Spillover effects from mixing conservation policies in neighboring areas: Evidence from a field experiment in Colombia

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Abstract

Equity is increasingly being recognized as a crucial issue for environmental conservation, not just from an ethical, but also from an efficiency perspective. Ignoring the sociopolitical context while implementing policies could undermine their environmental effectiveness as perceived unfairness may erode cooperation and compliance by policy addressees. For example, the sanctions commonly implemented in Protected Areas raise equity concerns as local people depend on these areas to pursue livelihoods. Relocation and loss of control over land and resources has been reported to result in resentment, poaching and antagonism (Mbaiwa, 2005). On the contrary, positive incentives such as Payments for Ecosystem Services – PES, are often seen as a way to improve livelihoods. Exclusion from PES has been reported to result in rule breaking, protest and sabotage (To et al., 2012). Nevertheless, when neighboring households of a protected area generate relevant levels of pressure on its border, practitioners could use PES as a complementary tool for buffer areas. Where state enforcement capacity is low, PES have also been discussed as complements to legal restrictions inside protected areas (Engel, 2016). However, the implications of implementing different policies in neighboring areas have not been formally studied yet.

We use field experiments in rural Colombia to examine spillover effects from implementing different policies or policy mixes in neighboring areas. The framed field experiment was implemented with farmers from a region in Colombia that is highly relevant for the provision of water in the country. The experimental game design mimicked farmers' decision situation on their farm. All participants first played a baseline scenario of the game without policy. Then they participated in a second game, for which they were divided into two groups (inside and outside an environmental priority area). Each group was assigned to a different policy. In a first treatment we mimicked PES targeting, with one group remaining under the baseline condition (no policy) while the other is offered a reward policy. In a second treatment, we resembled the case where a protected area is surrounded by a buffer area targeted by a PES. The group of farmers living inside the priority area therefore faces (weak) sanctions while the one living outside of the priority area is offered a reward. Finally, in a third treatment we studied the impact of using a PES as a compensation mechanism within a protected area. Farmers living inside the priority area therefore face sanctions but also receive a reward, while the others are only offered a reward. Control treatments with equal policies were implemented to allow testing for spillover effects. We assessed the impact of the different policy combinations on fairness perceptions and pro-environmental behavior. As expected, preliminary results suggest that exclusion from PES in absence of further policy reduces pro-environmental behavior. Surprisingly, penalizing some while compensating others increases pro-environmental behavior of those penalized. Differences in the effect of fairness concerns are the main potential explanation for this behavior.

Keywords: Watershed, PES, protected areas, policy mixes, spillover effect, fairness

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1. Introduction

Equity is increasingly being recognized as a crucial issue for environmental conservation. Environmental conservation can have negative impacts on local populations, and the degree to which such impacts are taken into account or not may be critical for conservation effectiveness (Hutton et al. 2005). As a result, equity in environmental conservation is not only relevant from an ethical perspective but also for instrumental reasons.

In the case of protected areas (PAs hereafter), the process of protecting an area from the threats caused by human activities implies, by definition, the inhibition of some human actions, which may negatively impact human livelihoods and affect fairness perceptions (Nelson et al., 2003; Andam et al., 2008; Franks and Schreckenberg, 2016). Relocation and loss of control over land and resources has been reported to result in resentment, poaching and antagonism (Mbaiwa, 2005), while restrictions on building new homes generated overcrowding (Slater, 2002). Even more, in cases where there are relevant levels of pressure on the border of a PA or when the PA does not cover completely the area of environmental priority, the implementation of payments for environmental services (PES hereafter) in buffer areas could be perceived as an effective strategy. However, applying such different policies in areas so close to each other could reduce the effectiveness of the PA because it may not be considered as fair to exclude people inside the PA from the PES program. Evidence of sabotage and reduction in conservation levels due to restricting access to PES has been reported (To et al., 2012; Alpizar et al., 2013a; Alpizar et al., 2013b).

In addition, PES could also be used as a complementary tool to traditional PA policies. By making payments conditional to conservation, PES would provide compensation for the loss of use rights (Pechacek et al., 2012). PES are increasingly being discussed as a complementary policy within the PA (Brimont and Karsenty, 2015). The latter implies a legally inconsistent approach, but its discussion likely reflects two realities often found in the Global South: a context of insufficient institutional capacity to enforce strict PA rules, and the latent fear of policymakers that too strict rules could cause social upheaval (Engel et al. 2013). Nevertheless, research about the effectiveness of juxtaposing PES and PAs is scarce and little is known about how the interaction between these policies could change their effects.

In this study, we implement a modified dictator-game lab-in-the-field experiment (*the watershed externality game*) with farmers in Colombia, to analyze the spillover effects from implementing different policies or policy mixes in neighboring areas. To the best of our knowledge this is the first experiment to do this type of analysis. We explicitly consider the interaction between fairness preferences and environmental effectiveness as a consequence of the implementation of PAs and PES in neighboring areas. We focus on three questions: i) how will farmers react if a PES is implemented in a close by area and they are excluded from receiving it? ii) how will farmers react if they live in a protected area and face sanctions for forest use while neighboring farmers receive PES to protect it? And iii) how does implementation of PES inside the protected area affect fairness perceptions and farmer behavior?

The experiment is framed under the context of watershed management. Upstream management of the forest directly affects the provision of water downstream. Watershed management is a typical case in which the delineation of a PA would not always cover all the zones important for water provision. The environmental policy in our treatment round takes the form of either a reward policy (imitating the basic principles of PES), a fines policy (imitating the basic principles of a PA with weak enforcement) or a policy mix of fines and rewards (imitating the case of a PA with weak enforcement plus a PES). To capture the effect of juxtaposing policies, participants' on each session are divided in two groups. Group 1 belongs to the priority area for conservation and group 2 to the neighboring area that is also relevant but less important (e.g. the buffer zone). In particular, we analyze three cases: 1) targeting of PES: group 1 is under a reward policy while group 2 has no policy. 2) PAs with PES in buffer area: group 1 is under a fines policy while group 2 is under a reward policy. 3) PAs with PES in core and buffer area: group 1 is under a policy mix of fines and reward while group 2 is under a reward policy. Preliminary results suggest that exclusion from PES in absence of further policy reduces pro-environmental behavior. Surprisingly, penalizing some while compensating others increases pro-environmental behavior of those penalized. Differences in the effect of fairness concerns are the main potential explanation for this behavior.

In what follows, we provide a brief literature review on the effectiveness of different conservation policies both from case studies and experimental evidence. Section 3 describes the study site and section 4 the experimental design. Section 5 presents the results. Finally, discussion and conclusions are presented in the last section.

2. Related literature

There is a growing literature on the evaluation of PES and PAs effectiveness separately. PES are often seen as more efficient than command-and-control policies, as they can target the most efficient providers and therefore avoid high monitoring and enforcement costs (Pagiola et al., 2002). However, several authors argue that both policies should be seen not as substitutes but as complements, and mixed approaches should be preferred (Stavins, 2003; Muradian and Rival, 2012; Börner et al., 2014; Higgins et al., 2014). Very few studies analyze the combination of these two conservation policies. Work in progress by Baylis et al. (2012) in Mexico, show limited effects of each policy individually while those communities who received both the ban and the PES conserved significantly more forest. Clements and Milner-Gulland (2014) conclude that two PAs in northern Cambodia were effective at conserving the forest. In addition, the zones where PES was implemented jointly delivered additional environmental outcomes, while also impacting positively participants' livelihoods. Finally, Robalino et al. (2015) analysis in Costa Rica, and Sims and Alix-Garcia (2016) study in Mexico, conclude that both PAs and PES individually are environmentally effective but when combined they do not provide additionality. At the same time, PES in buffer areas provides additional conservation only in the Mexican case. Nevertheless, as Mexico and Costa Rica are both countries which have more clearly defined property rights and stronger governmental institutions than other countries in the region the generalizability of these results is questionable (Min-Venditti et al., 2017).

However, while the improvement of methodologies for the evaluation of the effectiveness of PES and PAS has been receiving rigorous attention (i.e. a better estimation of baselines and comparable controls), the spillover effect of these policies are often ignored. On the one hand, PAs can influence human use on unregulated surrounding lands through leakage effects, particularly in areas where human livelihoods are highly dependent on agricultural commodities which results in inelastic demands (Baylis et al. 2013). Land managers may even clear or destroy habitat as a pre-emptive strategy to avoid the declaration of new PAs (Lueck and Michael, 2003). On the other hand, the introduction of money and transactions in the provision of environmental services, could erode intrinsic motivations to conserve (empirical evidence for concerns about 'no pay, no care' after the implementation of PES are found in Van Hecken and Bastiaensen (2010), Fisher (2012) and Rico Garcia-Amado et al. (2013)). Monetary compensations could legitimize detrimental land use practices by attributing a *de facto* entitlement to perform them. Kaczan et al. (2016) implement a modified forest conservation-framed dictator game among farmers in Tanzania, to assess persistent motivational crowding out after policy removal given four policy treatments: an individual payments type PES, a collective payments PES, and two mandated levels of contribution, low and high, backed by penalties. Individual payments and the two mandate treatments where effective in increasing contribution levels. None of the PES treatments induced any significant, persistent motivational crowding in or out, while the mandate treatments showed some evidence of a positive effect (motivational crowding in) beyond the policy period.

Furthermore, beyond the spillover effect on the areas and individuals covered by each policy, areas not covered by each policy could potentially be affected as well. Only two recent experimental studies analyze such type of spillover effect. In these experiments, participants were excluded from a PES based on their initial behaviour: in order to increase additionality, land users who were already conserving without a PES were not eligible to receive payments. As a result, initial cooperators decreased their cooperation. The experimental results are consistent both for students in the lab (Alpízar et al., 2013b) and for Costa Rican farmers in the field (Alpízar et al., 2013a). Nevertheless, unlike our study, the later studies do not focus on the case where the exclusion is based on where you live, such as the case of a PA with a buffer area with PES.

3. Case study, survey and sample profile

3.1. The municipality of Junín and the complex of páramos de Chingaza

This research was conducted with farmers from the *veredas*[2] of San Antonio Alto, San Antonio Bajo, San Rafael and Santa Bárbara within the municipality of Junín, department of Cundinamarca. Junín is located at 100 km east of Bogotá D.C. The agricultural sector is the most important sector in the municipality with cattle farming as the main source of income for many rural households or as an important asset to reduce the risk involved in other agricultural activities. The agricultural sector is characterized by a family production system of traditional smallholders with extensive and poorly technified farming and low profitability. Most of the time, animals and land are left unattended. This enhances water waste from the use of rudimentary water bowl systems, pollution from unsupervised animal contact with surface water and soil deterioration due to cattle trampling.

About 30% of Junín's territory is part of the eastern area of a relevant ecosystem known as the Chingaza complex of páramos. This complex supplies 80% of Bogotá's aqueduct water demand. For this reason, almost half of the páramo areas of this complex are under the protection of the National Park Chingaza, a strict form of protected area. In the case of Junín, 21% of these areas are inside of the park. Cattle farming is one of the biggest environmental threats and is prohibited inside the part. Thus, farmers in the municipality of Junín, are familiarized with the concept of a protected area and land-use restrictions. However, there have been reports of cattle presence inside the park, pointing to deficits in monitoring and enforcement of park rules.

Forced immigration and little economic growth due to the armed conflict in Colombia led to lower environmental threats in this municipality, compared to other areas. Given the introduction of a military base in 2009 and the potential for agricultural and mining activities in the area, we expect an increase in the environmental threats to this area. PES is a relevant potential policy in this area given that this policy is already common in areas on the western side of the Chingaza complex of páramos.

In summary, the case study provides a setting for conducting experiments with farmers in an area that is highly relevant for water ecosystem services and where the policy options mimicked in the

[2] Vereda is a territorial administrative subdivision of the rural area of a municipality in Colombia.

experiment are of relevance. At the same time, the fact that PES has not yet been implemented in the area prevents any influence of own experience on experimental results.

3.2. *Survey and sample profile*

Between February and April 2018, we interviewed 308 farmers, collecting information on their sociodemographic characteristics, perceptions about the environment and towards the use of different types of policies to secure the environment, and the degree in which their pro-environmental behaviour was motivated by external motivations such as incentives and penalties prior to the experiment. During the interview, we also elicited farmers' degree of risk aversion and inequality aversion.

To elicit risk aversion, we used a similar procedure as in Eckel and Grossman (2008). We asked each participant to choose one of nine different gambles. Each of the gambles involved a 50% chance of receiving the low payoff and a 50% change of the high payoff, and the expected payoff increased linearly with the variance between the low and high payoffs. The gambles in our risk task were proportional to the gambles associated to the treatment with a fines policy (i.e. we divided the payoffs in the fines policy by 2.5), but did not include any framing. In general, 84% of farmers in our sample can be classified as risk averse and we observe a higher proportion of participants among the highest levels of risk aversion in comparison to Eckel and Grossman (2008) (see appendix). These results are consistent with previous high levels of risk aversion found for farmers in low income countries (Yesuf and Bluffstone, 2009).

To elicit inequality aversion, we replicated Blanco's et al. (2011) elicitation task for disadvantageous inequality (α). The task use a strategy-elicitation method to obtain choices in all possible scenarios and is based on an ultimatum game, where the minimum-acceptable offer is taken as an estimate of α_i. For this task, each farmer was matched with another anonymous farmer who was being interviewed in another area. Interviewers communicated decisions and outcomes by radio, without revealing anyone's identity. Twenty-eight percent of the farmers in our sample are averse to disadvantageous inequality ($\alpha = 0$) and we observe a higher proportion of participants among the lowest levels of inequality aversion in comparison to Blanco et al. (2011).

From June until November 2018, we contacted again each farmer to invite them to participate in an experimental session. Farmers were randomly assigned to different experimental sessions reflecting different treatments. 81.5% of surveyed farmers attended the experimental sessions. We compared those who attended with those who did not and found evidence of a potential sampling bias (see appendix for more details. About 80% of farmers who participated in the experiments report cattle farming as their main source of income, around 85% are aware of the existence of the National Park Chingaza even though their farms are not inside the protected area, and almost 20% claim to have heard about PES programs, although only 11% correctly understand what they are. Some of them (n = 27) claim to have participated in a program where they got paid for conserving the environment, but in none of these cases the program could be categorized as a PES. Table 1 summarizes the characteristics of participants in the experiment.

	N = 251			N=251	
	Mean	St. dev		Mean	St. dev
Gender (proportion female)	0.65	-	Years of education	6.0	3.6
Age	54.5	17.0	Owner of land (proportion)	0.76	-
Years living inside community	40.2	23.2	Farm size (ha)	2.1	3.0
No. adults in household	2.6	1.3	Area with forest (%)	1.0	13.5
No. children in household	0.7	1.1	Area with pasture (%)	59.0	23.5
Household size	3.3	1.9	No. Cows	2.7	10.2
Self-reported monthly income (EUR)	212	235	No. Crops	3.6	2.2
State of environment (proportion)			Likert (1-4) of env. motivations due to		
Very good	0.02	-	Sanctions	1.97	1.20
Good	0.20	-	Payments	1.36	0.68
Regular	0.67	-			
Bad	0.11	-			
Trust env. authorities (proportion)			Management of env. authorities (proportion)		
A lot	0.02	-	Good	0.03	-
Something	0.20	-	Regular	0.32	-
Little	0.67	-	Bad	0.31	-
Nothing	0.11	-	Don't know	0.34	-

Table 1. Summary demographic, perceptions and motivations of sample

4. Methods

4.1. The watershed externality game: Experimental design

4.1.1. General framing and baseline

In the experimental sessions, we implemented four rounds of a modified dictator game, *the "watershed externality game"*. Each round represented a farming season and only one of them was randomly chosen for payoffs. In the game, each farmer was presented with a hypothetical farm located upstream of a watershed with eight hectares of forest each associated with a cash value of $1.500 pesos (0,45€) per farming season from self-consumption of a small garden. The total value of each farm was thus $12.000 pesos (3,60€). Conserving the forest upstream produced clean water for households living downstream. Specifically, each hectare of forest produced $4.500 (1,20€) of clean water downstream, for a total of $32.000 pesos (9,60€) per farm. Farmers had the option to clear the forest in each hectare to introduce cattle farming. Each hectare with cattle farming was associated with a higher cash value of $5.000 pesos (1,50€) from the commercialization of milk and meat. However, this implied a loss in the positive externality downstream. In other words: A hectare of farmland in cattle farming implied $5.000 pesos in farm value, but zero water benefits downstream, while a hectare of farmland with forest implied $1.500 pesos in farm value, but $4.500 pesos in benefits downstream. We referred to money directly instead of using points in the game to ease the understanding of the game. Parameters were set so that payoffs covered opportunity cost of participants, based on a daily wage in the zone which range from $30.000 to $40.000 (8.5 – 11.5€). The payoff for conserving all the forest represented 30% of the maximum payoff of $40.000 from changing all hectares to cattle farming. This ratio was set based on the percentage of participation of self-consumption in the economy of family farming production in Colombia (Resolution 464 of 2017, Colombian Ministry of Agriculture and Rural Development).

At the beginning of each session, each farmer randomly received a table with an envelope taped on its backside. Before the session, we introduced one of two different colored papers inside each envelope. The colored papers were used to randomly distribute participants between two groups to resemble the case of mixing different policies in neighboring areas. Because we run several sessions in each *vereda*, we used different colors between sessions so that participants were not able to anticipate their role in the experiment. To maintain consistency, we followed this procedure for all sessions, including the baseline and the treatments for which group subdivision was not needed. Instructions of the experiment were read following the conventional procedures for lab-in-the-field experiments. Posters with visuals were used to complement instructions and were displayed so that participants could refer to them whenever needed.

To incentivize the provision of downstream water services, downstream water recipient households were randomly selected households from the urban area of the municipality of Gachetá who were not present during the experiment. The ratio between participant farmers and water recipient households was 1:1, i.e. one water recipient household was randomly included in the beneficiary list per each participant farmer. However, water donations from all participant farmers were summed and the total payoffs were shared equally among households. This share was then deducted from each household's water bill through an agreement with the urban aqueduct of Gachetá, Serviguavio. Participant farmers were aware of this process during the experiment and had access to a signed letter confirming the agreement between us and the urban aqueduct. Donations were distributed in this way because it was logistically easier for the urban aqueduct. Moreover, since an increase in water services from upstream is a public good for downstream consumers, we considered this approach closer to a real case scenario.

In the first round (baseline), each farmer (i) received 8 units of land (L) and had to privately decide their preferred combination of forest $(L - x_i)$ and cattle farming (x_i) by marking their decision on a paper format that visually illustrated all possible scenarios and payoffs for both players (upstream farmer and downstream household). In the second round, a policy was introduced and in the third and fourth rounds the game reverted to the initial setting. Some groups that did not face any treatment policy during the second round but instead played the baseline setting for the whole game, formed the baseline.

4.1.2. Treatments

During the second round of all treatments, we explained to farmers that the local environmental authority in the municipality identified some of their hypothetical farms as part of a priority area critical for environmental conservation and the provision of water downstream, and for that reason, the environmental authority had decided to implement a particular policy inside it. For those who were not part of the priority area a contrasting condition in relation to the one inside the priority area was introduced. We explained the conditions for both groups to all participants, before they knew to which group they belonged, and the posters with the description of the conditions in both areas were displayed on a wall while they privately took their decision. Finally, in the third round, we explained that the environmental authority's funds to implement all policies were exhausted and thus, the conditions for all farmers went back to the initial setting without the implementation of any policy in any area.

The environmental policy took the form of either a reward policy (imitating the basic principles of PES), a fines policy (imitating the basic principles of a protected area with weak enforcement) or a policy mix (imitating the case of a protected area with weak enforcement plus a PES). Under the reward policy, the environmental authority payed an additional amount of \$1.500 pesos (0,45€) per each hectare of forest each farmer decided to conserve. Note that we set the payment level below the level of opportunity costs. Under the fines policy, the environmental authority sanctioned the farmers who decided to clear the forest on their farms. The sanction included confiscating cattle and corresponding production, and thus, the payoff of all hectares with cattle farming would be then \$0. However, due to a staff limitation in the area, only one in two farmers would be monitored. If the second round was the one chosen for payoffs, each farmer flipped a coin at the end of the experiment to find out if their farm had been monitored or not. Similar to the fines policy, in the policy mix, the environmental authority monitored one in two farmers and fined the farmer if she or he had decided to clear the forest in their farm. However, in this case, the environmental authority will only confiscate the production and not the animal, and thus, the payoff of each hectare with cattle farming was reduced to $1.500 instead of $0. At the same time, the environmental authority also paid an additional amount of $1.500 pesos (0,45€) as reward per each hectare of forest each farmer decided to conserve.

Our experimental treatments were as follows. In referring to treatments we will use the following abbreviations: *B* for baseline (no policy), *F* for fine, *R* for reward, and *M* for a mix of fine and reward. Also we will refer to the two groups as 1 and 2, for the group inside the priority area and the group outside the priority area, respectively. In our discussion we will use the terms priority area and PA interchangeably, but it should be noted that only the term priority area was used in communication with farmers in the experiment. Treatment 1 *(R1B2)* resembled the case of targeting PES: *a reward policy was implemented inside the priority area while outside the priority area no policy was implemented and farmers remained under the baseline*. Treatment 2 *(F1R2)* resembled the case of a protected area with a buffer area with PES: *a fines policy was implemented inside the priority area while for those outside the priority area a reward policy was offered*. Treatment 3 *(M1R2)* resembled the case of a protected area with a PES program both in core and buffer area: *a policy mix of fine and reward was implemented inside the priority area while for those outside the priority area a reward policy was also offered*. We also included two more treatments where all farmers land was inside the priority area (no group division). In treatment 4, every participant was part of the priority area under a fines policy *(F1)*, while in treatment 5 every farmer was part of the priority area under a policy mix *(M1)*. Finally, in treatment 6, no priority area was defined and everyone remained under the baseline setting *(B2)*. Table 2 summarizes each treatment's characteristics.

To answer if there is a spillover effect from the introduction of the reward policy in one area on behavior of people in the other area, we will compare the effect of each type of policy (no policy, fines policy or policy mix) in both settings: with and without a reward policy in a neighboring area. Our goal is therefore not to compare fines to rewards directly. Thus, even though we consider it an important avenue for future research, we will not focus on the behavior of participants who were offered the reward policy and their decisions won't be included in any analysis. For this reason, whenever we refer to any treatment with group division we will make reference only to participants who were part of the group that was in a disadvantageous position, i.e. excluded from the reward policy and/or penalized while others were not.

In that sense, to answer how farmers will react if they are excluded from a PES implemented in a targeted neighboring area, we will compare treatments B2 and B1R2. Similarly, we will analyze how farmers will react if they live in a PA and face sanctions if they clear the forest while for farmers in the buffer area rewards are proposed to protect it. For this purpose, we will compare treatments F1 and F1R2. Finally, we will investigate how does the implementation of PES inside the former type of PA affect farmer's behavior. For this purpose, we will compare treatment M1R2 with M1.

Name of the treatment	Description of the treatment	Treatment setting and number of participants			
		Inside Priority Area - Group 1		Outside Priority Area - Group 2	
		Description	Number	Description	Number
R1B2	Reward inside priority area and baseline outside	Reward policy offered	29	No policy implemented	22
F1R2	Fines inside priority area and rewards outside	Fines policy implemented	29	Reward policy offered	25
M1R2	Policy mix inside priority area and rewards outside	Mix of fine and reward implemented	29	Reward policy offered	22
F1	Fines inside priority area	Fines policy implemented	30	Everyone inside priority area	-
M1	Policy mix inside priority area	Mix of fine and reward implemented	30	Everyone inside priority area	-
B2	No policy and no priority area	No priority area	-	No policy implemented	31

Table 2: Description of treatment settings and sample size.

5. Theoretical predictions

5.1. Nash strategies for each type of policy

Our experiment is based on a dictator game. Each dictator (i) is endowed with *L* units of land of forest of which he converts x_i units (e.g. hectares) to cattle farming. Units of cattle farming sell at a constant price *c*, which is higher than the marginal return of forest *a*. Thus, dictator payoffs are:

$$U_i = cx_i + a(L - x_i), \quad \text{with} \quad 0 < a < c$$

Assuming classical preferences, maximizing U_i with respect to x_i yields *i*'s Nash strategy of $x_i^* = L$. Thus, in the absence of policy, all land is converted to cattle farming.

The introduction of the reward policy increases the marginal return of forest by *b.* However, in our setup it does not cover the opportunity cost of forest conservation $(a + b < c)$. This results in the following payoffs structure:

$$U_{i,PES} = cx_i + (a + b)(L - x_i), \quad \text{with} \quad 0 < a + b < c$$

Assuming classical preferences, maximizing U_i with respect to x_i yields *i*'s Nash strategy of $x_{i,PES}^* = L$. In other words, because the reward is below opportunity costs, it remains optimal to convert all land to cattle farming.

The introduction of the fines policy with a probability of audit $p < 1$ and a penalty for non-compliance *F* leads to the following expected utility:

$$E(x_i) = pU(y_1) + (1 - p)U(y_2), \quad \text{with} \quad \begin{aligned} y_1 &= cx_i - Fx_i + a(L - x_i) \\ y_2 &= cx_i + a(L - x_i) \end{aligned}$$

Assuming constant relative risk aversion we use the power utility function and then maximize expected utility for given parameters *c, a, F, L,* and *r*.

$$\begin{aligned} \frac{dE}{dx_i} &= pU'(y_1)\frac{dy_1}{dx_i} + (1 - p)U'(y_2)\frac{dy_2}{dx_i} \\ &= p(c - F - a)\frac{1}{{y_1}^r} + (1 - p)(c - a)\frac{1}{{y_2}^r} \end{aligned}$$

For a risk neutral person the best strategy will be $x_{i,fine}^* = L$ if $c - pF - a > 0$.

Similarly, under the policy mix, the best strategy for a risk neutral person will be $x^*_{i,mix} = L$ if $c - pF - a - b > 0$.

We set our parameters such that none of the policies we implement (reward policy, fines policy, policy mix) is sufficient to incentivize conservation for risk-neutral payoff-maximizing players, i.e. the Nash strategy for a risk neutral payoff-maximizing person is to convert all land to cattle farming, regardless of the treatment. In order to do so, the severity of the fine must be different between the fines policy and the policy mix. Using a lower penalty under the fines policy would make the policy too poorly enforced (i.e. the optimal strategy of a risk averse player would have been to clear all the forest), while using a higher penalty in the policy mix would make the policy too strongly enforced (i.e. the expected value of conserving all the forest would have been higher than the expected value of clearing it all). This is why we varied the level of the fine between the fines policy scenario and the scenario of a policy mix (see section...).

We also compute Nash strategies for risk averse subjects. Table 3 indicates optimal amounts of forest conserved under the fines and the policy mix scenarios, depending on risk aversion. The table shows that as risk aversion increases, the amount of forest conserved goes up.

Elicited CRRA (r)	Optimal amount of forest ($L - x_i^*$)	
	Fines policy	Policy mix
$r > 1.6892$	7	7
$1.6892 > r > 1.4263$	7	7
$1.4263 > r > 0.9183$	6	6
$0.9183 > r > 0.6615$	5	5
$0.6615 > r > 0.5076$	4	4
$0.5076 > r > 0.3980$	3	4
$0.3980 > r > 0.3068$	2	2
$0.3068 > r > 0.1948$	1	0
$0.0974 > r > 0.3068$	0	0

Table 3: Optimal amount of forest $(L - x_i^*)$ by level of risk aversion under the fines policy and the policy mix. The ranges of risk aversion were those measured with our risk elicitation task.

5.2. Between groups inequality

The implementation of different policies inside and outside the priority area leads to inequality between members of group 1 and members of group 2. This inequality translates into a disadvantageous position for one of the groups compared to the other. As explained earlier, we focus here on the members that are worse off. Indeed, for any non-zero level of conservation, those under the reward policy get a higher payoff than those in the baseline or under the fine policy. Table 4 describes this payoff inequality between groups for all policy combinations.

Inequality-averse participants may choose a strategy that minimizes the payoff difference between their group and the other group. For participants in R1B2 completely clearing the forest is the strategy that minimizes inequality between groups. While for participants in F1R2 or in M1R2 it is conserving all the forest that minimizes inequality between groups. In that sense, for inequality-averse farmers, we expect those in treatment R1B2 to reduce their conservation efforts while for those in treatments F1R2 and M1R2 we expect an increase in their levels of conservation.

Treatment	Nash-strategy			Strategy to minimize inequality		
	Forest	Cattle	Payoff-inequality	Forest	Cattle	Payoff-inequality
	$L - x_i{}^*$	$x_i{}^*$		$L - x_i$	x_i	
R1B2	0	8	0.00	0	8	0.00
F1R2	0	8	6.00	8	0	3.60
M1R2	0	8	4.20	8	0	0.00

Table 4: Level of payoff-inequality under the Nash strategy and under the strategy that minimizes payoff-inequality for each treatment where between groups inequality occurs.

5.3. Fairness perceptions

Rabin's (1993) game-theoretic framework that incorporates fairness into a broad range of economic models, shows that people are reciprocal (help those who help them and punish those who punish them). Similar analysis and results on reciprocity are observed in Fehr and Gächter (2000) and Falk and Fischbacher (2006).

In that sense, when an exogenous rule is perceived as unfair, people might feel the right to "punish" the implementer, for instance by reducing their conservation effort. This is the main channel through which we expect to find a spillover effect from the reward policy on forest conservation in neighboring areas.

For this reason, we also elicited fairness perceptions regarding the rule implemented. We expect that participants in treatments where a reward policy was offered for members of the other group, will perceive the policy implemented in their own group as more unfair, compared to a participant who face the same policy but without a reward policy in a neighbor area. The worse off a participant is, the more he or she perceives the policy implemented as unfair, and the higher its level of forest conversion. Thus, participants in treatment F1R2, who are not only excluded from the reward but also face a fine, should have the highest spillover effect compared to participants from treatments R1B2 and M1R2. On the contrary, M1R2 participants should have the lowest spillover effect, as there is no exclusion from the reward under the policy mix.

6. Results

6.1. Initial conservation levels

About 90% of participants chose to conserve at least one unit of forest, even though it was not the best possible strategy under conventional (neoclassical) preferences. On average, participants conserved 3.9 units of forest (st. dev = 2.4). Average giving in dictator games is around 20% of endowment (Camerer, 2003). In our experiment, conserving 2 units of forest resulted in a 17.5% payoffs reduction, while conserving 3 units of forest reduced payoffs by 26.25%. Only 20% of participants chose one of these options. In addition, 31% of participants chose to conserve between 4 (15%) and 5 units of forest (16%). Choosing 5 units of forest minimized the difference in payoffs between upstream and downstream watershed users, while 4 units of forest represented a 50-50%

distribution of land between forest and cattle[3]. This indicates a strong preference towards equal or fair distributions (social and environmental) by at least a third of the farmers.

We run two Kruskal-Wallis tests to compare initial forest conservation levels between *veredas* and between treatments. Results indicates that farmers' decisions were not correlated with the community of origin (p-value=0.6664) and that baseline levels do not differ between treatments (p-value=0.8515).

6.2. Spillover effects

To estimate the effectiveness of each policy we compared forest conservation levels before and after the policy was introduced. Thus, we created the variable Δ Forest, defined as the difference in forest area between round 2 and round 1. We used this estimation to compare the effectiveness of each type of policy in both setting: with and without a reward policy offered for another group. For instance, we compare the effectiveness of the fines policy in treatment F1 to the same policy in treatment F1R2. To estimate the spillover effect, we calculate the difference in the effectiveness of each type of policy under both settings. Figure 1 shows the mean change in forest area per treatment and the mean spillover effect of the reward policy on participants under different policies in neighboring areas. Table 5 summarizes the mean changes in forest area associated to each treatment.

Figure 1 suggests a negative spillover effect from excluding participants from the reward policy. Participants under R1B2 reduced on average their forest area compared to those under B2. Likewise, this figure also shows a negative spillover effect from the reward policy on those under a policy mix (M1R2). However, none of these average spillover effects was significant. On the contrary, a neighbor area under a reward policy produced a positive and significant spillover effect on the priority area with a fines policy. Thus, participants under F1R2 significantly increased their average levels of forest conservation by 1.26 units after the policy was introduced. Even more, while looking only at the effectiveness of each treatment, we can see in Table 5 that only in treatments F1R2 and M1 the implemented policy is effective. This indicates that the reward policy spillover effect on participants from F1R2 treatment turned the fines policy in F1 into an effective policy inside the priority area. On the contrary, the fact that the policy impact of M1R2 is not significant, indicates that the reward policy spillover effect on participants from M1R2 treatment destroyed the effectiveness of the policy inside the priority area.

To better understand the spillover effect, we also analyze the change in forest area using a difference-in-difference model in an econometric analysis. We conduct an ordinary least squares regression with the difference in forest area after the policy as the dependent variable. The dependent variable varied from minus six (reducing six units of forest) to seven (increasing seven units of forest). We controlled for the initial level of forest conservation, socio-demographic variables and self-reported perceptions towards sanctions (see appendix for more details). The resulting regressions are presented in Table 6. Coefficients represent the expected decrease or increase in the level of change of forest area after the policy was introduced, due to an increase of one unit in the independent variable.

[3] Even though most farmers recognize the relevance of protecting the forest and the páramo, they disagree with the implementation of strict land-use restrictions. They see cattle farming as a subsistence activity, and they resent policies that do not take into account the associated consequences in their livelihoods. This was confirmed during the post-experimental survey, in which many farmers agreed there should be a balance between conserving the forest and their economic activities. Thus, we conclude that an equal distribution of land, between forest and cattle, was seen by many of them as a fair environmental share.

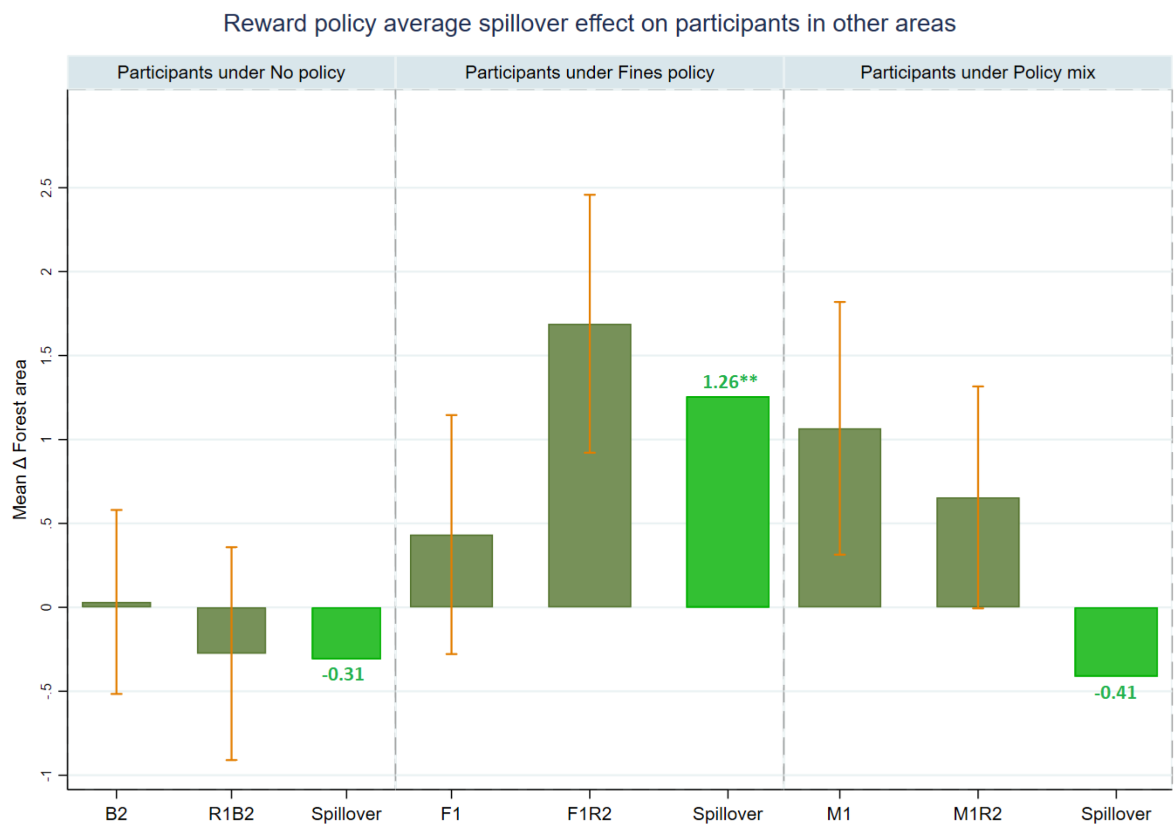

Figure 1. Spillover effects from the reward policy on each treatment. *Statistical significance levels at 10% (*), 5% (**) and 1% levels (***).

Treatment	Average forest area in round 1	Average forest area in round 2	Change between round 1 and round 2
F1R2	3.72	5.41	+1.69**
M1	4.10	5.17	+1.07**
F1	4.03	4.47	+0.43
M1R2	4.17	4.82	+0.66
B2	3.35	3.39	+0.03
R1B2	4.24	3.96	−0.28

Table 5. Average change in forest area per treatment.
*Statistical significance levels at 10% (*), 5% (**) and 1% levels (***).

In each model, dummy variables are used to test the effect of each treatment. Two additional dummy variables are used to control for the initial level of forest conservation. We use one dummy, *Fair in Round 1*, for those who chose a fair distribution (4 or 5 units of forest) and another dummy, *Selfish in Round 1*, for those who chose to conserve less than four units of forest.

We also separately control for risk aversion (models 1 and 2) and disadvantageous inequality aversion (models 3 and 4). Regarding risk aversion, we control by the elicited coefficient of each participant. In addition, we create a dummy for the levels of risk aversion in which we expect the policies to have more impact; we chose a threshold level of 0.3980 in the elicited CRRA coefficient (see table 5). This dummy is then interacted with two other dummies: *fines policy* and *policy mix*, which refer to all treatments for which we respectively implemented each of these policies, irrespective of whether a reward policy was implemented for one group or not. The reason for this is that those were the only policies that included risky choices by design. To capture the between groups inequality effect due to being in a disadvantageous position in the group, we interact the coefficient of disadvantageous inequality aversion with the dummies for treatments R1B2, F1R2 and M1R2.

Variables	Δ Forest area			
	Model 1	Model 2	Model 3	Model 4
F1	0.0731	0.0816	0.623	0.576
	(0.400)	(0.388)	(0.396)	(0.375)
F1R2	0.948*	0.965*	1.609***	1.644***
	(0.499)	(0.524)	(0.401)	(0.438)
M1	1.484***	1.409***	1.286***	1.178***
	(0.432)	(0.421)	(0.391)	(0.382)
M1R2	0.836*	0.841*	0.779*	0.930**
	(0.497)	(0.442)	(0.393)	(0.349)
R1B2			-0.0730	-0.130
			(0.480)	(0.514)
Group size	0.0679**	0.0586**	0.0732**	0.0591**
	(0.0335)	(0.0250)	(0.0317)	(0.0280)
Fair in Round 1	0.639**	0.611*	0.701**	0.728**
	(0.302)	(0.308)	(0.275)	(0.286)
Selfish in Round 1	2.144***	2.066***	2.132***	2.105***
	(0.296)	(0.295)	(0.270)	(0.273)
Risk aversion coefficient	-0.0699	-0.0848		
	(0.274)	(0.337)		
Risk high * Fines policy (*F1* + *F1R2*)	0.861***	0.819**		
	(0.257)	(0.359)		
Risk high * Policy mix (*M1* + *M1R2*)	-0.263	-0.246		
	(0.445)	(0.478)		
Disadvantageous inequality aversion (α)	-0.114	-0.176*		
	(0.0968)	(0.101)		
α * *F1R2*			-0.179	-0.238
			(0.163)	(0.158)
α * *M1R2*			-0.137	-0.301*
			(0.156)	(0.179)
α * *R1B2*			0.0606	0.0414
			(0.215)	(0.219)
Constant (Δ Forest area in B1)	-1.482***	-1.246	-1.647***	-0.931
	(0.435)	(0.965)	(0.366)	(0.999)
Socio-demographic	NO	YES	NO	YES
Observations	147	145	176	173
R-squared	0.366	0.397	0.359	0.383

Table 6. Ordinary Least Squares for Δ Forest area (Forest area in Round 2 – Forest area in Round 1)
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 shows that participants who chose an unfair distribution in round 1 increased their conservation levels at a significantly higher proportion than those who chose an equal or fair distribution. Nevertheless, those who chose an equal distribution also significantly increase their levels of conservation compared to those who chose a fair distribution, but at a lower proportion. In relation to effectiveness, only the policy mix was effective to increase forest conservation levels. However, looking at each treatment separately, we observe that the fines policy was also effective for those under a disadvantageous position. These results confirm the tendencies observed in Figures 1 and 2.

6.3. Risk averse participants react only to fines policy

Turning to the role of risk aversion, models 1 and 2 (table 6), suggest that risk aversion was only relevant for treatments under the fines policy. Even more, for those under a policy mix the coefficient of risk aversion is negative, although it is not significant. This result may be a consequence of the differences in the variance of expected payoffs between both policies due to our experimental design. Even though optimal decisions for each level of risk aversion are very similar between both types of policies, the variance of expected payoffs are higher in the fines policy (2.7 EUR) compared to the policy mix (0.04 EUR). We will go back to this result in the discussion.

6.4. Inequality averse participants in a disadvantageous position react only to policy mix

Interestingly, payoffs inequality between groups affects only those players under a policy mix. However, the effect is the opposite of what we expected for a person averse to disadvantageous inequality, as the coefficient for inequality averse players in M1R2 is negative and significant. Similarly, the direction of the coefficients for inequality averse players in F1R2 and R1B2 is opposed to what we expected, although they are not significant. We interpret this result as a consequence of a fairness negative effect that surpass the effect of between groups inequality.

6.5. Responses to fairness perceptions towards the implemented policy differ between treatments and types of player

We asked participants about their fairness perception towards the implemented policy in a post-experimental survey. In addition, we also asked participants three questions about their perceptions towards land-use restrictions for environmental reasons. The first one asked for their perceptions towards general land-use restrictions while the second and third ones included the implementation of a fines policy and a reward policy, respectively, to enforce compliance with the restriction (see appendix for more details). We calculated how their perceptions towards land-use restrictions changed when a policy was used for enforcement by calculating the difference between each pair of responses, and then we compared these results between treatments.

Figure 2 reports the percentage of participants who considered the policy implemented during the experiment as fair. We do not have information about the baseline group as no policy was implemented for that treatment. This is why we did not include fairness perceptions in our econometric analysis. We find no significant differences towards fairness perceptions between treatments (ANOVA, p-value=0.6423). However, the largest percentage of participants who considered fair to implement the policy is found in treatment F1R2, suggesting that the positive significant effect described in our econometric analysis could be related to their fairness perceptions towards the policy.

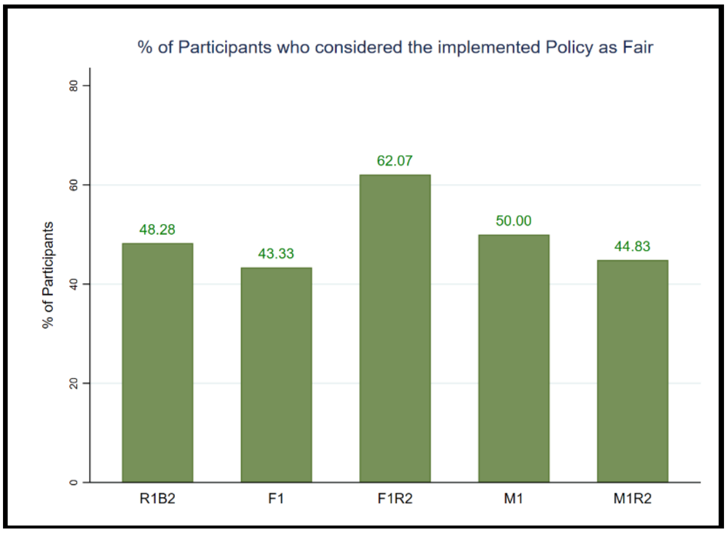

Figure 2. Percentage of participants who considered the implemented policy as fair per treatment.

To support this hypothesis, we analyze the differences in Δ Forest area for participants who considered the implemented policy as fair and participants who did not. Figure 3 shows the mean change in forest area for each type of player between fairness perceptions. Given that 57 participants in our treatments (around 32%) do not change their decisions between rounds 1 and 2 (Δ Forest = 0), we decided to complement our analysis by looking only at those who changed their decisions.

Figure 3 indicates that fairness perceptions play a role in the change in forest area. For all treatments except for F1R2, those who considered the policy as fair conserved more forest area on average after the policy was introduced compared to those who considered the policy as unfair. This tendency is more prominent when we constrain our analysis to participants who actually change their level of forest between round 1 and round 2 (Δ Forest area ≠ 0). However, this difference was only significant in treatment M1R2 (One-tailed Mann-Whitney, p-value=0.0926).

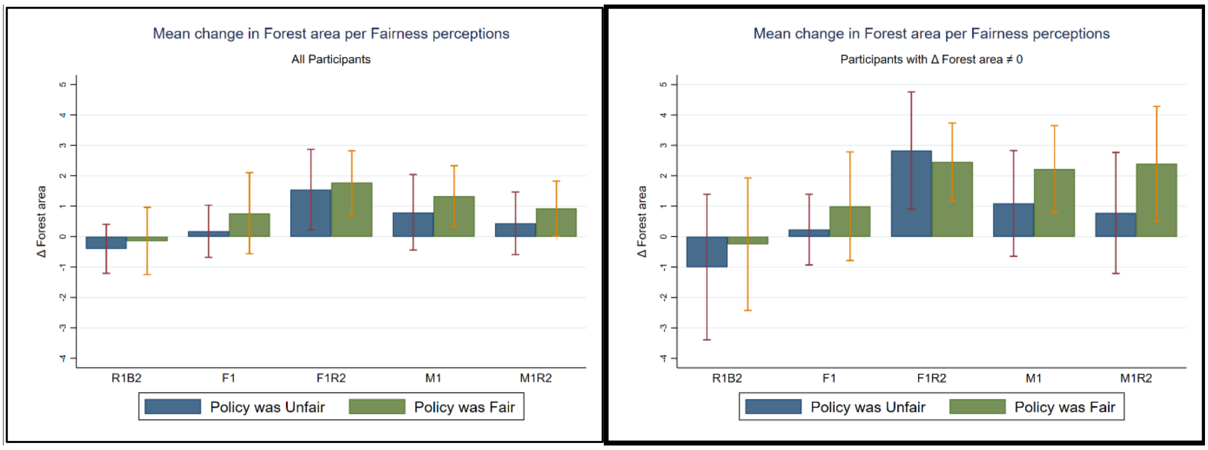

Figure 3. Mean change per treatment in forest area when participants considered the implemented policy as fair (green) or unfair (blue). Including all participants (left) and participants with Δ Forest area ≠ 0 (right).

Figure 4 present changes in perceptions towards land-use restrictions for environmental reasons, when a fines or a rewards policy was used to enforce compliance. We show again these results first for all participants and then only for participants who change their level of forest between round 1 and round 2 (Δ Forest area ≠ 0). In general, participants for whom no policy was introduced (baseline) have an average positive perception towards rewards policies and an average negative perception towards fines policies. Being exposed to a fines policy during our experiment exacerbates the negative perception towards fines policies although this effect is not significant. Nevertheless, when being exposed to a policy mix, average perceptions towards the fines policy improve compared to those under fines, and the difference is significant if we take into account only those participants with Δ Forest area ≠ 0 (Mann-Whitney, M1 vs F1R2: p-value=0.0610, M1R2 vs F1R2: p-value=0.0675).

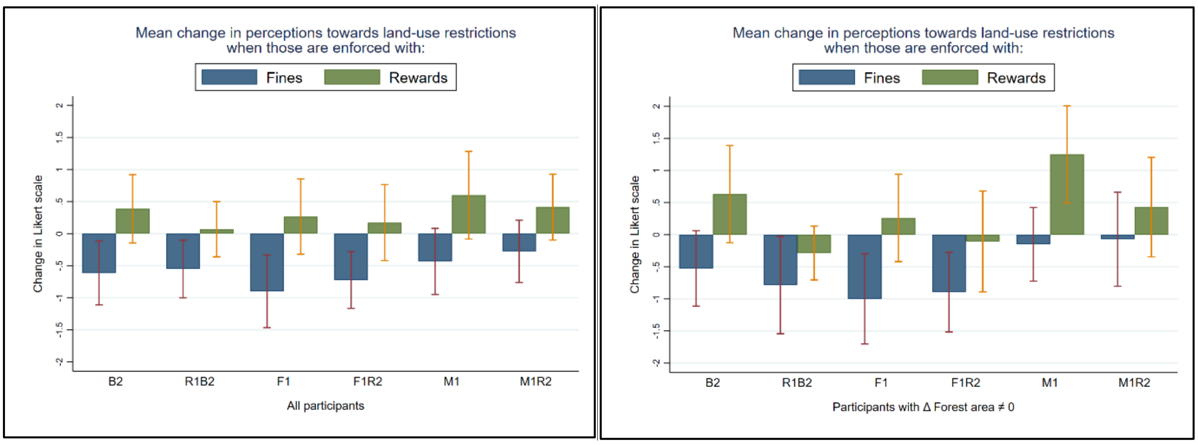

Figure 4. Per treatment mean change in perceptions towards land-use restrictions when those are enforced with fines (blue) or rewards (green). Including all participants (left) and participants with Δ Forest area ≠ 0 (right).

In the case of a reward policy, being excluded from the reward reduces positive perceptions towards the reward policy. This effect is higher if we only analyze those with Δ Forest area ≠ 0, as perceptions towards the reward policy actually become negative. This change is significant for those who were excluded from the rewards policy (B1R2) (Mann-Whitney, p-value=0.0803) but not significant for those who were also fined and excluded from the rewards policy (F1R2). A similar effect is observed for disadvantaged players under the policy mix (M1R2), who reduce their mean perceptions towards a rewards policy even though they were not excluded from the reward policy. However, this difference is not significant.

6.6. Summary of results

Adding all former results we summarize our findings: 1) for those in treatment B1R2, we observe a tendency to reduce conservation levels, although this tendency is not significant. Fairness perceptions towards the exclusion from the reward policy could be behind this tendency as conservation levels are lower for those who considered the policy as unfair and perceptions towards a reward policy get reduced. 2) For those in treatment F1R2, we observe an increase in conservation levels. Payoffs inequality between groups do not seem to play a role, while fairness concerns towards the policy play an ambiguous role, as conservation levels are similar between those who considered the policy as fair or not. Nevertheless, perceptions towards both reward policies and fines policies decrease. 3) For those in treatment M1R2, fairness concerns seem to reduce conservation levels. Inequality averse participants reduce their levels of conservation even though this decision increases payoffs inequality between groups. Similarly, conservation levels are lower for those who considered the policy as unfair while we also observe a reduction in positive perceptions towards a reward policy.

7. Discussion and conclusion

This paper investigates the effect of applying different policies in neighboring areas in the light of fairness concerns. In doing so, we implemented a modified dictator lab-in-the-field experiment (*the externality in the watershed game*) with different policies between inside and outside of a priority area. The experiment is framed under the context of watershed management and it involves 251 farmers from a municipality in Colombia, relevant for the provision of water in the country. In particular, we analyzed three cases: 1) PES exclusion: those inside the priority area were under a reward policy while those outside had no policy. 2) PAs with PES in buffer area: those inside the priority area were under a fines policy while those outside were offered a reward policy. 3) PAs + PES with PES in buffer area: those inside the priority area were under a policy mix while those outside were under a reward policy.

Our findings show that excluding from a PES triggers unfair concerns and that, driven by their fairness perceptions towards the implemented policy, participants tend to reduce their forest conservation efforts. This result fits well with previous results on PES exclusion (Alpizar et al., 2013a; Alpizar et al., 2013b). Surprisingly, while resembling the case of a protected area with PES in its buffer area, we find that those fined while other group was offered a reward increased their level of forest conservation compared to a participant under the same policy but without a reward policy in the neighboring area. On the contrary, when we introduce the reward policy as a compensation mechanism in the protected area, we find the opposite effect. Those who were under the policy mix while the other group was offered a reward do not significantly increase their forest conservation efforts compared to a participant under the policy mix without a reward policy in the neighboring area. We propose three exploratory reasons for these results.

As mentioned in the results, the variance of expected payoffs for those under the fines policy alone (F1 + F1R2) was higher compared to the variance of expected payoffs for those under the policy mix (M1 + M1R2), even though optimal decisions for each level of risk aversion are very similar between both types of policies. As a consequence of this, it is more costly to retaliate the policy for a participant who perceives the policy as unfair, if he or she is under a fines policy than if he or she is under a policy mix. The standard deviation of the expected payoffs under the fines policy is four times higher than the standard deviation of the expected payoffs under the policy mix. When a participant under a fines policy clears all the forest, she or he is risking to lose everything, while a participant under a policy mix is only risking to lose 50% of what he could earn by keeping all the forest and 70% of what he could get if he does not get caught by the authorities. This potentially explains why risk aversion was only significant for treatments under the fines policy and not those under the policy mix.

However, as we compare the levels of conservation for participants under the same policy but in different settings (with or without a reward policy offered in the neighboring area), this alone do not explain why conservation levels of F1R2 are higher compared to those of F1. Nevertheless, for a participant in treatment F1R2 it is also more costly to retaliate because of between groups payoffs inequality. Per each unit of forest they deplete, between groups inequality increases. Even more, for the same level of conservation, between groups inequality is on average 3 times higher in F1R2 treatment compared to M1R2. Thus, even though participants could find the policy unfair, they do not punish it by reducing their forest conservation efforts because it would cost them too much. Empirical evidence of the latter is provided in many protected areas, where the main reason for not harming the environment is fear of fines, imprisonment or violence from the guards (Holmes, 2013; Martin et al., 2014a; Martin, 2017).

A complementary exploratory reason for our results comes from Martin's (2017) idea of 'system justification'. The author studies the reason why local people simultaneously express support and resent (a cause of their own economic hardship) for a PA. He concludes that beyond institutional and ideational explanations, people had a psychological reason to support a PA. Local people are compelled to follow the rules of the PA, even if it results in severely limited ability to benefit from forest resources, which results in a form of cognitive dissonance. People resolve such internal tensions through 'system justification', which involves a disposition to more easily internalize the positive outcomes of supporting the PA. By looking at the post-experimental survey we also find evidence of this. For the F1R2 treatment, 62% of participants find the implemented policy as fair, and of those, 67% relate the fairness perception to conservation reasons (e.g. "it was fair because forest conservation is important for water and the environment"). In the case of the M1R2 treatment, only 45% of participants find the implemented policy as fair, and of those, only 46% relate the fairness perception to conservation reasons while the majority refers to institutional reasons in the form of rule abeyance (e.g. "it was fair because it was forbidden to clear the forest"). These differences between F1R2 and M1R2, complement the idea that it was more costly for F1R2 participants to rebel against the law. In order to solve the tension from having to support an institution that was detrimental to their own benefits they highlighted the positive outcomes of supporting it.

Finally, another potential explanation for our results may be that participants relate the F1R2 treatment to the familiar case of a protected area and find it acceptable, while in the M1R2 treatment participants do not have a real case to relate to and the implementation of a policy that is not the same for all but at the same time is not different for all raise fairness concerns and reduce pro-environmental behavior. Psychology's theory about social identity explains that the process of categorization (in-group or out-group definition) is achieved by a process of contrast: similarities within a group are accentuated while differences are minimized (Tajfel, 1969). The fact that the policies were very different and contrasting between inside and outside the priority area in the F1R2 treatment might have allowed participants to more easily accept that they were part of two different groups. However, in the M1R2 treatment, all participants shared the implementation of the reward policy, and this could reduce their perception of group division. If participants were not able to identify a clear difference between them and the other group, those who were under a fines policy might have felt under a more unfair situation, similar to discrimination. We asked participants in the post-experimental survey the reason why they found the policy implemented in round 2 as fair or unfair. By looking at the answers from those who found the policy as unfair we can find evidence of less resentment from participants in F1R2:

> Participants in M1R2 answered: "it is not fair because …"
> "… some were forced to conserve and others just did it for money"
> "… there were others who were getting paid for not doing it [cattle farming]"
> "… you paid them more while you took from us"
> "… there were others who were getting paid even if they did not conserve the forest"
>
> Participants in F1R2 answered: "it is not fair because …"
> "… we should all care for the environment and it's better if we do it under the same conditions"
> "… it is better all without fines, better rewards for everyone"

"… better equal for everyone"
"… it is better without fines, just by conscience"

In summary, our results suggest that practitioners should be careful while introducing PES both, inside or in the buffer area of PAs. The degree in which fairness concerns could play a role in effectiveness of the prohibiting policy could be related to the level of enforcement of the policy. For low levels of enforcement, participants could retaliate the policy because the risk of facing consequences is low. Nevertheless, when enforcement levels are high enough, additionality concerns emerge and implementing PES to compensate right of usage losses could not be cost-efficient. To conclude, we provided evidence of the importance of incorporating fairness into the design of environmental policies.

Appendix

Pre-experimental questionnaire:

- Intrinsic motivations

In a scale from 1 to 4, where 4 means that you completely agree and 1 that you completely disagree, how much do you agree with the following statements:

1. The people closest to you will get upset at me if I clear the forest
2. The people closest to you insist on that you do not clear the forest
3. Your neighbors will criticize you if you clear the forest
4. You do not clear the forest because you fear the fines from the environmental authority
5. You take care of the forest only If you get paid to do so
6. It is only worth not clearing the forest if doing so saves me money

- Perceptions towards sanctions

From the following options, which action do you consider the most efficient to punish those who harm the environment:

1. Jail or closure of establishment
2. Fines
3. Pedagogical sanctions
4. Punishments must not exist

Risk and inequality aversion

Distributions of the constant relative risk aversion (CRRA) coefficient as observed in Eckel and Grossman (2008 and as observed in our data.

CRRA (r)	E&G	Data
$r > 2$	4%	10%
$0.67 < r < 2$	16%	30%
$0.38 < r < 0.67$	33%	24%
$0.20 < r < 0.38$	23%	20%
$r < 0.2$	24%	16%

Distributions of disadvantageous and advantageous inequality as observed in Blanco et al. (2011) and as observed in our data.

Disadvantageous inequality (α)	Blanco et al.	Data	Advantageous inequality (β)	Blanco et al.	Data
$\alpha < 0.4$	31%	52%	$\beta < 0.235$	29%	3%
$0.4 \leq \alpha < 0.92$	31%	20%	$0.235 \leq \beta < 0.5$	15%	2%
$0.92 \leq \alpha < 4.5$	31%	27%	$0.5 \leq \beta$	56%	95%
$4.5 \leq \alpha$	10%	1%			

Differences between surveyed participants who participated in the experiment and those who did not

Comparing those who attended with those who did not, revealed some differences in characteristics. Those who did not attend are living in the community for less years (Mann–Whitney, p-value=0.0060), have lower perceptions of collective action in the community (Mann–Whitney, p-value=0.0167), trust less in environmental authorities (Mann–Whitney, p-value=0.0961) and their pro-environmental behaviour is less extrinsically motivated by rewards (Mann–Whitney, p-value=0.0585) (see appendix for more details). For this reason, caution should be taken when extrapolating our results.

Post-experimental questionnaire:

In a scale from 1 to 5, where 5 means that you completely agree and 1 that you completely disagree, how much do you agree with the following:

1. Agriculture and cattle farming will be prohibited in your farm in order to conserve the environment.
2. Agriculture and cattle farming will be prohibited in your farm in order to conserve the environment, and farmers who continue farming in their farms are fined.
3. Agriculture and cattle farming will be prohibited in your own farm in order to conserve the environment, and farmers get a payment to stop farming in their farms.

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