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Collective PES: More than the sum of individual incentives

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ABSTRACT

This study synthesizes findings from studies of the social and behavioral outcomes of collective payment for ecosystem services (PES) programs. The collective PES model is distinct from the conventional PES model in that by working with groups, not individuals, it breaks the direct relationship between an individual's consent to participate, the economic incentive and the expected conservation behavior. In doing so, it raises concerns about whether the collective model is effective and socially just. Here, we assess these concerns by synthesizing findings on four distinct challenges for collective PES: (i) voluntary and informed participation; (ii) household compliance with PES restrictions; (iii) the balance of costs and benefits across community members; and (iv) the interaction with local governance conditions to address the second-order collective action problem inherent in collective PES. Through a review of 41 studies covering 16 collective PES programs located in 12 countries, we find that collective PES can change behavior and provide socioeconomic and ecological benefits, but institutional context matters. Our review points to how program design and local governance dynamics can influence the ability of collective PES to attain desired social and behavioral outcomes.

1. Introduction

In the 1990s, Payment for Ecosystem Services (PES) emerged as a tool to promote forest and watershed conservation in low-income countries. Starting in Latin America, governments, donors and private organizations created programs by which, in theory, a buyer would pay a seller for environmental services provided on their conserved, individual land (Kerr et al., 2014; Wunder, 2005). Recent reviews of social and ecological impacts of PES highlight the potential for PES to provide small, but positive ecological and livelihood benefits (Blundo Canto et al., 2018; Calvet-Mir et al., 2015; Liu and Kontoleon, 2018). Reviews also, however, point to the need to further parse the results to understand how diversified program designs interact with and influence socio-economic, political and ecological factors and the resultant outcomes (Blundo Canto et al., 2018; Calvet-Mir et al., 2015; Ezzine-de-Blas et al., 2019; Ma et al., 2017; Muradian et al., 2010).

In recent years, policymakers and program managers have increasingly turned to collective PES arrangements in which groups or communities agree to provide ecosystem services on their lands in exchange for a reward that is theoretically conditional on collective fulfillment of contract conditions (Kaczan et al., 2017; Kerr et al., 2014). Collective PES contracts are particularly attractive when working in rural communities in the low-income tropics. First, collective PES contracts are often more suited to communal tenure arrangements or collectively managed resource systems (Kaczan et al., 2017). Communities and indigenous peoples are estimated to maintain customary or community tenure rights to as much as 65% of the world's land area (Rights & Resource Initiative, 2015). Land-use practices on these lands are critical for sustaining local livelihoods and ecosystem services. Second, collective contracts may reduce transaction costs when working with groups of smallholder farmers, and, likewise, they can potentially improve ecological effectiveness *via* the conservation of larger contiguous areas (Kaczan et al., 2017; Kerr et al., 2014; Parkhurst and Shogren, 2007; Swallow and Meinzen-Dick, 2009).

While still controversial (Muradian et al., 2013), proponents often argue that the conventional PES model is more effective and equitable than previous conservation policies as participation is voluntary, and payment is directly linked to (and conditional on) provision of an environmental service (Engel et al., 2008; Ferraro and Kiss, 2002). Though not all individual PES contracts live up to these ideals in

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practice, there is at least potential for them to do so in theory. In contrast, collective PES, by definition, challenges some of the theoretical assumptions of the conventional PES model and, in doing so, presents several social and behavioral concerns that could limit the degree to which collective PES is not only effective, but also socially just (Kerr et al., 2014; Pascual et al., 2010; Sommerville et al., 2010a,b).

Over the past twenty years, collective PES programs have been implemented by governments and donors in rural communities in Latin America, Asia and Africa (Kerr et al., 2014; Calvet-Mir et al., 2015). To our knowledge, however, no review has focused on the specific challenges unique to collective PES. Below, we identify four challenges facing collective PES programs that distinguish them from individual contracts. We then review the existing research on the social and behavioral outcomes of collective PES programs and synthesize the empirical findings as they relate to each of the four challenges.

2. Challenges of collective PES

First, collective agreements contest the theoretical assumption that participation in PES is **informed and voluntary** as the decision to join is based on often **ill-defined aggregated preferences**, casting doubt on the degree to which all participants are informed of contract terms and voluntarily agree to participate (Corbera et al., 2007; Pascual et al., 2014). In addition to respecting the rights of resource users, research suggests that voluntary participation may also improve compliance as participation in the decision-process can enhance the perceived legitimacy, effectiveness and equity of a program (DeCaro and Stokes, 2013; Tyler, 2006).

Second, the collective PES model **breaks the direct relationship between the economic incentive and an individual's conservation behavior** thereby raising concerns of **whether the collective model can attain the desired behavioral change**. One purported benefit of the individual PES model is its ability to, theoretically, avoid the free-rider problem, whereby participants could receive compensation despite continuing with environmentally degrading activities (Ferraro and Kiss, 2002; Gatiso et al., 2018). Collective PES, where the economic incentive is often to the entire group, allows the opportunity for individual members to receive benefits, even without changing their resource-use behavior (Kaczan et al., 2017; Muradian, 2013).

Third, related to the indirect relationship between behavior and incentives, collective payments also raise concerns about the **balance of costs and benefits within communities**, elite capture and intracommunity equity. Benefit allocation in the conventional PES model is proportional to contribution. In the collective model, however, the allocation of collective payments across households can vary greatly depending on programmatic and communal goals, as well as household resource use (Narloch et al., 2013). Thus, within a single community it is possible for some households to receive a net benefit without incurring any costs, while others may not be compensated for the opportunity cost they individually forego (Fisher et al., 2010). Of particular concern is how participation and allocation of collective compensation impacts poor and marginalized community members. PES could potentially support greater intracommunity equity *via* shared socioeconomic and ecological benefits from sustainable resource management (Farley et al., 2011). Conversely, PES may produce or reinforce existent power dynamics (Pascual et al., 2014).

Ultimately, at the crux of collective PES is how it interacts with **local governance dynamics** (Kerr et al., 2014; Muradian, 2013). Unlike individual contracts, collective contracts rely on the governance capacities of the respective groups, because they create a **second-order collective action problem** with respect to achieving the payment. Previous work on resource management suggests that local governance conditions may significantly shape decision processes, information sharing, application of rules, potential for elite capture, and the distribution of costs and benefits across community members (Cleaver, 2017; Lund and Saito-Jensen, 2013; Ostrom, 1990; Persha and Andersson, 2014). We lack, however, a comprehensive understanding of how local governance characteristics mediate social and ecological outcomes in collective PES (Hayes and Murtinho, 2018; Kerr et al., 2014). Furthermore, the relationship between PES and governance characteristics may not be unidirectional, as the specific design of PES may also influence the governance characteristics of the participating groups or communities (Kaczan et al., 2017).

3. Scope of the review

The literature on collective PES includes both framed field experiments (FFE) and observational studies. Our systematic review focused on evaluations of real-world programs, but it is worth briefly highlighting some of the findings from the FFE studies, which complement our observations in the rest of the paper. Much of this work cautions against collective models, finding that individual payments outperform collective compensation (Gatiso et al., 2018; Kaczan and Swallow, 2019; Narloch et al., 2012), but many of these studies are framed around land-use behaviors on individually, not collectively, managed lands, and pay varying attention to how community dynamics and communication may also shape behavior (Salk and Travers, 2018). Additionally, individual contracts are not always a feasible option when land is owned communally. A recent FFE finds that the positive conservation impact of collective PES can be sustained even beyond the eventual end of the payments (Andersson et al., 2018), and that the equity and effectiveness of such programs can be enhanced through combination with gender quotas (Cook et al., 2019).

In our review, studies were identified based on a structured literature survey in Web of Science, Academic Search Complete and Google Scholar using the following inclusion criteria: (i) peer-reviewed studies that (ii) empirically assessed (iii) real-life collective PES programs in low-income countries, which (iv) specified conditionality. We identified 41 studies covering 16 collective PES programs located in 12 countries. The social and behavioral outcomes were then independently coded by the first and fourth authors (see, SI part 1).

All PES contracts are with villages, *ejidos*[1], associations, hereafter referred to as "communities" to provide forest and land cover conservation to support biodiversity and wildlife, watershed services, and/or carbon sequestration. While most of the contracts are directed toward activities on collectively managed lands, some contracts also included land-use restrictions on individually managed lands.[2] In the majority of cases, communities receive collective cash payments as compensation, although several provide both cash and in-kind payments, often in the form of infrastructure or community development projects.

3.1. Overview of programs

The majority of studies are of government run programs supported by international non-governmental organizations (NGOs) with a smaller set examining programs by local NGOs or researchers. The governmental programs in Mexico and Ecuador that started in 2003 and 2008, respectively, are some of the largest and most-studied programs. Both of these programs work with individuals and groups, but a substantial area of land under contract is with communities that hold common-property titles (Alix-Garcia et al., 2018; De Koning et al., 2011). While each has evolved over the years, adapting to different social and ecological conditions, the collective contracts in each program are similar. Communities collectively agree to participate and receive a collective cash payment on the condition that they provide conservation activities (De Koning et al., 2011; Shapiro-Garza, 2013).

Table 1 shows the overall characteristics of the programs, as

[1] Ejidos are common-property lands in Mexico.

[2] The agri-environment program in Cambodia and the Vietnam forest conservation program both included activities on the individual's lands as part of the contract conditions.

Table 1
Overview of programs studied.

Program "name"	Creator	Who signs agreement	Type of Collective Payment	Who Pays	Who decides how use and distribute	Who monitors land-use
Cambodia						
CI Conservation agreements	Intl NGO	Community Committee	In-Kind and Cash	NGO	Program with community committee	Community Committee and Intl NGO
WCS agri-environment	Intl NGO	Not specified	In-Kind and Cash	Private	Program	Community Committee
WCS Ecotourism	Intl NGO	Not specified	Cash	Private	Community Committee	Community Committee, Intl NGO and Government
Colombia						
CI Conservation agreements	Intl NGO	Leaders	In-Kind and Cash	NGO	Program with community committee	Community Committee and Intl NGO
Ecuador						
Socio Bosque	Government	Community	Cash	Gov't.	Community with some program oversight	Community and Government
Guatemala						
WCS turkey conservation	Intl NGO	Not specified	Cash	Private	Not Specified	Intl NGO and Government
Kenya						
Kenya wildlife	Local NGO	Leaders	Cash	NGO & Private	Program with community leaders	Local NGO
Madagascar						
Durrell Conservation	Intl NGO	Not specified	In-Kind	NGO	Community Committee	Community and Intl NGO
Mexico						
Fondo Bioclimatico	Local cooperative	Not specified	Cash	Private	Not Specified	Not specified
Mexico Govt. PES	Government	Community	Cash	Gov't.	Community with some program oversight	Community Guards and Government
Namibia						
Ecotourism	Government	Leaders	Cash	Private	Community committee with some program oversight	Community and Government
Nepal						
Norad	Intl gov't.	Leaders	Cash	Intl. donor	Community committee with some program requirements	Not specified
Rwanda						
University PES REDIRECT	Intl University	Leaders	Cash	Intl. Donor	Community leaders with community and program	Government and Researchers
Tanzania						
REDD + Pilot	Local NGO	Not specified	Cash	NGO	Community committee with some program oversight	Not specified
WCS Ecotourism	Intl NGO	Community	Cash	Private	Community Committee	Community Committee and Government
Vietnam						
Vietnam govt. PES	Government	Not Voluntary	Cash	Private	Community with some program oversight	Government

described in the studies. They demonstrate a variety of decision-making arrangements for joining PES, distributing the incentives, and monitoring and enforcing the requirements. An important distinction to note across programs is who signs the collective contract and who decides how the incentive is invested and distributed. In the majority of programs, a community committee or group of leaders decide whether to join and/or how to invest and distribute the collective incentive. [3] Committees may be an existent governing body, or a group created specifically for the program. Leaders and committees vary in the extent to which they consult with all community members in the decisions to join and use the benefits. Similarly, programs differ in the degree to which they monitor participation and spending decisions.

4. Synthesis of studies by theme

Table 2 synthesizes each theoretical challenge of collective PES, the associated research question, the respective number of studies, and the overarching lessons from our review.

4.1. Decision to join: Voluntary and informed?

Ten studies looked at participation and information in five programs. Most examined the degree to which participants are informed of contract conditions, with less attention to the decision process itself (Bremer et al., 2014a,b; Kosoy et al., 2008; Murtinho and Hayes, 2017).

Findings suggest that programs often struggle to get full inclusion, agreement and understanding of contract conditions. In Mexico and Ecuador, studies find that the majority of households participated in the decision and are informed of the basic contract conditions (Almeida-Lenero et al., 2017; Bremer et al., 2014a,b; De Koning et al., 2011; Kosoy et al., 2008; Murtinho and Hayes, 2017; Perevochtchikova and Negrete, 2015). Nonetheless, participation and understanding may differ across households. In Ecuador, for example, Krause et al. (2013) found that while the majority of community members participated in the decision to join, there was less participation and program knowledge by non-community members (households that use lands and are affected by rules concerning their use, but are not recognized formally and do not hold voting rights). Participation and program knowledge by women also varied greatly by community. Studies indicate that participation in decision-making and knowledge of contract conditions may depend on a household's socio-political position within the community, use of conservation lands, community size, the number of programs a community is participating in, the degree to which the community is rural or urban, social capital, self-organization and support from extension agents (Almeida-Lenero et al., 2017; Bremer et al., 2014a,b; Caro-Borrero et al., 2015; Kosoy et al., 2008; Murtinho and Hayes, 2017; Perevochtchikova and Negrete, 2015; Rodríguez-Robayo and Merino-Pérez, 2018).

Studies also illustrate how program design can influence participation, and the potential dangers of relying on a committee or leaders to agree to a collective PES program. In Cambodia, Milne and Adams (2012) found that although the PES program asked a community committee to discuss the contracts with the respective members before signing the conservation agreements, few villagers considered the agreements voluntary and many were not aware of the contract terms. The researchers found that program reliance on the committees to share information with village residents enabled local elite to further their

[3] In six studies it was not clear how communities decided to join. The government program in Vietnam challenges the definition of PES as participation is not voluntary. And, although the government contracts are with households, communities, or associations, the payment does not go directly to the provider, but rather goes to the provinces and then the communities, thereby aligning the program with some of the dimensions of collective PES (McElwee 2012; Duong and de Groot 2018; Pham et al. 2014).

Table 2
Challenges of Collective PES.

Challenges of Collective PES	Ill-defined aggregated preferences (group-level decision to join)	Breaks the direct relationship between incentive and behavior		Second-order collective action problem
		No direct link between individual effort and reward	No direct link between individual costs and benefits	
Related Research Question	Is the decision to join voluntary & informed?	Do households comply?	How are the economic costs and benefits balanced?	How does collective PES interact with local governance?
Existing Research	10 studies; 5 programs *(See SI, Part 2 for complete summary)*	16 studies; 8 programs *(See SI, Part 3 for complete summary)*	a. Net benefits: 17 studies; 8 programs b. Distribution: 22 studies; 12 programs *(See SI, Part 4 for complete summary)*	17 studies; 9 programs *(See SI, Part 5 for complete summary)*
Review Takeaways	Programs and communities struggle to attain completely informed participation from all members. Programs that require only community leaders or a select committee to sign the contracts are particularly vulnerable with low levels of informed consent.	Generally positive impact on land-use behavior, but not clear that payment is driving these changes. More research is needed on how payment size, additional monitoring, technical support, and other contextual factors may each influence behavior.	Benefits (monetary and non-monetary) are often small, but positive. Communities often distribute based on egalitarian principles, not on contribution. Households prefer cash, particularly when there are low-levels of trust in communal governance bodies. Elite capture is more likely when only a few make allocation decisions, or in communities with weak governance structures.	PES has potential to strengthen a community's governance capacity, but pre-existent governance conditions may be instrumental in supporting voluntary and informed consent, compliance, and an equitable allocation of benefits.

political power by ensuring that the contracts did not threaten their own land use activities and charging themselves with the distribution of PES benefits. Similarly, Anyango-Van Zwieten et al. (2015) found that as the principal signatories of wildlife conservation agreements in Kenya, leaders had the greatest information about the contract conditions, which they used to their advantage in accessing the PES funds.

4.2. Do households comply?

Sixteen studies assessed eight programs with respect to their ability to gain desired conservation behaviors, using: stated behavior (5 studies); deforestation and/or landcover change (6 studies); monitored human activities (3 studies); and/or monitored wildlife populations (3 studies)[4]

Studies of programs in Cambodia, Colombia, Ecuador, and Mexico that compared outcomes to a control (total of 9) found a positive impact on land-use behavior or desired conservation outcomes, although estimates of the magnitude of the impacts vary and are difficult to assess given broader trends in land-use. In Madagascar, researchers were unable to tease out the program's impacts as increased monitoring of the control forests also increased compliance with land-use restrictions (Sommerville et al., 2010a,b). Similarly, in Rwanda, researchers did not find an impact when compared to a forest with increased monitoring (and no payment), although land-use activities reduced more in PES communities when compared to activities within the broader protected area within which they were located (Gross-Camp et al., 2012; Martin et al., 2014a,b). In Mexico, two studies found signs of leakage, or increased use of areas not under conservation (Alix-Garcia et al., 2012; Le Velly et al., 2017).

Studies of behavioral change in Ecuador, Mexico, and Madagascar suggest that household and community characteristics may influence who changes their behavior in collective PES. Specifically, older and wealthier residents are more likely to change their behaviors while those that rely heavily on the resource under conservation are less likely to change (Alix-Garcia et al., 2012; Hayes et al., 2017; Sommerville et al., 2010a,b). The research also suggests that community and program characteristics, namely, amount of total lands available to the residents, community organization and the amount of extension support and monitoring, may be critical in gaining behavioral change (Alix-Garcia et al., 2012; Hayes et al., 2017; Jones et al., 2018; Sommerville et al., 2010a,b).

4.3. How are the economic costs and benefits balanced?

Studies of the costs and benefits can be subdivided into those that examine net benefits to the community and those that focus on the distribution of costs and benefits within the community (see Table 2).

Studies indicate that the majority of programs provided communities with collective cash payments. While communities often used some of the funds to pay guards to monitor the conservation lands, pay for forest management activities, and invest in infrastructure or agricultural projects, a number of communities used at least a portion of the collective cash to pay individual households. Particularly when there were low-levels of trust in community leaders, studies found that households frequently preferred individual cash payments, rather than investing in community development or infrastructure projects as cash was considered more transparent and allowed the household to use the incentive in accordance with their individual needs (Hayes and Murtinho, 2018; Pham et al., 2014; Robinson et al., 2016). In Vietnam, Pham et al. (2014) found that when trust was lower, participants preferred individual payments to all members, even if that meant receiving less than the equivalent of one US dollar per year. When trust was higher, communities chose to spend the funds on a mix of forest conservation, communal infrastructure projects and equal individual payments across households.

Quantitative assessments indicate that economic benefits to households are often neutral to small, but positive (Alix-Garcia et al., 2015; Clements and Milner-Gulland, 2015; Libanda and Blignaut, 2008; Naidoo et al., 2016). Nonetheless, households and community leaders frequently reported that they perceived that their communities were better off for participating in collective PES. In many studies, researchers noted that households perceived not only economic benefits, but also broader social and ecological benefits from participation, ranging from improved well-being to positive conservation benefits (Almeida-Lenero et al., 2017; Bremer et al., 2014a,b; Gross-Camp et al., 2012; Perevochtchikova and Negrete, 2015).

With respect to the distribution of benefits across community members, the studies demonstrate the complexities involved in inter-household distributional equity and perceived fairness in collective PES. The three studies that quantitatively examined the relationship between household conservation activities and allocation of compensation found no significant association between conservation activities performed and receipt of benefits (Hayes and Murtinho, 2018; Jones et al., 2018; Sommerville et al., 2010a,b). Those households that made greater behavioral changes did not necessarily receive more economic benefits. Studies of distributional preferences indicate that communities often divide the payments equally across all households. However, those who bore the brunt of the costs of participation, were less likely to consider equal division of benefits fair (Duong and de Groot, 2018; Hayes and Murtinho, 2018; Martin et al., 2014a,b).

Similarly, analyses of the distribution of benefits across differences in wealth, gender, and/or position indicate mixed results and point to the importance of local distributional norms. For example, in Mexico, Rico Garcia-Amado et al. (2011) found that communally decided distributional rules followed a tiered scale that favored those with formal land title, and specifically the elderly, over those residents without lands. Similar distributional rules were found in Ecuador and Kenya (Krause et al., 2013; Zwieten et al., 2015).

In our review, five studies found evidence in which poorer or more marginalized individuals were less likely to receive benefits from the PES incentive (Clements and Milner-Gulland, 2015; Krause et al., 2013; Milne and Adams, 2012; Rico Garcia-Amado et al., 2011; Zwieten et al., 2015). Six, however, found no explicit association between socio-economic status and receipt of payment (Caro-Borrero et al., 2015; Hayes and Murtinho, 2018; Jones et al., 2018; Martin et al., 2014a,b; Perevochtchikova and Negrete, 2015; Sommerville et al., 2010a,b), and two studies found that payments actually served to reduce inequalities (Gross-Camp et al., 2012; Libanda and Blignaut, 2008). Relatively few studies, however, used quantitative models to assess how participant and community characteristics influence distributional outcomes, and specifically considered costs as compared to benefits, thus indicating an area for future research (Hayes and Murtinho, 2018; Hayes et al., 2017; Jones et al., 2018; Sommerville et al., 2010a,b).

4.4. How does collective PES interact with local governance?

The studies reviewed here demonstrate how local governance conditions and collective decision processes may be at the crux of informed and voluntary participation, behavioral change, and transparent and equitable division of costs and benefits in collective PES (Bremer et al., 2014a,b; Caro-Borrero et al., 2015; Duong and de Groot, 2018; Hayes and Murtinho, 2018; Milne and Adams, 2012; Perevochtchikova and Negrete, 2015; Rico Garcia-Amado et al., 2011; Saito-Jensen et al., 2014; Zwieten et al., 2015). Nonetheless, in our review, few studies explicitly assessed specific governance conditions as independent variables. Rather, the majority examined the impacts of collective PES on communal governance conditions (see Table 2).

Studies that did explicitly examine governance attributes as an

[4] Some studies used more than one assessment measure, thus adds to more than 16.

independent variable found that communities with weak organizational capacity may lack transparency, have limited community participation, and be less likely to attain desired behavioral changes (Hayes et al., 2017; Hayes and Murtinho, 2018; Jones et al., 2018). Analyses indicate how community size, existent resource management rules, and explicit forums where community members come to come together and engage in participatory decision-processes are critical in attaining collective participation, behavioral change, and a distribution of benefits that participants perceive fair (Hayes and Murtinho, 2018; Hayes et al., 2017; Jones et al., 2018; Rodríguez-Robayo et al., 2016).

Studies that examined governance conditions as a dependent variable considered how PES influenced communal governance institutions, organization, social capital and/or conflict. Three of the seven studies that examined conflict found that participation produced conflict (Krause et al., 2013; Milne and Adams, 2012; Saito-Jensen et al., 2014), often because of a failure to adequately address heterogeneity in the distribution of benefits and/or costs. They point to the importance of aligning program design with community tenure arrangements, land-use practices, and distributional norms, and reiterate the role of existent governance arrangements in mediating or reproducing conflict (Corbera et al., 2007; Hayes and Murtinho, 2018; Krause et al., 2013; Milne and Adams, 2012; Saito-Jensen et al., 2014).

Eight studies found PES strengthened governance capacity and social capital within and across communities by motivating communities to craft and clarify their land-use rules (Clements et al., 2010; Hayes et al., 2015; Ingram et al., 2014), increasing administrative capacity and collective land management activities (Alix-Garcia et al., 2018; Almeida-Lenero et al., 2017; Bremer et al., 2014a,b; Ingram, 2012), and/or strengthening connections across communities and with external officials (Bremer et al., 2014a,b; Gross-Camp et al., 2012; Nieratkaa et al., 2015). Alix-Garcia et al., 2018 provide a particularly rigorous analysis of the impact of PES on social capital in Mexican *ejidos*. They find that, despite concerns that PES may undermine pro-social attitudes and behaviors, the program increased communal social capital and time dedicated to land management activities (paid and unpaid).

It is worth noting that the relationship between collective PES and communal governance conditions is likely reciprocal. The empirical research reviewed here consistently highlights how pre-existent local governance conditions and decision-making processes may shape social and behavioral outcomes, and in turn, benefit by further strengthening their governance capacities under PES (Bremer et al., 2014a,b; Hayes et al., 2015, 2017; Nieratkaa et al., 2015). More research is needed, however, to build a stronger understanding of this relationship and the potential to support local governance conditions and collective PES.

5. Conclusions: the crucial role of local governance

In their inception, PES contracts seemed to promise a solution to the freerider problem in resource management, since individuals would be directly compensated for their conservation efforts beyond the shared, non-excludable benefits to the local environment/watershed. Collective PES contracts, in contrast, layer an additional social dilemma (with respect to earning and distributing the payment) on top of the original one related to resource conservation. Our review finds that despite these additional challenges, collective PES can change behavior and provide socioeconomic benefits, but the institutional context matters.

As individual PES has proven to be much more sensitive to social factors than originally conceived (Bremer et al., 2018; Pynegar et al., 2018; Grillos et al., 2019), collective PES, even more so (Alix-Garcia et al., 2018; Bremer et al., 2014a,b; Clements et al., 2010; Jones et al., 2018). Our review highlights how the unique characteristics of collective PES, namely, aggregate decision-making, indirect links between individual effort and reward, and the second-order collective action problems make collective PES highly dependent on local institutional dynamics. The studies consistently point to how program design and communal governance factors influence the likelihood that participation is voluntary and informed, that the benefits are allocated fairly, and that the program is able to attain its desired resource-use goals. Yet, PES reviews have largely overlooked the distinct nature of collective contracts and thus far largely shied away from an in-depth examination of local governance dynamics.

As PES continues to expand in low-income countries, we can expect that more programs will be using the collective model. There is a strong need to address and improve our understanding of the reciprocal relationship between local governance conditions and PES programs. Rather than considering collective PES a market-based tool, we encourage scholars and practitioners to consider collective contracts within the broader literature on community conservation and development. Previous research on community based natural resource management provides valuable lessons on the social, ecological and local governance conditions often found in successful resource management (Hajjar et al., 2016; Baynes et al., 2015; Pagdee et al., 2006)

We also encourage scholars and practitioners to draw from across the disciplines to better identify and understand the institutional factors likely to produce desired resource management and livelihood outcomes. Our review points to the need for balance between providing sufficient resources and oversight to support inclusive and transparent decisions, while also allowing communities sufficient autonomy to adapt program processes and goals to fit the local context (Corbera et al., 2007; Pham et al., 2010; Milne and Adams, 2012; Saito-Jensen et al., 2014). Collective PES practitioners, and those involved in community resource management more broadly, could thus benefit from extant literatures on inclusive decision-making (Cetas and Yasue, 2016; DeCaro and Stokes, 2013), communal capacity for collective action (Agrawal, 2001; Cox et al., 2010; Ostrom, 1990; Rodela et al., 2019) and the role of external interventions in supporting local governance (Andersson, 2013; Barnes and van Laerhoven, 2015). In recognizing the multiple social dilemmas involved in collective PES, we will be better equipped to develop interventions that support local collective action that is sustainable and just.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.envsci.2019.09.010.

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