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Analysis

An institutional analysis of Payment for Environmental Services on collectively managed lands in Ecuador

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ABSTRACT

The application of Payment for Environmental Services (PES) programs on communal lands raises questions about how PES interacts with collective resource management institutions. We explore how an Ecuadorian payment program is associated with the development of rules to manage shared grazing lands. In addition, we assess the communal characteristics that make it more likely that a participant community will change their land-use rules. Our analysis draws from an almost complete census of participant communities in the Ecuadorian highlands (n = 44), a survey of non-participant communities (n = 23) and a household questionnaire (n = 420). We find that the majority of participant communities have strengthened their land-use rules since program participation. Communities that craft new rules and apply their rules are more likely to be organized and have internal monitoring and enforcement mechanisms. Poorer communities are also more likely to have made a rule change in response to participation; wealthier communities are more likely to maintain existent land-use institutions. We find no association between rule change and level of payment. Our results highlight the need to disaggregate the role of payments and contract commitment and to further analyze how community characteristics may influence the effectiveness and equity of PES in communal contexts.

1. Introduction

The recent growth of Payment for Environmental Services (PES) programs prompts PES scholars and practitioners to contend with how PES fits as a conservation tool in impoverished communities, many of whom collectively manage their resource systems (Clements et al., 2010; Engel et al., 2008; Fisher and Christopher, 2007; Muradian et al., 2013; Sommerville et al., 2010a). The traditional PES model is often defined as a market-based tool for conservation in which a buyer pays an individual landowner to provide a specified environmental service or activity (Wunder, 2005). When implemented in developing countries, however, PES programs frequently deviate in two important ways.

First, PES is increasingly applied on communal lands where communities share rights (de facto or de jure) to use and manage their common-pool resource systems (Kerr et al., 2014; Sommerville et al., 2010a). Unlike the traditional PES model in which a buyer pays an individual landowner, payments are made to a communal governing body that must transmit the desired behavioral changes to the rest of the community. Second, many PES programs are funded by donors or governments that often stray from using PES as a market-based tool to efficiently conserve key environmental services, and rather, seek to use PES as a 'win–win' policy tool to support poverty alleviation and conservation (Engel et al., 2008; Grieg-Gran et al., 2005; Muradian et al., 2013; Muradian et al., 2010; Wunder, 2013).

The application of PES to communal management systems, particularly in the context of conservation and poverty alleviation, raises a number of concerns (Kerr et al., 2014; Pascual et al., 2014; Wunder, 2013). First, the success of PES on communal lands depends on the ability of communities to translate PES conservation goals into collective resource management rules that, in turn, produce additional environmental benefits (Kerr et al., 2014; Kosoy et al., 2008; Muradian et al., 2010; Sommerville et al., 2010b). A substantial body of research has demonstrated that communities can devise rules to sustainably manage their resources (Andersson et al., 2014; Berkes and Turner, 2006; Dietz et al., 2003; Gibson et al., 2000; Ostrom, 1990; Persha et al., 2011), however, the capacity of PES programs to support collective action for rule creation is poorly understood (Clements et al., 2010; Dougill et al., 2012; Kerr et al., 2014; Kosoy et al., 2008; Muradian, 2013). Critical concerns include the degree to which communities crafted rules prior to participation (Bremer et al., 2014a; Kosoy et al., 2008), whether payments thwart intrinsic motivations to collectively manage a resource (Kerr et al.,

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2014; Rodríguez de Francisco et al., 2013; Vatn, 2010; Vollan, 2008), and the potential of PES to strengthen local management systems, thereby providing additional environmental benefits via institutions for sustained resource management (Bremer et al., 2014b; Kerr et al., 2014; Muradian, 2013; Narloch et al., 2012; Rodríguez de Francisco et al., 2013; Vatn, 2010; Vollan, 2008; Wunder, 2013).

Second, the inclusion of poverty alleviation as a goal for PES programs raises concerns about whether payments will be used to produce additional conservation benefits. Some scholars worry that if PES is a means to alleviate poverty, payments may be used to distribute financial resources to the poor and *reward* impoverished communities for existing conservation efforts rather than *incentivize* behavioral changes to produce conservation outcomes that would not otherwise be achieved (Engel et al., 2008; Muradian and Rival, 2012; Pattanayak et al., 2010; Wunder, 2013; Wunder et al., 2008). In the context of communal resource management, this suggests that poorer communities that have already crafted resource restrictions may receive payment as a means of distributing economic benefits irrespective of whether they make rule and behavioral changes to provide additional environmental services.

Finally, the application of PES on communal lands in the context of poverty alleviation raises questions about the relationship between equity and additionality (Pascual et al., 2010). Although PES payments have the potential to reward impoverished individuals for existent conservation practices, previous studies suggest that in fact, poorer communities and individuals often make the greatest behavioral changes, although they do not necessarily receive any greater compensation (Pascual et al., 2014; Rico Garcia-Amado et al., 2011; Sommerville et al., 2010a). Questions regarding distributional equity are particularly important in communal land systems where differences in costs and benefits derived from participation may emerge not only between communities, but also within communities as individuals will differ in the livelihood losses incurred from new resource-use restrictions (Corbera et al., 2007a; Rico Garcia-Amado et al., 2011; Sommerville et al., 2010a).

Few empirical studies have specifically examined the relationship between participation in PES and the development of communal resource management institutions (Dougill et al., 2012; Kerr et al., 2014; Kosoy et al., 2008; Muradian et al., 2013). Here, we tackle a piece of the abovementioned questions in an exploratory study that examines how participation in an Ecuadorian payment for conservation program, Programa Socio Bosque (PSB), is associated with communal resource management. Specifically, we examine (*i*) the presence of communal land-use rules and assess the degree to which PES participation, particularly PES payment, corresponds with the development of these rules; (*ii*) the characteristics of the communities that are making rule changes to produce additional conservation benefits as compared to those that are paid to maintain the status quo; and (*iii*) the application of the rule systems.

Our analysis is based on a survey of all highland communities that were participating in the Ecuadorian payment program as of May 2013 (n = 44). In this survey we asked community representatives to discuss the ways in which the community had changed its resource management institutions in response to participation. A survey of non-participating communities from the same region (n = 23) illustrates the factors associated with the presence of restrictive land-use rules irrespective of participation in PSB. Finally, we interviewed households (n = 420) in twelve communities to further examine the degree to which participants perceive that the rules are applied in practice. We want to caution the reader not to interpret the results as causal, as we do not have an experimental setting where participant and non-participant communities were randomly selected and our results are limited to one period in time. The observational findings, nonetheless, highlight the potential of PES to strengthen rule development, and the need to further support rule application and assess critical equity considerations.

2. Context

2.1. Study Region

The study communities are located in the Ecuadorian Andes, a South American mountain range that runs north–south through the center of Ecuador (see Fig. 1). It is a densely populated region, where some of the poorest communities in Ecuador live alongside ecologically valuable high-montane forests and páramo systems (Bremer et al., 2014b; Buytaert et al., 2006). Páramo, a high-elevation ecosystem of grasslands and shrubs (at about 3500 m), provide critical ecosystem services, namely water provision and carbon storage in the soils (Farley et al., 2004, 2011; Madriñan et al., 2013). In many Andean countries, páramo systems provide water to the region's growing highland cities (Buytaert and De Bièvre, 2012). In Ecuador, over 3 million people directly benefit from the páramo's water supply (Crespo et al., 2010).

As in much of the northern Andes, in Ecuador, the páramo is threatened by grazing, agriculture, afforestation, urbanization, and climate change (Buytaert et al., 2006; Crespo et al., 2010; Madriñan et al., 2013). With the exception of a ban on burning, very few national laws explicitly dictate what activities are prohibited in the páramo. Rather, conservation laws largely consist of general stipulations to protect fragile ecosystems and biodiversity, many of which are weakly enforced (Echeverría and Suárez, 2013; Esty and Porter, 2001; Morales and Rivadeneira, 2011).

In the study region, indigenous and *mestizo* communities (of mixed Spanish and indigenous descent) continue to use the páramo for subsistence and semi-subsistence activities: potato production, and grazing of sheep and cattle (Buytaert et al., 2006). The communities in this study maintain communal rights (de facto and de jure) to their lands and have a history of collectively managing the páramo (Mosquera, 2010). By law, each community is governed by an elected "executive body", which consists of a President, Vice President, Secretary, Treasurer and two outstanding board members. The executive body is responsible for working with the community to make budgetary decisions, organize community assembly meetings and *mingas* (work parties), make rules to manage the communal lands, and mediate conflicts. The executive body is also responsible for seeking external support from governmental and non-governmental agencies and represents the community in all external relations (Korovkin, 2002).

2.2. Programa Socio Bosque (PSB)

In 2008, the Ecuadorian government instated PSB with the dual goals of preventing the destruction and degradation of native ecosystems, and increasing income and human capital in the poorest communities of Ecuador (De Koning et al., 2011). Similar to many PES projects in the developing tropics, in PSB, the government (the buyer) provides an economic incentive to poor farmers and communities who voluntarily enter into conservation contracts in which they agree to conserve native ecosystems in return for direct payments depending on the number of hectares conserved.[1] The program is not directly linked to a market and the payments are intended to act as an incentive or compensation for conservation behaviors; the payments are not based on calculated opportunity costs (De Koning et al., 2011). The program works with both individuals and communities, however, 88% of the conservation lands are under community contracts (MAE, 2012).

In July 2009, PSB designated a sector of the program to address the conservation of high montane ecosystems, specifically focusing on the páramo (Programa Socio Páramo). To ensure the dual goals of conservation and poverty alleviation, PSB targets páramo that (i) is threatened, (ii) provides valuable environmental services such as regulation of

[1] It is important to note that the Ecuadorian government does not recognize Programa Socio Bosque as a PES program, however, the conditions coincide with what is generally considered PES.

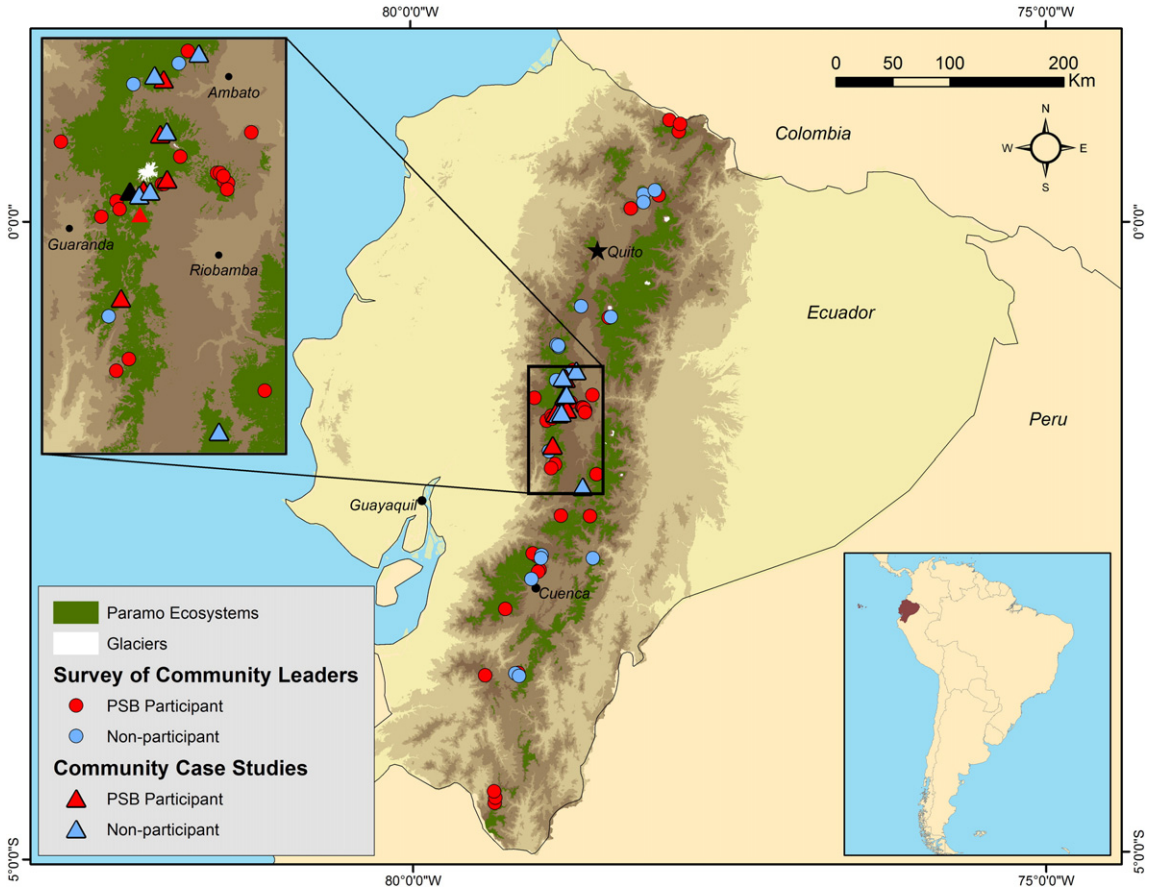

Fig. 1. Map of study area.

hydrological systems, carbon storage, and biodiversity; and (iii) is located in the poorest regions (MAE, 2009). As of February, 2013, PSB had signed 47 contracts with highland communities, encompassing approximately 42,000 ha of land and benefiting 15,000 households.

Participation in PSB is voluntary and communities decide collectively whether to participate. In signing the PSB contract, communities agree not to burn, hunt, practice agriculture, or introduce non-native species or any activities that may impact the conservation value of the designated area. In addition, communities agree to limit grazing in the páramo to less than semi-intensive levels, although no formal guidelines are given as to what constitutes semi-intensive levels (MAE, 2009).

Contracts are for twenty years and payments are made twice a year. Failure to comply with the land-use restrictions may result in a suspension of the payments and the application of penalties. Communities are responsible for crafting appropriate management rules and transmitting these rules to all constituents. PSB is responsible for overseeing compliance; communities are responsible for reporting any transgressions to PSB.

3. Methods

3.1. Conceptual Framework to Assess Institutional Change

Our analysis focuses on institutional arrangements to manage grazing, specifically examining rule creation, monitoring, and enforcement (Andersson et al., 2014; Crawford and Ostrom, 1995; Ostrom, 1990, 2005). Grazing is a principal threat to páramo in the region (Podwojewski et al., 2002), and an area where PSB communities have the greatest leeway to develop their own restrictions.

Fig. 2 illustrates the three institutional components in our analysis, and highlights the areas where collective action may create or strengthen local resource management systems. First, a community may create a new rule, or increase the restrictiveness of a present rule. For example, some communities may completely forbid grazing, whereas others may

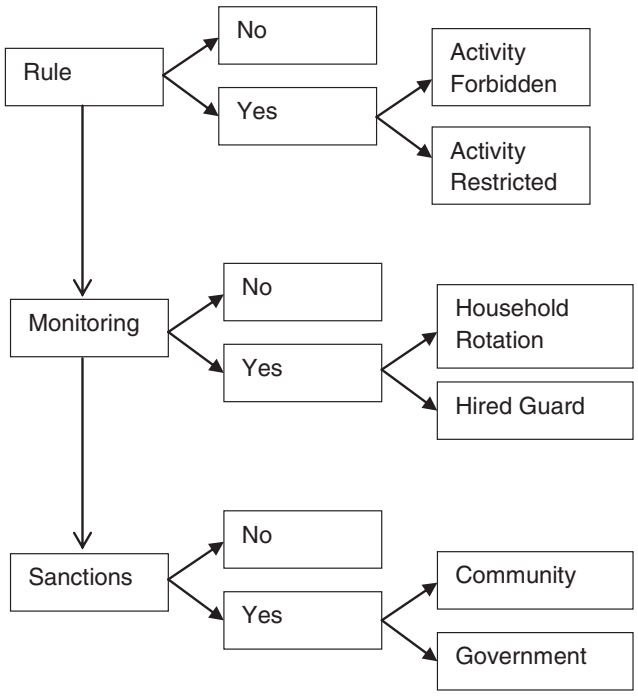

Fig. 2. Governance institutions and potential for institutional change.

restrict grazing by limiting the number of animals a household may have in the páramo, or designating specific areas for grazing. Designating a rule, however, does not necessarily indicate that the rule is recognized and applied (Ostrom, 1990). To apply a new or existing rule, a community may strengthen its organizational capacity to monitor its land-use rules. In our study, we asked whether the community had an organized system to monitor compliance with páramo rules. In those communities that were organized, some monitored via a rotation of community households, others hired a local to work as a forest guard. And, finally, to enforce land-use rules, a community may create its own sanctioning mechanisms or rely on external sanctioning mechanisms.

3.2. Data Gathering

3.2.1. Survey of PSB Participant Communities and Non-participant Communities

The principal source of data for this analysis is a questionnaire administered to community leaders in PSB communities in the Ecuadorian highlands (see Fig. 1). The sample is almost a complete census of all highland communities participating in the program as we surveyed 44 of the 47 communities participating in PSB as of February 2013. We were unable to locate contact information, or access three of the participating communities.

In each community, two representatives, hereafter referred to as 'leaders', were administered a questionnaire. Leaders were former and/or current members of the community's executive board and were selected based on their participation in the original decision to join PSB, their current position as a member of the executive governing body, and their ability to speak to questions regarding the general community characteristics and the decision to participate in PSB. On average, leaders had six years of experience on the executive body.

In addition to the survey of PSB participant communities, we also administered the questionnaire to leaders from highland communities that could potentially participate in PSB, but had not entered the program. Non-participant communities are not intended to act as a control due to inherent selection bias in the voluntary decision to join PSB. Rather, the communities help illustrate the factors associated with the presence of land-use rules across highland communities.

The non-participant communities all held collective páramo in the regions that PSB was targeting, had heard of PSB, but had not entered the program. We created a list of non-participant communities by talking with PSB extension agents and participating communities, obtaining lists of communities from the municipal offices of the target regions, and physically surveying communities in the target regions. In total we interviewed representatives from 23 of the 28 non-participant communities that we identified.

The questionnaire administered to participant and non-participant communities included closed- and open-ended questions that asked about current land-use practices and land-use rules, community decision-making processes, rule and behavioral changes in response to participation in PSB, and other biophysical, socio-economic and demographic information often associated with the presence of collective resource management rules (Ostrom, 2009; Ostrom and Cox, 2010).

Grazing rules were identified by questions about the different land-uses currently in the páramo, and the activities that are permitted, prohibited, and restricted. To understand how PSB influenced institutional development, leaders from participant communities were explicitly asked how grazing rules had changed as a result of participating in PSB, whether the community had changed their monitoring mechanisms, and the changes made by community members due to program participation. Respondents were also asked about how they monitored the rules, challenges in compliance, and if and how sanctions were applied for non-compliance. We created an index for community organization based on the number of community assemblies held per year, the number of mingas per year, and if there are monetary sanctions for members that don't attend assembly meetings (Schmitt, 2010). On average, communities held 10 assembly meetings and 19 mingas per year. For further description of the measurement of each variable, please see Appendix A.

3.2.2. Community Case Studies

To assess how community members perceived the rules, we conducted twelve community case studies (six participant and six non-participant communities). The participant communities had received at least three payments from PSB. The non-participant communities were selected from a set of communities that were in discussions with extension agents to enter PSB and were expected to enter within approximately the next year. The non-participant communities shared similar population, páramo size and biophysical characteristics with the participant communities. All case study communities were located in the central Andean region (see Fig. 1). All were indigenous communities whose livelihoods came principally from agriculture and grazing, and who had been using the páramo prior to the year 2000.

In each case study community, we administered a household survey to 30–50 households in each community for a total of 420 survey responses (a 4% margin of error at 95% confidence level). Houses in highland communities are often dispersed; different clusters are located higher up the mountain and others closer to the community center. Households were selected based upon a sampling process that stratified houses according to their proximity to the páramo. Within each cluster of houses, a relative percent was randomly selected to be interviewed. The male or female head of household was asked to respond to the questionnaire. The questionnaire asked about participation in community governance activities, land-use practices, and for those participating communities, their knowledge and perceptions of the impact of the program. For the purposes of this paper, the household survey supports our analysis of the application of páramo management rules in PSB and non-participant communities.

3.3. Analysis

Our results are divided into three sections. First, we present the characteristics of the participant and non-participant communities and the factors associated with the presence of restrictive grazing rules across all communities. We use bivariate analyses (Student t-test and chi square test of independence) to test for significant differences between the communities, and to examine the association of restrictions with PSB in addition to other factors that are commonly considered to influence the presence of conservation rules (see Appendix A).

The second part of the analysis uses the sub-sample of only those communities participating in PSB to examine rule creation within PSB. To identify who is receiving payment as an incentive to change land-uses versus those who receive the payment for existing practices, we use bivariate analyses to compare communities that stated that they made a change to their grazing rules as a result of participation to those that did not make changes.

The final section of the analysis examines how participation in PSB has contributed to monitoring and enforcement mechanisms. We draw on leader interview data from the 67 communities of participants and non-participants to compare monitoring mechanisms and the ability to control activities on the páramo. Household survey data from the twelve case studies demonstrates whether community members consider it likely that a rule-breaker will be caught, and if a community member knows of a rule-breaker that was caught in the previous year. We use chi-square tests of independence to compare enforcement activities across the case study communities to test for association between perceived application of the rules and the respective monitoring and sanctioning systems.

Table 1
Characteristics of PSB participant and non-participant communities.

	PSB participant communities (n = 44)			Non-participant communities (n = 23)		
	Median	Mean	SD	Median	Mean	SD
Indigenous (1 = indigenous)**	1	.52	.51	1	.78	.42
Off-farm income (1 = off-farm)	.5	.5	.5	1	.57	.5
Community size (# of households)	120	365	714	105	462	941
Organization index*	.06	.13	1.12	−.39	−.27	.63
Wealth index	.2	.05	.93	.13	−.09	1.14
Distance to páramo (min. walking)	120	111	88	105	125	144
Páramo size (ha)	555	1596	2932	990	1443	1605
Population density (households/ha)	.13	1.25	2.92	.289	.666	1.2
PSB annual payment (US$)	$11,396	$15,697	$12,752	*n/a*	*n/a*	*n/a*

* $p \le 0.1$.
** $p \le 0.05$.

3.4. Study Limitations

We recognize several limitations in this exploratory study. First, differences between participant and non-participant communities and the potential for endogeneity between the presence of rules and participation in PSB prohibit the use of regression models to assess the impact of PSB. We can only test for association. Second, the relatively small number of participant communities in the highlands limits the use of more sophisticated logistic regression analysis to assess change within participant communities. Finally, the use of leader and household responses to identify rules, rule change and rule application is limited. Future analyses are needed to look at actual behaviors and examine rule and behavioral change over time in a panel setting, preferably in a randomized treatment-control experiment, as communities self-select into voluntary PES.

4. Results

4.1. Presence of Rules to Restrict Use of the Páramo

Table 1 compares the basic characteristics of our sample of PSB participants and non-participants, and highlights key differences between the communities. Non-participant communities are significantly more likely to be indigenous ($\chi^2 = 4.296$, $p = 0.038$, $n = 67$) and are less likely to be organized than participant communities ($t = -0.179$, $p = 0.078$, $n = 63$). Although not statistically significant, non-participant communities also tend to have larger páramos as indicated by the median páramo value.[2]

With respect to land-use rules, all communities recognized at least one rule for the páramo. The majority of the communities crafted rules within the last 10 years, often with help from governmental and non-governmental agencies. Seventy-three percent of participant communities and 71% of non-participant communities stated that external organizations had helped in the development of their rules. This help was divided evenly between governmental and non-governmental organizations. The rule systems, however, varied in the degree to which they restricted activities on the páramo.

In particular, the degree to which communities restricted grazing varied greatly. While 15% of the communities did not have any grazing rules, 42% had some restrictions, limiting where grazing could take place or the quantity of animals allowed, while 43% completely forbid grazing on páramo lands.

Fig. 3 illustrates the distribution of grazing rules in participant and non-participant communities. Table 2 shows the community-level factors associated with the presence of community rules that prohibit grazing as compared to those that permit grazing (have no rules or only some restrictions). While those participating in PSB are more likely to forbid grazing, the prohibition of grazing is associated with several other community-level factors. Specifically, mestizo communities, wealthier communities, and those with smaller páramos and higher population densities are more likely to prohibit grazing.

4.2. Rewards Versus Incentives: Rule Change Within PSB Communities

To tease out the degree to which PSB influences the development of rules, we examine stated rule change in PSB communities. Of the 44 participant communities, 27% reported that PSB helped to craft their initial set of rules (i.e., that they had no rules prior to PSB), and in total, 65% of participant communities stated that they created or modified at least one páramo use rule after deciding to participate in PSB.

Fig. 4 shows the grazing rules in PSB communities. The black portions of each bar indicate the number of participant communities that stated that they created the rule as a result of participating in PSB, whereas the gray portions are the number of communities that had created their grazing restrictions prior to participation.

In total, 55% of the participants stated that they changed a grazing rule by either reducing the overall number of animals allowed in the páramo or completely prohibiting grazing. Of those communities that had some grazing restrictions, 75% stated that they made rule changes as a result of participating in PSB. Of those that now forbid grazing,

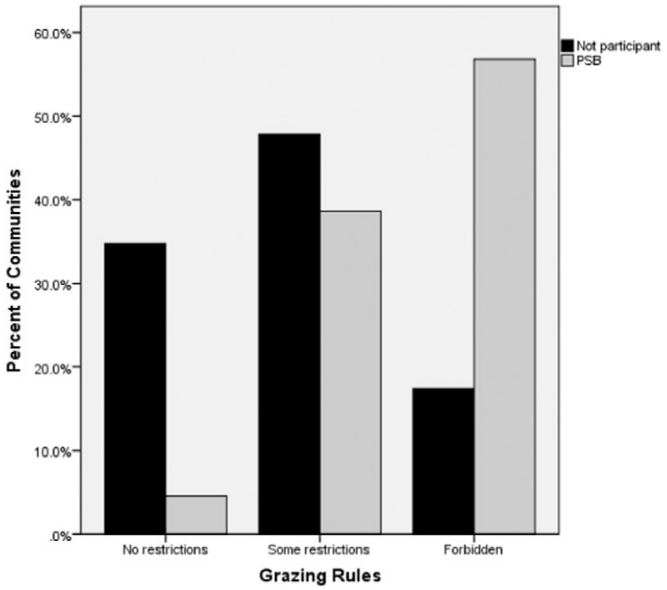

Fig. 3. Grazing rules in PSB and non-participant communities.

[2] Both community size and páramo size have wide ranges. To account for this, we ran t-tests by taking the log of each and ran t-tests after excluding outliers. In neither case were the differences between participant and non-participant communities significant.

Table 2
Factors associated with the prohibition of grazing.

Variables	Grazing permitted		Grazing forbidden		Test value	N
	Mean	SD	Mean	SD		
PSB (1 = participant)	0.5	0.507	0.86	0.351	$\chi^2 = 10.676^{***}$	65
Indigenous (1 = indigenous)	0.71	0.46	0.48	0.509	$\chi^2 = 3.59^{*}$	67
Off-farm income (1 = off-farm)	0.56	0.504	0.48	0.509	$\chi^2 = .341$	65
Community size (# of households)	361	834	359	628	t = .007	67
Organization index	0.061	1.1	−0.077	0.879	t = .542	63
Wealth index	−0.276	1.1	0.345	0.754	$t = -2.657^{***}$	63
Distance to páramo (min. walking)	114	117	119	101	t = −.193	66
Páramo size (ha)	2317	3179	659	713	$t = 2.996^{***}$	64
Population Density (households/ha)	0.505	1.06	1.75	3.48	$t = -1.859^{*}$	64

* p ≤ 0.1.
*** p ≤ 0.01.

44% stated that the rule resulted from participation in PSB. Two communities did not make any changes to their grazing rules and stated that they had no restrictions on grazing. One community stated that grazing restrictions were not needed as no one used the páramo for grazing. The other community stated that grazing was still permitted and that several families used the páramo to graze their cattle.

Table 3 compares the characteristics of communities that changed their grazing rules (either creating a new restriction or completely forbidding grazing) as a result of participating in PSB to those communities that did not change rules to participate in PSB. It also compares the average amount of incentive received by the two groups.

The results indicate no significant relationship between average amount of yearly payment and whether a community changed their grazing rules to participate. Although, on average, those that made a rule change received a larger payment, further analysis of the payments indicate that those communities that changed grazing rules to include only some restrictions received, on average, twice as much as those that crafted new rules to completely prohibit grazing ($22,232 as compared to $10,462). As shown in Table 3, communities that change their grazing rules after entering PSB are significantly more likely to be organized and are relatively poorer than communities that do not change rules in response to PSB. Those that change their rules also tend to have larger páramos.[3]

Results from the leader survey also indicate that residents of poorer and indigenous communities are more likely to change their individual land-use behaviors as a result of the new rules (r = −0.271, p = 0.086, n = 41; t = 2.429, p = 0.023, n = 43). Indigenous leaders reported that, on average 24% of the households in their respective communities had to change their land-use practices, namely grazing activities, in response to the new land-use rules. This is compared to an average of 3% for mestizo communities.

4.3. PSB & Rule Application: Monitoring & Enforcement

Findings indicate that the creation of rules is not necessarily linked to strengthened application. PSB participant communities are more likely to have an organized system for monitoring páramo use, although this difference is not statistically significant. Of the PSB communities, 61% had an organized system for monitoring compared to 38% of non-participants. Nine (21%) PSB communities explicitly decided to hire a local guard to monitor the páramo after signing the PSB contract.

Leaders in participant and non-participant communities frequently discussed the difficulties of controlling páramo use irrespective of the monitoring system in place. In 48% of the PSB communities and 57% of the non-participant communities, leaders stated that it was difficult to ensure that community members complied with the páramo rules. Of the 24 PSB communities that forbid grazing, in 6 communities (24%), leaders stated that several households still used the páramo for grazing.

Weak rule application is further supported by results from the household surveys administered in the twelve case study communities. In PSB communities, 72% of the households stated that PSB helped to clarify the community land-use rules, however, only 17% of the respondents stated that participation in PSB strengthened the application of the rules (n = 188). Furthermore, results from participant and non-participant households found that only 34% of households across all communities thought that a rule-breaker would be caught, and 20% of households knew of someone who had been caught in the past year. There was no association between PSB participants and perceived likelihood of being caught ($\chi^2 = 1.816$, p = .178, n = 418), or if someone was caught last year ($\chi^2 = .134$, p = .714, n = 419).

Recognizing the limits of a small number of case studies, the results indicate that rather than participation in PSB, the combination of community monitoring and sanctioning mechanisms is associated with the perception that rules are actually applied in practice. Fig. 5 compares the different monitoring and sanctioning arrangements found in the 12 case study communities and the percent of households in each of those arrangements that believed that rule-breakers would be caught, and the percent that knew of someone that had been caught. In the 12 case

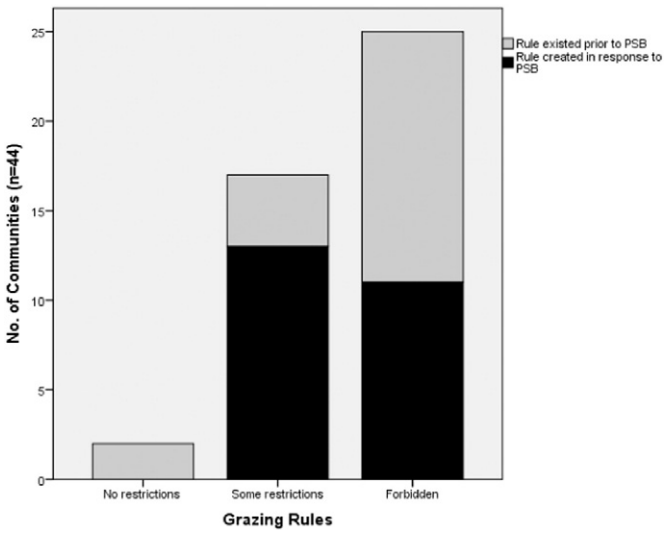

Fig. 4. Rule change in participant communities.

[3] Note that páramo size is not significant if run using the log, or if the outliers are omitted. Community size remains insignificant if run using log or if outliers are omitted. Also note the correlation between community characteristics of the participants. Poorer participant communities are significantly more likely to be indigenous (t = 2.863, p = .007, n = 38), significantly more likely to be organized (r = −.323, p = .040, n = 38), and to live closer to their páramo (r = .279, p = .073, n = 38).

Table 3
Characteristics of PSB communities not making rule changes compared to those that make a change.

Community characteristic	No rule change		Rule change		Test value	n
	Mean	SD	Mean	SD		
Indigenous (1 = indigenous)	0.4	0.503	0.63	0.495	$\chi^2 = 2.214$	44
Off-farm income (1 = off-farm)	0.6	0.503	0.42	0.504	$\chi^2 = 1.815$	44
Community size	233	369	446	886	$t = -1.07$	43
Organization index	−0.34	0.856	0.561	1.185	$t = -2.8^{***}$	42
Wealth index	0.313	0.869	−0.197	0.943	$t = 1.815^{*}$	42
Distance to páramo (min. walking)	134	97	93	77	$t = 1.855$	43
Páramo size (ha)	805	874	2350	3704	$t = -1.34^{*}$	44
Population density (households/ha)	1.17	2.76	1.32	3.12	$t = -.679$	44
PSB annual payment (US$)	13,596	10,308	17,274	14,327	$t = -.923$	42

* $p \le 0.1$.
*** $p \le 0.01$.

study communities, two communities had no community organized monitoring or sanctioning mechanisms, seven communities had organized monitoring, but relied on governmental agencies to catch and sanction rule-breakers, and three communities had organized monitoring and community mechanisms for sanctioning. Households in communities with internal monitoring and sanctioning mechanisms are significantly more likely to perceive that those that break the rules are caught ($\chi^2 = 150.769$, $p = .000$, $n = 418$), and to state that someone had been caught in the past year ($\chi^2 = 62.441$, $p = .000$, $n = 419$).

5. Discussion

5.1. PES and the Development of Communal Resource Management Rules

The objectives of this study were to begin to build our understanding of how PES interacts with the development of collective resource management systems in the context of conservation and poverty alleviation. The findings contribute to debates about whether PES can support collective action for rule development, the degree to which pro-poor PES programs reward existent conservation practices versus the creation of new conservation activities, and the degree to which communal rules are transmitted to inhabitants, who ultimately, must comply with the PES contract conditions.

First, regarding concerns about the ability of PES to support rule development, the findings suggest that PES has the potential to motivate communities to strengthen their conservation rules; however, payment may not necessarily be the driving factor. Results from the leader survey indicate that over half of the PSB communities crafted grazing rules in response to participation. Such rule changes correspond with the household perceptions that PSB served to further develop and clarify their rule systems.

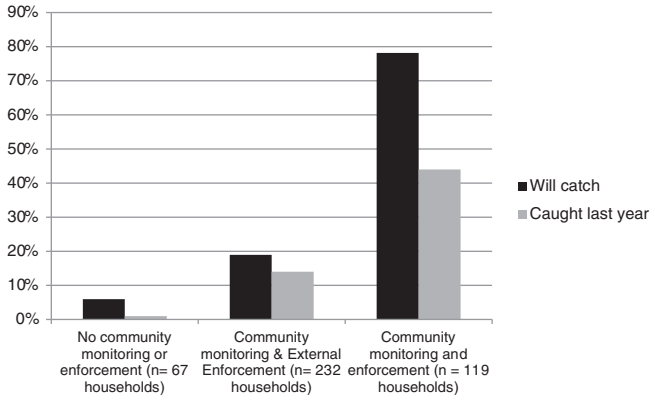

Fig. 5. Monitoring and enforcement mechanisms and application of rules.

The results did not find a direct association between level of payment and degree of rule change. In fact, those that made more restrictive rule changes and crafted rules to forbid grazing received, on average, 53% less each year than those that continued to allow grazing under some restrictions. Rule change is associated with organization. We found that organized communities were more likely to participate in PSB, and within PSB, organized communities were more likely to have made a rule change. This finding coincides with work by Bremer et al. (2014a) and the experiences of a number of practitioners working in the region who suggest that organized communities are also better able to derive livelihoods benefits from PSB.

Second, contrary to concerns that pro-poor PES programs may support impoverished communities irrespective of additional environmental benefits (Engel et al., 2008; Muradian and Rival, 2012; Pattanayak et al., 2010; Wunder, 2013; Wunder et al., 2008), our analysis found that poorer communities were more likely to make a rule change, while wealthier communities were more likely to be *rewarded* for existing conservation arrangements. While wealthier and mestizo communities were more likely to prohibit grazing, the majority of these communities had created their land-use rules prior to participation in PSB. Those that changed their grazing rules (55% of the participants) were more likely to be poor and depend more on their páramo; leaders in poorer and indigenous communities reported that a larger proportion of their households changed their land-use behaviors as a result of participation.

In conversations with personnel for PSB, several stated that they recognized that the program would pay certain communities for conservation actions already taken and these payments were given in recognition for the conservation work the community had committed itself to. The division of rewards and incentives according to wealth, however, points to questions regarding the equity of these payments.

Finally, the results indicate that while PSB may support rule development, participation does not necessarily signify that the rules will be applied. In interviews, leaders from participant and non-participant communities often noted the difficulties of fully applying land-use restrictions to all members of their communities and external users. There was no difference in perceived application of the rules across participant and non-participant communities. Rather, similar to other commons studies (Coleman and Steed, 2009; Gibson et al., 2005; Ostrom and Nagendra, 2006), our case study findings suggest that communities that have their own monitoring and sanctioning mechanisms are more likely to apply their rules than communities that rely on external governmental agencies.

5.2. Lessons for PES in the Context of Collective Resource Management

The findings from Ecuador suggest a number of lessons and future research venues for furthering our understanding of how PES interacts

with communal governance systems and its potential to support collective resource management, particularly in impoverished communities.

First, the findings suggest that we need to consider how PES interacts with a community's previous rule development and its organizational capacity to craft and apply new rules. Our survey of highland communities found that all communities recognized at least one land-use rule and that the majority had worked with some external organization to craft those rules. Although PES communities were more likely to have stricter grazing rules, those that were making rule changes had greater organizational capacity. A number of studies suggest that organizational capacity is essential for successful community-based resource management (Berkes et al., 2003; Folke et al., 2005; Lebel et al., 2006). In cases where organizational capacity is weak, PES alone may not be sufficient to jumpstart further rule development.

Second, the findings suggest a need to dig deeper into the role of the payment in comparison to other components of the PES program, such as the contract conditions, in instigating change. Previous studies have demonstrated that commitment to the contract, perceived legitimacy of the rules, and fear of sanctions may contribute to compliance with regulations (Hayes, 2012; Kuperan and Sutinen, 1998; Sommerville et al., 2010b; Tyler, 2006). Future research is needed to better disentangle the payment from other programmatic characteristics.

Third, for programs such as PSB that wish to support impoverished communities, the findings suggest a tension between equity and additionality. Greater a priori attention to the characteristics of communities and individuals that are likely to be making changes, in contrast to receiving a reward for existent behaviors, may help a program better target communities. Improved targeting, however, can be expensive and time consuming, and does not address the distributional issues within common-property systems as some residents may be asked to incur greater sacrifices than others (Corbera et al., 2007a, 2007b; Muradian et al., 2010; Pascual et al., 2010; Rico Garcia-Amado et al., 2011; Sommerville et al., 2010a). From an institutional perspective, research is needed to further our understanding on how programmatic and communal decision-making processes may mediate or aggravate inequities in the distribution of costs and benefits between individuals and across communities.

Finally, the findings reinforce how institutional development is not only the creation of rules, but also their application. The challenges of compliance, and effective monitoring and enforcement mechanisms are not specific to PES programs (Cerutti and Tacconi, 2008; Ravenel and Granoff, 2004), but are particularly important for decentralized conservation programs and other incentive-based approaches such as REDD + that aim to attain conservation goals by supporting community resource management (Kanninen et al., 2007; Karsenty, 2008). The concept of nested governance systems to support communal land-use institutions has become increasingly popular in the literature (Andersson and Ostrom, 2008; Cash et al., 2006; Clements et al., 2010; Kashwan and Holahan, 2014). Nevertheless, we have limited understanding of how to successfully structure such systems (Hayes and Persha, 2010). Government initiated payment programs, such as PSB, provide an opportunity for experimentation with how decentralized governance systems can support communal institutions for resource management and over time, assess how these rule systems contribute to land-use practices and the sustained provision of environmental services.

6. Conclusion

The findings from Ecuador, though exploratory in nature, suggest that PES can support rule development on communal systems. PES may, however, be more of a nudge than a driver for change. Further research is needed to assess how the different components of a PES program interact with community characteristics to influence communal resource management systems and the equity implications. Finally, panel studies, preferably in a randomized-control experimental setting, are needed to determine the links between PES, rule development, behavioral change, and the provision of conservation benefits on communal lands over time.

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