Using contingent valuation in the design of payments for environmental services mechanisms: a review and assessment

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1. Introduction

Payments for environmental services (PES) programs are an increasingly popular policy instrument in developing countries, especially for watershed protection. Most PES programs involve downstream water users—such as domestic water supply utilities or hydroelectric power (HEP) producers—paying upstream landholders to undertake activities to protect a watershed. Upstream landholders may be paid to stop deforestation, undertake afforestation, reduce soil erosion on agricultural lands, or cease slash-and-burn agriculture. The potential benefits to downstream water users include improvements in the quality, quantity, and reliability of water supplies, reduced risk of severe floods, and perhaps the bequest value of preserving natural areas for future generations.

The price to be paid for environmental services is a critical aspect of any PES program. The viability of any PES program requires that the maximum amount that users of environmental services ("buyers") would be willing to pay for improvements in those services exceed the minimum amount that providers of those services ("sellers") would be willing to accept. PES designers have often turned to stated preference methods, and particularly to contingent valuation surveys (CV), to estimate either or both of these values.[1] As use of CV in this context grows, it becomes important to assess how well this method is being applied, and how its results can best be used.

In this paper we review CV studies conducted in the context of PES programs (CV-PES), almost all of which attempt to estimate the demand of downstream water users for upstream watershed protection and, more generally, for improved water services. Our objective is to assess the quality of these CV-PES studies, and their usefulness for designing PES programs. We begin by briefly reviewing the use of PES in developing countries (section 2). We then discuss the possible uses of CV in PES design (section 3). Section 4 discusses nine indicators of good practice that we use to assess the quality of CV-PES. Although many of the issues that a well-

[1] Contingent valuation (CV) is just one type of stated preference method that could be used to estimate the willingness to pay of downstream users and the willingness to accept payment of upstream landowners. In this paper we focus on CV rather than stated preference methods more generally because the vast majority of stated preference applications in the PES field use CV. Many of our observations and conclusions are equally applicable to other stated preference methods.

designed CV must consider are not unique to CV-PES, the PES context introduces several special considerations, which we discuss in section 5. In section 6 we review the existing CV-PES studies and assess their overall quality. We then discuss the limitations of the results from this literature (section 7) and conclude by summarizing the implications of our findings (section 8).

2. Payments for Environmental Services

PES is a market-based approach to conservation financing based on the twin principles that those who benefit from environmental services (such as users of clean water) should pay for them, and that those who contribute to generating these services (such as upstream land users) should be compensated for providing them (Wunder, 2005; Pagiola and Platais, 2007; Engel and others, 2008). PES can thus be conceptualized as an attempt to strike a Coasian bargain between service users and providers, internalizing what would otherwise be an externality. PES is attractive in that it (i) generates new financing which would not otherwise be available for conservation; (ii) is likely to be sustainable as it depends on the mutual self-interest of service users and providers and not on the vagaries of government or donor financing; and (iii) is likely to be efficient in that it conserves services whose benefits exceed the cost of providing them, and does not conserve services when the opposite is true.

There are two basic kinds of PES programs (Pagiola and Platais, 2007; Engel and others, 2008): *user-financed PES programs* in which service providers are paid by service users, and *government-financed PES programs* in which providers are paid by a third party, typically a government. *User-financed programs* are preferred in most situations because they are most likely to be efficient as service users provide not only financing but also information on the value of services, can readily observe whether they are receiving the desired services, and have strong incentives to ensure that payments are used effectively. Conversely, *government-financed* programs typically cover much larger areas, but are less likely to be efficient because governments have no direct information on service value or on whether services are being provided, and need to respond to numerous pressures that are often unrelated to the program's objectives.

In developing countries, user-financed PES programs have most commonly been for water services, where users are easy to identify and receive well-defined benefits (Pagiola and Platais, 2007).[2] The dominance of payments for water services within PES programs is likely to continue. The very nature of the services involved means that water programs are much easier to implement than, for example, payments for biodiversity services (Pagiola and Platais, 2007).[3]

There are now numerous PES programs in existence that involve direct payments by various types of water users at a variety of geographic scales. Domestic water supply systems have been the most frequent participant in PES, at a wide variety of scales, ranging from large cities such Quito, Ecuador (Southgate and Wunder, 2009), through medium-size towns such as

[2] Our discussion in this paper focuses on the use of PES in developing countries. See Salzman (2005) for a discussion of some applications in industrialized countries.

[3] Programs aimed at sequestering carbon are a distant second, in terms of number of mechanisms and area covered, after water services (Camhi and Pagiola, 2009). This may change in the future, however, if markets develop for Reduced Emissions from Deforestation and forest Degradation (REDD).

Heredia, Costa Rica (Barrantes and Gámez, forthcoming), to small rural towns such as San Pedro del Norte, Nicaragua (Obando, 2007).

HEP producers are also well-represented in current PES programs. In Costa Rica, for example, many public-sector and private-sector HEP producers pay to conserve the watersheds from which they obtain water, generating payments of about US$0.5 million and conserving about 18,000 hectares (ha) annually (Pagiola, 2008, Blackman and Woodward, 2010). In Venezuela, power company CVG-Edelca will pay 0.6% of its revenue (about US$2 million annually) to conserve the watershed of the Río Caroní, where 70% of the country's HEP is generated (World Bank, 2007). Some irrigation systems have also participated in PES programs, for example, in Colombia's Cauca Valley (Echavarría, 2002).

Government-financed PES programs can, in principle, target any environmental service deemed to be of social importance. In practice, they have also focused primarily on water services. The main window of Mexico's Payments for Forest Environmental Services (PSAB) program targets water services (Muñoz and others, 2008). China's Sloping Lands Development Program (SLCP) focuses exclusively on areas at risk of erosion (Bennett, 2008). Costa Rica's Program of Payments for Environmental Services (PPSA) currently defines its eligible areas primarily on biodiversity criteria, due to early financial support from the Global Environment Facility (GEF), but the program is evolving towards a greater focus on water services (Pagiola, 2008). Some governments use public resources for PES programs aimed at biodiversity conservation, but such funding is very limited. The area enrolled under the biodiversity window of Mexico's PSAB program is less than one tenth that enrolled under the water services window.

3. Uses of CV surveys in PES design

Payments to service providers in a PES program must be less than the value of the service to users (or it would not make economic sense to provide it), but more than service providers' cost of supplying it (or providers would not supply it). The objective of a CV-PES could be to determine the maximum amount that a user would be willing to pay suppliers, the minimum compensation that sellers would accept to change their behavior by undertaking different land use activities, or both. To date, the vast majority of CV-PES has focused on estimating the buyers' willingness to pay (WTP) for improved environmental services; only a few examine service providers' willingness to accept (WTA) payments to modify their behavior.[4] In this paper we focus on the WTP studies.

One reason that most CV-PES surveys focus on the WTP of service users is that estimates of the cost of service provision by upstream landholders are often relatively easy to obtain by other means, as they consist primarily of the opportunity costs of displaced land uses, plus any out-of-pocket costs (for example, for planting trees). The rental value of land in an upstream watershed can also serve as a useful proxy for the costs of service provision.[5] The value of improved service provision to users, on the other hand, is typically harder to observe

[4] We found only two CV studies that examined upstream landholders' WTA payments to participate in a PES mechanism (Southgate and others, 2009; Lundine, 2005). In addition, Porras and Hope (2005) use conjoint analysis to examine farmer WTA payments in the Arenal watershed (Costa Rica).

[5] In fact, in San Pedro del Norte, Nicaragua, payments to participating farmers were explicitly based on land rental values (Obando, 2007).

because prices for such services are administratively determined and often heavily subsidized, and thus do not reflect the real value of the services to users.

CV can play several possible roles in PES design. The most obvious is to help assess whether PES would be feasible. By providing estimates of either WTP for services or WTA to provide them, CV-PES can help determine whether there is 'room for a deal.' A related objective is to assess whether PES would be welfare-improving. In this case the WTP estimates are used in a cost-benefit analysis to estimate potential welfare increases resulting from improved service provision. This role would be particularly important in the case of government-financed PES programs. CV-PES can also provide guidance on the price to be charged to service users. Finally, CV-PES can provide reassurance to policymakers that implementation of PES is politically feasible, by indicating that users would indeed be willing to pay for the benefits they would receive.

CV-PES can also be administered at different stages of PES design. A survey intended to determine whether a program is feasible would best be administered early in the process, while one aimed at establishing appropriate prices would be most useful late in the process. This has implications for the information that would be available for construction of the stated preference scenario, as discussed below.

4. Indicators of good practice in CV applications in the PES field

Carrying out CV-PES requires adherence to good practices that are needed in applications of CV in all sectors. CV consultants can refer to numerous excellent manuals and books (Mitchell and Carson, 1989; Arrow and others, 1993; Louviere and others, 2000; Bateman and others, 2002; Champ and others, 2003; Alberini and Kahn, 2006). Best practice in the design and implementation of CV is constantly evolving. What needs to be done to ensure high-quality results in any particular context is a matter of judgment and subject to budgetary constraints. In this section we briefly describe the nine indicators of good practice that we subsequently use to assess our CV-PES sample.

The nine indicators we use here are not meant to be comprehensive. Moreover, we recognize that CV-PES researchers may not always have the time or budget to implement all of these best practices. The National Atmospheric and Oceanic Administration (NOAA) Panel Guidelines (Arrow and others, 1993) form the basis for some, but not all, of our indicators. We have selected these nine because they are relatively easy and straightforward to assess from reading the CV-PES, and because they cover a range of design and implementation issues.

Using methods to reduce hypothetical bias

The main criticism that economists have leveled at CV has been that WTP estimates are inflated because respondents do not face an actual budget constraint (hypothetical bias), and because they are prone to say yes too easily, perhaps just to please the interviewer (enumerator bias). These are serious threats to CV-PES results (Whittington, 2010). However, CV researchers have developed several ways to reduce this yea-saying tendency, including (i) cheap-talk scripts (Cummings and Taylor, 1999; List, 2001; Carlsson and others, 2005), (ii) ballot boxes to simulate voting behavior (Carson and others, 1994; Krosnick and others, 2002; Harrison, 2006), (iii) recalibration of results with data from real experiments (Blackburn and others, 1994), (iv) time-to-think (TTT) experiments (Whittington and others, 1992), and (v) drop-off protocols

(Subade, 2007). Using any of these methods to reduce the risk of hypothetical bias is an important indicator of the quality of a CV-PES.

Asking debriefing questions

CV researchers typically follow-up a respondent's answer to the valuation question with a series of "debriefing questions." The NOAA Panel Guidelines (Arrow and others, 1993) called for debriefing questions, referring to them as "Yes/No Follow-ups." If respondents say "Yes," and agree to pay the offered amount (bid) in the CV scenario, the interviewer follows up with questions about the reasons why the respondents agreed to pay. If the respondents say "No," that they will not pay, then the interviewer follows up with questions about the reasons why they are not willing to pay. The purpose of debriefing questions is to try to determine whether respondents have interpreted and answered the valuation question in the way that the researcher intended. Respondents can offer legitimate and illegitimate reasons to both "Yes" and "No" answers to the valuation question(s). A well-designed CV-PES will include debriefing questions in order to separate legitimate from illegitimate answers to the valuation question(s).

Asking uncertainty questions

CV researchers routinely try to gauge the level of confidence—or certainty—that respondents have in their answers to the valuation question (Alberini and others, 2003; Li and Mattson, 1995; Loomis and Ekstrand, 1998; Whitehead and others, 1998; Samnaliev and others, 2006; Akter and others, 2008). A high level of certainty in respondents' answers may be an indicator that in fact they will pay the offered bid amount. Answers to uncertainty questions can be used during the analysis of the survey data to decide how many of the respondents who said "Yes" to the valuation questions should actually be treated as definite "Yes" votes. The NOAA Panel Guidelines called for including a simple "don't know" or "not sure" response. Other approaches have been used to assess respondents' uncertainty (for example, Wang, 1997). Some CV researchers prefer to embed the uncertainty questions directly into the available responses to the valuation questions (Ready and others, 1995). We consider any approach to obtain information about the uncertainty respondents feel toward their answer to the valuation question to be an indicator of a high-quality CV-PES.

Determining whether respondents are "in the market"

When a dichotomous choice, referendum question is used to elicit respondents' WTP, the researcher will typically want to carefully distinguish respondents who do not value the service at all from those who will not pay the offered price but may be willing to pay something. Policy makers are often interested in the raw data on the number of respondents who are not willing to pay anything. Also, if there are many such "zero WTP" respondents, spike models may be the most appropriate econometric framework for analyzing the co-variates of respondents' answers to the valuation questions (Hanemann and Kristrom, 1995; Kristrom, 1997). Several approaches are used in the literature to identify "zero WTP" respondents. The approach we prefer is to begin the valuation questions with the discrete price offer. Respondents who say "Yes" are clearly willing to pay something and are "in the market." If respondents say "No," then it is natural to follow-up by asking, "Would you pay anything?" If respondents again say "No," sometimes a second follow-up question is posed: "Would you take the service for free?" However, in our assessment we consider the inclusion of any sequence of questions to determine who is in the market to be an indicator of a high-quality CV-PES.

Using visual aids to explain the CV scenario

In well-crafted CV survey instruments, respondents are presented with a hypothetical management plan (policy intervention) and a choice as to whether they would be willing to pay a specified amount of money for it to be implemented. The NOAA Panel Guidelines called for an "Accurate Description of the Program or Policy," and said: "adequate information" must be provided to respondents about the program being offered (Arrow and others, 1993:10). One way to accurately convey the details of the hypothetical management plan and the results of its implementation is to use pictures, maps, diagrams, figures, and tables (Labao and others, 2008). Visual aids are not always required, but their use in a survey protocol suggests that the researcher is seriously concerned that respondents understand the CV scenario. In CV-PES, there are many possible uses of visual aids to convey relevant information. For example, if the management plan requires upstream landowners to change their land use practices, photographs could be used to show the current state of erosion in the upstream watershed and what the land would look like after afforestation. Diagrams could be used to show how downstream water quality would improve. Conveying such information to urban residents without visual aids could be very difficult. We consider the use of visual aids during the presentation of the CV scenario to be an indicator of a high-quality CV-PES.

Using split-samples to test for the robustness of results

The NOAA Panel noted that "common notions of rationality" impose requirements on CV results (Arrow and others, 1993:11). For example, one usually assumes that respondents should be willing to pay more for more of a service than for less of it. CV researchers may ask different split-samples of respondents their WTP for different levels or "scope" of the service to be provided to demonstrate that respondents' answers to the valuation questions are consistent with common notions of rationality. Such scope tests are not always straightforward, as there is often little a priori guidance as to how much such estimates should differ. But we consider the use of scope tests and other split-sample experiments to test for the reliability and accuracy of the WTP results to be an indicator of a high quality CV-PES.

Testing if income is positively correlated with WTP

Demand theory suggests that WTP for normal goods increases as income increases. Other things equal, we expect high-income respondents to have higher WTP than low-income respondents. If this is not true, it suggests that respondents may not be answering the valuation questions as the CV researcher intended. We thus expect a high-quality CV-PES to report whether income is positively correlated with respondents' WTP.

Addressing intrahousehold allocation

Intrahousehold allocation issues pose complex research design decisions for CV researchers (Adamowicz and others 2005; Whittington and others, 2008; Prabhu, 2010), including whether respondents are supposed to answer the valuation questions for themselves or for the entire household, and whether to interview the husband, the wife, or both. The simplest approach is to use the household as the sampling unit and interview whoever is identified as a household decision maker, usually either the husband or the wife. However, when households' decision-making is best characterized as cooperative bargaining, this simple approach is likely to be inadequate. We consider an explicit effort to address such intrahousehold allocation issues in

the determination of whom to interview and in the construction of the CV scenario to be an indicator of a high-quality CV-PES.

Obtaining informed consent

Obtaining informed consent from respondents is necessary to ensure that they can choose whether or not to participate in the survey (Whittington, 2004). An informed consent form is presented to potential respondents before an interview. It tells respondents about the research objectives, the sponsoring agency, and any potential risks to their household or others. It promises respondents anonymity and provides them with someone to contact if problems occur (this person cannot be directly affiliated with the research project). If compensation is offered to respondents, it should be clear in the form that this compensation will be paid even if they decline to participate. Offering respondents an informed consent form certainly does not solve all the potentially problematic ethical issues involved in conducting CV, but it is a step in the right direction. We consider an effort to obtain respondents' informed consent to be an indicator of a high-quality CV-PES.

5. Special challenges in the design of CV-PES

The nine indicators of good practice described in the previous section are broadly applicable to CV in all sectors. In addition, there are specific challenges in the design of CV-PES that need to be recognized. In PES programs, payments from downstream water users are collected and used to pay upstream landholders to undertake land uses that are expected to improve water services. There are several sources of uncertainty in this context.

The first challenge arises from the difficulty of predicting how specific upstream land uses will affect downstream water quality and quantity in a particular watershed, as the scientific evidence to establish this relationship is often weak. Downstream users thus bear a risk that benefits will be lower than anticipated (Pagiola and Platais, 2007). Undertaking detailed *ex ante* hydrological studies reduces this risk, but cannot completely eliminate it.[6] The impact of this risk can also be mitigated in well-designed PES programs by including monitoring and evaluation systems that enable adjustments to be made to landholder contracts to ensure that downstream users receive the benefits for which they are paying. In user-financed PES programs, users also have the option of ending payments if they are unsatisfied with the services they receive, thus putting a limit on possible losses.

CV-PES designers need to decide how much of this scientific uncertainty to try to explain to respondents during the interview. Broadly speaking, there are two ways to proceed. One is to attempt to convey to respondents the true degree of scientific uncertainty about the consequences of upstream actions, and try to ensure that respondents incorporate an understanding of these risks in their responses to the valuation questions. In this case the WTP estimates will incorporate the information that the policy outcomes are uncertain. Survey designers could also describe the features of PES that can help mitigate the risk. The other approach is for survey designers to try to estimate WTP for specific policy outcomes contingent on the success of the watershed protection activities. In this case the downstream users' WTP estimates are policy relevant only if planners are confident that the upstream watershed protection activities being

[6] Such studies were rarely undertaken during the design of most existing PES programs, but are common in the design of new PES programs.

contemplated will result in outcomes at least as good as the respondents were told to assume in the CV-PES.

A second challenge concerns the description of institutional uncertainty. PES requires that money be collected from service users, be administered, and then be used for the intended purposes. In many developing country situations, respondents may be skeptical that any monies they provide will actually be paid to upstream landholders, or that landholders will respond as expected. Respondents may refuse to participate in PES not because of scientific uncertainty or because they place low values on service improvements, but because they lack confidence in the institutions. Researchers could handle this institutional uncertainty by acknowledging in the questionnaire that many people feel this way, and specifically instructing respondents to suspend their lack of trust in institutions and assume that the money would be handled honestly and provided to the upstream landowners as promised. This challenge is especially severe in the case of CV-PES administered early in the program design process. Here, too, the value of the service could also be estimated contingent on its successful delivery.

A third challenge survey designers face is that respondents may have preferences for more than just improved service delivery. Downstream users may also care about protecting upstream watersheds because they may provide wildlife refuges, forests for recreation, and non-use environmental benefits. Upstream landholders may be poor, and downstream respondents may place a premium on helping them. If people care about upstream land uses for reasons other than downstream service improvements, omitting these other reasons from the information set provided to respondents may result in WTP being under-estimated. An important question thus concerns how much detail respondents should be provided about how the PES program would work in upstream areas—who would be paid, and to do what. One extreme is not to tell respondents anything about the management plan (or even the PES program itself), and to simply measure their demand for specific improvements in the downstream water services without telling them *how* these improvements will come about. The other extreme is to tell respondents a good deal about the management plan and what landholders would actually have to do to receive the proposed payments.

The different studies can thus be classified according to the degree to which they recognize and address the challenges of explaining scientific and institutional uncertainty, and describe the elements of PES management plans that can affect respondent preferences. At one extreme, studies could provide information on all three of these aspects. In a simpler approach, the survey could provide information on some, but not all of these aspects. Finally, respondents could be simply presented with a scenario that asks them to value specific improvements in downstream water services without being told about either the management plan or the uncertainty in the outcome.[7]

[7] In fact, there are a large number of CV studies in the literature that attempt to measure households' WTP for improved water services (See Whittington et al. 2009 for more details on this literature). Even though studies in this literature were not conducted in a PES context, their results are potentially useful for PES program design—as long as respondents were not told that the improvements in service quality would occur by some other means.

6. An assessment of the quality of existing CV-PES

To assess the quality of existing CV-PES, we sought studies that had been undertaken specifically in the context of actual or hypothetical PES programs for watershed protection. We collected 25 such studies, listed in Table 1.[8] Many of the applications we review are in the grey literature; only a few have been published in refereed journals.[9] Two of the studies were Masters theses. Almost half of the papers are only available in Spanish. Several researchers recur frequently among the contributors.

All the studies in our review were carried out in the past decade—not surprisingly, since PES has only been in use since the late 1990s. Almost all are from Latin America—again, not surprisingly, as most existing PES programs have been implemented there (Southgate and Wunder, 2009; Camhi and Pagiola, 2009). In fact, 10 studies are from Mexico[10] and 5 from Costa Rica. Only one is from Africa, and two from Southeast Asia (both from the Philippines)[11]; none are from the Middle East or other parts of Asia. In practically every study, the downstream parties were urban water users. There are only a few studies of irrigators' WTP to preserve their water supplies (Lopez and others, 2007; Shultz and Solis, 2007), and only one of electricity users' WTP to protect watersheds where HEP is generated (Alpizar and Otarola, 2004).

In assessing the studies, we were limited by the information provided by the papers and reports. Many CV-PES did not include the survey instrument or report the CV scenario. Nor was the approach described in sufficient detail for us to fully assess the quality of the fieldwork and the results—even the grey literature reports, which do not face the length restrictions of journal articles, often failed to provide sufficient detail on the methodology used.[12]

Many CV-PES studies were undertaken as part of the design of proposed or actual PES programs, or examine working PES programs; we describe these as "policy" studies. Other applications are for purely hypothetical PES programs. Among the policy studies, almost all were undertaken during the design phase of PES programs, but one (Moreno-Sánchez and others, 2009) examines the possible expansion of a working program.

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[8] Note that some studies have been the subject of more than one publication, and that some publications cover several studies. We count studies rather than publications.

[9] Whittington (2010) notes that most stated preference applications now carried out in less-developed countries never make it to refereed journals, for two reasons. First, most support ongoing policy work and were never intended for distribution to a wide, academic audience. Second, most journals have increasingly stringent publication standards for stated preference articles. A simple reporting of empirical findings of straightforward, professional applications of the methods is of little interest to most editors, however useful it may be for policy work. Many well-executed studies thus never reach a wide audience.

[10] Nine of the studies conducted in Mexico were contracted as part of an effort to help jumpstart local PES mechanisms to complement the national PES program, while the other two were academic studies.

[11] Bennagen and others (undated) also conducted CV studies for a hypothetical PES program in the Philippines, including separate surveys of domestic water users, irrigated rice farmers, and tourists. However, we omitted this paper from our review as it provides no description whatsoever of its methodology.

[12] Because of this, we may be under-estimating the extent to which the studies in our sample use particular indicators. However, failure to provide sufficient methodological information to enable readers to assess a study's quality could itself be considered an indicator of a poor-quality study.

Table 1: Characteristics of CV surveys used for analyzing PES Programs

Location (country, site)	*Policy or hypothetical*[a]	*Date of study*[b]	*Size of sample*[c]	*Sources*[d]
Bolivia				
Comarapa (town)	P		221	Shultz and Soliz, 2007 [PR]
Comarapa (lower watershed)	P		188	Shultz and Soliz, 2007 [PR]
Colombia				
Chaina	P	2006	300	Moreno-Sánchez and others, 2009 [WP]
Costa Rica				
Cartago	?	2003	413	Alpízar and Otarola, 2007 [BC]
Dos Novillos watershed	H	2005	398	Kaplowitz and Lupi, 2008 [UN]
Esparza	?	2005	365	Alpízar and Madrigal, 2007 [UN]
Reventazón watershed	H	2006	300	Ortega-Pacheco and others, 2009 [PR]
Turrialba		2002	200	Berggren and Stahl, 2003 [ST]
Ecuador				
Cotacachi	H	2002; 2004	274	Rodriguez and others, 2009 [PR]
Ghana				
Weija	H	2008	89	Peprah, 2009 [ST]
Honduras				
Copan Ruinas	P	???	285	Cisneros and others, 2007 [UN]; Madrigal and Alpízar, 2007 [UN]
Siguatepeque	?	2002 (?)	337	Cruz and Rivera, 2002 [UN]
Mexico				
Bahías de Huatulco, Oaxaca	P	2007	376	González-Ortiz, 2007 [CR]
Coatepec and nearby towns, Vera Cruz	P	2007	197	Puente-González, 2007 [CR]
Colima-Villa de Alvarez, Colima	P	2007	422[e]	Pizano-Portillo, 2007 [CR]
El Cielo-Ciudad Victoria area, Tamaulipas	P	2007	432	Campos-Benhumea, 2007 [CR]
Monterrey, Monterrey	P	2007	384	Saldivar-Valdés, 2007 [CR]
Saltillo, Coahuila	P	2007	180	Arias-Rojo, 2007 [CR]
Santa María de Huatulco, Oaxaca	P	2007	381	González-Ortiz, 2007 [CR]
Six small towns, Quintana Roo	P	2007	377	Contreras-Benítez, 2007 [CR]
Tapalpa watershed, Jalisco	?	2005 (?)	243	López and others, 2007 [PR]
Upper watershed of Rio Balsa, Mexico	P	2007	837[f]	Vargas-Pérez, 2007 [CR]
Nicaragua				
San Dionisio	H	1998	153	Johnson and Baltodano, 2004 [PR]
Philippines				
Metro Manila	H	???	2232	Calderon and others, 2006 [PR]
Tuguegarao City	?	2006	401	Amponin and others, 2007 [WP]

Notes: a. P = Policy; H = Hypothetical
b. Dates marked '(?)' are not stated in the report but inferred from the context.
c. Values refer to completed interviews. Response rates are rarely reported, so it is generally not possible to determine the original sample size.
d. BC = Book chapter; CP = Conference paper; CR = Consultant report; PR = Published in a peer-reviewed journal; ST = Student thesis; WP = Formal working paper series; UN = Unknown
e. In addition, the researchers also surveyed 356 commercial water users.
f. 168 households in the watershed; 353 in the city; 316 in the suburbs.

Most of the studies appear to have involved in-person interviews in respondents' homes. All studies used a monetary numeraire to measure WTP.[13] With the notable exception of the Calderon and others' (2006) study from Manila, Philippines (n=2232), the sample sizes of the CV-PES are relatively small.[14] Almost all (18) used dichotomous choice questions, mostly single-bounded, while four used a payment card and one asked an open-ended valuation question.

The most common payment vehicle was the household water bill, but a surprisingly large number of studies did not specify a payment vehicle. Respondents were simply asked if they would pay a given amount, without telling them how this amount would be collected. In some cases neither the elicitation procedure nor the payment vehicle were reported in the study.

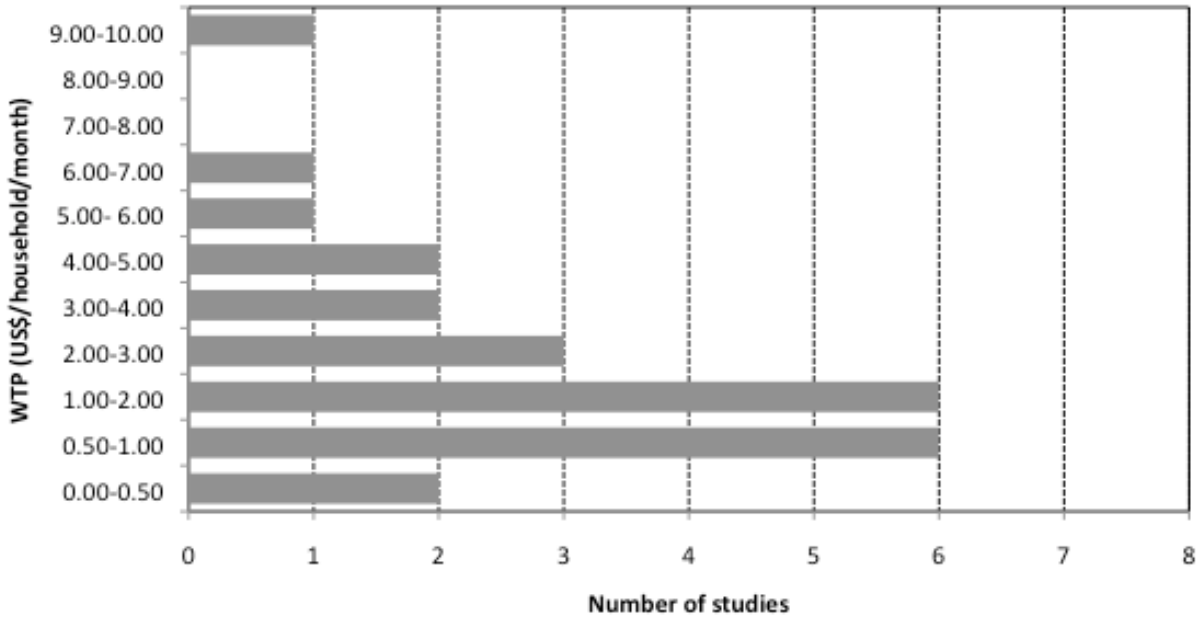

Figure 1: Estimated households willingness to pay for improved water supplies in CV-PES studies

The mean or median household WTP of water users for improved services is not reported in all studies. Figure 1 summarizes the available results from studies of WTP for improved domestic water supplies. Estimates range from US$0.42 per month for households living in five small communities in Nicaragua (Johnson and Baltodano 2004) to US$6.90 in Turrialba, Costa Rica (Berggren and Stahl, 2003), and about US$10 in Jalisco, Mexico (Lopez and others,

[13] This is reasonable in that almost all PES mechanisms take monetary payments from service users and make monetary payments to service providers. Asquith and others (2008) describe one of the exceptions: a case in Bolivia in which providers receive bee hives and training in honey production as compensation for conservation activities.

[14] However, some studies were conducted in small communities with correspondingly small sample frames, so small samples sizes do not necessarily indicate inadequate sample sizes.

2007).[15] Two-thirds of WTP estimates are less than US$3 per household per month. In one of the most carefully executed studies, Calderon and others (2006) reported a mean WTP for households in Manila of US$0.50 per month. However, these estimates are not strictly comparable, as they refer to different degrees of improvements.

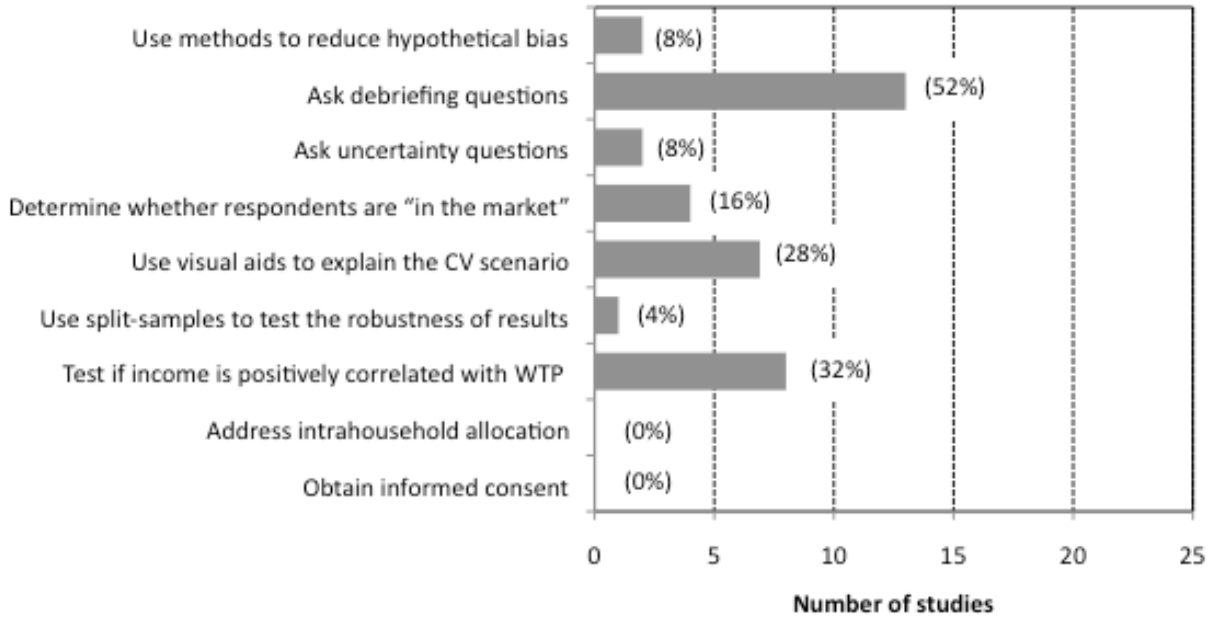

Figure 2: Number of CV-PES studies that included each indicator of study quality

Figures 2 and 3 examine how the CV-PES we reviewed fared in terms of our nine indicators of good practice. Figure 2 shows the number (and percentage) of studies in the sample that used each of the nine indicators of good quality. The three indicators found most often in the CV-PES were debriefing questions (52%)[16]; tests of whether income was positively correlated with income (32%); and using visual aids in the presentation of the CV scenario (28%). Only two studies (8%) used any of the currently available techniques to minimize hypothetical bias: Calderon and others (2006) and Amponin and others (2007) used 'cheap talk' scripts. Very few studies asked questions to assess respondents' uncertainty (8%); or used split sample experiments to test for the robustness of respondents' answers to the valuation question (4%). None of the studies explored intrahousehold allocation issues or reported obtaining informed consent. Figure 3 presents a simple count of the number of studies in our sample that used different numbers of quality indicators (from 0 to 9). For example, 7 of the 25 CV-PES did not have (or did not report) using any of the nine quality indicators. Eight studies had only one of the nine attributes. Only 2 of the 25 studies had 6 or more indicators of quality (neither was from Latin America). The mode was one indicator; the mean was 1.6 indicators.

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[15] The WTP estimates reported here are in US$ for the year the study was conducted. They have not been normalized to a base year. Expressing these results as a percentage of household income or of current water bills would probably be more meaningful, but few studies provided the information necessary to compute these indicators.

[16] However, most only asked a single debriefing question to respondents who refused to pay: "Why?"

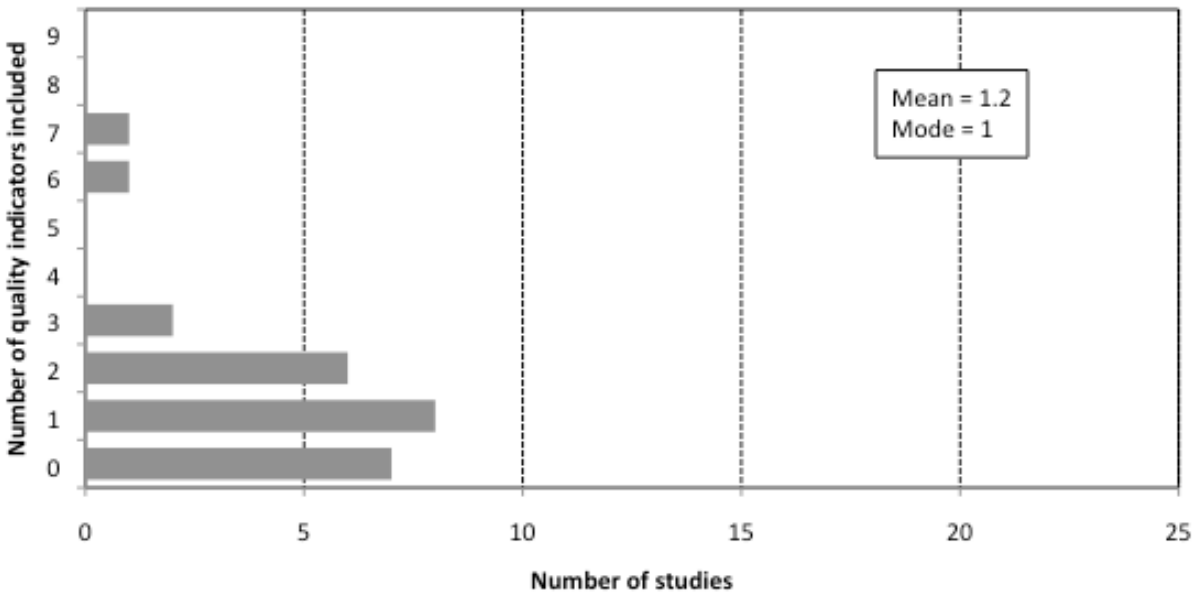

Figure 3: Number of quality indicators included in CV-PES studies reviewed

The best studies provided figures, tables, and photographs to respondents to help them understand the choice task, but only seven studies in our sample reported doing so. Many studies provided respondents little or no information on how service improvements would be achieved; indeed, many studies provided almost no information on what kind of service improvement respondents would receive, and simply asked respondents their maximum WTP for "water service improvements." None of the studies attempt to convey to respondents the uncertain outcomes associated with upstream watershed protection activities. Nor did any of the studies ask respondents to suspend their possible skepticism about institutional uncertainty. In most studies, respondents were not told about either the management plan or the scientific and institutional uncertainty associated with the management plan and downstream outcomes. Calderon and others' 2006 study provides a good example of an information set in which respondents were told about watershed protection activities upstream and the downstream consequences but not about the risk that some of these outcomes might not materialize.

There are two especially revealing indications of the wide variation in the quality of the CV-PES in our sample. First, many studies fail to find a statistically significant relationship between respondents' answers to the valuation questions and household income (or wealth). This is quite unusual in well-executed stated preference studies. Second, the choice tasks presented to respondents vary widely in their clarity and policy-relevance. Some of the valuation questions are not incentive-compatible, meaning that respondents have an incentive to misrepresent their preferences, and are inappropriate in the PES context of collective action. For example, an open-ended valuation question that asked respondents their maximum WTP for upstream watershed protection would not be incentive compatible (Carson and Groves, 2007; Whittington, 2002).

The state-of-the-art in conducting stated preference studies is constantly evolving, and some of these CV-PES are now a decade old. While it would of course be unfair to impose today's standards on the older studies, the NOAA Panel's recommendations for CV (Arrow and

others, 1993) are now almost two decades old, and most CV-PES studies in our review do not meet these standards. We thus believe it is accurate to characterize most CV-PES studies as methodologically uninspired and generally low quality applications of stated preference methods.[17]

7. How useful are the results of the stated preference studies for policy purposes?

PES programs are not always financed by levying additional charges on water users. In many cases, payments for conservation activities are financed from the savings resulting from lower treatment costs or the avoided costs of building new infrastructure (Pagiola and Platais, 2007). In such cases, WTP surveys would not be necessary: if utility payments to upstream service providers are lower than the cost savings, there would be no need for water users to pay more. Because estimates of cost savings would be based on assessments of existing conditions, they would generally be preferred to estimates based on stated preferences. Understanding WTP could be useful, however, when current spending is required to avoid future costs, or when substantial investments are needed to improve water services (or avoid their degradation). None of the studies in our sample, however, appear to have considered alternative approaches to estimating the benefits of watershed conservation before undertaking CV-PES.

In cases where CV-PES studies are called for, their potential usefulness depends in part on their accuracy and reliability. As discussed in the previous section, the quality of many studies raises questions in this regard. However, even if the WTP estimates from CV-PES are accurate and reliable, they are just one input into a negotiation process between upstream landholders and downstream water users. Almost all of the papers are silent on how their results can be used in PES design.

The authors of some studies seem to argue that a PES deal is feasible if the summation of downstream users' WTP is greater than the upstream landholders' minimum WTA to implement the watershed protection plan. In fact, for PES to be feasible, three conditions must hold. First, the potential revenue collected from downstream users for the PES program must exceed the minimum payments required by upstream landholders to participate. Water service providers are not perfectly discriminating monopolists, so it is not possible to collect revenues equal to the summation of the maximum WTP of all downstream users. Only one CV-PES study attempted to use the WTP estimates to calculate the revenue that might be collected (Calderon and others, 2006). Although CV-PES could provide some of the raw data needed to support PES design, there is little evidence that these data are actually being used correctly to estimate potential revenues. Second, the payments from downstream water users must be less than the costs of alternative means that achieve the same service improvements. In the language of negotiations, the PES deal for the downstream users must be better than their "Best Alternative to a Negotiated Agreement (BATNA)." Third, the transaction costs of collecting payments from service users and making payments to service providers must be less than the difference between the WTP and the WTA. These three conditions together imply that there is potential for PES if the potential revenues from downstream users are greater than the sum of the payments necessary to

[17] We attempted to split our CV-PES sample to see whether more recent studies (since 2005) showed improvements over earlier studies, but did not find any significant differences. The sample is too small, however, for any definitive conclusions in this regard.

compensate landholders and the program's transaction costs, *and* they are less than the costs of alternative means of delivering service improvements.

The results from CV studies of downstream users alone are not sufficient to demonstrate this condition. None of the authors of the papers included in our sample supplement their CV-PES results with additional information on the costs of alternative means of achieving equivalent service improvements, or on the compensation needed by participating upstream landholders, in order to examine the feasibility of a potential PES negotiation, and none provide information on transaction costs (indeed, most do not even mention them).

There is a strong inclination for authors to simply claim that their results are policy relevant without demonstrating how these estimates of demand for improved services and/or upstream watershed protection can be used to make better decisions. In some cases, this may be because CV-PES was undertaken primarily for academic purposes, with the authors' search for policy relevance occurring after the research was finished, when they sought to market their findings to policy makers. But some of these CV-PES were in fact undertaken for clients. For example, the national forest commission (CONAFOR), which administers Mexico's PSAB program, commissioned most of the Mexico studies, and several of the Honduras studies were undertaken under the FOCUENCAS project that implemented a pilot PES.

The CV-PES studies are largely silent on how the estimated WTP amounts can be used to revise water tariffs in order to collect the revenues needed to make payments to upstream landholders. In some CV-PES studies, respondents were asked an open-ended maximum WTP question; in others respondents were presented with a fixed increase in their monthly water bill. None of the CV-PES offered respondents a higher volumetric charge for their water, and asked them how much water they would want to purchase at this higher price.[18] Alpizar and Madrigal (2007) simply divide the estimated WTP by the average water use to estimate WTP in volumetric terms, but this ignores the fact that use would fall if the unit price increased. In rural communities in Latin America volumetric tariffs are relatively rare, but in medium-size and large municipalities, volumetric charges (often in the form of increasing block tariffs) are often used. If volumetric charges are used, the only reasonable way that CV-PES results can be used for tariff design is to estimate the amount that can be added to a fixed charge component in the tariff structure. This is how the extra fee for PES should be described to respondents in the CV-PES, but it may not be the most appropriate way to modify the tariff (Boland and Whittington, 2000).

Some authors use the estimated WTP to calculate the consumer surplus, and simply give this as a maximum total payment that should be collected from water users (Cisneros and others, 2007; Alpizar and Madrigal, 2007). While this is technically correct, it does not provide program developers much concrete guidance. Alpizar and Madrigal (2007) suggest charging 50 percent of the estimated WTP, so as to "divide the consumer surplus equally between service users and service providers" (p.17). This approach does not, however, incorporate information on the service provider's minimum WTA, and would not necessarily result in a feasible or fair deal. From the perspective of a two-party PES negotiation, both parties might perceive a negotiated

[18] In our opinion this was the correct decision, but it is important to recognize that the information collected cannot be used to predict how water users would respond to a change in the volumetric component of a water tariff.

settlement to be fair if it approximately split the difference between a provider's minimum WTA and a buyer's maximum WTP.[19]

How can the WTP estimates be used to estimate the amount of this increase in the fixed charge? One approach would be to use the CV-PES results to estimate the monthly charge that would pass a public referendum (for example, 50% approval), perhaps with a super-majority (for example, 66% or 75%). From both an economic and political perspective, utilities may not want to implement tariff reforms that would result in dramatically reduced household water use – or in substantial numbers of households disconnecting from their network. None of the CV-PES asked respondents what their household would do if the proposed monthly fee were implemented even if they personally said they would not pay. A household that voted "no" to a proposed increase in their monthly water bill might disconnect from the water system. Alternatively they might pay the proposed increase in the fixed charge and suffer a welfare loss (Whittington and others, 2002). This uncertainty about how households would behave in response to a tariff increase may be one explanation for what occurred in Heredia, Costa Rica, where CV was used to estimate households' WTP, but actual fees were set far below the estimated WTP (Barrantes and Gámez, forthcoming).

The policy relevance of WTP estimates from these CV-PES studies for the redesign of water tariffs is limited by another factor. In many instances, the existing water tariffs generate revenues below the costs of system operation and maintenance, and far below the cost of capital replacement. In such a situation households' total water bill may still be quite modest even with an added fee for upstream watershed protection, and they may be more likely to approve the fee. Their WTP for a PES program might have been quite different if the water utility had already implemented a higher water tariff structure. In this case, the estimates of incremental WTP for watershed protection may be highly contingent on the low initial water tariff. The utility may have some room to increase water tariffs and still maintain public support, but this slack could be quickly used up by any increase in the monthly water bills, for whatever reason. In other words, utilities could not increase the water tariffs in an attempt to recover more capital costs, and then still rely on the CV-PES results to justify raising the tariff again to pay for upstream watershed protection.

That several CV-PES studies have been carried out in a policy context could, in principle, allow a comparison of ex-ante WTP estimates with ex-post payments. Such a test of the accuracy and reliability of WTP results is, however, not always possible.[20] In Copán Ruinas, Honduras, for example, initial payments under the local PES programs were made using funds provided by a donor rather than from charges to water users (Madrigal and Alpizar, 2007). The putative WTP was thus left untested. Water user charges for PES have actually been implemented in several cases where prior CV-PES studies had been undertaken, including Heredia, Costa Rica (Barrantes and Gámez, forthcoming), and Saltillo, Mexico (Pagiola, 2010). Unfortunately, we have been unable to obtain copies of these studies.[21] In both of these cases, the introduction of water charges has been problem-free. The test of predicted vs. actual behavior is not very

[19] Note that for a multi-party negotiation splitting the maximum WTP of all users between users and upstream providers might not be a deal that would receive majority support from either the user or the providers.

[20] Similarly, Griffin and others (1995) found that the actual behavior of households in Kerala, India, where piped water distribution systems were installed, was predicted accurately by their responses to an ex ante CV survey.

[21] A separate CV study was conducted in Saltillo by Arias-Rojo (2007), after the PES program had been instituted.

stringent, however, because the payments assessed to water users have usually been far below the estimated WTP. In the case of Heredia, for example, the actual charge was only about 10 percent of the estimated WTP (Barrantes and Gámez, forthcoming). Perhaps the most interesting case here is that of Saltillo, where a study showed positive WTP. A purely voluntary payment mechanism was created, in which water users can, at their discretion, add an amount to their water bill. In 2009, 31,000 households (about 10 percent of water users) made voluntary contributions to the program, totaling M$1.2 million (Pagiola, 2010). In a more recent case, the PES program in Chaina, Colombia, increased its charges from US$0.50/household/month to US$1.00/household/month based on the results of a CV-PES study (Moreno-Sánchez and others, 2009).

8. Discussion and recommendations

Our objective in this review of CV-PES is quite modest. We have read many of existing CV-PES studies, and have reported on their quality. We do not know the actual impact of the CV-PES on the design of the PES programs, nor how useful decision makers found CV-PES results, except in a few cases. It is possible that they were satisfied with the work despite our assessment that the quality of most studies was quite low judged against the state of the art.

However, there is little reason that the quality of CV-PES cannot be substantially improved at only a modest increase in costs. The primary impetus will probably come from the purchasers of CV-PES – the clients of the CV-PES consultants – who should demand higher quality products for their money.[22] A necessary first step will be improved terms of reference (TORs) for CV-PES.

We do not recommend that TORs require CV-PES consultants to rigidly adhere to the NOAA guidelines (Arrow and others, 1993) or other such protocols. Agencies commissioning CV-PES have various information needs and different budget constraints. However, we believe that it is reasonable that TORs should include at least the following four elements.

First, clients should be involved in the selection of the information set(s) to be presented to respondents in CV scenarios. CV-PES consultants should provide clients with alternative information sets and discuss the pros and cons of each before the CV-PES is launched. Clients should expect that CV-PES consultants use photographs, figures, tables, and perhaps video clips to communicate information to respondents, and should ask to review such information before the survey is launched.

Second, TORs for CV-PES should require researchers to demonstrate that they have considered:

- alternative means to reduce hypothetical bias;
- alternative payment vehicles for collecting monies from service users; and

[22] This assumes that there is a client. Studies of hypothetical PES programs would not generally have a client per se. Even many policy studies, however, may not have a formal client. The CV-PES study in Chaina, Colombia, for example (Moreno-Sánchez and others, 2009), was undertaken by the researchers on their own initiative, and only later presented to the PES program operators (Moreno-Sánchez, pers. comm., June 2011). The case studies contracted by CONAFOR in Mexico asked for estimates of the potential benefits of watershed conservation but did not specify that CV should be used. Indeed, the consultants were specifically cautioned *against* using CV unless other approaches were not feasible or indicated.

- the choice of respondent within a household (i.e., who to interview).

The TORs should request that CV-PES consultants discuss the pros and cons of different options for these three design issues, and justify their recommendations. Although it may be difficult for many clients with little experience with stated preference techniques to effectively review such decisions, advisory panels or outside consultants may be engaged to provide suggestions for improvements or alternative perspectives.

Third, the TORs should specify that CV-PES consultants provide estimates of the potential revenues that could be obtained from downstream water service users if different prices or charges were implemented, and that they be specific about the options they propose for adjusting tariff structures. Decision makers typically want to understand their options, and CV consultants should be asked to tie their studies and recommendations more closely to the actual decisions that need to be made in the design of pricing and tariff structures.

In addition to improved TORs, it would also be helpful for agencies involved in PES programs and that commission CV-PES to have easy access to information on what others are doing through a web-based clearinghouse. It would be relatively simple and inexpensive for an international organization, NGO, or one of the regional environmental economics networks (for example, the Latin American and Caribbean Environmental Economics Program, Economy and Environment Program for Southeast Asia, South Asian Network for Development and Environmental Economics), to post both studies and survey instruments so that both clients and researchers could easily see what others have done and how they have tackled some of the challenges discussed in this paper.

An old joke in economics concerns a drunk who searches for his lost house keys under a streetlight, not because that is where he lost them, but because that is where the light is. The use of stated preference techniques in the design of PES programs often has a strong hint of this. Our impression is that the use of the CVS is often driven by the perceived ease with which it can be applied in the PES context, rather than by its being the best tool for the job. Properly designed, carefully conducted CV-PES can in many cases provide useful insights for the design of PES programs, but they are certainly not required in all instances.

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