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Payment for Environmental Services: Estimating Demand Within a Tropical Watershed

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ABSTRACT *The long-term success of payment for environmental services (PES) schemes depends on adequate demand for services and sustainable financing. We examine the viability of using locally financed payments to protect watershed services in rural eastern Costa Rica. Using dichotomous choice contingent valuation, we measure households' willingness to pay higher water bills for a local PES programme to adjust upstream land use practices to protect downstream water quality. We found that every income segment of the local population of water-users exhibited significant demand and willingness to finance the PES programme to protect local water quality.*

Introduction

Tropical deforestation, advanced technologies for resource use, and population growth are some global factors threatening ecosystems (Dietz *et al.*, 2003). Despite these threats, the international donor community has been shifting from environmental protection towards poverty alleviation strategies (Wunder, 2006). During the 1990s, the bilateral and multilateral agencies' forest-sector funding dropped by approximately 25% and 60%, respectively (Molnar *et al.*, 2003). As a result, multilateral agencies (e.g. World Bank, 2003), and nations (e.g. Castro, 2001; Miranda *et al.*, 2007) are promoting and adopting new approaches to finance *in-situ* conservation and watershed management. This paper explores the viability of one such approach, payment for environmental services (PES), for use in small rural watersheds in Costa Rica.

Payment for environmental services (PES) approaches attempt to use economic incentives within regions to protect natural resources while accommodating agricultural production, forestry, tourism, and drinking water supply (Wunder, 2007). Watershed PES programmes have been designed to use direct payments to compensate upstream resource users for their natural resource stewardship and changes in land use that result in ecological

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services to downstream beneficiaries (Wunder, 2006). Direct payment approaches such as PES have been found to be cost-effective means for resource conservation and sustainable ecosystem management (Ferraro & Simpson, 2002).

Costa Rica has implemented a PES programme focused on the provision of forest services such as carbon sequestration, biodiversity protection, and watershed protection (República de Costa Rica, 1996). The Costa Rican PES programme has been designed, implemented, and supported at the national scale with the help of external financing from such agencies as the World Bank (Pagiola *et al.*, 2005). Like most PES programmes in the world, the Costa Rican experience has operated as monopsony (Salzman, 2005), with only one larger buyer (i.e. FONAFIFO governmental agency) for multiple service provider sellers (Pagiola, 2002; República de Costa Rica, 1996). However, recent assessments of the Costa Rican PES scheme have recommended: a) reducing transaction costs associated with equity concerns (e.g. minimize contractual stages and facilitate access to information among landowners groups, small farmers in particular) (Zbinden & Lee, 2005); b) targeting payment schemes, on a priority basis, to encourage the sustainability and recuperation of forests in selected drainage basins, and not just in conservation areas (Sánchez-Azofeifa *et al.*, 2002); and c) using differentiated payments to allow for differences in both the level of service provision and the opportunity cost of providing services (Pagiola, 2006).

With these recommendations in mind, this paper explores a PES approach linking local beneficiaries and service providers using local payments for environmental services. Our approach builds on research that argues that new conservation and development efforts should be tailored to site-specific ecological and socio-economic conditions to achieve effective and sustainable preservation and management of threatened natural habitats (Bawa *et al.*, 2004; Ferraro & Kiss, 2002). More generally, there is a growing consensus that local management and protection of resources is essential for addressing site-specific complexities that externally imposed management systems often fail to address (Kerr, 2002). Micro-watershed management is one area that lends itself to both local community participation and incentive-based approaches (Kerr, 2007). Thus, local PES programmes may enhance *in-situ* conservation by working with affected populations within the context of their watersheds, in which relationships between forest-use practices and the condition of water can be better recognized and managed (Food and Agriculture Organization of the United Nations (FAO), 2004). Ongoing efforts such as the New York City–Catskill PES (Postel & Thompson, 2005) and the Procuencas programme in Costa Rica Central Valley (Miranda *et al.*, 2007; Redondo-Brenes & Welsh, 2006) provide evidence that successful PES schemes may be watershed-based, may not require international or national financing, and can result in economic, environmental, and equity gains.

A salient feature of most watersheds and their services is that the design of instruments to protect them is complicated because costs and benefits are usually borne by spatially and temporally separated parties (Postel & Thompson, 2005). Field evidence has shown that linking beneficiaries with providers via local PES programmes to financially support local protection and management of watershed's hydrological services in developing countries is not always straightforward (Dillaha *et al.*, 2007). Implementation of payments for watershed services remains at incipient stages in Latin American countries, albeit much farther along than in any other part of the developing world (Southgate & Wunder, 2007). One problem that has materialized is that many watershed PES schemes have failed to cultivate local buyers of environmental services, relying instead on one-off contributions from external donors. As such, researchers working on PES programmes argue that improved understanding of the demand for the services of PES programmes may be a necessary pre-condition for: 1) assessing viability of PES schemes (FAO, 2004), and 2) mainstreaming PES institutional arrangements in the tropics (Wunder, 2007). More generally, an understanding of demand has been acknowledged as a key research step and need for all PES (Southgate & Wunder, 2007), and several authors have called for more empirical research on the demand for and financial sustainability of such programmes (Arocena-Francisco, 2003; Postel & Thompson, 2005). This paper generates such demand information for rural eastern Costa Rican communities as a contribution to our understanding of the potential viability of local, self-financing PES.

Costa Rica's Water Quality and Aqueduct System

Though water quantity has not generally been a problem in many areas of Costa Rica, in 2005 only 82% of the Costa Rican population had access to a drinking water supply system, and 30% of the water provided by municipalities and communities was not potable based on national quality standards[1] (Astorga, 2005). Deforestation and forest fragmentation in Costa Rica have adversely impacted water quality and availability. The rate of deforestation in Costa Rica between 1986 and 1992 was about 4% per year and it is expected to continue into the country's remaining unprotected forests (Sánchez-Azofeifa *et al.*, 2001). One watershed with less than 50% forest cover remaining and the highest degree of forest fragmentation in Costa Rica is the Reventazón macro-watershed, where this study's research sites are located (Sánchez-Azofeifa *et al.*, 2002). Water quality scarcity in Costa Rica may also be linked to deficient water treatment (Calvo, 1990). Estimates of a 45% growth in demand for potable water between 2000–25 signal the likely additional strain on existing systems, thus exacerbating the current problems (FAO, 2000). Furthermore, the Costa Rican national water agency could face severe financial constraints if new financing mechanisms are not undertaken (see Astorga, 2005; AyA and OPS/OMS, 2002; Espinoza *et al.*, 2003).

The threats to Costa Rican watersheds suggest the potential for local PES programmes to protect local water supply and quantity. However, implementing a PES programme to effectively secure improvements in water supply and quality requires some knowledge of the relationship between land uses and watershed services. Often the precise effects that various land uses in and around watersheds have on watershed services remains somewhat uncertain, especially for water supply (Pattanayak, 2004). Thus, in this research we focus on the provision and maintenance of water of potable quality. Indeed, specific linkages between changing land uses and water quality have been reported (Bruijnzeel, 2004). Furthermore, Kosoy *et al*. (2007) assert that watershed PES programmes are more likely to be effective when they address water quality problems since there is less scientific ambiguity concerning the relationship between land use changes and water quality, and less divergence between public expectations and scientific evidence on the link between land use and water quality. Like Johnson & Baltodano (2004), Kosoy *et al.* also suggest that Central American rural populations widely perceive water provision to be a primary forest benefit, and high quality and quantities of water to be a function of large forest cover upstream, and this is consistent with the empirical findings of Máñez Costa & Zeller (2005).

In addition to the threats to water quality, various institutional factors make Costa Rica an interesting place to study the potential demand for local PES approaches to protect water quality. Importantly, Costa Rica's existing water policy framework is watershed-based and community-oriented (Astorga, 2005; MINAE, 2005; Mora Portugués, 2006). Thus, a local-scale PES programme is consistent with the scale of the existing water policy. In addition, many rural areas of Costa Rica have prior experience with community-financed and operated aqueduct systems (Espinoza *et al.*, 2003). Such communities are familiar with collective provision of drinking water systems and the potential costs involved if a new water source must be found.

Research Focus

To address the need for empirical research on the demand for and financial sustainability of local PES programmes, this paper examines the viability of using locally-financed direct payments to protect watershed services as an incentive-based policy instrument for protecting and managing watersheds in eastern Costa Rica. Using a dichotomous choice Contingent Valuation survey, we measure households' willingness to pay higher water bills for PES programme payments to adjust local, upstream land use practices so that they better protect downstream water quality, quantity, and reliability.

Methods

Contingent Valuation

The contingent valuation method (CV or CVM) is a non-market valuation technique to estimate the benefits derived from environmental amenities (Carson, 2000; Carson & Groves, 2007; Cummings *et al.*, 1986). Key elements of CV survey questionnaires include a constructed/contingent market, the good's description, and a careful presentation of the payment vehicle (Zilberman & Marra, 1993). Under a commonly used CV question format, the respondent is offered a binary choice between two alternatives (often set in the context of a referendum) (Carson & Groves, 2007), one of which is the status quo policy and the other, an alternative policy that has a greater cost than the status quo (Carson, 2000). Bishop and Heberlein (1979) showed that this format could be used along with a random assignment of different monetary costs to different respondents, to obtain the empirical distribution of willingness-to-pay (WTP) or willingness-to-accept (WTA) values in a given population. As long as the economic agents being surveyed believe that their responses might influence policy actions, the standard economic model suggests that agents should respond to the survey in such a way as to maximize their expected welfare (Carson & Groves, 2007). The referendum model for eliciting economic values in a contingent valuation framework has had great appeal since it was popularized by Bishop & Heberlein (1979) and Hanemann (1984). Among its virtues are the apparent incentive compatibility and informational properties (Carson & Groves, 2007). The referendum approach was specifically endorsed by the NOAA Panel on Contingent Valuation (Haab & McConnell, 1998).

In recent years, the CVM has been used to inform policy-makers about individuals' preferences for basic infrastructural projects in developing countries such as water supply and sanitation (e.g. Merrett, 2002; Whittington, 1998), and surface water improvement (e.g. Choe *et al.*, 1996; Smith & Desvousges, 1986). A recent study in a micro-watershed in the hillsides of Nicaragua employed the CVM to assess the economic value of improving local watershed services for rural residents (Johnson & Baltodano, 2004). The good being valued in most of these studies is drinking water and it is usually provided through some type of water project. We follow that approach here but explicitly include PES payments to local landholders in the specification of the provision of the good, protection of drinking water.

To derive the econometric model, we make the standard assumption that if a respondent's true WTP is greater than the cost, then the respondent is assumed to vote 'yes', and 'no' otherwise. Specifically, we assume that person *j* will vote for the programme ($y_j = 1$) if WTP is greater than the programme cost, or will vote against otherwise ($y_j = 0$). We measure this with error, so we have the standard statistical model of $WTP_j = \beta Z_j + \varepsilon_j$ where the latter term, βZ_j, represents the parametization of the mean for *j*'s demographic variables, Z_j. Consequently, we model the probability of a yes vote as:

$$Prob(y_j = 1) = \Phi((\beta Z_j - C_j)/\sigma), \qquad (1)$$

where Φ is the cumulative density function for the standard normal distribution, C_j is the cost faced by *j*, and σ is the common standard deviation of the underlying errors. This specification of the econometric model allows us to recover estimates of the variance term σ by observing that the parameter on the cost term, α, will be equal to $1/\sigma$ (Cameron, 1988). From this specification, one can then compute mean WTP as $\beta Zj/\alpha$.

Study Site

The field research took place in eastern Costa Rica about 130 km east of the capital city, San José. The research sites are located in the lower basin of the Reventazón watershed, the second largest watershed in the country ($\approx$ 3000 km^2) (Espinoza *et al.*, 2003). Its tributaries include the Destierro, Peje, and Cairo rivers, which make up two sub-watersheds supplying water to the research site's community aqueducts. Intensive systems of pineapple and banana production for export are the largest reported land uses in the area. Other land uses in the area include private forest, pastures, tourism activities, rural towns, and commercial and industrial facilities. With respect to forests, the watershed under consideration presents mostly lowland fragmented tropical rain forests (i.e. secondary moist broadleaf forest). The communities of Cairo-Francia and Milano (Table 1) rely on the local watershed to supply drinking water to their aqueducts because the nearby surface water is too polluted for potable uses.

Table 1. Characteristics of the two community aqueducts

Micro-Watershed	Elevation (m)	Community Aqueduct	Estimated Households per Aqueduct	Interviews Collected
Río Destierro	79–62	Milano	344	136
Ríos Cairo y Peje	88–71	Cairo-Francia	656	164

The communities of Cairo-Francia and Milano were selected for this study because of their prior experience with community-financed aqueduct systems. Moreover, these sub-watersheds, like many in the area, face potential environmental threats due to increasing deforestation, urban expansion, and proliferation of factor-intensive agricultural production, especially pineapples. In response to these changes, local agencies must often consider projects to relocate drinking water sources in order to pipe in drinking water from alternative drainage basins. The costs associated with moving drinking water sources means that *in-situ* alternatives, such as better protection of available water sources, merit close attention. Indeed, our research addresses household willingness to pay to finance a PES programme targeting the land uses in and around aqueduct water sources.

The water to Cairo-Francia and Milano is transported via two independent aqueducts, which are administrated by community-based committees called 'Comités Administradores de Acueductos Rurales' (CAARS).[2] These committees were organized during the construction of the water infrastructure to administer, operate, and maintain the drinking water supply systems and are financed by revenues from a set monthly water fee. Community members actively engage in their drinking water system activities including water aqueduct construction, setting local policies, volunteering on community committees/boards, voting in local elections, helping to collect water use payments from neighbours, etc. This institutional arrangement is stipulated on the various Costa Rican policies aimed at managing water resource use, conflicts, and degradation in watersheds. Costa Rica's water law has moved towards mandating: a) strong focus on the watershed as the unit of management, and b) active community involvement in decision-making (see Astorga, 2005; MINAE, 2005). In fact, approximately, 80% of the Costa Rican population receives water from one of 1572 locally financed rural aqueducts operated by some form of CAARS (Espinoza *et al.*, 2003). This institutional setting for water management, both locally and nationally, indicates potential success factors for local-scale PES (Kaplowitz *et al*., 2008), and were key factors in our selection of these communities for this study.

Survey

The data were collected through a survey of randomly selected households from the two communities, Cairo-Francia and Milano. Face-to-face interviews were implemented during a 31-day period in July 2006. The target population of the research was heads of household that were 18 years of age or older. Households that could not be interviewed on an initial visit were revisited up to two additional times. The survey yielded 300 completed interviews. Based on American Association for Public Opinion Research (AAPOR, 2006) standards for reporting survey response rates, the present study had an 81% minimum response rate (RR1) and a 94% cooperation rate (COOP1).

The survey collected non-market valuation data to estimate each household's demand for protecting and maintaining their watershed's hydrological services using a community-based PES programme. The CV questionnaire and its components were pre-tested and refined using an iterative approach to appraise scenario plausibility and respondents' understanding (Kaplowitz *et al.*, 2004). The survey provided background information about the aqueduct and sub-watershed that supplies the communities' water and about land use issues within the watershed. A referendum format was used to elicit each household's willingness to pay higher water bills to finance PES programme payments to alter land uses to protect their water quality, quantity, and reliability. The CV scenario asked if respondents would vote for the PES programme to protect their drinking water at a specific monthly cost that would be added to their existing water bill. Respondents were also instructed that if the majority of the population votes 'yes,' the programme would go forward and they would have to pay the specified monthly fee on the top of current water bill. The referendum question was followed up by a debriefing question to verify that the good was understood. The monthly fee in the CV scenario was randomly assigned across respondents. The fee amounts were set based on priors from in-depth qualitative research and a small pilot study.

Results

Key summary statistics from the survey are presented in Table 2, along with a description of the variables used in the estimation. When accounting for item non-response across variables, there are 286 observations available for the econometric model. Hence, Table 2 presents results for these 286 cases. We found that on average, monthly income was about 135 400 colones. The average monthly household income for our sample is similar to the

Table 2. Variable derivation and descriptive statistics for the variables (N = 286)

Variable	Description	Measurement	Mean	Std. Dev.	Min.	Max.
Vote	Response to 'Would you vote for or against the programme if you would have to pay [cost] colones more on your monthly water bill?' (yes or for = 1, no or against = 0).	1 or 0	0.69	0.46	0	1
Monthly cost	Monthly cost of programme (on top of current water bill) from the vote question. Defined in the preamble to the vote question and varied across respondents.	10 000 colones	0.12	0.08	0.04	0.24
Income	Monthly household income. Elicited as an open-ended question for those that could provide an exact answer and within categories for others.	10 000 colones	13.69	11.6	1.7	85
Current protection	Perceived current level of protection of natural resources in their area on a 1 to 5 scale with 1 = 'extremely well protected' and 5 = 'extremely poorly protected'.	1, 2, 3, 4, 5	3.81	0.97	1	5
Threatened in future	A dummy for perception of what would happen to drinking water sources in the future if nothing more was done to protect them, coded as 1 if threatened and 0 otherwise.	1 or 0	0.83	0.38	0	1

national average household income (i.e. 140 000 colones) and slightly lower than household incomes in urbanized and metropolitan areas of Costa Rica's Central Valley (Kaplowitz *et al.*, 2006). On average, we found that households perceived that natural resource protection in the area was somewhat poor. Most of the households (83%) believed that water sources would be threatened in the future, absent additional efforts to protect them.

Table 2 also presents the dependent and independent variables that enter the econometric model of the willingness to finance the PES programme. The dependent variable in our model, 'Vote for the PES programme' (y_j), is a dummy variable taking the value 1 if the household voted yes to support the PES programme, and 0 otherwise. Based on economic theory we expect PES programme cost to have a negative effect. Moreover, we hypothesize that believing that drinking water sources were threatened in future, absent an intervention to protect them, would have a positive effect on the household's WTP higher water bills for PES programme payments to change land uses to protect water sources.

A probit model was estimated using household votes for the proposed PES programme from 286 completed questionnaires. Coefficients, test statistics, robust standard errors, and marginal effects for the participation decision are reported in Table 3. Overall, the chi-squared test of the model indicates that it is significant ($p < 0.000$). The key variables in the model were significant and of the expected sign. For instance, as expected, the monthly cost of the protection programme had a negative effect ($p < 0.000$). Income per month also had positive effect ($p = 0.054$) on estimated household's WTP. Household beliefs regarding the potential for water sources to be threatened in future if nothing else is done to protect them had a significant positive effect ($p = 0.038$) on estimated WTP. This effect means that people who believe that their drinking water sources were threatened in the future if nothing else is done to protect them are more likely to vote yes to pay for the PES.

In nonlinear models such as the probit, the individual parameter estimates do not directly indicate a variable's marginal effect. That is, it is of interest to know how changes in a model variable will affect the estimated probability of voting yes to a programme. The marginal effects are the unconditional marginal effects of each variable on the probability of voting yes to the referendum when evaluated at the sample means for other variables (Table 3). Since the marginal effects represent the change in the predicted probability of voting yes for a one-unit change in an underlying variable, their interpretation depends on the scale and range of the variable. For instance, an additional 10 000 colones per month is

Table 3. Probit model estimates and statistics

Variable	Coefficient	P-Values[a]	Marginal Effects
Monthly cost (in 10 000 colones)	−4.98	0.000	−1.703
Income (in 10 000 colones)	0.017	0.054	0.0059
Current protection	0.041	0.636	0.014
Threatened in future	0.437	0.038	0.159
Constant	0.419	0.011	
N	286		
LogL	−160.5		
−2ln(Lr/Lu)	29.1	0.000	

Note: [a]P-values are based on robust standard errors computed using the sandwich estimator.

predicted to raise the likelihood of voting yes by less than 0.6 percentage points. A 10 000-unit change in income akin to a 7% change in the sample average income (see descriptive statistics in Table 2). If a household believes that the water source is threatened in the future, absent an intervention to protect it, their predicted probability of their voting yes increases by about 16 percentage points. Since the threat variable is a dummy (and not continuous), the marginal effect is computed as the change in the predicted probability with the level of the threat variable evaluated at 0 and then at 1. This latter effect provides evidence that respondents are sensitive to their perception of the scope of the change in water quality protection provided by the PES programme.

Analysis of Willingness to Pay

The results yield an estimated mean willingness to pay (WTP) for the sample of about 2300 colones per month per household. The estimated mean WTP values are about twice the current average monthly water bills of 1015 colones. The elicited WTP amounts to support the PES programme are additional fees on top of the current monthly water bill. Interestingly, the results are quite similar to those of Máñez Costa & Zeller (2005) who found mean WTP for improved drinking water quality in a rural Guatemalan watershed to be twice the existing water bill.

Since there are issues that have been raised in the literature regarding the equity and distributional effects of PES programmes (see Grieg-Gran *et al.*, 2005 for an exhaustive discussion; Pagiola *et al.*, 2005; Zbinden & Lee, 2005), it is of interest to consider the effect income levels have on the above-mentioned estimate of WTP. Figure 1 illustrates the effect of household income levels on WTP. It shows the probability of a yes vote at the

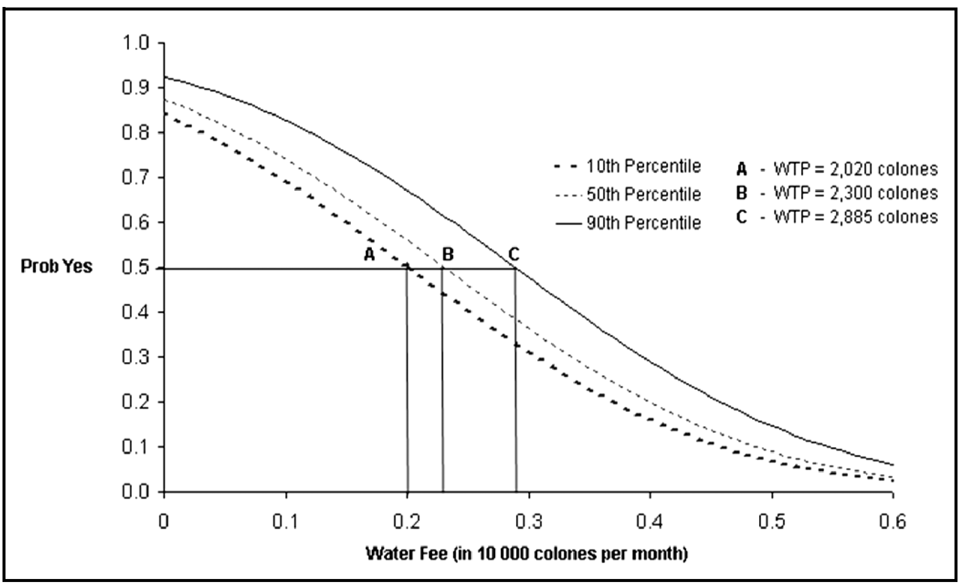

Figure 1. Mean WTP and probability of yes vote at different fees for three different monthly income levels, representing the 10th, 50th, and 90th income percentiles for the study sites.

10th, 50th and 90th percentiles for income from our sample data (40 000, 120 000, and 290 000 colones of monthly income, respectively). At these income levels, mean WTP is estimated as 2020, 2300 and 2885 colones, which roughly represent 5%, 2%, and 1% of the corresponding income levels.

These results demonstrate that every segment of the population exhibited significant demand and willingness to finance the PES programme to protect local water quality. From this analysis, we argue that in the context of our communities, water users indicate substantive willingness to pay for the provision of the service and that concerns over possible imbalances in the burden or distribution of provision costs across differing segments of population do not seem to constitute a demand-side barrier to local-scale PES programmes to protect water. This is supported further by the consideration that the resulting total water bills under the proposed PES programme with an additional monthly charge equal to the mean WTP would still be about half the amount of the basic water tariffs imposed by governmental water authorities in more developed communities near the study site (≈ 6,000 colones).

Our findings are similar to contingent valuation results for households in a rural Bolivian watershed (Shultz & Soliz, 2007). Shultz & Soliz (2007) found that household's mean WTP for a watershed plan to improve drinking water quality was about 2% of income. Our results also follow the findings from a recent household-level empirical study in Queretaro, Mexico by Mendoza *et al.* (2007). These researchers examined WTP for water supply service improvements (increase in quantity and quality of water) and found that households with private piped water connections were willing to pay 3% of their income for the improvements. Interestingly, households from informal settlements (i.e. areas with very low income levels and lacking private piped water services) were willing to pay 9% of their income for private piped water services that included the water quality and quantity improvements.

Conclusions

Payment for environmental services approaches are institutional arrangements that may help to align incentive structures to protect highly valuable watershed land uses that provide ecosystem services. The core idea of PES is that downstream beneficiaries of environmental services make direct contractual payments to local landowners who, in return, adopt land and resource use practices that secure ecosystem protection (Wunder, 2007). The potential for PES programmes as an *in-situ* incentive-based policy instrument to financially support conservation is of interest among ecologists, environmental scientists, managers, and policy-makers. A better understanding of the demand for the services provided by PES programmes may be a key to successful implementation of locally financed PES schemes. To address this research need, we estimated household demand in two relatively small rural communities for protecting and maintaining their watershed's hydrological services via community-based PES programmes.

Our research finds a strong indication of support for and willingness to pay for local, collective protection of hydrological services in the study areas' headwaters. Using data from a household referendum contingent valuation survey, we empirically measured household willingness to pay (WTP) higher water bills for PES programme payments to change land uses to protect water quality. We found that household's propensity to vote for the programme (and hence pay for the protection programme) was significantly affected by the programme's monthly cost, and household WTP is significantly affected by income and the presence or absence of the belief that water sources are threatened in future absent an intervention to protect them. The results yield an estimated mean WTP for the sample of about 2300 colones per month per household, which was about twice the current monthly water fee and about 2% of median income. Moreover, in an attempt to examine issues regarding the equity and distributional effects on those that would be required to finance a local-scale PES programme, we found that every income segment of the population exhibited significant demand and willingness to finance the PES programme to protect local water quality.

In summation, the results of our case study demonstrate that local demand is not an obstacle for using locally financed PES approaches as a mechanism for the protection of watershed and associated ecological services. However, it is important to note that several follow-up inquiries are necessary to provide additional clarity with respect to the viability of local PES approaches in eastern Costa Rica. Specifically, further research is needed to generate accurate hydrological information concerning the specific link between certain land uses and the several dimensions embedded in the provision of drinking water (i.e. quantity, quality, and spatial and temporal distribution). Moreover, an examination of the supply-side of a potential trading scheme is necessary to identify potential matches or mismatches between water users' willingness to pay for provision of watershed services provision and landowning service providers' willingness to accept that compensation. Finally, it is necessary to scrutinize the institutional dimensions of PES programmes as a policy instrument that could effectively align incentives to sustainably finance the provision of environmental services from watersheds. In our case, favourable legal and institutional settings (Kaplowitz *et al.*, 2008) along with prior experience with community provision and governance of water aqueducts were key criteria for the selection of our study sites. Further studies and analyses may help to determine the extent to which local and national institutional settings contribute to the potential demand for local scale PES programmes.

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Notes

1. In Costa Rica, quality potable water is defined as water that can be consumed without diminishing users' health. National quality standards (i.e. Reglamento para la Calidad del Agua Potable) require potable water to fulfil certain physic-chemical and microbiological levels. Costa Rica's water quality regulation is updated according to new developments in the Standard Methods for the Examination of Water and Wastewater, which is a joint publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF).
2. CARRS are also called Asociaciones Administradoras de Acueductos Rurales (ASADA). The only difference between these locally administered organizations is that ASADAs have gained legal authorization as a service provider from AyA, the Costa Rican National Aqueducts and Sewage Agency.

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