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Collective Local Payments for ecosystem services: New local PES between groups, sanctions, and prior watershed trust in Mexico

Alexander Pfaff[a,*], Luz A. Rodriguez[b,**], Elizabeth Shapiro-Garza[c]

[a] Sanford School of Public Policy, Duke University, USA
[b] School of Environmental and Rural Studies, Pontificia Universidad Javeriana, Colombia
[c] Nicholas School of the Environment, Duke University, USA

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ABSTRACT

Payments for ecosystem services (PES) programs are now high in number, if not always in impact. When groups of users pay groups of service providers, establishing PES involves collective action. We study the creation of collective PES institutions, and their continuation, as group coordination. We use framed lab-in-field experiments with hydroservices users and providers within watersheds participating in Mexico's Matching Funds program in Veracruz, Yucatan and Quintana Roo states. We explore the coordination of contributions between downstream users and upstream providers, plus effects of different types of sanctions that can affect expectations for both users and providers. Both information alone and sanctions raise contributions overall, although outcomes varied by site in line with our rankings of 'watershed trust'. For instance, monetary sanctions raise contributions in the watershed we ranked high in trust, yet initially lowered them for the lowest-trust watershed. This suggests that upstream-downstream social capital will be central to new collective local PES, while our overall trends suggest social capital can be raised by successful coordination over time.

1. Introduction

Payments for ecosystem services (PES) are voluntary contracts, between users of services and land managers who provide services, that specify transfers based upon service flows or related actions. Such agreements can arise voluntarily if both users and providers feel they will benefit sufficiently to incur transactions costs [1]. Establishing such contracts does involve significant costs: finding willing counterparts; coordinating on payments as well as the metrics to be used to measure the flows of services; and deciding how compliance will be monitored and enforced [23].

States can lower transaction costs and help with coordination in organizing new PES institutions. States also stand in for the users of services, as in the largest and best known PES (e.g., Costa Rica, Mexico, and China[1]). Yet state involvement in PES faces challenges. Payments are public costs that can be put at risk by overall budget reductions and shifts in priorities across political regimes. Further, states face high costs of monitoring and enforcement, particularly for rural forest frontiers.

Involving local users of ecosystem services can both costs of monitoring and local political risks. Local users also heighten the

* Corresponding author.
** Corresponding author.
E-mail address: alex.pfaff@duke.edu (A. Pfaff).

[1] That could include compelling providers to participate (even while compensating them), as some have described PES in China [78]. Here we focus on states' roles in contexts that are purely voluntary for all actors.

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focus on outcomes, i.e., truly conditioning payments on service flows or related actions. Overall, implementation costs may be lower, and payment effectiveness higher, due to involved users who are proximate to the forest relative to the state's limited local presence. Finally, local involvement may more generally allow PES designs to be adapted to local contexts, e.g., to focus on activities that are least costly upstream or that best fit local facts and institutions.

Even local services users, though, may face high costs of monitoring individual providers' actions and measuring any program's outcomes as well as baselines which are needed to estimate impacts. These issues motivate contracting with groups of providers [2] – which also can follow from collective tenure or property rights upstream. Using group or collective measures within such contracts can lower monitoring costs. States may more easily measure both baselines and ongoing forest or water quality at scales above the individual or the property level. Other examples of a focus on collective or group-performance instruments in environmental policy include ambient-based non-point source pollution control (e.g. Refs. [3,4], and the use of aggregate permits for natural resources [5]. For a much more general discussion of potential policies based upon group performance, see Kotchen & Segerson [6].

Yet it is unclear how the upstream providers of ecosystem services will respond to group contracts. As both services flows and institutions that generate them can be public goods that benefit many, one known hazard is free riding, i.e., doing nothing yet gaining from others' actions under contracts [7,8]. For instance, a provider upstream might not contribute to land-use changes required for services flows, or a user downstream may not contribute financially. The former might be addressed by upstream institutions, including those created within collective tenure regimes (Kaczan et al., 2017's results suggest upstream capacity to solve free-riding hurdles for the same program in Mexico). The latter might be addressed by downstream institutions, e.g., water utilities charging fees. Yet even if both of these local solutions arise, upstream and down, there remains a challenge of coordinating effort levels between upstream and downstream groups.

1.1. Mexican program

Mexico's National Forestry Commission (CONAFOR) has valuable experience with these issues. It implemented a national 'state pays landowner' PES program in 2003 that continues to this day. Multiple studies discuss its origins, function and outcomes [9–11]; and [12] as well as 2015) and find on the whole relatively little conditioning of payment on higher ecosystem service flows. That is very consistent with national-level findings for a similar state-led national PES program in Costa Rica (see, e.g., Refs. [13,14]. That Mexican and that Costa Rican PES program also have both been vulnerable to shifts within broad political and economic forces that can threaten program budgets and, ultimately, viability [10,15].

To support development of local PES initiatives, with involvement of users, in 2008 CONAFOR started a Local Payments for Ecosystem Services Mechanisms through Matching Funds program (*Mecanismos Locales de Pagos por Servicios Ambientales a través de Fondos Concurrentes*), i.e., "Matching Funds". In this program, CONAFOR matches up to 50% of the funding committed by local users. Strong interest and involvement by downstream users are central to this program's 'theory of impact'. All applications must include up-front financial commitments from the users.

Because there are often numerous downstream users or ecosystem-service beneficiaries in such situations, these PES initiatives often require local organization and collective action downstream. Upstream collective action also is often required: an estimated 60% of the forested land in Mexico is under collective title in *ejidos* or indigenous communities [16] − and [17] find that the great majority of the enrolled properties in the national PES program 2004–2010 were under collective title). Thus, often upstream groups already have confronted and are likely to have significant experience with the challenge of martialing groups for effective collective action.

1.2. Experiment & results

In sum, for PES in Mexico and elsewhere, involving local actors can raise the salience of services flows to users and can lower the cost of monitoring those flows. Yet, even with perfect institutions at each end of a watershed, upstream-downstream coordination is a challenge. Creating new local PES can, therefore, usefully be considered as a between-group coordination or 'assurance' game: each group will gain if the PES works (assuming a price exists that is below users' gains yet above providers' costs); yet contributing is pointless if one believes the other group will not also do so.[2]

Creating and sustaining PES has significant costs, including time required for building consensus and new processes and institutions, then all of that again if shocks occur. Since effort is pointless if it is at only one end of the watershed, expectations are critical for contributions. We model PES interactions as an assurance game between these two groups. Any one group (upstream providers or downstream users) will lose out from contributing if the group at the other end of the watershed contributes little. Yet it does not lose if the other group contributes a lot. Whether contributing is rational depends upon one's belief about the other group. The problem is one of 'mutual assurance' [18]. Critically, there exist high (efficient) and low (inefficient) symmetric equilibria.

What shapes groups' expectations of each other should be a focus for design and implementation of local PES. Perceptions at one end of a watershed concerning the other end obviously are critical. It matters not only if there exists trust between upstream providers and downstream users but also whether each group thinks the other handles internal free-riding effectively to function as a group. Evolving 'watershed trust' is a central focus within this study in multiple ways: we conduct surveys and post-games group discussions,

[2] [42] highlights a 2nd-order collective action dilemma: a new institution is to solve an incentive problem but its creation faces incentive problems. On rationality of cooperation given others' cooperation, see Skyrms [74].

to explore attitudes and perceptions (at the individual level and the group level, as well as the watershed scale); we implement Trust games between individual upstream and downstream participants (also framed around PES), before our assurance games; and we study the dynamics with (non-) monetary sanctions on providers for insufficient contributions.

Our interest in sanctions follows from our belief that there is low 'additionality' in PES schemes, i.e., little conditioning of payment on services, and thus services do not rise relative to the baseline. Sanctions, such as cutting payments for a lack of action, can be one way to increase conditioning. Yet external, judgmental interventions might produce anger instead of increased service provision. This tension highlights the value of experiments with field populations. While we could not alter CONAFOR's actual PES policy design to test speculations about reactions to possible sanctions,[3] experiments let us work with the agency to simulate the behavioral impacts of potential policies by randomizing possible variations upon local PES structures – with the relevant field populations.

We find that few groups in our experiments start at high or low equilibria, yet many move toward social optima (i.e., efficient high equilibria) over time, in accord with payoffs from coordination. We find that site conditions matter: upstream-downstream trust perceptions vary and align, by site, with both baseline (pre-sanction) assurance behaviors and the impacts of our sanction treatments. Monetary sanctions raise contributions by upstream provider for our highest-prior-trust site, yet the same sanctions initially lower contributions by downstream users within our lowest-trust site.

At an individual level, we find that having gotten a sanction leads providers to raise contributions. Further, after initial rounds which can include negative reactions, both information provision alone and our sanctions treatments raise overall contributions from both the user and the provider groups. Thus, our results suggest that for institutional settings that require collective action between users downstream and providers upstream, upstream-downstream social capital is central to local PES creation and function − plus it can be built through success, even if successes required sanctions. Both prior 'watershed trust' and sanctions can act as assurance tools which align key expectations.

Sections 2 and 3 review literature and the development of PES in Mexico. Section 4 presents our sample, motivation for, and details of our upstream-downstream assurance game (framed as local PES). Section 5 then describes our results in detail, while Section 6 provides additional discussion.

2. Related literature

Voluntary contracts for clear services ([19,95]; resemble Coase (1960) [1] response to Pigou. Socially inefficient externalities can be resolved by bargaining to transactions, if property rights are defined and enforced while transaction costs are low [20].

That sounds simple − yet, in practice, the design and implementation of PES have not been simple. In fact, it is difficult to link specific actions by providers to the flow of ecosystem services [8,21], given scales and biophysical complexities [22]. Compliance, additionality, temporal permanence and spatial leakage are immense challenges too. Returning to Coase, also transaction costs can be high [21]. As noted above, all of these challenge could suggest gains from state roles within PES [22,23].

However, as noted above, there are clear ways in which the involvement of local individuals and groups might improve outcomes. It can lower political risks, both by lowering federal dominance of program support and by fostering a sense of local 'ownership' of all the agreed arrangements. Certainly it can lower costs of monitoring. Local users may also heighten the focus on outcomes, making payments more strongly conditional on services or related actions from which they benefit. Finally, as noted in literature on potential benefits from decentralization [24], involvement of locals may allow PES designs to be adapted to local contexts, e.g., with activities that are least costly or fit institutions upstream. Altogether, then, payment effectiveness can rise given users in closer proximity to forest frontiers − relative to the state's often limited presence.

2.1. Local collective institutions & payments for ecosystem services

State versus direct-user financing is a key PES dimension. In user-financed PES, buyers are actual users of ecosystem services – more like 'a Coasian ideal' − while in government-financed PES, the buyer is a third party acting for users. Users have clearest incentives to ensure that services are actually delivered. They may also be able to directly observe the delivery of services and, if it fails, be able to end PES [25]. Wunder et al. [21] find user-financed programs better targeted, more locally adapted, better monitored, and more likely to enforce conditionality.

In practice, varied public, private and hybrid PES institutions exist − which can be closer to market transactions, government subsidies, or social agreements for collective action around public goods. While all PES use transfers between actors to align individual and social incentives, they vary in emphasis upon social elements: values, perceptions, relationships, power and politics [26,27].[4] Variations are clear in local PES ([28–31,93]; including with regard to upstream-downstream conflict resolution plus trust, fairness and social motivations [15,32,33] − raising the issue of whether PES reduce or even enhance related intrinsic and social motivations [34,62]).[5]

[3] CONAFOR has not emphasized sanctions within PES, consistent with PES globally not insisting on additionality. We note that sanctions have occurred, though, in the Monarch Butterfly Biosphere Reserve [98].

[4] There is great variation. Wunder et al. [21] distinguish the Sloping Land Conversion Program in China, with over 12 m ha and a central government buyer, from the Los Negros watershed program in Bolivia which covers ~3k ha with variety of actors (including municipalities, NGOs) as the demanders negotiating agreements with the upstream actors.

[5] Underlying this idea is a psychological notion of intrinsic versus extrinsic motivation [79]. There is ample literature for situations such as blood

Collective contracts can help coordinate landowners over large areas and reduce transaction costs of verification and payments [2]. This could improve performance (see Ref. [35] meta-analysis of 47 watershed schemes with 17% community contracts), although social capital and trust are critical for better participation and function [36], given roles for local social norms[6] and neighbors' decisions [37]. PES design could, in turn, help to build local social capital (for evidence in Mexico see, e.g. Ref. [38], that helps to address other group challenges [22,39].

Participation, cooperation and coordination are highlighted in common-pool resource management [40–42], with insights for PES design [43,44]. Conceptualizing the provision of ecosystem services in part as social dilemma, rather than solely an externality issue for which market instruments are sufficient, can facilitate local roles within hybrid structures in which monetary incentives are just a part [45].

2.2. Economic experiments

2.2.1. Social dilemmas, cooperation & coordination

Noussair and van Soest [46] review two uses of economic lab experiments on environmental policy. First, as a 'test bed' for market mechanisms, such as for water or pollution permits. Second, to explore social dilemmas in providing public goods and extracting common-pool resources (e.g. [42,47,48,72]). For the latter, the focus has been the identification of conditions in which self-regulation and cooperation occur, including the specifics of policy design (and taking into account possible motivational crowding[7]).

Some such conditions produce coordination challenges, as in the assurance game [18,49] with efficient and inefficient equilibria. We want to employ assurance – rather than pure coordination between equally valued equilibria[8] – because having a functioning new, local PES institution Pareto-dominates an equilibrium of non-contribution, i.e., both groups fare better. Yet there is a risk in contributing to creating new local PES institutions if others do not contribute; thus, as in the assurance structure, the non-contribution (inefficient) equilibrium is risk-dominant. Compared to being in a prisoners' dilemma, achieving the efficient high-contribution equilibrium seems less demanding, even given the risk of being the only contributor. Yet coordination involves expectations, often a function of prior interactions and institutions. Camerer [49] finds that in assurance, failure is common, i.e., play often does not converge to the Pareto-efficient equilibrium.

Games requiring threshold levels of contributions to generate public goods have been widely used in laboratories with standard student subjects and abstract framing (as opposed to field settings). They require a minimum level of contributions to trigger the provision of the public-good reward, from which all benefit. Marginal benefits of contributions are zero up to the threshold. Then, at the threshold, it is beneficial to cooperate. Above the threshold, defecting again is a preferred strategy.

Experimental literature mainly explores coordination challenges for different institutional designs [50–52]. Coordination upon an efficient equilibrium is highly dependent on institutional features but it can be 30%–40% [53,54,55,96]. When coordination devices are employed – e.g., money-back guarantee (e.g. Ref. [50], or various forms of communication [56] – success rates increase significantly.

2.2.2. PES experiments

PES experiments can consider designs not yet observed[9] and permit the exploration of motivations [57,58]. Payments may raise efforts if norms of communal work are absent [59] – and perhaps by more when coupled with a 'nudge' [60]. Collective contracting in PES is an understudied element. Kaczan et al. [61] take PES as given – i.e., do not focus on institutional creation by upstream and downstream groups, as we do here – and employ an upstream public-goods game facing PES incentives, with incentives to free ride. In watersheds involved in the same Mexican PES program we study here, they find that groups solve this challenge. That implies greater impacts when the PES contracts demand greater additionality. They also find better outcomes when players can participate in rule making and when mechanisms such as the availability of non-monetary sanctions within a community can facilitate cooperation.

(*footnote continued*)

donation, civic engagement, and punctuality of parents in picking up children from day care (see, e.g. Refs. [69,70,80,81].

[6] Social norms are shared understandings of how individual members should behave in a given circumstance. People within a community reward or punish people for their behaviors in following or breaking the rules [37].

[7] Changes in motivations due to interventions with economic incentives have been for common-pool resources and public-goods games. Cardenas et al. [47] find extraction is closer to the selfish Nash solution when a fine is imposed. Vollan [82] showed that a supportive intervention (e.g., reward) does not crowd out initial cooperative motivations while restrictive external interventions (e.g., punishment) may, especially for situations with substantial trust and social norms in the community. Kolinjivadi et al. [83] observed that pre-existing social norms and tradition explain baseline cooperation, while collective monetary incentives and individual image-based incentives boost cooperation. Most results do not support 'crowding out' of intrinsic and social motivations [34,84], though incentives may reduce motivations of those excluded if that is considered unfair [85]; 2016).

[8] Coordination games can be matching games, games with asymmetric payoffs and games with asymmetric equilibria [49]. In matching games, all equilibria have the same payoffs for each player. In games with asymmetric payoffs, players disagree about which equilibrium is best (e.g., 'battle of the sexes'). In games with asymmetric equilibria, players are symmetric but payoffs for efficient and inefficient equilibria are not (e.g., assurance games).

[9] PES experiments also have considered auctions to reveal private information to reach more cost-effective allocations among landholders (e.g. Refs. [86–88] and Jindale et al. [89] use auction results and household data to simulate tradeoffs between cost-effectiveness and maximizing participation by poor households.

As Kaczan et al. [61] find success in this setting, in overcoming free-riding problems upstream to supply services, we assume functioning institutions at each end of a watershed and instead focus on the coordination between upstream and downstream groups to create new collective local PES.

Collective payments can crowd out social norms, given the free-riding potential in collective action [57,58]. On the other hand, success with collective incentives can enhance social motivations, even when individual incentives do not [62]. For this same setting, in fact, Kaczan et al. [61] find if anything a 'crowding in' of contributions by PES.

[63] and Cardenas et al. [64] use Trust games [65] to mimic a PES relationship between upstream and downstream. Jack [63] finds removing an intervention lowered transfers, relative to the situation without enforcement at any point. Cardenas et al. [64] focused on initial trust levels, finding lowest levels among the downstream users in considering upstream providers. We also focus on upstream-downstream interactions, with groups at each end of the watersheds. We employ an assurance game with efficient and inefficient equilibria – unlike most prior work. Moreover, rather than considering coordination by individuals, we explore coordination of groups.

2.2.3. Peer sanctioning

Sanctions allow less drastic signaling than a collapse of cooperation. Participants express prosocial motives by condemning negative behaviors or rewarding cooperation [66], aiding cooperation [67,68] by reinforcing reciprocity and fairness, signaling prosocial motives, and activating shame or other social preferences [69,70]. Field and experimental evidence find that conditional cooperation and costly punishment of free riders are key for collective action (e.g. Refs. [42,71,91]) especially if greater deviations from cooperation lead to heavier sanctions [67,68].

Sanctions need not be monetary. Expressions of disapproval can boost cooperation [48,61,72]. Non-monetary sanctions have a monetary cost only for sanctioners – and thus they are more efficient in situations in which they are equally effective. Yet they may have less effect over time [48,66,72]. Our coordination is between groups and adds sanctioning of upstream, mostly from downstream. This novel inclusion – relevant for real PES – allows us see: whether our downstream participants are willing to invest in signaling upstream participants, while simultaneously contributing to PES; and whether upstream participants in turn respond to sanctioning by increasing their contributions.

3. PES in Mexico

3.1. Government-financed national PES

Mexico's federal payments-for-ecosystem-services program was started in 2003, as a response to water scarcities and deforestation. Communal or small private landholders sign 5-year contracts with CONAFOR to conserve enrolled forest lands in exchange for a per-hectare annual payment. If deforestation is detected, CONAFOR reduces the payments, proportional to the hectares lost. CONAFOR data indicate that 8969 contracts enrolled 6,310,344 ha between 2003 and 2016.

Key factors in eligibility involve supply and demand (e.g., being upstream of a population center) [11]. Smallholders can enroll yet the majority of suppliers, and land area, are from federally-recognized communal properties which include *ejidos* and indigenous communities [17]. Enrollment is by the democratic governing bodies of these communal properties [10]. Those involved make required forest-management plans, from a menu of activities: firebreaks; patrols to prevent illegal logging; fencing to exclude cattle; pest control; and soil conservation. The program has prioritized sites with high poverty and high percentages of indigenous populations [17].[10] The national PES program has been funded to date by federal revenues from water fees, with few initiatives evolving into local and user-financed PES [11,73]. Yet funding has varied with budgets and priorities.

3.2. Federal facilitation of local PES

In response to the lack of development of user-financed initiatives from the national PES program, in 2008 CONAFOR created the innovative Matching Funds PES program. Its novel objective is to incentivize and support the development of the new institutions necessary for local PES initiatives. CONAFOR partners with a local organization (e.g., an NGO, water utility, hydroelectric company, municipal or state government) and matches the funding that users committed to pay the providers. The partners select users and providers, find and manage the funds and, largely, monitor the results.

The great majority of Matching Funds initiatives involve hydrological services. Users have varied (e.g., bottling plants, irrigators, state and municipal water utilities, hydroelectric and mining firms). CONAFOR data from 2008 to 2016 indicate 157 total agreements with partners who have, in turn, developed 2061 contracts with communal and private landowners that enrolled 515,454 ha.

Requirements for lands getting CONAFOR funds are similar to those in the national PES program. However, partners can impose distinct standards for areas being paid through funding from users. In those areas, local partners can pay higher rates, target land and land use of particular local value, and require different management activities than CONAFOR. This flexibility allows the program to be adapted to local conditions and needs. Unlike the national PES program, the Matching Funds program also allows that some of the

[10] Alix-Garcia et al. [90] found that even though there is generally a trade-off between poverty reduction and avoided deforestation, the situation in common-property lands is different. Compared to individual properties, the program is more effective in avoiding deforestation in common-property and still has positive effect on poverty reduction.

monitoring of activities that are undertaken by the providers, and some of the sanctioning for non-compliance, be done by local partners on behalf of the users.

4. Coordination to create collective local PES

In a 'stag hunt' – assurance – game [74], a hunter can put in effort to help catch a high-value stag, yet whether others will help is uncertain so it may be rational to hunt small prey alone, yielding a lower but certain value. If sufficient others help, so the group can succeed with the stag, it is rational for each to help. Either effort or defection could be rational, depending upon beliefs [18]. One symmetric Nash equilibrium is Pareto dominant and efficient, in which all are fully contributing. Another is inefficient, where none contribute. The latter is risk dominant, since it minimizes players' joint risk [49]. As expectations are central, and based on the past, equilibria can be self-reinforcing: reaching the Pareto-dominant equilibrium depends on prior and updated expectations of others' trustworthiness. If achieved, that may be repeated [18]. Generally, any tools that can influence beliefs clearly can affect the ongoing levels of cooperation.

4.1. Assurance games

Our assurance game was inspired by the design of CONAFOR's novel Matching Funds program.[11] Building a new, local PES can be represented, we believe, as a between-group coordination game: both users and providers are better off if the institution is created and functions; yet organizing one's end of a watershed is pointless if one does not think that the other end can and will do so too. Given PES institution, payments are not productive if cooperation breaks down upstream and thus behaviors do not shift, while costly upstream shifts to create services are not productive if users downstream fails to collect funds so payments end. If the other group does not do its part, then the payoffs from effort are negative. This interdependence makes beliefs about the other end critical.

In our field-lab experiment, each provider and each user decide how much effort to contribute. No player receives direct benefits from their own group's contributions. Instead, individuals' earnings rise with the other group's total contributions, while falling with one's own level of contributions – unless the other group has high contributions, in which case one does not lose from contributing. As noted, and distinct from standard public-goods provision, there are multiple equilibria here: defecting could dominate; or full contribution may remain stable. We cannot predict contributions. We can expect that higher contributions by another group will raise expectations and contributions.

In our game, each participant in each group chooses to contribute 0, 1, 2 or 3 units of effort to PES (recall that we used an explicit frame of PES). Contributions by providers are represented as trees, i.e., changes in land use that raise tree cover, while contributions by users are represented as coins, i.e., payments that flow to upstream providers. All participants make decisions simultaneously.

Table 1 shows payoffs as a function of one's own contribution and the average contribution at the other end of a watershed (Appendix 1 shows the materials that were actually used out in the field). Each person chooses between 0 and 3 units of effort. Groups of 5 users and groups of 5 providers are randomly matched. Thus, the total contribution by any user or provider group ranges from 0 to 15. In Table 1's upper left cell are the payoffs due to zero effort by users and zero effort by providers (i.e., no payments and baseline land use). Moving to the right, each cell represents increased efforts to conserve trees upstream. Moving down, each cell represents greater contributions to payments by downstream users. We used ranges or intervals to make this table simpler for field participants.

There is an equilibrium at all zeros, i.e., no contributions, and a cooperative equilibrium with full contributions. Neither is dominant, as the best choice depends on expectations of others. As above, we highlight our across-watershed focus: the payment of an individual participant does not depend on their own group contribution but on the collective contribution of the other end of the watershed. Again, taking as given the institutions upstream and downstream, we are focused upon the creation of a new upstream-downstream institution that requires coordination for sustenance of ecoservices.

As we think often occurs in PES, upstream and downstream actors decide how much effort to put into the creation and continuation of an institution that can benefit both groups. Once PES exists, each year downstream users sign contracts with upstream providers. Yet as PES are very often not highly conditional, users do not have great information on flows when they make their payments. Over time, at least proxies for direct measures are available. Our game models this through rounds.

4.2. Trust games

In the same experimental sessions, before assurance games, we anonymously and randomly paired each provider with an individual user for a Trust game [65], framed in terms of PES. Each player had no information other than their partner's location, i.e., upstream or downstream. Each was endowed with eight tokens. First movers decided how many tokens (s = 0 to 8) to send. That amount was tripled by the experimenter, so that second movers had their initial eight tokens plus three times the amount (s) sent by the first mover. They then sent back between zero and $8+3s$.

First-mover decisions were made without knowing that a second-mover role would follow,[12] with random assignment to one role

[11] Similar dynamics could arise within a gift-exchange game [67,68] in which a contribution by one group may be reciprocated. It is sequential. We think assurance mimics better local PES in which decisions in each group are made without being certain about the other group's total contribution, while contributions evolve over time across rounds. Yet a sequential version of our group-group coordination experiment could be an institutional variant.

Table 1
Group assurance game.

Contribution by individualin Group 2	Contribution by individual in Group 1			
	0	1	2	3
0–2	**9**	**6**	**3**	**0**
3–7	**10**	**8**	**6**	**4**
8–12	**11**	**10**	**9**	**8**
13–15	**12**	**12**	**12**	**12**

If Group 1 is the providers (users), then Group 2 is the users (providers). Group 1 individuals' payoffs are a function of own contribution and the total contribution of Group 2. Each individual in Group 1, say, chooses 0, 1, 2 or 3 units of effort. Participants play in groups of 5 users and 5 providers, always randomly matched. Thus, the sum of total contributions of Group 2 must range from 0 to 15 units. The value of each point was MXN$10 (one Mexican peso is about 0.05 dollars).

to calculate earnings (role-reversal with random rematching [75] for payments purposes). After first-mover decisions, participants were asked how many tokens they expected in return. For our analysis, we only use decisions as 1st movers, plus the expectations about what will be returned. We do not use 2nd-mover decisions, given a focus on expectations or trust (i.e., not trustworthiness). We also collected perceptions of inter-group (upstream-downstream) and intra-group trust in surveys, post-games group discussions and qualitative observations. Our site descriptions (subsection 4.5) focus on the trust perceptions.

4.3. Information & sanctions

We explored policy interventions to maintain local PES institutions and to increase contributions. Sanctions can be signals of dissatisfaction, e.g., in the 'matching funds' program non-compliance could be sanctioned by a reduction of payments, as decided by CONAFOR or by the local partner. In our experiment, the largest sanction could enforce a lack of contributions, so all are worse off. That is analogous to not having a new local PES institution: either a new mechanism never started; or it started but then was cancelled, as the largest possible sanction, which has happened in reality.

After an initial baseline round played (as described in subection 4.1), we played three additional rounds in which we gave information to all participants concerning individual choices of providers. Beyond that information, which everyone always had, our treatments are three types of sanctions. To estimate impacts of sanctions, we compared each sanction treatment to information alone, i.e., to sessions in which information about provider choices was provided but there were no sanctions. We focus treatments on providers as, within PES, payments are conditioned on provider behavior and imposed by users. Our sanctioning treatments are intended to explore whether some sanctions can be useful, for cases of upstream non-compliance, in avoiding the total cancelation of payments:

- *Information on the Behavior of Providers:* anonymously list the actions of all the providers for all participants to see (and anonymity is achieved via random assignments of pictures). The groups who were randomly assigned to this treatment functioned as our control groups.
- *Providers-Providers Nonmonetary Sanction:* after seeing individual choices by providers, for a financial cost (MXN$1) providers could send a red card to disapprove of a provider; if any were sent, then the facilitators displayed the red cards received by each participant.
- *Users-Providers Nonmonetary Sanction:* after seeing the individual choices by providers, for a financial cost (MXN$1) any user could send a red card to disapprove of any provider; if any were sent, then the facilitators displayed the red cards received by each participant.
- *Users-Providers Monetary Sanction:* after seeing all of the individual choices by providers, for a financial cost (MXN$1) any user could monetarily sanction a provider as disapproval (again anonymous via use of random pictures). The cost of being sanctioned was MX$3.[13]

Expectations are critical. If users expect to send sanctions which raise contributions by providers, users who sanction should increase contributions – a virtuous cycle of strategic complementarities. Yet if users think sanctions exist since providers are not trustworthy, they will lower contributions.

4.4. Recruitment & implementation

After a field pilot – in Coatepec in Veracruz State – we conducted experiments in three sites where the Matching Funds program had been implemented, recruiting 240 users and 240 providers (80 each per site). Sessions had 10 users and 10 providers, meeting

[12] In the strategy method, with respondent decisions for each possible offer by the 1st mover. Thus our 2nd movers do not know the 1st movers' decisions but decide for each hypothetical choice (from 0 to 8 tokens) made by a 1st mover.

[13] A 3:1 fine-to-fee ratio is widely used in sustaining contributions [91,92].

Table 2
Participants (10 per group), by site, by treatment.

	Provider Information Alone	Up-to-Up Nonmonetary Sanction	Down-to-Up Nonmonetary Sanction	Down-to-Up Monetary Sanction
Veracruz	80	40	40	–
Yucatan	40	–	60	60
Quintana Roo	40	–	60	60
Total	160	40	160	120

simultaneously in different places. Providers are inhabitants of communal properties enrolled in the PES, where they gathered. Users live and gathered in cities that receive services produced by those upstream communal properties: Xalapa, Veracruz; Cancun, Quintana Roo; and Merida, Yucatan. Upstream and downstream sites are separated by over an hour of driving. All the recruitment was done by the local NGOs involved in the Matching Funds program, in each of these sites. Invitations were extended through word of mouth, as well as through advertising in NGOs' headquarters and other local venues (in Xalapa, at the office of the water utility). All of the adults who showed-up were accepted into the sessions.

The facilitators were researchers from Duke University and staff from the NGOs. For consistency, a single experimenter led all the sessions with providers, while another led all sessions with users. Users and providers interacted through facilitators, via cell phone calls. Treatments followed the logic within Table 2, which reflects our downstream-upstream focus. We employed less upstream-upstream sanctioning (noting that it has been considerably more studied in the existing literature).

For the Trust games, the anonymity was assured using randomly assigned identification numbers also used for upstream-downstream matching. After Trust games, although without their results, participants played our assurance games. Each group was anonymously matched with one group at the other end of the watershed, using the (random) color of identification-number cards. After the baseline assurance round, i.e. the initial round with no treatments (information or sanctions), participants in all treatments played three more rounds in which all participants received all of the information about providers' behavior within each treatment − again always with full anonymity.

Decisions were made simultaneously. We did not provide the baseline results so that we could test reactions to treatments alone, in the round after the baseline, without reactions to baseline results. Results of trust games and assurance baselines were communicated after all decisions were made, at session's end. Contributions during the treatment rounds were communicated after each round.

We played only a few rounds because the logistics of the experiment were very challenging, as it required upstream-downstream communication where the cell phone signal was poor. In addition, due to lower education it took some time to play upstream. Each session lasted about three hours.

Given multiple sessions per location, to avoid the risk of communications from all those who had already participated we shifted villages, once per day, for upstream participants. For downstream, participants were invited to participate through different means, including word of mouth, and the games were always in the same venue. In the regressions, we have included controls per session.

4.5. Sites

For our framed experiment, we chose three sites for experiments during the summer of 2014, after consulting with CONAFOR and visiting 12 Matching Funds sites in mid-2013: one site in the state of Veracruz, led by the NGO SENDAS; one in the state of Yucatan, led by the NGO Niños y Crias; and one in the state of Quintana Roo, led by the NGO Amigos de SianKa'an. A primary selection criterion was that there be multiple services users and multiple providers, unlike when single large actors such as the state or a downstream utility as a user, or an upstream landowner as a provider, can decide with no collective action required. Our experimental design explicitly matched reality.

We complement experiments with surveys and post-games group discussions with the participants in order to get contextual information on both the individuals and the site to inform interpretation of experimental results [76]. Characteristics of participants, by site, based upon surveys and baseline choices in the trust and the assurance games, are summarized in Appendix 2. Below, we highlight contrasts across the sites based on surveys and post-games group discussions.

For instance, while *ejidos* in the case of Quintana Roo have not been divided into individual plots, in Yucatan and Veracruz cases the property rights have been partially individualized, following a 1992 constitutional reform [94]. Yucatan and Veracruz *ejidos* also face larger financial opportunity costs of conservation than in Quintana Roo. While most of the Quintana Roo and Veracruz providers participating in our experiments are *ejidatarios*, i.e. have property rights, most Yucatan participants do not have but are allowed to live within the *ejido*. This is reflected in the *asambleas*, i.e., meetings of all those with rights in *ejidos,* where decisions about community governance and communal lands are made. *Asamblea* participation was higher in Quintana Roo (at an average of 7.91 meetings), with a rate of attendance of 90% of the assemblies on average.

Most providers in Quintana Roo and Veracruz spend 1–2 days per month on forest management. Most participants in Yucatan are not in community groups and 40% are not actively involved in forest management. Involvement in community organizations is higher in Veracruz, with 60% of our participants devoting, on average, a solid 17.5 h per month to community activities. Intra-community trust is generally higher within Quintana Roo and Veracruz than it is in Yucatan: while ~80% of participants in Quintana

Roo and in Veracruz stated that they can trust most people in their community, the share is significantly lower in Yucatan (55.3%). Upstream-to-downstream trust also is higher within Quintana Roo, where 72.6% of providers think they can trust most people within the city, well above Veracruz (38.4%) and Yucatan (35.1%). Generally, historical tensions between users and providers were more evident in the post-games groups' discussions in Yucatan, where some providers stated that the city is buying up but underpaying *ejido* lands to ensure water provision in the long run, leaving those *ejidatarios* in relevant locations with no land and no water.

Users' perceptions of environmental issues − and their causes − also contrast sharply across sites. While 50% of Veracruz participants believe that there exist serious issues of local water scarcity, only ~16% perceived local water scarcity in Quintana Roo and Yucatan. Water quality issues were noted in post-games group discussions in Quintana Roo and Yucatan. Yucatan downstream users said they distrust upstream providers, blaming them for a fall in water quality and more generally expressing doubt about provider commitment to forest conservation (Yucatan users said providers 'in the jungle' are responsible for the reduction in the city's water quality), while Quintana Roo downstream users expressed that their upstream providers do comply with forest conservation − once they have committed to it for payment. These results coincide with the downstream-upstream trust reported in the survey: while ~80% of downstream users in Quintana Roo think they can trust most people upstream, that share is ~70% in Veracruz and Yucatan. Users in Quintana Roo also report higher willingness to pay the providers for ecosystem services than users in the other sites (at US$111.3 per year in Quintana Roo, versus US$22.0 in Veracruz and US$35.5 in Yucatan).

In sum, we find differences across space in levels of prior upstream-downstream 'watershed trust', within both the survey data (above) and qualitative data including post-games group discussions. From our interpretation of the data, we identify an upstream-downstream "apparent trust gradient" across the sites: Quintana Roo has the highest prior level of upstream-downstream trust; Veracruz has intermediate prior trust level (or perhaps 'ambiguous', based upon the information we have); and Yucatan has the lowest prior trust. This perceived gradient, as well as Trust game results, allow us to explore effects on assurance contributions of perceived 'watershed trust' among users and providers. We believe upstream-downstream trust should affect not only average contributions but also, in principle, the impacts of having any sanction available for signaling dissatisfaction. As noted above, how the option of sanctions affects expectations could vary considerably by group.

5. Results

5.1. Assurance contributions (separating watersheds) in baseline (before any mention of sanctions)

Yucatan had the lowest contributions by providers in group-group assurance baselines (Table 3). Among the users, once again the Yucatan participants contributed least. Quintana Roo, in contrast, had the highest contributions among the users as well the providers (note that those Quintana Roo provider participants included some men quite familiar with PES as longstanding *ejidatorios*). In total, by watershed, contributions averaged: Quintana Roo (2.21); Veracruz (2.1); Yucatan (1.85). Thus, these baseline contribution levels align with our perceived 'trust gradient' across watersheds. Also, the number of tokens sent in the initial Trust game, as well as the expected return, had some predictive power for users' assurance baselines (Appendix 4, pooled or by site, showing stronger effects in Veracruz and Quintana Roo but not focused on differences in trust across watersheds).

Table 3 also shows the share of participants making each possible choice, by site and role. While the equilibria are zero and three units, two is the modal contribution for both users and providers, perhaps reflecting uncertainty about others' choices. Table 4 shows that over half of the upstream-downstream pairings of groups are in the (8–12, 8–12) cell, i.e., (2,2) on average − whose payoff is no more than the zeros equilibrium but whose downside risk is lower than contributing three units. Since within our relatively challenging assurance game the highest payoff from raising one's own contributions is zero, the baseline contributions seemed relatively high. We speculatively link this to both a predilection toward and exposure to local PES, as our sites participate in Matching Funds. Given such prior experiences, we might expect our games to start with relatively high cooperation.

5.2. Sanctions' impacts (pooling watersheds) on assurance contributions across rounds

Options for some actors to sanction upstream participants are announced after the baseline decision (Round 0) but before participants make Round 1 decisions. Thus before Round 1 all are aware that some actors will have the option to impose a sanction on

Table 3
Assurance baseline choices.

	PROVIDERS			USERS		
	Yucatan	Veracruz	Q.Roo	Yucatan	Veracruz	Q. Roo
Zero (%)	6.25	5.0	5.0	0	1.25	0
One (%)	43.75	30.0	18.75	11.25	8.75	7.5
Two (%)	40.0	32.5	37.5	61.25	51.25	52.5
Three (%)	10.0	32.5	38.75	27.5	38.75	40.0
AVERAGE CONTR'N.	*1.54*	*1.92*	*2.1*	*2.16*	*2.27*	*2.32*
# obs	*80*	*80*	*80*	*80*	*80*	*80*

Table 4
Assurance baseline outcomes.

	Providers' Total Contributions			
Users' Total Contributions	0–2	3–7	8–12	13–15
0–2	0%	0%	0%	0%
3–7	0%	0%	0%	0%
8–12	0%	22.9%	52.1%	8.3%
13–15	0%	0%	14.6%	2.1%

any participant upstream, after Round 1. Sanctions would be based on upstream individuals' contributions in Round 1, which after the round will be listed for all to see (albeit anonymously) as the core information we always made available. Any impacts of sanctions upon Round 1 are due to the threat, not to having received any sanctions. For Rounds 2 and 3, though, players could also react to having received, or sent, some sanction(s).

Fig. 1 shows provider choices before (Round 0) and after sanctions are announced (Round 1), and implemented (Rounds 2 and 3). We see that, on average, all treatments raise providers' giving. We note that while treatment assignment was random, treatments varied in baseline contributions. Thus, to best perceive the impacts of the treatments, we need to assess not just endpoints but slopes: through repetition, a larger percentage of participants tend to move towards the optimum of three. This can be seen also in Appendix 3 where we report the distribution of choices per round and site. Fig. 2 shows users' choices before (Round 0), plus after sanctions are announced (Round 1) and implemented (Rounds 2 & 3). Again, giving rises with treatments, even with initial negative effects (again more details are in our Appendix 3, where we report the all the choices per round and site).

What we take away from Figs. 1 and 2, beyond the overall increases in contributions over time, is that there existed considerable differences between responses by upstream providers and those by downstream users, across the rounds, as our information and sanctions treatments played out.

This is confirmed in Table 5's regressions. On average, across the watersheds, providers and users varied in reactions to sanctions (consistent with average differences in baselines in Table 3 above). In short, average provider contributions responded positively if sanctions were available, and used, while average user reactions to having and sending sanctions were, if anything, initially negative.

Tables 5's first three columns compare individuals' Rounds 1, 2, 3 with their Round 0 baselines. The last two columns analyze contributions' changes, [Round2 - Round1] and [Round3 - Round2], to allow a focus upon who received or sent sanctions (once we control for sanctions that occurred, however, coefficients on the treatments themselves are harder to interpret than in initial columns).

Table 5A shows that, on average, providers responded positively to sanctions. By the 3rd and final round, each type of sanction ended up with higher contributions, relative to baseline, than did the information-alone treatment. All coefficients are positive and, across the three sanction treatments, they increase in both magnitude and significance when looking at the 3rd round versus the 1st

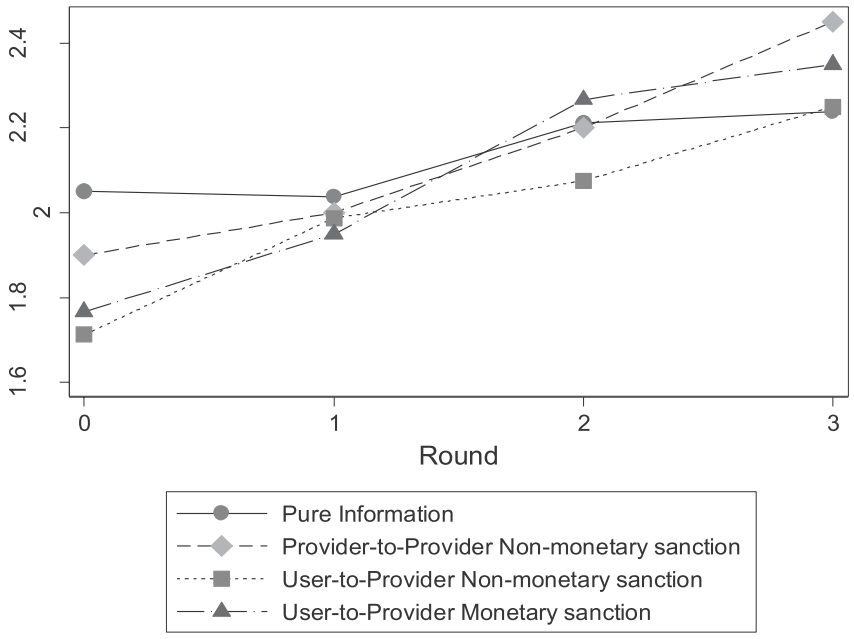

Fig. 1. Upstream providers' assurance contributions.

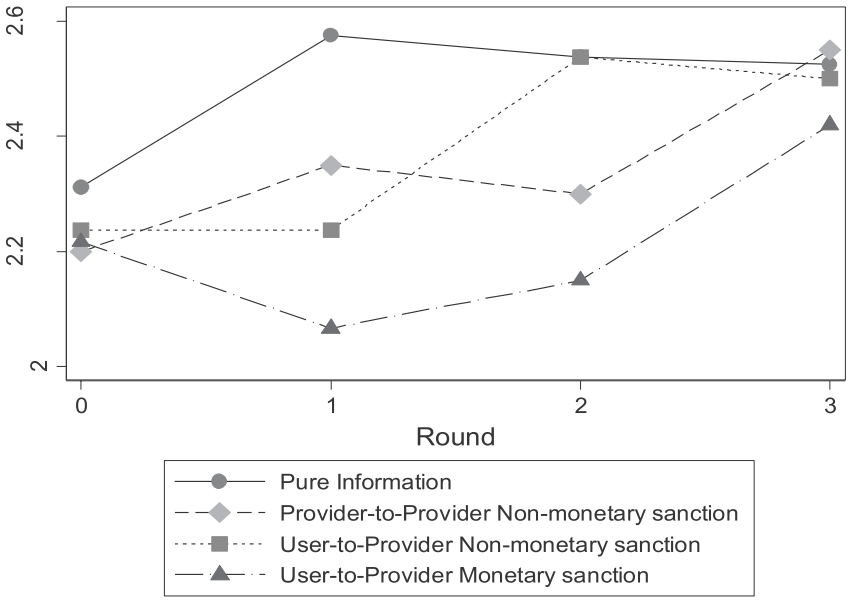

Fig. 2. Downstream users' assurance contributions.

round. Further, looking at the table's final two columns, for changes across rounds once a provider could have been sanctioned (which at earliest could happen as a reaction to a provider's 1st-round choice), we see that when an individual provider has received a sanction, that too increases contributions.

Table 5B tells a rather different story for users. No coefficient is significant for Round 3. Further, no coefficient is significant for nonmonetary sanctions. The only significant sanctions coefficients are for monetary sanctions, for earlier rounds, and those are not positive but significantly negative. Thus, averaging across watersheds, having the option to sanction lowered Round 1 contributions, seemingly in anticipation of lower provider contributions than are expected without any sanctions. Further, as sanctions arose, the only significant coefficient on sending a sanction also is negative. Thus, if one felt the need to sanction, not surprising that lowered expectations and contributions (Finally, as it raised the baseline (Appendix 4), Trust giving has a negative coefficient for change.).

5.3. Sanctions' impacts (separating watersheds) on assurance contributions across rounds

5.3.1. Upstream providers' contributions (by site)

In Tables 6, we use regression analyses to study impacts of sanctions on assurance contributions by site, yet like Table 5 still considering separately the providers (Table 6A) and users (Table 6B). We believe that prior upstream-downstream trust levels varied across the three sites and, further, that those differences in 'watershed trust' could impact not only average contributions in assurance – consistent with Table 3 discussed above – but also impacts of the existence and use of sanctions.

For providers, sanction impacts vary by watershed – with a consistent gradient by prior trust level between upstream and downstream (again almost all our sanctions were from down-to up-stream). Monetary sanctions consistently raise overall upstream contributions in Quintana Roo, where we observed more trust from upstream-to-downstream and vice versa (i.e., our 'high prior trust' site). Monetary sanctions never raise overall upstream contributions in Yucatan ('low prior trust' site).

The other user-to-provider sanctions, from downstream to upstream, are non-monetary sanctions.[14] They did not significantly raise providers' assurance contributions in Veracruz. However, they did have some initial effects in Quintana Roo and Yucatan, seemingly anticipating better coordination. Yet, as in Veracruz, ultimately they did not raise provider contributions for group-group assurance.

Finally, in Veracruz alone we also tried another non-monetary sanction, i.e., provider-to-provider. They were non-monetary because we feel that is more likely for upstream (i.e., peer) sanctioning. Interestingly, if tentatively, given only one site: those non-monetary sanctions started slowly; but, in contrast to user-to-provider non-monetary sanctions, they rose in impact across the three rounds.

[14] Appendix 5 presents details about the frequency of each type of sanctions received and sent per site and treatment. The non-monetary sanctions were more common (31% vs. 18% for R1, 26% vs. 12% for R2, 26% vs. 7% for R3), which is consistent with overall cost-efficiency being higher for non-monetary sanctions than monetary sanctions given not only lower total costs of non-monetary sanctions but also on average at least as high contribution gains.

5.3.2. Downstream users' contributions (by site)

Now examining downstream users' assurance contributions, given these treatments, to start we continue with non-monetary sanctions (Table 6B). For the high trust site, again the sanctions help. After Round 1, this option to signal displeasure to upstream raised contributions by downstream. That is consistent with sanctions being a tool to nudge providers so all move to a better equilibrium. Yet with intermediate trust, in Veracruz, these sanctions have no significant effect on contributions and for low trust, in Yucatan, if anything these sanctions appear to lower the users' contributions.

Expectations could explain effects in either direction. If with high trust providers will respond well (as in fact they did − as seen in Table 6A), then users may be more hopeful about site cooperation. Yet, on the other hand, having the option to sanction could itself lower expectations of providers. Bowles [69] hypothesized that institutions impart information that affects individual decisions: here, an option to sanction may 'slander' providers, i.e., lead users to believe providers will defect; if not, the reasoning goes, then the experiment would not have involved any such sanction option. In other words, sanctions may 'tell' downstream participants that the providers are not trustworthy. Further, those who sent a sanction, after judging contributions lower than sufficient, likely lowered their expectations − as is suggested, in Table 6B, by negative effects even in the higher-trust site.

With this in mind, we further consider the monetary sanctions, which might send stronger signals. Were Bowles' idea to apply, we might expect such a negative inference from the option to sanction to be more prevalent for low prior trust. Table 6B supports such a conjecture. Monetary sanctions had no significant effects in Quintana Roo, yet they actually reduce user contributions in Yucatan. It seems possible, then, that by offering sanction options we are reinforcing low-trust perceptions.

Yet even in Yucatan, eventually the contributions catch up to baseline (with no effect in Round 3). That clearly could be due to the power of observed behavior to overcome any inferences based on, e.g., simply the option to sanction. If people actually contribute, eventually users should expect it. Thus, Table 6B is consistent with complementarity of upstream and downstream groups' efforts. Because sanctions increase providers' contributions, downstream participants should update their expectations based on use of sanctions. After initial reductions in contributions, they end up rising. Even if sanctions are needed to encourage contributions, eventually expectations or trust can rise.

6. Discussion

Inspired by the design of a novel Mexican policy to support the development of new local PES, we used a novel experimental design to model creation and continuation of collective, local PES mechanisms. We model them as an assurance game between downstream user groups, who pay, and upstream provider groups, who are paid to take costly actions upstream which conserve forests. If both the costly actions and the payments occur, both groups will be better off. Yet if one group – upstream or downstream – fails to do its part, efforts at the other end will lower welfare there. That can yield a collapse of PES coordination, i.e., failure to create or continue the new local PES.

The results of our games, carried out in three watersheds in Mexico, support the supposition that outcomes in such a coordination setting will be a function of expectations, including prior beliefs as well as both positive and negative impacts upon expectations created by the option to sanction. We found sanctions can increase trust and contributions over time, albeit with different average impacts upon the contributions by upstream services suppliers and downstream services users.

We also documented what we believe to be significant different across watersheds in prior trust between upstream and downstream. That should affect baseline coordination and sanction impacts. Our results suggest that is the case. Differences in baseline contributions aligned with prior trust. So too did the impacts from sanctions, which could be either monetary or non-monetary sanctions. For instance, monetary sanctions raised upstream contributions only for our higher-trust watershed while they initially lowered downstream contributions only for our lower-prior-trust watershed. This suggests that, for collective settings, 'trust capital' is central for creation and function of PES.

Our finding regarding the role of trust within successful coordination during these games matches observations made by program implementers about the importance of social capital in PES sites. It is also in line with our observations that some of the earliest and most successful adopters in the Matching Funds program are located in sites that had some prior upstream-downstream success in coordination, which can build 'watershed trust', as well as high levels of organization upstream. Building on prior 'watershed social capital' is consistent with Ostrom [42]: trying a new policy where conditions are easier can help with harder cases later by setting precedents and expectations.

Our results also suggest potential for positive impacts from introduction or greater use of sanctions in PES, including in collective local PES in which downstream groups pay upstream groups. We find that getting sanctioned raise individual contributions and sanctions raise total contributions (even after any initial negative effects). In settings where mutual assurance or coordination is key, sanctioning can help local PES institutions to start and to build 'watershed' (user-provider) trust. However, such sanctioning has not been common within PES initiatives in Mexico or elsewhere, perhaps not surprisingly given the lack of conditioning payments on services [77]. Our results suggest that stronger conditioning through the imposition and enforcement of sanctions could bring watershed gains and other lab-in-feld experiments also help to examine their potential. Kaczan et al. [61] combine sanctions with greater insistence upon additionality in ecoservices: an agency could sanction, as a signal, before cancelling payments for lack of services generation. Yet how will upstream providers respond? They find conditioning on contributions above baseline ("additionality") raised contributions upstream for Matching Funds sites in a public-goods game, while non-monetary sanctions similar to those tested here can function to improve coordination. This may be particularly important if PES need to be applied to higher-pressure regions for impacts [97] and others show higher impacts with more pressure – and those regions have higher opportunity costs and non-compliance requiring monitoring and enforcement. Our results show that, for assurance settings, external intervention could be

welcome as a tool to coordinate.

In practice, local partners interested in ensuring ecosystem services flows can monitor compliance of providers with PES contracts. In our Yucatan site, NGOs partner with CONAFOR to monitor and then decide upon sanctions – which nicely highlights the potential for flexibility in local PES. In our Veracruz site, even before the PES mechanism was implemented, external and local actors were integrated through a watershed governance committee including upstream and downstream actors plus authorities. In this case, decision making and governance of the local PES program, including verification and ensuring compliance with contracts, were easily taken up by the existing committee. This shows the potential value of allowing flexibility for local institutional innovations that adapt to details of local settings, including for the construction and enforcement of sanctions.

Stepping back, our results suggest a potential to create and sustain local collective PES − and that this is more likely with greater watershed trust between upstream providers and downstream users. We found both that prior social capital is important for coordination and sanction impacts and that so too is the building up of trust that can occur over time when there is a successful coordination.

That, in turn, points to the potential of sanctions as tools for 'keeping everybody in good order' to create and sustain environments in which social capital can be built. Yet we also show the potential for sanctions to elicit negative reactions − highlighting the value of piloting policy variation within experiments with relevant field populations before attempting to change program rules in practice. Our experimental design explored some variations related to upstream-downstream coordination. As a complement to learning about trust and sanctions from all actual ongoing PES arrangements, further research can explore additional variations to inform the design of future PES mechanisms.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.wre.2019.01.002.

Table 5A
Sanctions & Providers' Contributions (regressions pooling across sites).

	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, ProviderProvider	0.278	0.922**	1.122***	0.250	0.124
	(0.543)	(0.408)	(0.386)	(0.445)	(0.646)
Nonmonetary, UserProvider	0.653*	0.417	0.706**	−0.576	−0.0106
	(0.365)	(0.324)	(0.299)	(0.367)	(0.440)
Monetary, UserProvider	0.546	0.635*	0.750**	−0.677*	0.130
	(0.428)	(0.352)	(0.329)	(0.403)	(0.486)
Got nonmonetary sanction in t-1				1.144***	1.667***
				(0.372)	(0.522)
Got monetary sanction in t-1				1.882***	1.198**
				(0.421)	(0.576)
Others' contribution in t-1				0.161**	−0.0277
				(0.0721)	(0.0892)
Trust	0.00480	−0.0694	−0.0423	−0.0730	0.0649
	(0.0746)	(0.0659)	(0.0627)	(0.0637)	(0.0839)
Age (years)	0.00427	0.0147	0.00144	0.00169	−0.00994
	(0.0114)	(0.0110)	(0.0101)	(0.00968)	(0.0134)

(*continued on next page*)

Table 5A (*continued*)

	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Gender (1 if woman)	0.0581	0.235	0.275	0.553*	0.573*
	(0.302)	(0.256)	(0.242)	(0.287)	(0.335)
Education (years)	−0.0231	0.0755*	−0.000950	0.0656*	−0.123**
	(0.0443)	(0.0391)	(0.0358)	(0.0341)	(0.0544)
Quintana Roo	−0.0668	−0.231	−0.266	−0.668*	−0.0538
	(0.371)	(0.326)	(0.300)	(0.387)	(0.461)
Veracruz	−0.0445	−0.145	−0.611*	−0.691**	−0.884*
	(0.395)	(0.343)	(0.314)	(0.340)	(0.480)
Constant	−1.308	−1.430**	−0.287	−1.734**	−0.334
	(0.835)	(0.724)	(0.643)	(0.835)	(1.197)
Observations	222	222	222	222	222

Tobit regressions of changes in providers' contribution caused by treatment announcement and use of sanctions. Pure information treatment omitted. Robust standard errors in parentheses***p < 0.01, **p < 0.05, *p < 0.1.

Table 5B
Sanctions & Users' Contributions (regressions pooling across sites).

	Changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, ProviderProvider	−0.682	−0.155	−0.480	0.359	0.369
	(0.563)	(0.411)	(0.396)	(0.476)	(0.525)
Nonmonetary, UserProvider	−0.337	0.102	0.124	1.121***	−0.270
	(0.289)	(0.227)	(0.259)	(0.328)	(0.421)
Monetary, UserProvider	−0.734**	−0.479*	−0.374	0.587	0.837**
	(0.348)	(0.279)	(0.317)	(0.471)	(0.421)
Sent nonmonetary sanction in t-1				−1.007**	0.242
				(0.430)	(0.513)
Sent monetary sanction in t-1				−0.986	−1.220
				(0.631)	(0.951)
Others' contribution in t-1				0.0425	−0.0958
				(0.0868)	(0.0653)
Trust	−0.107*	−0.107**	−0.110*	−0.0835	0.0216
	(0.0629)	(0.0518)	(0.0570)	(0.0641)	(0.0723)
Age (years)	−0.00338	−0.0131	−0.0206**	−0.0155	−0.00281
	(0.00987)	(0.00806)	(0.00914)	(0.0108)	(0.0124)
Gender (1 if woman)	−0.0627	−0.0707	−0.486**	−0.430*	0.0138
	(0.240)	(0.186)	(0.207)	(0.250)	(0.281)
Education (years)	0.0241	0.0414	0.0357	−0.0265	−0.0808**
	(0.0330)	(0.0260)	(0.0297)	(0.0300)	(0.0391)
Quintana Roo	0.545*	0.310	0.167	−0.398	−0.868**
	(0.282)	(0.219)	(0.274)	(0.324)	(0.403)
Veracruz	0.220	−0.118	0.292	−0.223	0.0345

(*continued on next page*)

Table 5B (*continued*)

	Changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
	(0.346)	(0.271)	(0.291)	(0.347)	(0.384)
Constant	−0.511	0.159	0.679	0.0992	1.174
	(0.736)	(0.587)	(0.652)	(1.194)	(1.141)
Observations	235	235	207	236	207

Tobit regressions of changes in users' contribution caused by treatment announcement and use of sanctions. Pure information treatment omitted. Robust standard errors in parentheses***p < 0.01, **p < 0.05, *p < 0.1.

Table 6A
Sanctions & Providers' Assurance Contributions (regressions by site).

Quintana Roo (high prior trust)	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	**0.504***	0.341	0.213	−0.167	−0.160
	(0.261)	(0.237)	(0.222)	(0.244)	(0.273)
Monetary, User-to-Provider	**0.605***	**0.499****	**0.516***	−0.265	−0.0145
	(0.334)	(0.247)	(0.263)	(0.269)	(0.275)
Got nonmonetary sanction in t-1				0.175	0.238
				(0.225)	(0.480)
Got monetary sanction in t-1				**0.884*****	0.288
				(0.315)	(0.285)
Others' contribution in t-1				−0.00841	0.0478
				(0.0572)	(0.0592)
(demographic controls)	✓	✓	✓	✓	✓
constant	−0.413	−0.566	−0.0744	−0.0938	0.150
	(0.406)	(0.463)	(0.518)	(0.495)	(0.625)
#obs	*70*	*70*	*70*	*70*	*70*
Veracruz (ambiguous prior trust)	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	0.037	0.318	0.390	−0.109	−0.008
	(0.248)	(0.291)	(0.303)	(0.254)	(0.219)
Nonmonetary, Provider-to-Provider	−0.0878	0.266	**0.455****	0.292	−0.062
	(0.198)	(0.224)	(0.212)	(0.273)	(0.241)
Got user-provider sanction in t-1				**0.754***	0.204
				(0.390)	(0.247)
Got provider-provider sanction in t-1				0.167	**1.141***
				(0.724)	(0.580)
Others' contribution in t-1				**0.103****	0.0273
				(0.049)	(0.0378)
(demographic controls)	✓	✓	✓	✓	✓
constant	0.0551	−0.0844	0.0434	−1.143	−0.153
	(0.467)	(0.464)	(0.494)	(0.703)	(0.721)
#obs	*77*	*77*	*77*	*77*	*77*
Yucatan (low prior trust)	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	**0.443***	−0.0797	0.355	−0.578*	0.406
	(0.226)	(0.225)	(0.217)	(0.291)	(0.246)
Monetary, User-to-Provider	0.319	0.207	0.0891	−0.120	−0.208
	(0.199)	(0.220)	(0.273)	(0.247)	(0.248)
Got nonmonetary sanction in t-1				**0.524***	**0.639***
				(0.311)	(0.368)

(*continued on next page*)

Table 6A (*continued*)

Quintana Roo (high prior trust)	Changes in contributions by upstream providers				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Got monetary sanction in t-1				**0.933***	**0.791***
				(0.476)	(0.418)
Others' contribution in t-1				**0.219****	0.0918
				(0.0916)	(0.0651)
(demographic controls)	✓	✓	✓	✓	✓
constant	−0.264	−0.597	−0.753	−1.809*	−1.020
	(0.510)	(0.692)	(0.927)	(0.955)	(0.976)
#obs	*75*	*75*	*75*	*75*	*75*

Robust standard errors in parentheses. Baseline is the individual's Round 0 baseline decision. ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6B
Sanctions & Users' Assurance Contributions (regressions by site)

Quintana Roo (high prior trust)	Changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	0.0268	**0.594****	**0.656****	0.524**	0.270
	(0.173)	(0.257)	(0.287)	(0.213)	(0.448)
Monetary, User-to-Provider	−0.0540	0.163	0.138	0.346	0.147
	(0.238)	(0.318)	(0.403)	(0.288)	(0.376)
Sent nonmonetary sanction in t-1				−0.0722	−0.0414
				(0.272)	(0.371)
Sent monetary sanction in t-1				**−0.509***	**−0.720***
				(0.297)	(0.383)
Others' contribution in t-1				−0.0161	−0.130
				(0.0685)	(0.118)
(demographic controls)	✓	✓	✓	✓	✓
constant	0.284	−0.125	2.525**	−0.00859	4.401**
	(0.504)	(0.761)	(1.230)	(0.795)	(1.868)
#obs	*77*	*77*	*49*	*78*	*49*
Veracruz (ambiguous prior trust)	Changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	−0.135	−0.0623	−0.0741	0.298	1.282**
	(0.159)	(0.233)	(0.180)	(0.278)	(0.552)
Nonmonetary, Provider-to-Provider	**−0.580****	0.112	−0.0485	1.205***	−0.251
	(0.226)	(0.230)	(0.276)	(0.259)	(0.247)
Sent user-provider sanction in t-1				−0.216	0.186
				(0.277)	(0.271)
Observed provider-provider sanction in t-1				0.0094	**−0.554*****
				(0.123)	(0.204)
Others' contribution in t-1				**0.197*****	0.070
				(0.071)	(0.0625)
(demographic controls)	✓	✓	✓	✓	✓
constant	0.0407	−0.483	0.0452	−2.483***	−0.315
	(0.439)	(0.473)	(0.459)	(0.854)	(0.758)
#obs	*79*	*79*	*79*	*79*	*79*
Yucatan (low prior trust)	changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
Nonmonetary, User-to-Provider	−0.308	**−0.746*****	−0.330	−0.275	0.126
	(0.251)	(0.263)	(0.314)	(0.241)	(0.338)
Monetary, User-to-Provider	**−0.709*****	**−1.125*****	−0.299	−0.304	0.641*
	(0.260)	(0.246)	(0.290)	(0.295)	(0.325)
Sent nonmonetary sanction in t-1				−0.251	0.437

(*continued on next page*)

Table 6B (*continued*)

Quintana Roo (high prior trust)	Changes in contributions by downstream users				
	R1-baseline	R2-baseline	R3-baseline	R2-R1	R3-R2
				(0.239)	(0.282)
Sent monetary sanction in t-1				0.282	−0.588
				(0.29)	(0.462)
Others' contribution in t-1				**0.120****	**−0.093****
				(0.0584)	(0.038)
(demographic controls)	✓	✓	✓	✓	✓
constant	−0.108	0.271	1.086*	−0.7774	1.951**
	(0.475)	(0.753)	(0.594)	(0.905)	(0.877)
#obs	*79*	*79*	*79*	*79*	*79*

Robust standard errors in parentheses. Baseline is the individual's Round 0 baseline decision. ***p < 0.01, **p < 0.05, *p < 0.1.

APPENDIX 1. Visual Materials Used in Experimental Sessions

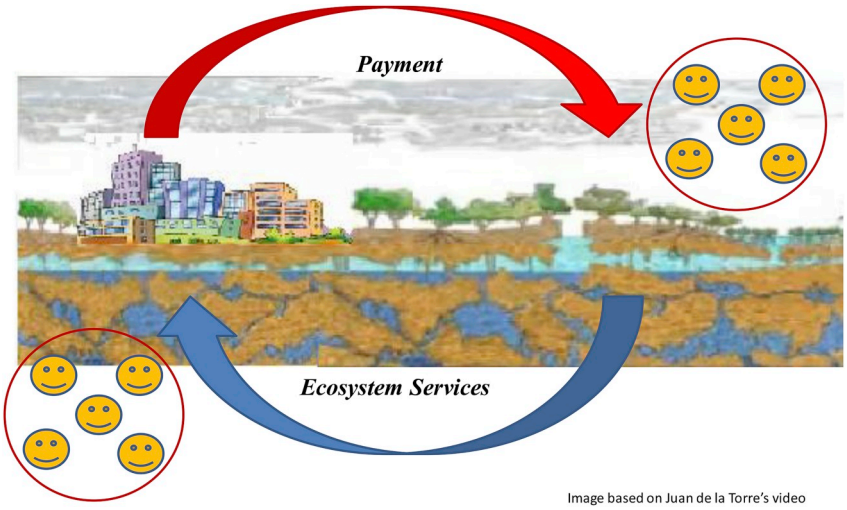


Fig. A1.1. Representation of Upstream-Downstream interaction.

Users-providers assurance game mimics the PES interaction between upstream and downstream participants. In our game, each upstream group of five participants was matched with a group of five downstream participants. Individual decisions were anonymous and individual payoffs depend on the collective decision of the group at the opposite end of the watershed. Decisions were framed as contribution to the creation and maintenance of the local PES institutions: forest protection in the case of providers (represented as trees in the game) and contribution to the collective payments in the case of users (represented as coins in the game).

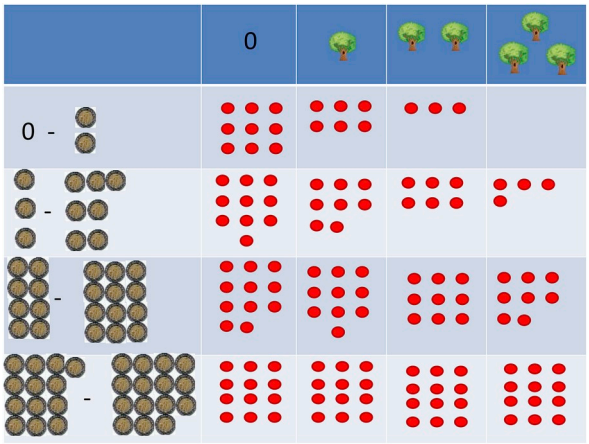


Fig. A1.2. Providers' payoffs table.

Providers' individual payoffs are a function of their one's own contribution and the total contribution of users. Each person chooses 0–3 units of effort (trees). Participants play in groups of five users and five providers, always randomly matched, thus the sum of total contributions of users ranges from 0 to 15 units (coins).

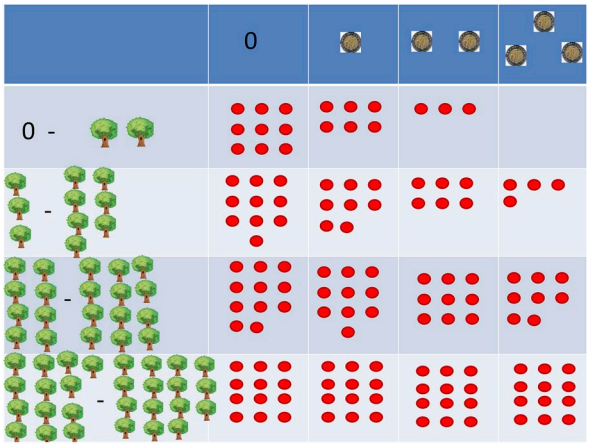


Fig. A1.3. Users' payoffs table.

Users' individual payoffs are a function of their one's own contribution and the total contribution of providers. Each person chooses 0–3 units of effort (coins). Participants play in groups of five users and five users, always randomly matched, thus the sum of total contributions of providers ranges from 0 to 15 units (trees).

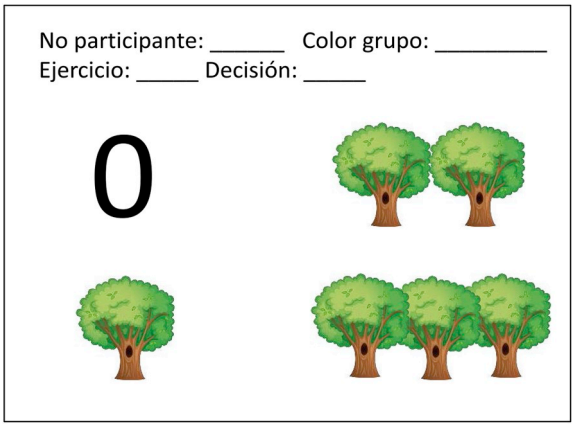


Fig. A1.4. Providers' decision sheet.

In each round in the assurance game providers decide how much effort to contribute to the PES local mechanism. Effort was represented as trees (forest protection) and providers have four possible levels of effort: 0, 1, 2 or 3 trees.

Fig. A1.5. Users' decision sheet.

In each round in the assurance game users decide how much effort to contribute to the PES local mechanism. Effort was

represented as coins (money) and providers have four possible levels of effort: 0, 1, 2 or 3 coins.

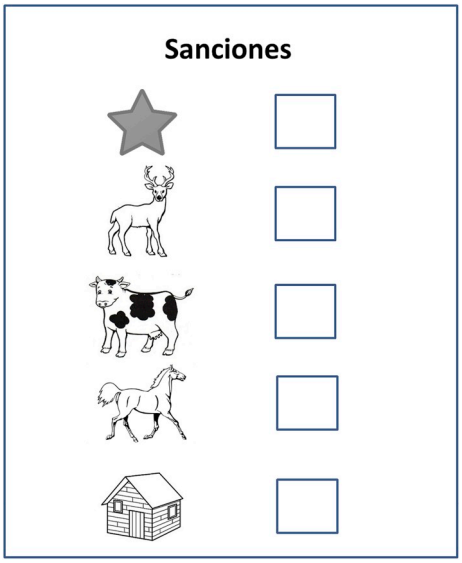


Fig. A1.6. Sanctioning decision card.

After each round in the sanctioning treatments, participants were showed individual decisions of all providers in the board. Pictures were used to keep anonymity so each picture corresponds to a participant. After observing individual contributions, in a card like this, participants marked with an X those providers they wanted to sanction. For the non-monetary sanctions, sending the sanction had a financial cost for the sanctioner but receiving a sanction did not have a financial cost for the sanctionee. Each non-monetary sanction was represented by a red card that the facilitator displayed on the board. For the monetary sanctions, both sending and receiving a sanction had a financial costs with a relation of 1–3.

APPENDIX 2. Descriptive Statistics of Participants (by site)

Table A2.1
Descriptive Statistics for Upstream Providers

UPSTREAM PROVIDERS 80 people per case	Veracruz	Q. Roo	Yucatan
Sociodemographic characteristic			
Gender (proportion of women)	57.5	23.2	68.3
Age (years)	38.3	49.3	32.5
Education (years)	5.2	6.3	7.8
Household size	5.4	5.2	5.1
Time living in the community (years)	28.4	42.7	27.8
Weekly income (US$)	$43.4	$43.4	$46.7
Weekly expenses (US$)	$32.4	$39.8	$37.6
Land use and property			
Farmer (proportion)	62.3	81.6	30.4
Land use for cropping (hectares)	3.2	6.8	16.6
Ejidatario or ejidatario's wife (proportion)	53.2	78.4	30.0
Avecindado or comunero (proportion)	45.5	15.2	53.7
Small landholder (proportion)	1.3	0	16.2
Trust and social capital			
Participation in a community groups (proportion)	60	52.9	41.3
Hours per month devoted to community activities	17.5	8.3	9.2
Number of *ejidal* assemblies per year (average of individual responses)	7.15	7.91	3.56
Attendance to *ejidal* assemblies per year (percentage)	61.5	90.0	50.3
Who you can trust in your community? (proportion)			
You can trust most people	77.9	80.0	55.3
You have to be careful with most people	22.1	20.0	44.7
Who you can trust in the city? (proportion)			
You can trust most people	38.4	72.6	35.1
You have to be careful with most people	61.6	27.4	64.9

(*continued on next page*)

Table A2.1 (*continued*)

UPSTREAM PROVIDERS 80 people per case	Veracruz	Q. Roo	Yucatan
Days a month devoted to Local PES forest maintenance (proportion)			
0 days	13.8	9.2	40.0
1–2 days	51.3	46.0	18.8
3–5 days	23.8	17.2	23.8
More than 5 days	7.5	17.2	11.3

Table A2.2
Descriptive Statistics for Downstream Users

DOWNSTREAM USERS 80 people per case	Veracruz	Q. Roo	Yucatan
Sociodemographic characteristic			
Gender (proportion of women)	55.0	61.2	55.0
Age (years)	35.1	33.3	31.9
Education (years)	13.3	13.7	14.8
Household size	4.1	3.4	3.7
Time living in the community (years)	20.3	14.2	22.8
Weekly income (US$)	$182.6	$347.2	$217.0
Weekly expenses (US$)	$115.9	$186.0	$129.9
Trust and social capital			
Participation in a community groups (proportion)		42.5	35.0
Hours per month devoted to community activities		35.5	15.4
Who you can trust in your community? (proportion)			
You can trust most people	78.1	81.8	85.3
You have to be careful with most people	21.9	18.2	14.7
Who you can trust upstream/in the jungle? (proportion)			
You can trust most people	69.7	80.5	68.8
You have to be careful with most people	30.3	19.5	31.2
PES program			
Perceptions about water scarcity in the community (proportion)	50.0	15.0	16.3
Payment in the water bill for forest protection (proportion)			
Yes	5.0	0.0	
No	37.5	42.3	
Not know	57.5	57.5	
Willingness to pay per month (US$)		9.3	2.5
Willingness to pay per year? (US$)	22.0	111.3	35.5

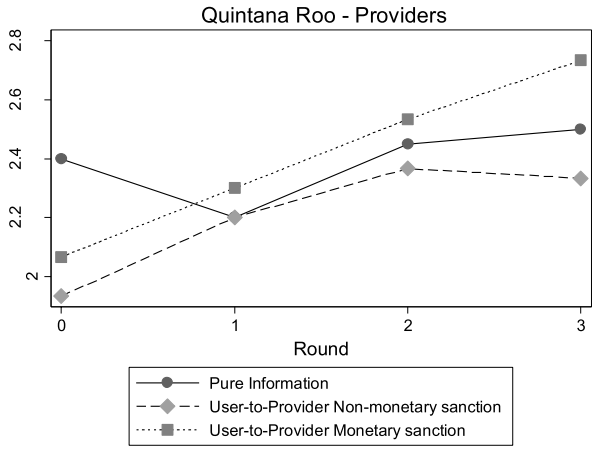
APPENDIX 3. Assurance Contributions per Treatment (across rounds and cases)

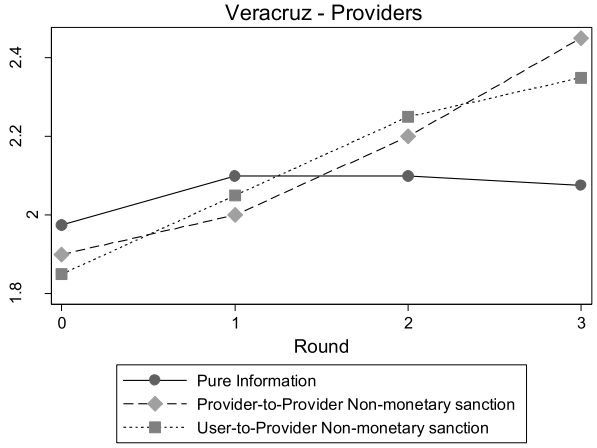
A3.1. Provider Decisions

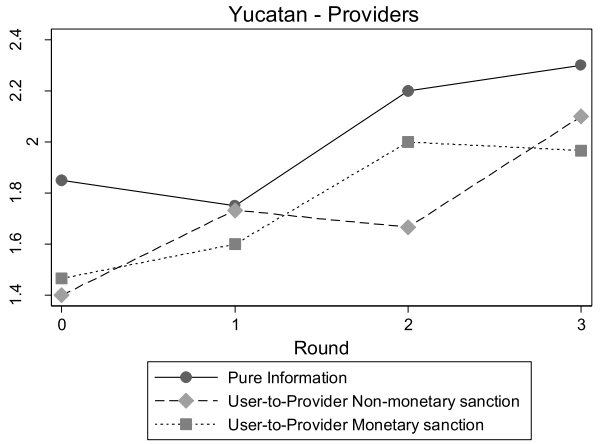
	Information Alone									Provider-to-provider non-monetary sanction		
	Veracruz			Yucatan			Quintana Roo			Veracruz		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Zero (%)	5	2.5	5	5	0	0	5	5	0	0	5	0
One (%)	27.5	27.5	30	30	10	0	5	5	0	30	15	15
Two (%)	20.0	27.5	17.5	50	60	70	55	30	50	40	35	25
Three (%)	47.5	42.5	47.5	15	30	30	35	60	50	30	45	60
Mean contribution	2.1	2.1	2.07	1.75	2.2	2.3	2.2	2.45	2.5	2.0	2.2	2.45
Observations	40			20			20			20		

	User-to-provider non-monetary sanction									User-to-provider monetary sanction					
	Veracruz			Yucatan			Quintana Roo			Yucatan			Quintana Roo		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Zero (%)	15	0	0	10	10	10	0	0	3.3	0	3.3	0	0	0	0
One (%)	15	10	15	26.7	26.7	6.7	16.7	13.3	10	43.3	6.7	33.3	13.3	3.3	6.7
Two (%)	20	55	35	43.3	50	46.7	46.7	36.7	36.7	53.3	76.7	36.7	43.3	40	13.3
Three (%)	50	35	50	20	13.3	36.6	36.6	50	50	3.3	13.3	30	43.3	56.7	80
Mean contribution	2.05	2.25	2.35	1.73	1.67	2.1	2.2	2.37	2.33	1.6	2	1.97	2.3	2.5	2.7
Observations	20			30			30			30			30		

A3.2. Providers' Average Decisions, by site, by round





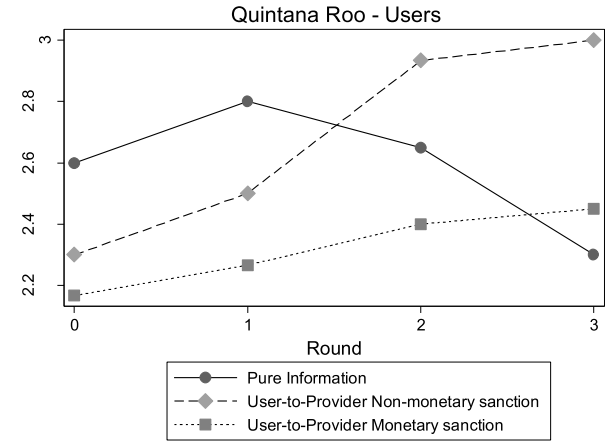


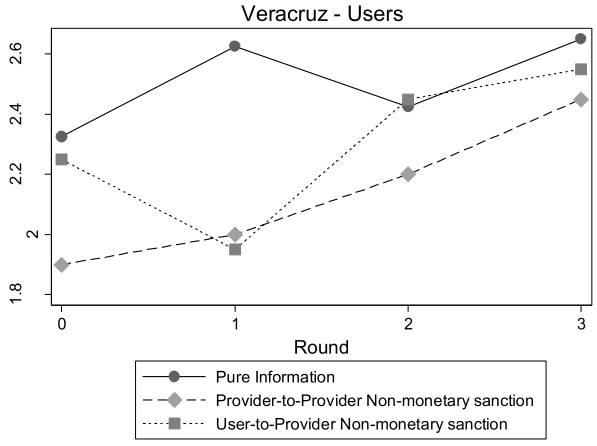
A3.3. Users' Decisions

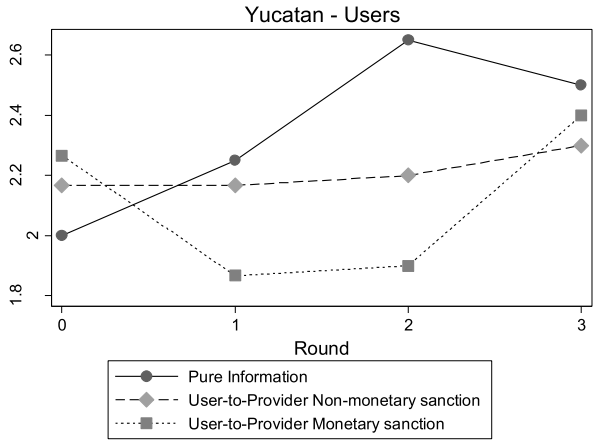
	Information Alone									Provider-to-provider non-monetary sanction		
	Veracruz			Yucatan			Quintana Roo			Veracruz		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Zero (%)	0	2.5	2.5	0	0	5	0	0	15	0	5	0
One (%)	5	5	7.5	5	0	5	0	5	5	15	10	0
Two (%)	27.5	40	12.5	65	35	25	20	20	15	35	35	45
Three (%)	67.5	52.5	77.5	30	65	65	80	75	65	50	50	55
Mean contribution	2.2	2.4	2.6	2.2	2.6	2.5	2.8	2.65	2.3	2.35	2.3	2.55
Observations	40			20			20			20		

	User-to-provider non-monetary sanction									User-to-provider monetary sanction					
	Veracruz			Yucatan			Quintana Roo			Yucatan			Quintana Roo		
	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3	R1	R2	R3
Zero (%)	5	0	0	0	3.3	3.3	0	0	0	3.3	6.7	0	3.3	3.3	0
One (%)	20	0	0	10	20	13.3	10	0	0	20	26.7	6.6	10	13.3	15
Two (%)	50	55	45	63.3	30	33.3	30	6.7	0	63.3	36.6	46.7	43.3	23.3	10
Three (%)	25	45	55	26.7	46.7	50	60	93.3	100	13.3	30	46.7	43.3	60	75
Mean contribution	1.95	2.45	2.55	2.17	2.2	2.3	2.5	2.93	3	1.87	1.9	2.4	2.27	2.4	2.45
Observations	20			30			30			30			30		

A3.4. Users' Average Decisions, by site, by round







APPENDIX 4. Assurance Baseline Contributions, linked to Trust games

A4.1. Assurance Baselines (pooled sites)

LHS = contributions	All	Providers	Users	All	Providers	Users
Tokens Sent	0.0949***	0.0219	0.145***			
	(0.0295)	(0.0474)	(0.0349)			
Expected Return				0.0353***	0.0219	0.0499***
				(0.0107)	(0.0146)	(0.0140)
Veracruz Providers	−0.599***			−0.631***		
	(0.220)			(0.227)		
Quintana Roo Providers	−0.431*			−0.281		
	(0.229)			(0.245)		
Yucatan Providers	−0.963***			−0.892***		
	(0.185)			(0.182)		
Veracruz Users	0.112			0.180		
	(0.161)			(0.160)		
Quintana Roo Users	0.223			0.217		
	(0.154)			(0.153)		
Quintana Roo		0.435*	0.181		0.486*	0.182
		(0.227)	(0.143)		(0.260)	(0.144)
Veracruz		0.338*	0.0738		0.268	0.181
		(0.185)	(0.153)		(0.192)	(0.152)
Age (years)	0.00813*	0.00912	0.00598	0.00781*	0.0106	0.00359
	(0.00461)	(0.00833)	(0.00485)	(0.00474)	(0.00915)	(0.00479)
Gender (1 if woman)	0.0932	−0.141	0.217*	0.163	−0.0141	0.259**
	(0.108)	(0.185)	(0.125)	(0.108)	(0.193)	(0.125)
Education (years)	−0.0229	−0.0215	−0.0202	−0.0187	−0.0187	−0.0160
	(0.0156)	(0.0280)	(0.0184)	(0.0159)	(0.0304)	(0.0184)
Constant	1.943***	1.461***	1.655***	1.996***	1.245**	1.901***
	(0.338)	(0.494)	(0.350)	(0.332)	(0.511)	(0.333)
Observations	458	222	236	440	204	236

Tobit regressions of initial contribution decisions of providers-users assurance game. Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1 Yucatan users omitted in by type (users and providers) regressions.

A4.2. Assurance Baselines (by site)

	PROVIDERS			USERS		
LHS = contributions	Veracruz	Yucatan	Q. Roo	Veracruz	Yucatan	Q. Roo
Tokens Sent	0.0662	0.0360	−0.0366	0.146**	0.00528	0.265***
	(0.0872)	(0.0683)	(0.119)	(0.0648)	(0.0530)	(0.0540)
Age (years)	0.0244*	−0.00139	0.000866	0.00811	0.00137	0.00546
	(0.0146)	(0.0161)	(0.0131)	(0.00773)	(0.00814)	(0.00877)
Gender (1 if woman)	−0.495	−0.205	0.552	0.0694	0.252	0.297
	(0.353)	(0.230)	(0.531)	(0.242)	(0.192)	(0.218)
Education (years)	0.0301	−0.0362	−0.0452	−0.0182	−0.0319	−0.0223
	(0.0419)	(0.0571)	(0.0536)	(0.0284)	(0.0343)	(0.0340)
Constant	0.972	1.872*	2.667***	1.736***	2.547***	1.254**
	(0.744)	(0.959)	(0.974)	(0.560)	(0.643)	(0.491)
Observations	77	75	70	79	79	78
Expected Return	0.0139	0.0214	0.0350	0.0201	0.0328	0.0868***
	(0.0238)	(0.0192)	(0.0379)	(0.0277)	(0.0231)	(0.0224)
Age (years)	0.0309*	−0.00320	−0.00115	0.00736	7.14e-05	−0.000644
	(0.0157)	(0.0165)	(0.0159)	(0.00878)	(0.00796)	(0.00878)
Gender (1 if woman)	−0.173	−0.205	1.139	0.139	0.260	0.369
	(0.351)	(0.217)	(0.729)	(0.248)	(0.186)	(0.237)
Education (years)	0.0367	−0.0373	−0.0599	−0.0115	−0.0361	−0.0165
	(0.0470)	(0.0565)	(0.0589)	(0.0291)	(0.0342)	(0.0299)
Constant	0.621	1.951**	2.413**	2.222***	2.415***	1.838***
	(0.818)	(0.950)	(1.031)	(0.542)	(0.636)	(0.485)

Observations	68	75	61	79	79	78

Tobit regressions of initial contribution decisions of providers-users assurance game per site. Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

APPENDIX 5. Earnings Per Treatment (information alone & sanctions)

Average payments per round and treatment in MXN$

	Provider Information Alone	Up-to-Up Nonmonetary Sanction	Down-to-Up Nonmonetary Sanction	Down-to-Up Monetary Sanction
R0	93.56	89.25	86.94	87.33
R1	98.31	100.4	95.76	91.93
R2	102.69	100.37	98.28	95.47
R3	104.56	98.15	100.89	98.81

Increase in payments compared to the baseline

	Provider Information Alone	Up-to-Up Nonmonetary Sanction	Down-to-Up Nonmonetary Sanction	Down-to-Up Monetary Sanction
R1	5.1%	12.5%	10.1%	5.3%
R2	9.8%	12.5%	13.0%	9.3%
R3	11.8%	10.0%	16.04%	13.1%

APPENDIX 6. Who Sanctions? Who Gets Sanctioned?

A6.1. Monetary and non-monetary sanctions received (after rounds 1 and 2)

	After R1			After R2		
	# of sanctioned	Avg.Contr. (sanctioned)	Distance to Group Average	# of sanctioned	Avg.Contr. (sanctioned)	Distance to Group Average
Provider-to-provider non-monetary sanction	3	1.33	−0.67	4	1	−1.2
User-to-provider non-monetary sanction	28	1.32	−0.67	22	1.23	−0.84
User-to-provider monetary sanction	11	1.18	−0.77	7	1.71	−0.56

	# of sanctions	After R1		After R2	
		# of sanctionees	Average contribution (sanctionees)	# of sanctionees	Average contribution (sanctionees)
Provider-to-provider non-monetary sanction	1	2	1.5	2	1
	2	0	–	1	1
	3	1	1	1	1
User-to-provider non-monetary sanction	1	14	2	12	1.58
	2	6	0.83	9	0.78
	3	3	0.67	0	–
	4	5	0.4	1	1
User-to-provider monetary sanction	1	6	1	5	1.6
	2	4	1.5	2	2
	3	1	1	0	–

A6.2. Non-monetary Sanctions Received, users-to-providers, by site

	# of sanctions	After R1		After R2	
		# of sanctionees	Average contribution (sanctionees)	# of sanctionees	Average contribution (sanctionees)
Quintana Roo	1	4	2	3	2
	2	1	1	2	1

	3	1	1	0	–
	4	0	–	1	1
	Total	6	1.67	6	1.5
Yucatan	1	11	1	11	0.82
	2	0	–	0	–
	3	0	–	0	–
	Total	11	1	11	0.82

A6.3. Monetary Sanctions Received, users-to-providers, by site

	# of sanctions	After R1		After R2	
		# of sanctionees	Average contribution (sanctionees)	# of sanctionees	Average contribution (sanctionees)
Quintana Roo	1	6	1.33	2	2.5
	2	0	–	0	–
	3	0	–	0	–
	Total	6	1.33	2	2.5
Yucatan	1	5	1	5	1.4
	2	0	–	0	–
	3	0	–	0	–
	Total	5	1	5	1.4

A6.4. Monetary & Non-monetary Sanctions Sent

	After R1			After R2		
	# of sanctioners	Average contribution (sanctioners)	Distance to group's average	# of sanctioners	Average contribution (sanctioners)	Distance to group's average
Provider-to-provider non-monetary sanction	4	2.5	0.5	5	2.4	0.2
User-to-provider non-monetary sanction	22	2.23	−0.01	26	2.54	0
User-to-provider monetary sanction	16	2.19	0.18	7	1.86	−0.29

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