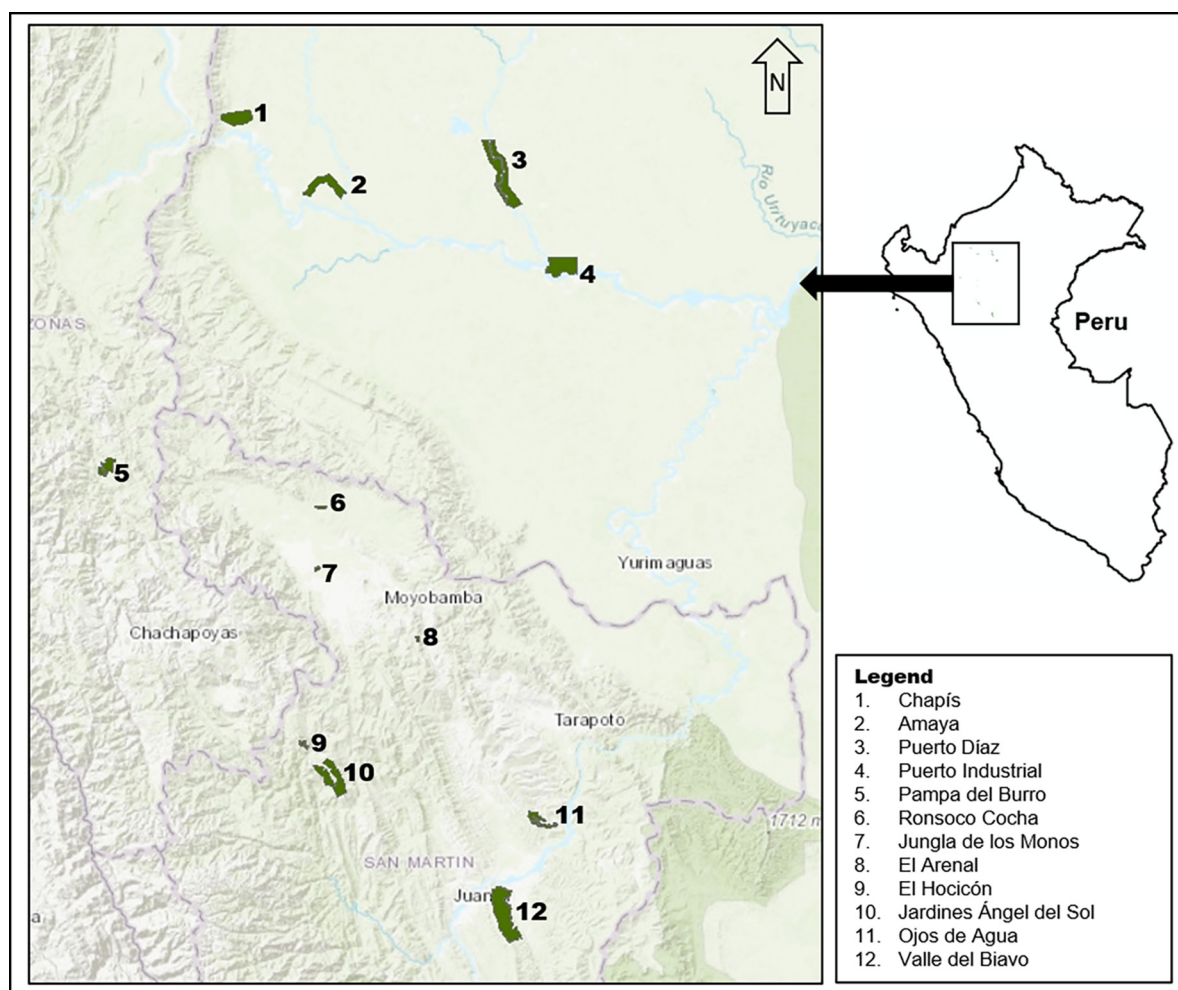


Fig. 1. The 12 cases of voluntary community conservation initiatives.

Comunidades campesina titles are awarded to indigenous peasant communities over communal agricultural lands, mostly in the Andes mountains. *Comunidades nativas* titles are granted to indigenous forest communities and are generally composed of a communal property title over agricultural lands and exclusive communal user rights over forests (*cesión de uso*). Private conservation areas are given out to legal landowners by the national government over a forested area for a period of 10 + years. These are registered in the national protected areas system (SINANPE) and managed by the landowners, generally without any government support. In *Pampa del Burro* and *Ronsoco Cocha* community members applied for a private conservation area, after several conversations with representatives of a grassroots NGO. The NGO provided help with the administrative processes to obtain the private conservation area but has not been further involved in the initiative. The second (2) tenure arrangement comprises 'titled indigenous communities that form part of semi-formal municipal conservation areas' (*Puerto Industrial, Chapís*). Municipal conservation areas are created by local level, municipal governments. While many municipal conservation areas exist in Peru, the national government does not recognize them, which weakens their legal status. The third (3) tenure arrangement consists of 'conservation concessions over forest areas under a customary property claim by community groups on public lands' (*Ojos de Agua, Valle del Biavo, Jardines Ángel del Sol*). Conservation concessions are nature areas on public land over which the regional government has awarded management rights to private parties for forty years. Most conservation concessions are not registered in the public registry, which affects their legal status. The fourth (4) tenure arrangement represents 'untitled communities that form part of semi-formal municipal conservation areas' (*Puerto Diaz*). The fifth (5) involves 'forest areas under a customary property claim by community groups on public land in an area that forms part of a semi-formal municipal conservation area' (*Amaya*). The (6) sixth kind comprises 'informal *ronda campesina* conservation areas in untitled communities' (*Hocicón, Jungla de los Monos*). The *ronda campesina* is a traditional patrol system in campesino or peasant communities in northern Peru. It was created during the guerilla war in the 1990 s and members of all families in the community are obliged to participate. Members patrol the communal lands, maintain social order, administer justice, and protect the interests of the community. The *ronda* has remained in place in many communities to compensate for the absent government. Most *rondas* are currently legally recognized. Yet, the government does not recognize *ronda campesina* conservation areas. Finally, (7) the tenure arrangement with the least legal strength consists of 'community forests on public land with private conservation contract between a community and an NGO' (*El Arenal*).

Regarding community enforcement, in the majority of cases (7 out of 12) a specialized community conservation association or committee oversees day-to-day management and enforcement of the conservation area. Conservation committees are created and recognized at the community level while conservation associations are legal entities which landowners are required to create for the management of their conservation concession. Their functions are quite similar in practice. In one case (*Ojos de Agua*) the conservation association is the only community entity involved in conservation; in three others (*Jardines Ángel del Sol, Valle del Biavo, Pampa del Burro*) they receive support from the *ronda campesina*; and in yet another three cases they are supervised by the communities' general assembly, the highest authority in many communities and composed of a member of each family in the community. The conservation association receives support from a multi-community conservation board consisting of representatives of communities that together manage the conservation area (*Amaya*), the village authorities (*Jungla de los Monos*), or the community

police (*Ronsoco Cocha*). Community police exists in some indigenous forest communities to assist community leaders with daily monitoring and control activities. It consists of community members elected by the general assembly. In three cases (*Puerto Industrial, Chapís, Puerto Diaz*) where communities have not created a specialized community conservation association or committee for daily management of the conservation areas, village authorities are directly in charge of conservation enforcement. They are supervised by the general assembly and assisted by a multi-community conservation unit. Finally, in two cases (*El Arenal, El Hocicón*), the *ronda campesina* is directly and solely in charge of conservation enforcement.

3.2. Data collection

Data collection took place during various field visits between October 2016 and August 2017. We visited the communities, conducted 74 semi-structured interviews, reviewed legal, project, media, and other relevant documentation, and analyzed satellite images for forest cover change. Fieldwork in each community took three to five days and was complemented by meetings in nearby towns or in the capital of Lima with local experts with knowledge of the community and the initiatives of interest, mainly local staff of conservation organizations who had been in contact with the communities for several years. For each community we conducted extensive interviews with the conservation leaders and local experts. In addition, we had shorter interviews with three to nine (randomly picked) community members. These last interviews served mainly to get a better idea of participation of community members, characteristics of the community leadership, and to validate data provided by the conservation leaders and local experts. For the interviews, we prepared interview guides, but did not strictly follow these, as we preferred to let interviews go their natural course. Even so, we made sure to have all questions answered. Tables A.3, A.4 and A.5 of [Appendix A](#) provide an overview of the interview questions.

To assess deforestation in each community, we used Landsat-based satellite data ([Hansen, et al., 2013](#)). In two cases (*Jardines Ángel del Sol, Chapís*) master students conducted related fieldwork (2 month in 2019 and 3 months in 2017 respectively) to deepen our understanding of the social, cultural, economic, and organizational aspects of the communities and their conservation initiatives.

3.3. Operationalization of outcome and conditions

We used the fuzzy-set QCA variant, as it allows representing conditions that cannot be easily dichotomized, as is often the case in social science ([Wagemann, et al., 2015](#)). As explained in §3.1, legal forest ownership and community enforcement, for example, come in many gradations. The same holds for deforestation, where dichotomizing the cases into the categories 'effective' and 'not effective' based on deforestation scores, would cause loss of precision (see [Table 1](#)). In fsQCA, cases can be full, partial, or non-members of sets. For each case, we scored non-members with 0, more non-members than members with 0.33, more members than non-members with 0.67, and full members with 1. We did not use a more detailed scale, as this would have complicated the distinction of the membership scores ([Basurto & Speer, 2012](#)).

In QCA terminology, data consists of several *conditions* and an *outcome*. In this study, some of the conditions are composed of *measures*. Measures are subcomponents of the conditions, for each of which we collected and analyzed data separately and gave a membership score. Later we combined the membership scores of the measures to define the membership score of the condition ([Basurto & Speer, 2012](#)). To define membership scores, we summa-

Table 1

The twelve voluntary community conservation areas.

Voluntary community conservation initiative	Conservation tenure arrangements	Community enforcement institutions	Starting year	Forest area (ha)	BACI score*
Pampa del Burro <i>La Perla - Yambrasbamba, Bongara, Amazonas</i>	private conservation areas in titled indigenous campesino communities	conservation committee (+ <i>ronda campesina</i>)	2013	2,769	0.00 %*
Ronsoco Cocha <i>Paz y Esperanza - Moyobamba, Moyobamba, San Martin</i>		conservation committee (+community police, general assembly)	2015	360	0.06 %*
Puerto Industrial <i>Puerto Industrial - Pastaza, Datem del Marañon, Loreto</i>	titled indigenous native communities in municipal conservation areas	village authorities (+general assembly and multi-community conservation board)	2013	7,092	0.11 %
Chapís <i>Chapís - Manseriche, Datem del Marañon, Loreto</i>			2013	8,652	0.14 %
Ojos de Agua <i>Pucacaca - Pucacaca & Caspisapa, Picota, San Martin</i>	conservation concessions over common use forests on public lands of non-indigenous farmers communities	conservation association	2003	2,351	-0.88 %
Jardines Ángel del Sol <i>La Primavera - Pachiza & Huicungo, Rodriguez de Mendoza, Amazonas</i>		conservation association (+ <i>ronda campesina</i>)	2009	7,172	-0.11 %
Valle del Biavo <i>Dos Unidos - Bajo and Alto Biavo, Huallaga & Bellavista, Bellavista, San Martin</i>			2015	12,299	0.45 %
Puerto Diaz <i>Puerto Diaz - Pastaza, Datem del Marañon, Loreto</i>	untitled indigenous native community in municipal conservation area	village authorities (+general assembly, multi-community conservation board)	2013	11,619	0.05 %
Amaya <i>Pueblo Libre - Morona, Datem del Marañon, Loreto</i>	informal conservation area in untitled mestizo communities within municipal conservation area	conservation committee (+general assembly, + multi-community conservation board)	2012	5,615	-0.01 %
El Hoción <i>Líbano- Huicungo, Mariscal Caceres, San Martin</i>	informal peasant-patrol (<i>ronda campesina</i>)	<i>ronda campesina</i>	2013	509	0.01 %
Jungla de los Monos <i>El Tambo - Posic, Rioja, San Martin</i>	conservation areas in untitled non-indigenous farmers' communities	conservation committee (+village authorities, <i>ronda campesina</i>)	2013	256	-0.27 %
El Arenal <i>El Arenal - Jepelacios, Moyobamba, San Martin</i>	internal conservation agreements and contracts with NGO over common use forest in non-indigenous farmers' communities	<i>ronda campesina</i>	2015	209	-0.47 %

* See section 'Outcome and conditions Operationalization of outcome and conditions' below for explanation of BA and BACI scores. For most cases the BACI score was used. For two cases (Ronsoco Cocha y Pampa del Burro) the BA score was used. See paragraph 3.3.1 for details.

alized all interviews in formats with an introductory section and sections on each measure, condition, or outcome. Using these summaries, we filled out a data sheet for each case. Comparing these sheets, we were able to confirm that there was enough variation between cases. To increase internal validity and to make sure we had enough reliable data for the measures, conditions, and outcome, we triangulated the data from the interviews with community leaders with those from the interviews with the local experts and community members, as well as with legal texts, satellite images, management plans, annual reports, our observations, and broader context knowledge. If two sources provided conflicting information, we discussed the issue with our main informants (mostly conservation leaders and local experts) to clarify the information. A main instance in which we changed our interpretation of data after triangulation was related to deforestation satellite data for the communities of *Ronsoco Cocha* and *Pampa de Burro* (see description in §3.3.1). Online appendices A and C include a detailed overview of the QCA calibration process, including the interview guidelines, and the scoring of measures and conditions.

3.3.1. Outcome

Our outcome is 'conservation effectiveness'. We measure this using before-after-control-intervention (BACI) deforestation scores for all cases (Bos, et al., 2017). BACI scores allow conducting cross-scale integration of deforestation data and to allow a more accurate judgement of deforestation performance. They compare average yearly deforestation in the intervention areas (the conservation initiatives) with that in a larger control area. We selected the geographical district(s) in which the conservation initiatives are located as the control areas, as these are subject to quite similar time-varying factors as the conservation areas (idem). For both the conservation area and the control area, we aggregated defor-

estation data for the periods before and after the start of the conservation initiative (starting years differ, ranging from 2003 to 2013, see Table 1) and calculated the BACI score, using the following steps:

(1) Calculate the before-after (BA) score for the intervention area (the conservation area) using the formula:

average yearly deforestation within the intervention area while the conservation initiative was running – (minus) average yearly deforestation within the intervention area before the intervention started.

A negative BA score indicates conservation effectiveness, as it means that average annual deforestation since the start of the initiative has been lower than it was in the years before the initiative started. A BA score of -3, for example, shows that the average annual deforestation in the intervention area decreased by 3 % points (Bos, et al., 2017, p.3).

(2) Calculate the before-after (BA) score for the control area (the geographical district in which the intervention area is located):

Average yearly deforestation within the control area while the conservation initiative was running – (minus) average yearly deforestation within the control area in the period before the intervention started.

(3) Calculate the BACI score:

BA score for the intervention area – (minus) BA score for the control area.

A negative BACI score indicates a greater reduction in or lower rise of deforestation in the intervention area compared to that in the control area (Bos, et al., 2017, p.4), and thus suggests conservation effectiveness. We used Landsat-based satellite data showing annual tree-cover loss for 2000–2016 (Hansen, et al., 2013). We generated a 'tree cover' forest mask in the 2000 layer, thereby defining forest areas (>10 % tree cover) and non-forest areas

(<10 % tree cover) in 2000. We defined deforestation as tree cover change from > 10 % to ~ 0 % in any subsequent years.

We triangulated the BACI scores with interview data to define final scores. Bos et al. (2017) advise to be cautious in drawing conclusions from BACI scores where absolute deforestation is low, as small year-to-year deviations can determine the scores. When triangulating our BACI scores with data from interviews with community conservation leaders and local experts, we found that these were unfairly high for two cases (*Ronsoco Cocha y Pampa de Burro*). In both, absolute deforestation in the community forest was near 0 % before the start of the initiative and remained equally low during the initiative. Deforestation in the control area was much higher during the entire period but went down a little during the period in which the initiatives were running. For these cases, we decided that the before-after (BA) score, which only considers deforestation changes in the community conservation area, better reflected conservation effectiveness (see BACI and BA scores in Table 1).

3.3.2. Conditions and measures

The three conditions that we included in our analysis are 'legal forest ownership', 'strong community enforcement' and 'strong local government support for enforcement' (see Table 2). The scoring systems and scores for all conditions and related measures are detailed in online Appendix A.

'Legal forest ownership' is present in communities that have a combination of the measures 'legal access rights', 'legal subsistence & commercial withdrawal rights', 'legal management rights', and 'legal exclusion rights' (RRI, 2012). We define the raw QCA score using the formula:

Eq. 1: Legal forest ownership score.

Legal forest ownership score = $\text{score}(\text{legal access rights} + \text{legal subsistence \& commercial withdrawal rights} + \text{legal management rights} + \text{legal exclusion rights})/4$.

'Strong community enforcement' is present in community initiatives with a combination of the measures 'strong physical occupation', 'strong monitoring', and 'strong sanctioning of internal & external rule breakers'. We define the raw QCA score using the formula:

Eq. 2: Strong community enforcement score.

Strong community enforcement score = $\text{score}(\text{strong physical occupation} + \text{strong monitoring} + \text{strong sanctioning of internal \& external rule breakers})/3$.

'Strong local government support for sanctioning' exists in community initiatives which successfully request help for sanctioning rulebreakers from local government agencies. As detailed in Appendix A, we measured this condition directly.

Table 2
Summary of conditions related to the outcome 'conservation effectiveness'.

Conditions	Definition
Legal forest ownership	Legal forest ownership is present in communities that have a combination of legal access rights, legal subsistence & commercial withdrawal rights, legal management rights, and legal exclusion rights.
Strong community enforcement	Strong community enforcement is present in community initiatives with a combination of strong physical occupation of the conservation area, strong monitoring, and strong sanctioning of internal & external rule breakers.
Strong local government support for sanctioning	Strong local government support for sanctioning exists in community initiatives which successfully request help for sanctioning rulebreakers from local government agencies.

3.3.3. Data analysis and calibration

We conducted our analysis in R (QCA package in R) and kept referring to the qualitative data to see whether the outcomes made sense. This allowed us to keep nuance and consider case complexities (Schneider & Wagemann, 2012, p. 121; Wagemann, et al., 2015).

To calibrate our data, we followed the method developed by Basurto & Speer (2012), which consists of six steps and ensures transparency and replicability. We started with a preliminary list of conditions, measures, and the outcome, based on theoretical concepts and empirical knowledge of the research context. We reformulated the measures and conditions several times. The most important adjustment was related to the condition 'local government support for sanctioning', which we had initially selected as 'local government enforcement'. We decided to reformulate it as we observed that in none of our cases the local government actively conducted enforcement activities. Yet, in some cases it sanctioned rule breakers upon the request of community conservation leaders.

Before defining partial membership set scores (0, 0.33, 0.67, 1), we developed preliminary anchor points for each measure, condition, and outcome: 1 (fully in), 0.5 (cross-over point), and 0 (fully out). During data analysis, we changed a few anchor points. The calibration decisions are detailed in online Appendix A and C.

3.3.4. Truth table and logical minimization

As required for QCA, we first conducted a necessity analysis to identify conditions that are indispensable for effective conservation to take place. We then moved forward to conduct a sufficiency analysis. We created a truth table, listing paths and associated outcomes in Boolean representation (values of 0 and 1), which we used to conduct a minimization process to simplify the algebraic expression of our paths and outcomes, and determine the sufficient pathways. These pathways are 'causal recipes' that can be presented as complex or parsimonious solutions. Complex solutions are based solely on existing data, while parsimonious solutions also include paths that exist logically but have not been observed (*logical remainders*). There is much discussion as to which solution type should be used (Toshkov, 2017). As our analysis only included three conditions, we have few logical remainders, and both solutions are probably similar.

Consistency and coverage are two essential parameters of fit in QCA. Consistency is a measure of strength for the sufficiency and necessity of conditions or paths. For a perfect match, the consistency score is 1. The score decreases depending on the number of cases that contradict the assumption that a condition or path is necessary or sufficient. Coverage is an analogous measure that expresses how much of the outcome is covered by a sufficient condition or path (Schneider & Wagemann, 2012). It is somewhat comparable to R^2 in statistical models (Legewie, 2013). Online appendices A to D detail the QCA analyses.

4. Results: Pathways to effective conservation

The performances of the conservation initiatives in terms of BACI deforestation scores varied strongly. As listed in Table 3, three cases are classed as successful (*Ojos de Agua, El Arenal and La Jungla*), four cases as more successful than unsuccessful (*Jardines Ángel del Sol, Ronsoco Cocha, Amaya, Pampa del Burro and El Hocicón*), and one case as more unsuccessful than successful (*Puerto Diaz*) and three cases are unsuccessful (*Puerto Industrial, Chapís, El Biavo*).

(Quite) effective conservation initiatives in our dataset have (quite) strong community.

ownership claim (see Table 3). Our observations show that lower monitoring costs often underpin strong ownership claims

Table 3

Fuzzy set values of cases effective conservation.

Case	Legal forest ownership	Strong community enforcement	Strong local government support for sanctioning	Effective conservation
Ojos de Agua	0.67	1.00	0.67	1.00
El Arenal	0.00	1.00	0.67	1.00
La Jungla	0.00	0.67	0.67	1.00
Jardines Ángel del Sol	0.67	1.00	0.00	0.67
Ronsoco Cocha	1.00	1.00	0.33	0.67
Amaya	0.00	0.67	1.00	0.67
Pampa del Burro	1.00	0.67	0.33	0.67
El Hoción	0.00	1.00	0.00	0.67
Puerto Diaz	0.33	0.00	0.33	0.33
Industrial	1.00	0.00	0.67	0.00
Chapis	1.00	0.00	0.00	0.00
Valle del Biavo	0.67	0.33	0.67	0.00

(Dietz, et al., 2003). In almost all cases (10 out of 11) communities cleared and maintained paths around and within the conservation areas, which also served as boundaries. In *Ojos de Agua*, *Pampa del Burro* and *Jardines Ángel del Sol*, they also built guard posts or small guest houses. In addition, two effective communities (*Ojos de Agua*, *Jardines Ángel del Sol*) complicated entry by creating semi-protected forest areas adjacent to the conservation area. Monitoring takes place from the village when the borders are easily overseen, or the only access is from the village. Otherwise, communities patrol the conservation areas frequently. Regarding sanctioning, we observed that social pressure from community members is important (see also Schnegg, 2017). Sanctioning of community members only becomes more severe if violations are repeated or result in major infractions. In the case of *Jardines Ángel del Sol*, for example, when a community member breaks a conservation rule, the conservation association invites the rule breaker to participate in a meeting. As community members wish to avoid conflicts with other families, such meetings generally suffice to convince community members to improve their behavior. Rarely, when rule breaking is more serious or continuous, the conservation association involves the *ronda campesina* and the district attorney to sanction the rule breakers. Similarly, in the case of *Ronsoco Cocha*, a small community where members value good internal relationships, conservation leaders had never had to sanction a community member, even though they have approved a detailed sanctioning system.

As illustrated in the first three rows of Table 4, strong community enforcement results in effective conservation when combined with strong local government support for sanctioning (*El Arenal*, *La Jungla*, *Amaya*), legal forest ownership (*Jardines Ángel del Sol*, *Ronsoco Cocha*, *Pampa de Burro*) or both (*Ojos de Agua*). After conducting logical minimization, we found two sufficient pathways resulting in effective conservation (*complex and parsimonious solution*; *solution consistency*: 0.877; *solution coverage*: 0.702):

Eq. 3: Sufficient pathways for strong community enforcement.

- strong community enforcement * strong local government support for sanctioning => effective conservation (unique coverage: 0.301)
- strong community enforcement * legal forest ownership => effective conservation (unique coverage: 0.301)

The first pathway confirms our hypothesis that in voluntary community initiatives that also have strong community enforcement mechanisms, local government support for sanctioning contributes to effective conservation (H2). In *El Arenal*, for example, local conservation leaders struggled with a member that cleared forest for agriculture in the conservation area. Yet, they successfully motivated him to stop clearing forest, by inviting the regional environment authority to explain possible legal implications of his actions during a community general assembly meeting. In *Amaya*, on various occasions illegal fishermen and loggers from outside the community failed to respect orders of the conservation committee to leave the conservation area. Using funds provided through compulsory contributions of local fishermen, members of the multi-community conservation unit successfully requested assistance of the district judge (*juez de paz*) and facilitated his transport to the conservation area to verify the facts and detain the rule-breakers.

The second pathway reveals that conservation in voluntary initiatives that have strong local enforcement also benefit from legal forest ownership, thereby rejecting our third hypothesis (H3). In the cases where strong enforcement is present, we identified that legal forest ownership especially contributes to effective conservation (i.e., private conservation area or conservation concession) rather than general communal land ownership. In *Ojos de Agua*, for example, the gradual formalization of the conservation

Table 4

Truth table effective conservation.

Legal forest ownership	Strong community enforcement	Strong local government support for sanctioning	Effective conservation	n	Consistency*	PRI**	Cases
0	1	1	1	3	0.876	0.859	El Arenal, La Jungla, Amaya
1	1	0	1	3	0.876	0.804	Jardines Ángel del Sol, Ronsoco Cocha, Pampa de Burro
1	1	1	1	1	0.801	0.670	Ojos de Agua
0	1	0	0	1	0.751	0.668	El Hoción
0	0	0	0	1	0.496	0.330	Puerto Diaz
1	0	1	0	2	0.330	0.000	Industrial, Valle del Biavo
1	0	1	0	1	0.284	0.000	Chapis

* Raw consistency refers to the sufficiency of truth table rows. We used a raw consistency threshold of 0.8, meaning that only truth table rows with a consistency of 0.8 or higher are included in the logical minimization process, used to determine the sufficient pathways.

** PRI (Proportional Reduction in Inconsistency) is an alternative measure of consistency for fuzzy sets based on a quasi-proportional reduction in error calculation. It is lower when a condition X is sufficient for both Y and ~ Y (the negation of Y).

area over time helped the association to keep logging companies and settlers out. Among other things, the association used the local media to enforce its ownership rights and scare away invaders. In *Ronsoco Cocha*, legal ownership contributed to conservation success in a rather unexpected way. The community has had a land title since 1999 and started its conservation initiative soon after, but following local traditions, newcomers were still allocated forestland for agriculture and the conservation area kept shrinking. In 2015, however, the community officially registered *Ronsoco Cocha* as a private conservation area, which facilitated breaking with the tradition, and deforestation dropped from an average of 2.86 ha. per year to 0. While the legal land title did not contribute to conservation success, the private conservation area did.

4.1. Pathways to strong community enforcement

As our analysis revealed that strong community enforcement is a necessary condition for effective conservation, we moved forward to investigate conditions and pathways that facilitate such enforcement. Even though this information is essential for effective community forest management and conservation, the literature is largely limited to identifying that creating and maintaining strong enforcement mechanisms is challenging (Ostrom & Nagendra, 2006; Coleman & Steed, 2009). In addition, critical institutionalists highlight the crucial importance of new institutions being embedded in the cultural and social realities of the community and its members (Klooster, 2000; Cleaver & De Koning, 2015; Schnegg, 2017; Jespersen and Gallemore, 2018).

We explore three conditions we expect to be especially important for strong community enforcement: clear and legitimate rules, strong pre-existing community enforcement mechanisms, and strong leaders (see Table 5). We select these conditions as we observed their presence in several successful cases. QCA is a suitable for such more explorative research. Like in our first analysis, we apply fsQCA using the data we collected during our field visits. Similarly, we organize and calibrate our data following Basurto & Speer (2012) and scored each case as 0, 0.33, 0.67 or 1, based on its set membership. Online Appendices C and D provide details on data collection and analysis.

4.2. Clear and legitimate rules

Community conservation rules are often a mix of government-imposed and local rules. Communities tend to filter government rules, adapt them to their habits (Gibson, et al., 2005), and combine them with rules relevant to their culture and specific environment.

Table 5
Summary of conditions related to the outcome 'strong community enforcement'.

Conditions	Definition
Clear and legitimate rules	Clear and legitimate rules are present in conservation initiatives that have rules regarding agricultural fields, logging, and other extractive activities, and community members with knowledge and acceptance of these rules.
Strong pre-existing community enforcement mechanisms	Strong pre-existing enforcement mechanisms refers to cases in which communities embed the conservation enforcement in preexisting sanctioning and monitoring institutions.
Strong leaders	Strong leaders entail conservation initiatives with leaders who are embedded, inclusive, interactive, visionary, with managing skills, with succession vision, and 'persistent'.

Oftentimes clear and legitimate rules are considered a given, as without such rules it is ambiguous what to enforce. While in several cases rules were clear, well-known, and accepted, in others, rules were incomplete, or community members were unaware of them. Indeed, enabling adequate and legitimate rules is challenging and time-consuming, and not all communities succeed. Mostly when external party incentives are involved, communities risk bypassing the complex process of locally designing and accepting conservation rules, needed to give these publicity and legitimacy (Gibson et al., 2000b; Hayes, 2006).

4.3. Strong pre-existing community enforcement mechanisms

We observed that several communities embedded their conservation enforcement mechanisms in pre-existing community mechanisms, i.e. the *ronda campesina*, a general assembly with control authority, or community police. Sociological studies reveal that communities' institutional precursors and cultural history shed light on institutions that emerge for specific purposes (i.e., conservation). Waylen et al. (2010) explain how understanding and engaging existing local institutions, be it community councils or local spiritual guidance, contribute to successful conservation institutions. They also mention the improbability of generating effective community institutions, if these are not embedded in local cultural history (Paciotti & Borgerhoff, 2004; Katz, 2000). Building upon pre-existing institutions lowers the transaction costs of creating conservation enforcement mechanisms and increases their durability and flexibility needed to adapt to changing conditions (Dietz, et al., 2003; Ostrom, et al., 2002; Arts & de Koning, 2017). Largely, this is due to the important role these institutions play in the lives of community members. They are based on deep cultural and social content and meaning, but also provide a cultural and social context within which communities members think and act. They, for example motivate community members to participate and contribute to community activities, rather than free-ride (Klooster, 2000).

4.4. Strong leaders

In several case studies we also observed the presence of strong community leaders, "the most powerful and influential members in a community" (Bonjean, 1963, p. 672), who can influence people "to achieve a common goal" (Northouse, 2013, p. 5). Such leaders enhance long-term sustainability of enforcement mechanisms (Kenyon & Black, 2001; Davies, 2007). Of course, it is important that the common goals that these strong leaders put forward directly or indirectly promote forest conservation (Zinda & Zhang, 2019).

For our study, we deduct basic concepts from the literature on community leadership. Community leaders cannot depend on power and authority alone but must rely on social relationships developed through extensive interactions and align their leadership style with their social context (Ricketts, 2005). This type of leadership is sometimes called 'servant leadership' (Ricketts, 2005; Laub, 1999). Onyx and Leonard (2011) identify-seven elements of strong community leaders. (1) They are embedded in the (in)formal community networks and actively initiate projects, (2) they take decisions with other community representatives, (3) they interact with community members and outsiders to fill knowledge, skills and material gaps, (4), they are visionary and inspire to follow their vision and the path for achieving it, (5) they know management systems and processes well, (6) they engage in succession to ensure the project continues when original leaders leave, and (7) they have commitment, persistence and energy, which enables them to overcome resistance.

4.5. Hypotheses and operationalization of conditions

We formulate the following hypotheses, for which the scoring systems and scores for all conditions and related measures are detailed in online [Appendix C](#).

H4: Clear and legitimate rules contribute to strong community conservation enforcement mechanisms.

Clear and legitimate rules are present in conservation initiatives that have 'rules' and community members with 'knowledge' and 'acceptance' of these. The measure 'rules' is composed of rules regarding 'agricultural fields', 'logging', and 'other extractive' activities. We define the raw QCA score using the formula:

Eq. 4: Clear and legitimate rules score.

Clear and legitimate rules score = $\text{score}((\text{rules on agricultural fields} + \text{rules on logging} + \text{rules on other extractive})/3 + \text{knowledge of rules} + \text{acceptance of rules})/3$.

H5: Strong pre-existing enforcement mechanisms contribute to strong community conservation enforcement mechanisms.

'Strong pre-existing enforcement mechanisms' refers to cases in which communities embed the conservation enforcement in pre-existing 'sanctioning' and 'monitoring' institutions. We define the raw QCA score using the formula:

Eq. 5: Strong pre-existing enforcement mechanisms score.

Strong pre-existing enforcement mechanisms score = $\text{score}(\text{pre-existing sanctioning mechanisms} + \text{pre-existing monitoring mechanisms})/2$.

H6: Strong leaders contribute to strong community conservation enforcement mechanisms.

Strong leaders entail conservation initiatives with leaders who are 'embedded', 'inclusive', 'interactive', 'visionary', 'with managing skills', 'with succession vision', and 'persistent'.

Eq. 6: Strong leaders score.

Strong leaders score = $\text{score}(\text{embedded} + \text{inclusive} + \text{interactive} + \text{visionary} + \text{with management skills} + \text{with succession vision} + \text{persistent})/7$.

4.6. Results

As listed in [Table 6](#), five cases are characterized by strong community enforcement, three cases by quite strong enforcement, one case by quite weak enforcement and three cases by weak enforcement. We do not identify any necessary conditions. Yet, logical minimization of the truth table data shown in [Table 7](#) revealed that clear and legitimate rules are crucially important for strong community enforcement (consistency: 0.890). As illustrated in [Table 6](#), all cases with (quite) strong community enforcement have (quite) clear and legitimate rules in place. *Valle del Biavo* is however a contradictory case. It has quite weak enforcement even though it has quite clear and legitimate rules. This could be because the conservation initiative has only existed for two years. We observed that

in cases with longer existence that deforestation incidents tend to continue in the first years and diminish over time.

The QCA analysis, as detailed in online [Appendix D](#), confirms all three our hypotheses, as it identifies that the presence of the combination of clear and legitimate rules, strong preexisting enforcement mechanisms, and strong leaders is sufficient for strong conservation enforcement to occur (solution consistency: 0.890; solution coverage: 0.364). The three cases in the first row of the truth table ([Table 7](#)) indeed combine all three conditions (*Ronsoco Cocha*, *Jardines Ángel de Sol* and *Amaya*).

5. Discussion

Our analyses identify that a strong community enforcement mechanism is necessary for effective conservation in voluntary community initiatives. This is similar to [Chhatre and Agrawal \(2008, p. 13286\)](#), who observe that "higher levels of local enforcement have a strong and positive but complex relationship to the probability of forest regeneration". It is also compatible with [Nepstad et al. \(2006, p. 70\)](#) who find that indigenous communities with low deforestation rates, located in agricultural frontiers, are characterized by their practice of enforcing legal conservation restrictions. Strong community enforcement mechanisms tend to be present in communities that have clear and legitimate conservation rules, strong preexisting community enforcement institutions and strong conservation leaders. Of the three conditions that together enable strong community enforcement, clear and legitimate conservation rules is most important. This is in line with [Gibson et al. \(2000a, p. 22\)](#) who argue that "successful enforcement at the local level partially depends on individuals who generally agree on what rules they should follow (and hopefully, why they have been adopted). Without this agreement, there is less incentive to comply with rules".

Regarding pre-existing community enforcement institutions, we observe that communities that embedded their conservation enforcement mechanism within pre-existing community institutions could build upon their legitimacy and flexibility. However, in communities with strong sanctioning precursors but without monitoring precursors, conservation enforcement mechanisms are generally weak (for details, see [Appendix A](#) tables A.10, A.11 and A.12). We observed this especially for three indigenous forest communities located in the peatlands in the Loreto department (*Puerto Diaz*, *Puerto Industrial*, *Chapís*), which have strong traditional sanctioning institutions, but lack institutions to monitor their extensive peatlands; probably because this requires important resources: boats, gasoline, and lots of time. This is in line with the findings of [Coleman \(2009\)](#) that no sanctioning takes place in communities that do not monitor, as rule breakers are not caught. When it comes to strong leaders, we find that these contribute to conservation enforcement mechanisms with vision, inspiration,

Table 6

Fuzzy set values of cases strong community enforcement.

Case	Clear and legitimate rules	Strong pre-existing enforcement mechanisms	Strong leaders	Strong community enforcement
Ojos de Agua	0.67	0.00	0.67	1.00
El Arenal	0.67	1.00	0.00	1.00
Jungla de los Monos	0.67	0.33	0.33	0.67
Jardines Ángel del Sol	0.67	0.67	1.00	1.00
Ronsoco Cocha	1.00	1.00	1.00	1.00
Amaya	1.00	0.67	0.67	0.67
Pampa del Burro	1.00	0.67	0.00	0.67
El Hoción	0.67	1.00	0.00	1.00
Puerto Diaz	0.33	0.67	0.67	0.00
Industrial	0.33	0.67	0.00	0.00
Chapís	0.33	0.67	0.00	0.00
Valle del Biavo	0.67	0.00	0.67	0.33

Table 7
Truth table strong community enforcement.

Clear and legitimate rules	Strong pre-existing enforcement mechanisms	Strong leaders	Strong community enforcement	n	Consistency*	PRI	Cases
1	1	1	1	3	0.890	0.859	Jardines Ángel del Sol, Ronsoco Cocha, Amaya
1	0	1	0	2	0.748	0.599	Ojos de Agua, <i>Valle del Biavo</i>
1	1	0	0	3	0.730	0.629	El Arenal, Pampa del Burro, El Hoción
1	0	0	0	1	0.668	0.404	Jungla de los Monos
0	1	1	0	1	0.496	0.330	Puerto Diaz
0	1	0	0	2	0.372	0.283	Industrial, Chapís

*Raw consistency threshold: 0.8.

persistence, and energy. In some cases, they also possess communication and fundraising skills (Onyx & Leonard, 2011), teach community members, and make personal sacrifices to advance conservation.

We found that in addition to a necessary condition, a strong conservation enforcement mechanism is a sufficient condition for effective conservation when combined with legal forest ownership or with strong local government support for sanctioning. In communities with strong enforcement mechanisms, legal forest ownership mostly contributes to conservation success when it is specifically related to conservation, i.e., a conservation concession or private conservation area, rather than a general land title. Similarly, in communities with strong enforcement mechanisms, strong local government support for sanctioning contributes to effective conservation independent of legal property rights. In some communities, enforcement institutions are strong but still struggle to sanction community members because of strong social ties between families. In others, external rule breakers fail to respect the authority of community institutions. In both cases, sanctioning-related assistance of an external actor is a practical alternative (see examples in §4). While there is ample research on the role of government institutions in local forest management (Coleman & Steed, 2009; Gibson et al., 2000a; Andersson, 2004; Dietz, et al., 2003), the idea of communities requesting and receiving local government assistance just for situations they feel they cannot handle alone is new.

Our research has some limitations. First, we use deforestation as a proxy for effective conservation. We do not look at biodiversity, or forest condition, as we lacked the means to get those data. Nor do we consider social outcomes. Yet, an advantage of evaluating only deforestation is that the criteria for effective conservation are rather straightforward, and thus comparable across cases. Second, we only take single moment time shots for each case. Gathering long-term data would facilitate a deeper understanding of necessary and sufficient conditions and pathways. Third, our sample is small ($n = 12$), which limits the external validity of our findings. Our internal validity, however, is high, as is usually the case with fsQCA analysis, especially as we triangulated our data and constantly went back and forth between statistics and empirical observations.

6. Conclusion and policy implications

While the interest of policymakers in community forest management and conservation in tropical forests keeps growing, a large body of research shows varied levels of success of such initiatives. When designing and implementing community forest management and conservation projects, governments and development agencies often prioritize legal ownership rights over the forest, as they consider these indispensable for effective conservation. Yet, there is consensus among many scholars that conservation effective-

ness depends rather on a broader set of local institutional arrangements, and their fit with the biophysical, ecological, and social-political context of the forest. In this paper we analyze how two institutional arrangements, tenure and local enforcement, interact within different contexts of community forests, and how this interaction impacted on conservation effectiveness. We studied 12 voluntary conservation initiatives in northern Peru. The communities that implement these initiatives have a real motivation to protect their forests, mostly as they rely on their ecosystem services. Each of them has put unique institutional conservation arrangements in place, each based on and adapted to their specific forest and social context and based on the community's history and culture. Conservation effectiveness, however, differs between the communities. Our study identified the components that impact conservation success and the ways in which they conjoin to assist (or impede) effective conservation.

Our qualitative comparative analysis shows that robust community mechanisms to enforce conservation rules are a prerequisite effective conservation. Additionally, some government back-up, in the form of local government support for enforcement and/or legal rights to the forest, significantly increases the likelihood of success in communities with strong enforcement mechanisms. Interestingly, the sources of legal property rights and local government support were different in all cases and many times unexpected. When it comes to creating and maintaining strong conservation enforcement mechanisms, clear conservation rules that community members know and accept are essential. Furthermore, the possibility to embed the conservation mechanism in prospering existing community institutions and the presence of community leaders with characteristics such as persistence, inclusiveness, and vision, facilitate strong community conservation enforcement. Additional quantitative and qualitative (longitudinal) follow-up research could further increase the external validity of our findings on each of the relevant conditions and paths and contribute to the effectiveness of conservation and forest management projects.

Our results suggest the importance of playing close attention to community characteristics during project design and refraining from one-size-fits-all solutions, such as focusing mainly on legal property rights over the forest. Instead, more focus needs to be placed on understanding why communities manage, or fail to manage, their forests and natural resources, as well as on the composition, history, and logic of existing community enforcement and management mechanisms of all kinds. Any strong preexisting community institution can be an important basis for conservation enforcement, as it is likely to be deeply embedded in the community members' culture and social structures and contribute to how they think and act. As such, it can play a key role motivating community members to collaborate to conserve their forests. As community institutions come in many forms and shapes and are both defined by and define the culture in the community, understanding their characteristics, logic, strengths, and weaknesses is not an easy

endeavor for outsiders and requires time, effort, and an open mind. Therefore, our results also suggest that policymakers and implementing agencies should support communities to come up with and/or strengthen and adapt their own unique monitoring and sanctioning mechanisms that fit well with their forest and social context, rather than imposing standardized training programs and predesigned management and enforcement infrastructure or elements thereof. To help policymakers in doing so, there is also a need in future academic research to do further nuanced analysis of institutional variation. Finally, strong enforcement mechanisms should be at the forefront of any support to communities. Policymakers can also help communities to obtain legal rights over the forests they conserve and promote strengthening the relationship between communities and local government agencies, as well as the capacity of the local government. This way, communities can rely on local government support in situations they struggle to handle alone.

CRediT authorship contribution statement

Marieke van der Zon: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Wil de Jong:** Writing – review & editing, Supervision. **Bas Arts:** Writing – review & editing, Supervision.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.worlddev.2022.106071>.

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