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Community-based water markets and collective payment for ecosystem services: toward a theory of community-based environmental markets☆

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In the last few decades, the scope of governanceauthr solutions for environmental problems has increased substantially. The old trichotomy of governance by government, governance by markets, and governance by communities has been replaced by a new interest in hybrid solutions in the recognition that no single-governance mode possesses the capabilities to address the multiple facets, interdependencies, and scales of current environmental problems. This paper takes stock on experiences that combine community-based natural resource management and market-based solutions, or as we call them *community-based environmental markets* (CBEMs). Specifically, we draw lessons from the literature on community-based payment for ecosystem services in the forest context, and from water markets in the context of water user associations (WUA markets). Similarities across the two contexts include the role of communities to ensure participation, compliance, and distributional equity, and the importance of markets as a source of revenue for communities, among others. Differences across highlight the importance to pay attention to the authority held by the communities (stronger in the context of WUA markets) and the nature of the market (i.e. whether it is a service or a resource market). These commonalities and differences motivate the interest of generating new theory on CBEMs, that is, one that builds on but also transcends community-based natural resource management and environmental market theory and allows to compare experiences from different resource contexts.

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Introduction

The trichotomy of governance by markets, communities, or governments has been surpassed by a new interest in hybrid instruments, in the recognition that no single-governance mode possesses the capabilities to address the multiple facets, interdependencies, and scales of current environmental problems [23,40,55,79]. New research programs addressing the coexistence of different modes of governance have emerged. A paradigmatic example is the scholarship on comanagement, which recognizes that some governance functions are better carried jointly by governments and local communities, and identifies conditions under which that can be the case [10,24].

Studies addressing the merits and challenges of community-market hybrids (heretofore community-based environmental markets (CBEMs)) are much scarcer. To be sure, there is considerable literature on community-based

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payment for ecosystem service programs (C-PES) [15], and community-based certification and ecotourism programs (e.g. [8,59,70]); and there is also literature on water markets in the context of water user associations (WUA) [26,80], and a few works on pooled transferable fish quotas [39,84], or community forest certification programs [48,6]. However, the literature is scattered across disciplinary divides and resource contexts, which prevents knowledge cumulation.

The hope embodied in hybrid modes of environmental governance is that they address the weaknesses of a particular mode and build on the strengths of the other mode(s). Environmental markets (i.e. tradable resource use rights and services) have been promoted mostly for their economic efficiency related to resource allocation, and flexibility against environmental changes, and criticized for their overemphasis on economic profitability over other values, generate or aggravate existing inequalities, and issues of democratic accountability [17,29,55]. Community-based natural resource management (CBNRM), that is, the organizations, rules, and norms that articulate cooperation within local communities, has been praised for coping with resource use interdependencies in complex socioecological contexts, and associated with strong levels of social capital and legitimacy, enforcement effectiveness, and fit with local conditions [1]; however, they have also been questioned for being transaction-cost demanding, mostly effective at local scales, slow against environmental changes [49,7].

The above theory aligns well with the reasons argued to either 'communalize' management in environmental market contexts, or 'marketize' rights in community-governance contexts. In the forest sector, payment for ecosystem services (PES) programs simulate a market through which stakeholders (e.g. downstream drinking water users) interested in a particular service (e.g. water quality) pay stakeholders with the means to provide such service (upstream landowners) to adopt certain land use practices that ensure the service (e.g. forest conservation in riparian areas). Although prices are not usually set according to a supply and demand basis, they are supposed to reflect the preferences of the two groups of stakeholders. However, prices do not always promote sufficient participation among providers or reflect their preferences or local conditions. An answer to this deficit has been the search for local legitimacy and fit with local socioecological conditions of the programs by organizing providers into new or existing communal organizations and having them collectively decide whether to participate, and/or co-design or manage the PES programs [63]. In the irrigation sector in many countries, water management authority resides with WUAs, which organize farmers for water allocation among other tasks. Here, markets have been advocated as means to add flexibility to the collective use rights held by WUAs, in the advent of water scarcity and increased competition over water resources [16]. In the fishing sector, the pooling of individual transferable quotas has been advocated as a solution to overfishing and bycatch resulting from the complexity of certain marine Socio-Ecological Systems (SES) [39].

Some PES literature has theorized around the role of collective action [4,50,63] and proposed frameworks to study community PES that partially build on the distinction between community and market features [15,34]. As pointed to by these works, however, the relationship between local environmental markets and communal governance conditions is still poorly understood [34].

This paper builds on the above efforts to draw lessons across the diversity of CBEM experiences and move us toward a theoretical framework for the study of CBEMs. The questions that guided this endeavor were: *Can we meaningfully study CBEMs experiences as hybrids of community and market features? Which role can community organizations play in environmental markets? How do environmental markets influence community governance?* In addressing those questions, we also aimed to provide preliminary answers to: *Do commonalities and differences across CBEM experiences reflect larger patterns? Could those patterns inform future larger comparative efforts?*

To answer the above questions, we reviewed the literature of C-PES and WUA-based water markets (WUA markets), two prominent examples of CBEMs, in an attempt to disentangle the mutual influence of community organizations and markets in those contexts.[1] Irrigation systems are managed by WUAs in many countries worldwide via common property regimes [15,34]. Some of these WUAs have combined share-based water distribution and trading for years and even centuries [21,60]. More recently, the increased competition over water resources has also driven the institutionalization of transfers

[1] The two reviews were based on larger reviews carried by the second and third authors in collaboration with the first author. These reviews were systematic in the search and content analysis of the publications, and included a variety of other findings that can be found in van der Lingen [78] and Hermann [38]. The reviews, however, did not aim at comprehensiveness, but just offer a preliminary exploration of patterns. After a keyword search and initial screening of the articles, each of the two authors coded 34 WUA-market and 21C-PES studies. The coding was supervised by the first author for a selection of the articles. The review on C-PES was restricted to articles based in Latin America due to the relevance of community-based forest management in that region and to the need to make the review manageable. The review on WUA markets aimed to be comprehensive but, contrary to the PES literature, was confronted with the lack of explicit connections between community organizations (WUAs) and markets in the literature. This made the search and screening stages more difficult. It is for these aspects that these reviews are not comprehensive, and this paper should be taken more as an effort to generate rather than to test theory.

across WUAs and also to external users, mostly cities [27,67]. In C-PES, payment for desired conservation activities and/or ecosystem services is collectively made to a group of individuals. C-PES arrangements are often considered an appropriate strategy to gain participation in rural communities where residents collectively manage their resource systems [50], and likewise, to reduce transaction costs when working with groups of small landowners and potentially conserve larger contiguous areas [47].

We build our review on Hayes et al. [34,34], which explores the performance of C-PES with regard to three aspects: i) the decision to participate in a CBEM and resolve associated conflicts, ii) effectiveness and compliance, and iii) the distribution of the costs and benefits associated with the participation. From this perspective, the question of participation is important because it casts doubt on both the willingness of individuals to participate and the way preferences are aggregated. Also, the responsibility to fulfill the market requirements (i.e. compliance and effectiveness) is not individual but collective, and this confronts participants with free riding behavior and cooperation issues. Finally, the issue of distribution of payoffs becomes also one of collective concern; communities' internal decision-making structures and power dynamics may ameliorate or aggravate the impact of markets on inequality.

Aligning with resource management theory, our review suggests that the property rights and decision-making authority held by the communities [76], and whether transactions involve resources or services [92], could serve as a steppingstone for further theoretical development in our understanding of hybrid modes of environmental governance.

Results and discussion

Our observation of how community and market attributes influence participation, compliance, and distributional aspects across the WUA markets and C-PES contexts[2] reveals a series of similarities and differences (see Table 1). Although with differences in richness (see below), both literatures directly or indirectly provide insights about preference aggregation, free riding, and equality issues associated with participation in the markets, proving their relevance beyond the C-PES context [34,34]. In this section, we pick on those in an attempt to derive larger theoretical insights.

[2] Here we refer to context as a broad group of CBEM cases, defined mostly by the resource at stake (i.e. forest or water) and the governance tradition from which they have been studied (PES or WUA, respectively). Also, we refer to cases as temporally and spatially (locally) bounded instances of CBEMs in the two contexts under study. In the review, we found some studies that contained information about more than one case.

Similarities: nontrivial role of communities

Both CBEM contexts illustrate that community organizations are not mere witnesses of markets but can have significant leverage to promote or hinder the implementation and sustainability of the markets. WUAs can promote participation in markets by articulating the different willingness of farmers to sell or buy water, but also act as clearing houses and facilitate negotiations with the state and organizations in other sectors [28,32,32,41,42,51,58,75,83]. Regarding compliance, WUAs play an important role to ensure water availability and distribution via storage and conveyance infrastructure, as well as register, monitor, and enforce water deliveries [77,80], provide technical support, and solve conflicts [56]. WUAs also tend to ensure fair distribution of costs and benefits of market participation if only because they tend to operate according to cooperation and proportionality principles [33,51,56].

In C-PES programs, community assemblies and leaders are well positioned to convey the benefits of participation and persuade communal and private landowners to participate. This is particularly the case if the communities can build on previous community-based development experiences, which is important if participation of individuals within communities is voluntary, that is, community members are allowed to enroll PES independently [19]. In some cases, participation can benefit from collective binding decisions, that is, decisions made by the ensemble of the community that everyone has to abide by [3,12,19,46,53,64,65,72]. Moreover, pre-existing resource management rules, prosocial norms, as well as effective monitoring and sanctioning (including accountability of leaders) can notably reduce the chances of free riding and corruption [3,12,19,20,22,46,65,73]. Finally, distributional policies that are democratically decided by the community, can ensure equality and the protection of less wealthy community members [19,22,22,46], particularly in communities with pre-existing social capital and egalitarian values [12,20,73].

On the negative side, pre-existing power asymmetries within WUA's decision-making bodies can affect the inclusiveness of participation decisions [30,77] and the distributional effects of water markets if, for example, only certain WUA members are entitled to newly acquired water or some member's rights are more vulnerable to restrictions associated with the selling of water [30,42,80].

Similarly, in the C-PES context, community organizations can jeopardize participation and even contribute to conflict if, for example, the organizations impose certain participation and tenure conditions [5,13,19,74], or if said conditions are used as political weapons [25,61]; and concentration of knowledge and decision power and the associated benefits around PES programs on certain

Table 1

Similarities and differences across the WUA markets and the C-PES contexts.

	Participation		Compliance		Distribution	
Similarities and differences	WUA Markets	C-PES	WUA Markets	C-PES	WUA Markets	C-PES
Similarities: non-trivial role of communities	+ Articulating preferences and clearing/negotiating prices for both internal and external markets[1-8] - Power asymmetries in WUA decision making bodies[13,14] - Add participation restrictions[3,13,15]	+ Convey benefits of participation; enforce one voice in some cases[24,25,26,28-32] - Add participation restrictions[30,31,35-38] - Failure to represent interest of marginal groups[24,30,36,45] - Economic incentives favor elite capture[24,28,34,35]	+ Ensure water storage and conveyance infrastructure[14,15] + Register and enforce water deliveries[14,15] + Provide technical support and solve conflicts[10]	+ Possibility to build on existing CBNRM rules that reduce free riding behavior and corruption[25,26,28-31,32] + Ensure additionality[27,33,41] + Ensure socio-ecological fit[28,32,33,35]	+ Cooperation and proportionality principles favor equality of costs and benefits[1,10,12]	+ Democratic practices can ensure equality[29,30,32,]
Differences: community authority	+ Enforce one voice via majority voting + State can organize or provide support[4,6,8,9,10] - Credibility to secure property rights that are sold[3,12]	+ Mostly persuade; enforce one voice in some cases[24-30] + Dependence on state and NGOs promotion and support[24,25,30-34, 45] - Organizational capacity and leadership issues[28,31,39-42]- Bad experiences with previous community development projects[43]		+ Formalization of property rights [30] + Institutional building[25,27,31-33] + Strengthen social capital[34,31,38,47] - Information issues and conflict due to lack of organizational capacity [24,28-29,31,35,39,42,43]	- Pre-existing water use right asymmetries among farmers[11,12]	- Organizational capacity and discretionary leadership issues[42,45]
Similarities: opportunities and risks of markets	+ Source of revenue for WUA water management operations[19]	+ Source of revenue for new collective ventures and forms of participation[25,31-33,39]	- Speculative behavior[11] - Crowding out of cooperative behavior in some cases[20] - Add confusion about property rights[17]	- Incentivize encroachments[30,31,42] - Crowding out of cooperative behavior in some cases[24,34,44] - Undermine traditional governance practices[24,30,33,34] - Congest organizational capacity[27]	- Asymmetric benefits within WUAs[13,14,15]	- Reinforcement of existing inequality and power imbalances[24,28,45,35,38] - Conflicts over distribution of payments[26,27,30]
Differences: the nature of markets			+ Resource allocation flexibility[15,18]	- Fail to recognize lack of additionality[29]	- Externalities between WUAs[7,22,23]	+ In kind payments for community development[25, 31, 32, 33, 40, 43] - Fail to accommodate socio-economic heterogeneities within communities[26]

Note: '+' and '-' refers to whether the aspect contributes to or hinders performance, respectively, and is based on explicit statements found in the revised studies or our interpretation of the information contained in said studies. **References**: Water markets: [89][1], [28][2], [42][3], [83][4], [41][5], [58][6], [75][7], [32][8], [81][9], [56][10], [71][11], [33][12], [30][13], [77][14], [80][15], [37][16], [27][17], [31][18], [2][19], [86][20], [90][21], [54][22], [57][23]. CB-PES: [53][24], [65][25], [93][26], [36][27], [3][28], [46][29], [19][30], [13][31], [64][31], [22][32], [66][33], [43][35], [87][34], [25][35], [61][36], [74][37], [5][38], [12][39], [44][40], [14][41], [18][42], [91][43], [43][44], [94][45], [52][46], [85][47].

community members can potentially favor 'elite capture' in the decision-making resulting in benefits that are derived by only a few. This can not only harm participation in PES, but also in local governance beyond PES programs [3,20,25,53].

Similarities: opportunities and risks of markets

Both contexts illustrate that markets can be an important source of revenue for community operations and development. In the water context, WUAs can obtain revenues and use them to cover the irrigation operation and maintenance costs [2]. In the C-PE context, in kind, payments can occur in the form of funding or support for community development projects such as potable water systems or social security mechanisms [12,22,22,64,65,66], the management of which can stimulate participation in community affairs and political activism more broadly [18,18,65].

That said, markets can also reinforce uncooperative behavior. In the WUA context, they may add confusion about the distribution of water use rights and corresponding collective management duties [27]; trigger speculative behavior among farmers [71]; or crowd out prosocial behavior [86]. In the C-PES context, programs' administrative and organizational demands can undermine traditional (more community-oriented) governance practices [19,20,53,66] and congest the communities' organizational capacity [35]. Also, the 'market' logic can crowd out prosocial and environmental values [19,44,53], as well as incentivize illegal resource encroachments and privatization of collective resources [12,18,18].

Finally, markets can create or aggravate inequalities. In the WUA case, this may happen, for example, market prices are dominated by large farmers/companies [30,77], or the initial allocation of rights is asymmetric from the start [80]. In the C-PES case, it may happen if economic or political elites 'capture' the decision-making process [3,5,20,25,53].

Differences associated with community authority

Differences also emerge and these are equally important toward theorizing about CBEMs at large if put in sufficient perspective.

An important set of differences has to do with the authority held by community organizations.

As holders of collective water use rights in most cases, WUAs have usually the last word about whether participate in a market (i.e. sell or buy water) or not. This applies both to the organization of transfers within their jurisdictions as well as the buying and selling of water externally. Also, WUAs can hinder 'free' transactions by, for example, by restricting transfers to certain quantities or duration [33,71]. By the same token, the lack of capacity of WUAs to guarantee tenure security can indeed jeopardize participation, such as in some groundwater systems [42] or in cases where land and water use rights lie in the hands of different actors [33]. The authority of WUAs is also evident with regard to some of the above-mentioned operational tasks and the management of water infrastructure and allocation at large. Institutional compliance with markets is indeed less of an issue in the literature as compared, for example, with the reproduction of vested interests and power asymmetries. To be sure, WUAs are supported by governments in many countries. Governments can both provide infrastructure, information, and monitoring resources [32,32,58,83] and also ensure water tenure security [56,81]. However, this support is mostly complementary to the WUA's autonomy.

Alternatively, the authority of community organizations in C-PES is considerably less clear. Communities may be able to enforce participation through majority voting but most likely need also to use persuasion because participation of individuals within communities may be voluntary, that is, when community members are allowed to enroll PES independently [19]. Similarly, communities may have formal authority but lack it de facto, due to lack of sufficient organizational capacity. This in turn translates into difficulties to pull sufficient social capital or information to gather interest around PES, to negotiate participation conditions [3,12,14,18,44,64], or to ensure compliance [3,18,25,46,53,91]. Also, governments and NGOs are in many cases promoters of the markets. They not only ensure funding stability but also facilitate participatory processes, technical assistance and support, and collective negotiations within the communities [12,19,20,43,53,66].[3] In some cases, they can also prevent inequalities [20,65]. To be sure, and contrary to the WUA's case, the C-PES context includes quite a wide diversity of experiences of community organization in terms of authority. The participating in the 'market' can be an opportunity for communities to have their collective land and political rights recognized or secured, and/or take control over local natural resource management and public services [19]; collective institutional building [13,22,65,66,88] and to strengthen reciprocity relationships and social capital within communities [5,13,43,72,85]. Finally, there are cases (i.e. some ejido instances in Mexico) where the community role is carried out by community-based forest management organizations (i.e. alike to WUAs) to which some of the above implications might not apply [15].

[3] Note here that WUA markets, and water markets and WUAs at large, also tend to be supported by governments. Still much of that support is limited to regulatory frameworks and in some cases to the organization of clearing houses (see Table 1).

Differences associated with the nature of markets

The WUA and C-PES experiences also point potential difference dependent on the nature of the market and the good exchanged, whether it is the resource (e.g. water) or an ecosystem service (e.g. water quality, bio- diversity conditions) that is being transacted [92]. In the C-PES context, for example, scholars tend to focus on additionality, that is, ensuring the added value of the programs in terms of ecosystem services and the role that community organizations can play to ensure ecological fit, and facilitate compliance [3,22,25,66]. Proving said additionality is, however, quite challenging more frequently than not [69,9].

These fit and additionality concerns are rather absent in the WUA-market literature and replaced instead with concerns about natural resource management (e.g. water storage and conveyance). Central in the WUA-market literature are the benefits of markets in terms of water allocation flexibility and their capacity to minimize the incentives to violate allocation rules during water scarcity periods [31,80]. Afterall, it is the resource itself that is transacted and not improvements in specific ecosystem services (i.e. additionality).

The relationship between the buyers and the sellers also differs depending on the good exchanged. WUAs are involved in both the buying and selling of water externally and internally among their members or urban water users, while community organizations in C-PES contexts have so far been responsible for the selling of services externally, usually to users located far away and of markedly different socioeconomic profiles and interests. Also, concerns raised in the WUA-market literature about scarcity externalities that emerge across communities [54,57,75] are rather absent in the C-PES literature. All this can be related to the nature of the markets in two ways. First, water markets are understood as mechanisms to allocate water to the highest value and therefore there are no predefined buyers and sellers (it depends on needs and/or willingness to pay), while (ecosystem) service markets have so far been understood as a way to compensate certain resource owners for changes in the way they use the resource. Second, the differences reflect varying monitoring requirements, as water (and natural resources at large) are, everything being equal, easier to monitor than specific services provided by, for example, forests, and therefore more prone to be exchanged in different directions and visible in the resulting externalities.

Associated with the above, is the relevance of socioeconomic heterogeneity within the communities in relation to the resource or service sold. We found this to be more of an issue in the C-PES than in the WUA-market literature. CBNRM organizations such as WUAs include relatively homogeneous user groups; farmers within WUAs can be quite different with regard to wealth, business models, or economic dependence from the resource [27,30,37,42,80], but they all share a similar (usually economic) understanding and use of the resource. This is not necessarily the case in service markets such as C-PES that can involve resource owners that rely on and understand their relationship with the resource and/or the ecosystem service provided in quite different ways [11,47,52,82].

A final difference has to do with the emphasis made on the economic and monetary value of exchanges. Other than promoting conservation, PES have been defended as solutions against community poverty [68]. In this vein, the C-PES literature has been keen on the study of in-kind payments and their positive effects on community development [5,12,18,22,64,65,66], as well as quite critical of the monetary valuation of certain ecosystem services [19,43,44,53]. These debates are rather absent in the water market literature likely due to its focus on water as an economic resource and the only marginal interest in conservation (as opposed to, e.g. allocative efficiency). We believe this can be associated again to the nature of the good being transacted. The understanding of resources as bundles of services that can be managed separately offers an opportunity to value each service in the most appropriate terms and circumvent the traditional understanding of said resources as economic goods.

Conclusions: toward new theory on community-based environmental markets around community authority and the nature of markets

Our review, while not exhaustive, demonstrates a thriving scholarship on hybrid governance that builds on market-based and community-based solutions. The overview of WUA markets and C-PES sheds light on the complexity behind CBEMs and hybrids at large. Still, the similarities found across the two sectors illustrate the existence of general patterns and the interest of developing a larger research agenda on CBEMs. Just like CBNRM or markets alone, the performance (i.e. participation rates, compliance, and equality) of both C-PES and WUA markets depends on both community features (e.g. institutional capacity, heterogeneities), and market features (e.g. revenue, in-kind payments, role of governments, and NGOs). More importantly, these features interact, and these interactions can both strengthen and undermine the performance of the hybrid. As shown here, for example, community-based institutions can ameliorate the natural tendency of markets to promote inequality within and between communities but can in that process also hinder participation in said markets.

Also, the differences found across the two contexts point to how we might begin to classify CBEM arrangements and think about types of cases, so as to organize broader

comparisons and understand larger patterns of performance. Namely, our review suggests that a classification that observes the distribution of property rights and associated management authority, and the nature of markets, and nature of markets, can serve as a steppingstone toward a theoretical framework for CBEMs. We believe these two features could be used to meaningfully distinguish types of experiences that have so far been treated separately in the water, fishing, or forest sector experiences (e.g. pooled fish quotas, community forest certification, community ecotourism…). Further research shall test the classification against a larger set of carefully sampled cases (e.g. C-PES where communities have different degrees of authority, or WUA markets vs. community-based payments for hydrological services). Also, one should not take the 'old' trichotomy of governance by markets, communities, or governments as obsolete. Theory on each of these modes of governance alone keeps evolving, for example, by integrating institutional analysis and political ecology lenses [95] and shall offer new insights into the study of CBNRMs. As shown in our review, governments and NGOs can indeed play important roles in CBEMs. Further research shall thus better conceptualize and integrate them in the classification.

Data Availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.cosust.2022.101221.

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This paper presents a conceptual framework and literature review for evaluating the contextual factors influencing community participation in PES and the outcomes of community participation. As shown in the results, the literature demonstrates how a range of participatory mechanisms can improve social capital, community assets and the legitimacy of PES, which may feedback to improve community support over time. However, there is limited evidence that Community-based-PES improves environmental outcomes and mixed evidence for equity and economic efficiency outcomes. There is also wide variation in the level of community engagement in CB-PES. In some contexts, additional efforts may be needed to strengthen property rights and institutional capacity to increase community engagement in CB-PES.

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lenges 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 stu- dies covering 16 collective PES programs located in 12 countries, they show how program design and local governance dynamics can influ- ence the ability of collective PES to attain desired social and behavioral outcomes.

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