Measuring the costs of conservation:

willingness-to-accept measures of the impacts of protected areas in Africa.

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Abstract

Protected areas are employed world-wide as a means of conserving biodiversity. Unfortunately, restricting access to such areas imposes costs on local people who have traditionally relied on access to local natural resources such as fuelwood and bushmeat. In this paper, we use contingent valuation to estimate these costs of conservation across a gradient of protected area types and income groups for rural households in Uganda. Methodologically, we innovate by implementing a "provision point" payment mechanism to Willingness to Accept compensation (WTA) for the loss of access to protected areas. We show that the provision point reduces the extent of over-statement of WTA to a significant degree.

Keywords: conservation costs, protected areas, Uganda, willingness to accept, provision point mechanism.

1. Introduction

The establishment of Protected Areas (PAs), such as national parks and game reserves, as a means of protecting biodiversity from habitat loss and hunting, is now common in many developing countries, especially in Africa. Protected Areas enhance conservation by prohibiting certain land uses, such as bush meat hunting and the collection of fuel-wood, and by restricting the conversion of land into agriculture. Unfortunately, such land use restrictions impose potentially high costs on local resource users (Norton-Griffiths and Southey, 1995; McPherson & Nieswiadomy, 2000).

Communities adjacent to protected areas in Uganda normally consume, exchange or sell timber and non timber forest products (NTFP) sourced locally as part of their livelihood strategies. In National Parks, legislation precludes the hunting of wild animals and the extraction of timber and NTFP. Yet, poor enforcement by under-resourced management authorities often translates into continued exploitation of protected areas, especially those immediately adjacent to communities. Indeed, the use of protected area resources such as fuel wood has increased dramatically in Uganda in recent years (NEMA, 2001; Bush et al., 2004; ITFC, in prep). Without sustained access to forest resources or an alternative source of revenue, many rural households face high levels of impoverishment

As user pressures on protected areas continue to increase, so do efforts to put in place more effective management strategies to control access, curb illegal hunting and provide communities with alternative means of ensuring their welfare. However, exclusive management practices tend to create tensions between local people and the authorities (Hulme and Murphee, 2001; Plumptre et al., 2004). If local communities wish to receive direct benefits from protected areas in the future, and if park authorities wish to see more stringent enforcement of unpopular management rules, it seems essential to put in place a management regime that promotes their acceptance by local communities. Information on the costs of access restrictions is a key indicator of how much effort must be deployed in order to mitigate the effect of losses by local people. Such information can then be used to devise mechanisms that, perhaps in conjunction with integrated conservation and development projects (ICDP), can at least ensure a similar level of welfare through alternative livelihood options.

This paper reports the results of a research project that aimed to measure the value of a complete loss of access to PA under a scenario in which local users would receive monetary compensation for those losses. It aims to quantify the local economic cost of effective conservation to four communities adjacent to protected areas in Uganda. While market could be useful in measuring some aspects of the losses deriving from land use restrictions – where losses can be substituted by market purchases, or where losses are in terms of foregone sales - they cannot capture the full economic values of access to such resources to local people (Vedeld et al, 2004). This is because access to PAs is viewed by locals as an insurance policy, given fluctuations in agricultural incomes both within and between years (Pattanayak and Sills, 2001); and also because access has cultural and social values which are not captured by market prices for products such as fuelwood and bushmeat. In such circumstances, contingent valuation methods are useful for measuring the economic value of loss of access to Protected Areas. Thus, the research attempts to estimate the full cost of access restrictions using contingent valuation. In doing so, we document how these costs vary across different ecosystems and according to the characteristics of people affected by restrictions.

Since stricter access restrictions deprive local resource users of what are considered *de facto* property rights, their willingness to accept compensation (WTA) for those losses is the theoretically correct measure of these costs. Despite their appropriateness, WTA studies are comparatively rarely performed in contingent valuation since they are suspected of systematically over-stating welfare losses (Rowe et al, 1980; NOAA, 1993; List and Shogren, 2002). We attack this vexing problem by presenting survey respondents with a payment method constructed from a Provision Point Mechanism (PPM) (Rondeau et al, 1999 and 2005). To our knowledge, this is the first application of a PPM to a WTA survey. The second objective of this paper is therefore to investigate how the PPM affects WTA value estimates, within the context of contingent valuation. We show that the PPM significantly reduces the number of high value outliers and the resulting estimate of average welfare loss.

In what follows, Section 2 introduces the idea of a provision point mechanism for WTA. Section 3 describes the survey implementation, whilst results follow in Section 4. Conclusions are drawn in the final section.

2. Considerations in measuring WTA using contingent valuation.

The use of Contingent Valuation (CV) in developing countries is now quite widespread (Whittington, 2002, 2004). As is the case for studies from developed countries, the Willingness To Pay (WTP) format has been largely favoured over WTA, even when the objective of the research is to assess a welfare loss to individuals being surveyed (Smith et al, 1998). Harrison and Rustrom (2005) discuss the historical side-stepping of WTA measures, attributing the pervasiveness of WTP questions to the difficulties researchers have encountered in their attempt to control scenario rejection and the strong hypothetical bias it appears to create. This bias relates to a tendency of respondents to overstate their true welfare loss from a change in environmental quality or access: in other words, WTA estimates of welfare change obtained using CV are thought to be “too big”, with a greater degree of bias present than for equivalent WTP formats (this is independent of differences between true WTP and WTA for a given environmental or access change: see Plott and Zeiler, 2005). WTA formats are also expected to result in a higher degree of protest bidding in some cases. As a result, there is a general avoidance of WTA format surveys, even when it is theoretically the more appropriate welfare measure to use for a given situation (Knetsch, 2007).

In this paper, we are interested in whether mechanisms can be introduced to reduce WTA over-statement, since as argued above, WTA seems a more natural welfare measure to elicit to measure the costs of restricted access to protected areas, due to *de facto* access rights at present. The Provision Point Mechanism is the mechanism considered here.

The Provision Point Mechanism (PPM) is an institutional arrangement for the voluntary provision of a discrete public good. The original setting for the PPM is where a public good, with predetermined magnitude and characteristics, is to be provided through voluntary contributions only if the sum of contributions from a defined group of individuals equals or exceeds its cost of provision (Rondeau et al., 1999; Rose et al., 2002). Innovations such as the addition of a rebate rule (to dispose of contributions in excess of costs) and money back guarantees (to return contributions when the provision point is not met) have also been found to increase contributions (Rondeau et al., 1999; Rose et al., 2002). While the Provision Point Mechanism is not incentive compatible, an empirical regularity that emerges from the research previously cited and that of Cadsby and Maynes (1999), Krishnamurthy (2001) and Messer, Schmit, and Kaiser (2005) that the PPM can radically curtail free-riding and can provide a more efficient level of public good provision by improving demand revelation.

Despite promising experimental evidence that the PPM results in more efficient voluntary provision of public goods, few have introduced it to hypothetical surveys. Murphy et al (2005) compare real and hypothetical payments to a land conservation organisation using a PPM. They observe a difference in amounts contributed between the two treatments and conclude from an analysis of additional survey questions that the difference stems from hypothetical bias rather than from free-riding. In other words, the PPM appears to perform well when real money is involved, but some hypothetical bias remains. Using a PPM design, Poe et al. (2002) compared real sign up rates to an environmental program to open ended and referendum format CV surveys. They found a weak hypothetical bias for the Open-Ended format but that a strong bias was present in the case of the referendum format. However, to our knowledge, all of the evidence to date regarding the effectiveness of the PPM has been obtained from a WTP setting. We now turn to an adaptation of the mechanism to the WTA setting.

In the WTA setting relevant to our field work, the Provision Point (PP) is the sum of money available for compensating all affected individuals in a group where a potential loss is in prospect. Respondents are asked to make a claim for compensation from a fund. If the sum of claims exceeds the money available (the PP), no compensation payments are made and another pre-determined course of action is implemented (e.g. the status quo is maintained). If the sum of claims is less than or equal to the PP, individual claimants receive their claim plus a share of the remaining portion of the total funds available that went unclaimed by participants. To be specific, define B_j as an individual claim on the compensation fund by individual j, PP as the total amount available in the fund and N as the number of potential claimants. Then, the compensation mechanism functions as follows:

- $if \sum_{j=1}^{N} B_j > PP$ the sum of claims exceeds the available funds and no compensation is paid

- $if \sum_{j=1}^{N} B_j = PP$ the sum of claims exactly equals the amount available. The compensation scheme goes ahead, and people receive exactly the individual amount of their claim.

- $if \sum_{j=1}^{N} B_j < PP$ the sum of claims is less than the funds available for compensation. In this case, the compensation scheme goes ahead and people receive their individual compensation claim plus a share of the unclaimed compensation fund. In our application, the share to claimant *j* is simply equal to the proportion of *j*'s claim relative to the sum of all claims.

In considering how large a claim to make on the fund, the individual considers maximising his utility derived from the value of having access to the protected area (V_i) and income from other sources (I) subject to the external constraint imposed by the provision point. The claim B_i represents the individual WTA for accepting "the policy", namely access restrictions to the protected area. The utility of individual *i*, contingent on the all participant's claims is then given by[1]

[1] Without loss of generality, V_i is taken to represent the actual value lost by an individual following the imposition of access restrictions. Since some individuals may plan to violate those restrictions and continue with some level of illegal resource extraction, V_i (and therefore the individual's claim on the compensation fund) may not represent the full value of current resource usage.

$$U_i = u\begin{cases} I_i + V_i & if \sum_{j=1}^{N} B_j > PP \\ I_i + B_i - V_i & if \sum_{j=1}^{N} B_j = PP \\ I_i + B_i - V_i + \frac{B_i}{\sum_{j=1}^{N} B_j}\left(PP - \sum_{j=1}^{N} B_j\right) & if \sum_{j=1}^{N} B_j < PP \end{cases} \qquad (1)$$

It is relatively straightforward to extend the game theoretic equilibrium prediction for a PPM in the WTP context (Bagnoli and Lipman, 1989; Marks and Croson, 1998) to the WTA context. There exist two types of Nash equilibria in this claims game. In both cases, rationality imposes that all individual claims be at least as large as the amount of their expected loss: $B_i \geq V_i$. Otherwise, the imposition of land use restrictions would necessarily result in a net loss to an individual, even with the compensation payment. Imposing this rationality condition and maintaining as a working assumption that the amount available for compensation (PP) is sufficient to compensate all losses, one set of equilibria is inefficient and characterized by the following conditions:

$$\begin{aligned} &\sum_{j=1}^{N} B_j > PP; \text{and} \\ &\left(\sum_{j=1}^{N} B_j - PP\right) > \left(B_i - V_i\right) \forall i \end{aligned} \qquad (3)$$

The first condition states that the sum of claims is greater than the amount available for compensation. Therefore, no compensation is paid and the policy does not go ahead. For this to be an equilibrium, it must be the case that no individual is in a position to decrease his claim (in a rational manner) such that the provision point could be met. This is the meaning of Equation 3. If no rational revision of a single bid can be made that would result in the provision of compensation, then no one has an incentive to deviate from their original claim and the vector of claims is an equilibrium.

There are also efficient equilibria in which the proposed policy is implemented and compensation is paid. This set is made up of any combination of claims such that

$$\sum_{j=1}^{N} B_j = PP \qquad (4)$$

In such cases (and always maintaining the rationality condition), no single individual would have any incentive to modify their claim (if they were given a chance to) since increasing the claim would lead to the regulation not being imposed (with no compensation received), and decreasing one's claim would simply lower the compensation received.

While efficient equilibria Pareto-dominate inefficient ones, it is important to realize that, in general, this mechanism is not theoretically incentive compatible. For everyone to make a claim equal to their individual value is only optimal under the unlikely scenario that $\sum_{j=1}^{N} V_j = PP$. Whenever $\sum_{j=1}^{N} V_j < PP$, this game provides incentives for the sum of claims to be equal to the PP, and thus, for individual bids to exceed the true value of losses. Theory, then, provides little guidance about how individuals will choose the amount of their claim since any sum of claims that equals the PP is an efficient equilibrium.

This could be particularly problematic if individuals know the PP amount, or the exact size of the target group in a scheme. A respondent might make a decision based primarily on an equal share of the PP rather than on a more careful consideration of his own losses. One way around this problem is to withhold information on the precise level of the provision point to prevent participants from using an equal or higher benefit share strategy or from easily establishing a veto. Whilst this does not make the PPM incentive compatible, it may in practice bring individual claims closer to true values. The evidence on this issue in an experimental WTP context is weak (Rondeau et al., 2005), since either with or without this information the PPM produced contributions that were close to truthful revelation of one's value. The general direction of any possible effect seems nonetheless consistent with this hypothesis.

A potentially more important shortcoming of the PPM in a WTA context is that the mechanism gives each participant the power to veto the entire scheme by bidding an amount greater than the PP. As previously mentioned, protest bids are a common problem in all WTA valuation exercises, and the PPM cannot be expected to eliminate true protests. The reasons behind such a protest response in any study may be difficult to ascertain. In cases such as that considered here, it may be due to cultural factors i.e. opposition to any form of control over local access, or due to people having a grudge about being displaced from former traditional lands. However, we posit that a credible PPM scenario should curtail the number of very high claims that are not simply true protest bids. At a minimum, the limit on the total amount that can be paid out in compensation provides a strategic incentive to bring one's claim closer to the true value of losses. If anything, PPM results might also make it easier to screen for true protest bids by comparing the distributions of bids across payment scenarios[2].

Summing up, the balance of arguments in favour of the PPM is that the establishment of a provision point in the WTA context should decrease the likelihood of an individual's

[2] Another possibility, not explored here, is that if respondents think that the size of the compensation fund is partly endogenous, they might increase their bids to raise the provision point.

overstatement of a bid, giving a more accurate measure of true WTA. In our policy context, this would provide a useful tool for assessing the full economic costs of changes in local access arrangements to Protected Areas as part of conservation policy We now test this proposition empirically.

3. Case Study Design

A contingent valuation survey was administered in villages situated close to three Protected Areas in Uganda. Data were collected on 690 households in communities around each of three different PAs, and included not only WTA responses, but also various social, economic household data. Table 1 gives details of the sampling regime. The three Protected Areas are ecologically different (tropical closed canopy rainforest, afro-montane forest and savannah woodland), implying that the value of access V_i (in terms of timber, NTFPs, fuelwood and bushmeat extracted) was expected to vary considerably both across and within areas. In general, fuel wood was the main resource extracted by local households, followed by timber for construction, and bushmeat (Bush, 2009). The history of protection varies across the case study sites, with a much more recent introduction of access restrictions in Tengele than at the other sites.

Respondents were asked to state the maximum level of compensation (WTA) they required to forgo access to all resources from their local Protected Area for a period of one year. The scenario in the survey sets up a framework for the implementation of a hypothetical community-based park management scheme in collaboration with park management authorities aimed at improving the conservation status of the protected areas. It stipulated that direct payments would be made to the local community to provide compensation for lack of access and to finance the enforcement of access regulations.

Two separate payment mechanisms were employed in the study. The control treatment is an an open-ended CV format in which respondents were simply asked to state their WTA compensation to forgo the benefits from the PA for one year. This provides a basis for comparing the results of the second, PPM treatment. In each of the communities surveyed, respondents were randomly assigned to one of the two treatments (ie with or without the PPM). Table 1 shows the treatment distributions by site. The open-ended format was selected based on the experience gained in an extensive pilot test of the study, and for reasons of sampling efficiency. Note also that previous work by Poe et al (2002) found an open-ended design WTP with the PPM resulted in lower levels of hypothetical bias than a referendum format WTP.

In the PPM version of the questionnaire, the provision point was explained in the following fashion:

> "The community is being asked to make monetary bids to assess the demand for such a scheme and estimate the level of compensation. Only a limited amount of funds are available for such a scheme. If the sum of all the communities compensation bids is **less than** or **equal to** the money available then the scheme would **go ahead** as described and a proportional share of any surplus funds between the community bid and the compensation fund will be made.
>
> If the sum is **more** than the money available then such a scheme **would not** go ahead and it is likely that the current management practices would continue with increased enforcement efforts."

The survey was administered by a group of trained enumerators and was pre-tested in the field. Surveying was rigorously supervised to ensure that enumerators complied with established procedures. Pre-testing was conducted to identify weaknesses in the presentation and comprehension of the questionnaire by both the enumerators and respondents, and to determine the most appropriate response formats to different questions (as noted already). In general there was consensus from enumerators that the scenario was found to be credible by respondents. The scenario addressed both a real conservation issue (illegal use) and an appropriate response to resolving it (direct payments for conservation), with an enforceable set of rules.

It typically took the team of 5 enumerators about 3 days in each community to complete the interviews. During this period the research team either found local lodgings, or camped within the community. The extended period of contact with local people allowed the team to develop a high degree of familiarity with the social and natural environment of each community. This often gave opportunities to discuss responses and resolve sampling problems. For example, amongst some of the diverse local cultures in which the survey was administered, it was culturally taboo to tell strangers how many children or livestock the household has for fear of bringing bad luck. However it is not a social taboo for neighbours or other local key informants to divulge information about one another's situations, so information could be gathered in this way.

Sampling of households was on a random stratified basis of wealth categories within a community (identified through a participatory wealth ranking exercise). An estimate of total household income (adjusted per adult equivalent unit) was made so that households could be allocated to income quartiles as a basis for comparison. An assessment was made of the demographic composition of each household, level of education, and employment. Data was also collected on total household income from the sale of PA and non-PA goods.

4. Results

A total of 10 interviews were discarded as incomplete due to poor completion or respondent unwillingness to complete the interview, leaving 680 completed surveys to be included in the analysis.

4.1 Descriptive Analysis

Typically all households surveyed were involved in subsistence agriculture on small land-holdings (mean land area owned was 4.5 hectare(ha.)/hsld, mean land area rented was 1 ha./hsld). Population densities were high. Mean household size was 6.6 persons, with a mean age of 22 years (half the population of Uganda is younger than 15 years). Around 60% of respondents over 15 had received primary education, and 12% secondary education. This latter varied significantly across the four communities studied (Budongo, Tengele, Queen Elizabeth National Park and Bwindi).

Household income levels are shown in Table 2. Mean annual income was $1,011 per household., with significant differences across communities. Respondents in this survey are overwhelmingly poor by international standards, with per capita income less than the $2 per day per capita global poverty measure.[3]. In addition, survey households were highly reliant on natural resources: less than 2% of the sample had sources of income other than agriculture, livestock or PA related income. Here, PA related income is defined as the market value of resources extracted from the PA, whether consumed within the household or sold. The largest fraction of household income directly accounted for by access to PAs was 5% in Tengele, falling to almost zero for Bwindi. However, as noted above, the economic

[3] The $2 value is in purchasing power parity terms
Source:http://unstats.un.org/unsd/mdg/Metadata.aspx?IndicatorId=0&SeriesId=580

value of access will likely be much larger than this, since for instance access to the PA offers insurance during seasons when other income sources are unexpectedly reduced.

4.2 Analysis of Contingent Valuation responses.

WTA bids were solicited in the local currency (Ugandan Shillings, UGS), but results are presented in $US terms (exchange rate, 1900UGS/$US). A total of 4 zero bids and 5 non-responses were recorded out of the 680 completed surveys. Where a zero or non- response to the WTA question was forthcoming, clarification was sought from the respondent. Zero bids are consistent with zero value attached to PA access.

As argued in the preceding section, the main effect of inclusion of a Provision Point Mechanism for WTA elicitations should be to reduce the mean bid value, when compared to bids solicited without the use of a PPM device. We would also expect the variance to fall, since if the largest WTA value is reduced then the spread of bids is also reduced. Table 3 shows results. The mean WTP with the PPM device was $354 per household (95% confidence interval $319-$388), compared to $482 without the PPM device (95% confidence interval $424-$540). This difference was found to be statistically significant at the 99% level ($Z= -2.605$, $p<0.01$). With the PPM device a lower standard error of the mean was recorded ($17 compared to $29) and a lower maximum bid value ($1,579 compared to $3,158) than when the PPM device was not used. Given that we believe that use of the PPM will reveal WTA values closer to true values, then our best estimate of the mean welfare loss to households from access restriction to Protected Areas is thus $354/household/year. This is the “cost of conservation” referred to in the title of the paper, and is very high relative to sample mean household income of $1,011/hsld/yr..

The distributions of bids under the different experimental treatments are shown in Figure 1. This shows that the effects of the PPM treatment were mainly felt in the upper tail of the distribution. These effects can also be seen in Table 4, which compares the treatment effects in terms of quartiles. It can be observed that the differences in quartile means and standard deviations are quite small and not significant except for the highest quartile, where the mean bid value with the PPM treatment was significantly lower than without the treatment (Z= -3.852, p<0.001). In all, then, the main effect of the PPM seems to have been to reduce very high WTA bids.

4.3 Explaining the Variation in WTA bids

A bid curve was estimated using OLS (Tobit estimates were very similar to OLS, since few zero bids were recorded). We were interested in identifying the determinants of the costs of conservation measures to local households, as represented by their WTA bids[4]. The loss of access to resources within PAs might depend on household's ability to collect resources from the PA (proxied here by household size), on alternative sources of income (measured here by the amount of agricultural land cultivated by the household), and on how much income the household reports that it collected from being able to access the PA in the past. We also included variables measuring how far the household lives from the nearest market, and how far they live from the PA (as a measure of accessibility), since other studies have shown these to be important drivers of income from protected areas (Vedeld et al, 2004). The four protected areas studied also vary in terms of their current governance structures, and how current access restrictions are enforced. These two effects cannot be separated out in the data, but are represented instead as a joint effect by using site-specific dummies (the excluded site

[4] The severity of multi-collinearity among explanatory variables was checked using the Variance Inflation Factor (VIF) comparison. VIF estimates for the regressors showed that there were no serious multi-collinearity problems (all were below 2.1).

is Queen Elizabeth Park, which currently has the most restricted access). Finally, a dummy variable is included for whether bids were collected using the PPM or not.

The results are presented in Table 6. It is evident that households with a larger area of agricultural land to cultivate state significantly lower WTA amounts ($p<0.05$). These households may depend less on PA resources since they have alternatives for income and food production.

The number of occupants in a household leads to higher WTA bids, perhaps as they have higher abilities to exploit PAs or their needs are greater ($p<0.01$). Households living near Tengele Forest Reserve have a significantly lower WTA than those living near to Queen Elizabeth Park ($p<0.01$), but neither of the other two locational dummies are statistically significant. The results for Tengele may reflect the higher degree of community involvement in PA management compared to Queen Elizabeth Park. Community involvement in Tengele might have contributed to a greater awareness of the fragility of park resources and more effective enforcement of access restrictions, resulting in lower losses under the CV scenario. No significant effects are observed for distance to markets or distance to the park: this may be due to insufficient variability in the data for these variables, since neither distance measure was used as a sampling criterion.

4.4 Comparing WTA bids with income loss

As noted above, the market value of losses from access restrictions to protected areas are likely to under-value the costs to rural households of access restrictions to PAs. This is because access is viewed as an insurance policy given fluctuations in agricultural incomes both within and between years; and because access has cultural and social values which are not captured by market prices for products such as fuelwood and bushmeat. As Table 2 showed, mean income loss from access restriction was \$21.56, which is considerably lower than the mean WTA bid (using a PPM) of \$354. Even allowing for hypothetical bias within the WTA bids, this seems an interesting difference. One hypothesis is that that the more PA-dependant a household, the higher the difference between the two measures will be, where dependency is a function of the lack of other alternatives to maintain a household's livelihood and social status. To explore the possible determinants of the difference between WTA and market income lost, a variable was constructed for each household in the sample which measured this difference, restricting the analysis to those respondents who received the PPM treatment. This variable (GAP) was then regressed on a range of possible determinants, and the results are shown in Table 7.

We find that the number of household occupants (HHTOTALO) has a positive and significant effect on the gap, with larger households more likely to show a bigger difference between WTA and market income values. This might be because larger families feel more dependant on forest resources for livelihood security i.e. a larger household may have higher vulnerability to seasonal shocks such as when crops fail, thus they may attribute a higher value to being able to access the PA. AGRILAND was significant and negatively associated with higher differences between WTA and market income lost ($P<0.05$). The more agricultural land a household has, the smaller the difference in the values, showing clearly that household perception of dependency on the PA is related to having other livelihoods options. The gap between individual WTA and the financial value of goods extracted from the PA was also significantly different if respondents were from Tengele rather than from Queen Elizabeth Forest Park.

5. Conclusions

This paper has investigated the use of a Provision Point Mechanism (PPM) to estimate the costs of conservation actions to local people using a Willingness to Accept (WTA) contingent valuation approach. As we noted earlier, researchers have become reluctant to use WTA approaches even when the distribution of property rights (whether *de facto* or *de jure*) suggests that compensation-based welfare measures are more appropriate than payment-based measures. This has been due to the tendency of WTA questions in hypothetical markets to lead to the over-statement of true losses, and to encourage protest bidding. By extending the basic idea of the PPM from a willing to pay context, we show that a WTA-PPM can significantly reduce the magnitude of mean hypothetical WTA in a way consistent with theoretical predictions that the PPM improves demand-revelation. The most notable difference between the distributions of claims under the two payment mechanisms are at the upper end of the distribution. The significant decrease in the number of claims that could be considered protest bids or outliers suggests that the PPM mechanism could facilitate the applications of WTA designs in contingent valuation (or, indeed, in choice modelling) when compensation is the appropriate welfare framework to adopt..

For the specific case study investigated, use of a WTA format for assessing the costs of conservation to local people does indeed seem more appropriate than asking a WTP question. Local people living in and around the four Protected Areas (PAs) in Uganda depend on access to these areas for fuelwood, bushmeat and non-timber forest products. Exploiting such resources is a livelihood strategy which these very poor households employ irrespective of legal restrictions. Since international treaties such as the Convention on Biological Diversity have stated that use of protected areas as a way of safeguarding biodiversity should not come at the cost of perpetuating or worsening poverty, finding ways of measuring the true costs of conservation to communities in developing countries is important. We also argued that measuring the financial cost of losses in access to PAs would under-estimate the welfare loss to such households, and indeed found that our mean WTA estimate of US$354 per household was much higher than the financial value of lost access, costed at US$21/household. Whilst there is good reason to suppose that the WTA estimate is biased upwards due to hypothetical market bias, a strong argument can still be made that the true costs of loss of access to PAs is greater than $21. Important determinants of WTA were found to include access to agricultural land and household size; whilst mean compensation demanded also varied across protected areas. This variation across PAs could be due to a variation in both the productivity of the four different ecosystems, and the governance arrangements currently in place in each (which vary considerably).

However, many important questions remain unanswered. With respect to the use of a PPM in WTA designs, future experimental work could quantify how much of the effect of introducing a PPM is in terms of moderating hypothetical market bias, compared with changes in strategic behaviour. It is also unclear how important the use of a PPM is in moderating protest bids, since in our study very low levels of protesting were found in the control treatment. Finally, the effects of respondents believing that the size of the compensation fund depends at least partly on WTA bids (ie is endogenous) could be investigated.

Much environmental economic analysis has been devoted to showing the benefits of conserving the world's most valuable ecosystems and biodiversity (Kontoleon, Psacual and Swanson, 2007). Establishing protected areas is a dominant means of achieving such conservation world-wide. Yet in poor countries, the costs of conservation also needs to be taken into account, and ways sought to mitigate these costs. Finding effective ways of measuring the “costs of conservation” is thus an important imperative.

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Table 1 Data collection sample frame

Protected Area	**Bio Type**	**Governance Type**	***No of Households in survey***	***Treatment applications***	
				With PPM	***Without PPM***
Queen Elizabeth National Park	Savannah Woodland & Grassland	Strict National Park (no community co-management)	*330 (10 communities)*	*165*	*165*
Bwindi Impenetrable Forest National Park	Afromontane Forest	National Park with some community co-management	*240 (8 communities*	*120*	*120*
Community Forest Reserve (Masindi District)	Tropical High (Closed Canopy) Forest	Forest on private (community) land, community owned and managed	*60 (2 communities)*	*30*	*30*
Collaborative Forest Management	Tropical High (Closed Canopy) Forest	Forest Reserve (public land), with community co-management	*60 (2 communities)*	*30*	*30*
		Total HH	***660***	***330***	***330***

Table 2 Household Income ($US per annum)

Site	n	Mean net total hh income	Mean net total PA income	Mean net total PA income consumed	Mean net total PA income sold	% PA income consumed	PA income as a % of total hh income
Budongo	60	373.30	4.40	1.05	3.35	23.93	1.18
Tengele	59	894.00	44.16	29.79	14.37	67.47	4.94
QEPA	319	1393.05	36.24	1.44	11.18	3.98	2.60
Bwindi	232	681.37	0.05	0.05	0.00	100.00	0.01
All	670	1011.35	21.56	3.42	10.54	15.88	2.13

hh= household ; PA = Protected Area

Table 3 Impacts of the PPM treatment on mean WTA

Treatment	n	Mean	Std. Dev.	Std. Error	Coeff. of Variation	95% Confidence Interval for Mean		Minimum Value	Maximum Value
						Lower Bound	**Upper Bound**		
NO PPM	**337**	**482**	**541**	**29**	**1.12**	**424**	**540**	**0**	**3,158**
WIITH PPM	**338**	**354**	**320**	**17**	**0.90**	**319**	**388**	**0**	**1,579**
ALL	**675**	**418**	**448**	**17**	**1.07**	**384**	**452**		

Notes: (i) all monetary amounts are in US dollars.

(ii) Mann Whitney U test for mean WTA(no ppm) = WTA (ppm): $Z = -2.605$, $p<0.01$.

Table 4 Comparison of treatment quartiles

Treatment	Treatment* Bid Quartile	Quartile Mean bid ($)	N	Std. Deviation	Std. Error of Mean	Coefficient of Variation
NO PPM	Lowest 25%	65.47	79	32.18	3.62	0.49
	Lower middle 25%	212.19	79	53.67	6.04	0.25
	Upper middle 25%	435.64	79	105.87	11.91	0.24
	Highest 25%	1835.95	77	2007.60	228.79	1.09
WITH PPM	Lowest 25%	58.60	79	31.93	3.59	0.54
	Lower middle 25%	206.76	79	53.92	6.07	0.26
	Upper middle 25%	405.46	79	112.12	12.61	0.28
	Highest 25%	1102.70	78	953.51	107.96	0.86

* Quartiles assigned from within each treatment distribution not entire sample

Table 5 Variable descriptions for determinants of bid value

Variable	**Description**
HHTOTALO	Household total occupants; total number of individuals in the household irrespective of age/sex class
AGRILAND	Agricultural land (Ha.); area of agricultural land cultivated by the household
ATHI	Net annual adjusted total household income; net total annual household income, per adult equivalent unit
APAI	Net annual adjusted protected area income; net total annual protected area income , per adult equivalent unit
DISTMARK	Distance to market (Km); distance from households dwelling to travel to nearest market
DISTPA	Distance to PA (Km); distance from household’s dwelling to the protected area boundary
EXPTREA	Experimental Treatment; bid with (=0) or without (=1) the PPM device.
GTDUMMY1	Governance type, dummy variable 1; national park with some community co-management (Bwindi Impenetrable Forest National Park)
GTDUMMY2	Governance type, dummy variable 2; forest reserve with collaborative management (Budongo Central Forest Reserve)
GTDUMMY3	Governance type, dummy variable 3; community owned and managed reserve (Tengele Community Forest Reserve)

Note: the excluded site category is Queen Elizabeth Park.

Table 6 Results for determinants of WTA bid value

Variable	Coefficient	Standard Error	t-ratio	Mean of X|
HHTOTALO *	12.91	6.50	1.987	6.33
AGRILAND**	-0.14	0.07	-2.100	2.48
ATHI	0.00	0.00	1.017	166.36
APAI	0.00	0.00	0.575	5.40
DISTMARK	0.08	0.07	1.130	3.24
DISTPA	-0.19	0.16	-1.195	1.43
EXPTREA	52.70	16.74	3.148	1.42
GTDUMMY1	-69.50	38.12	-1.823	
GTDUMMY2	-75.43	61.84	-1.220	
GTDUMMY3**	-179.97	63.74	-2.823	
Constant	296.47	54.71	5.419	

* $p<0.05$, **$p<0.01$,
Model Summary: $r^2 = 0.047$; F = 4.2d.f.=8, 671, $p<0.001$
Dependant Variable = CV-WTA bid value

Note: variable definitions given in Table 5.

Table 7 OLS regression determinants of the difference between WTA bids and self-reported income losses from access to PA.

Variable	Coefficient	Standard Error	t-ratio	Mean of X|
HHTOTALO **	18.854	6.458	2.919	6.32
AGRILAND *	-0.137	0.070	-1.957	2.48
APAI	0.000	0.000	0.518	162.54
ATHI	0.000	0.000	1.159	3.24
GTDUMMY1	-44.593	38.875	-1.147	
GTDUMMY2	-12.520	61.388	-0.204	
GTDUMMY3***	-220.967	68.268	-3.237	
Constant	248.704	49.215	5.053	

* p<0.05, **p<0.01, ***p<0.001

Model Summary: r^2= 0.067; F=3.40, df = 7, 329, p<0.01

Dependant Variable= GAP (Household CV-WTA bid value minus financial value of goods form PA)
Note: variable definitions given in Table 5.

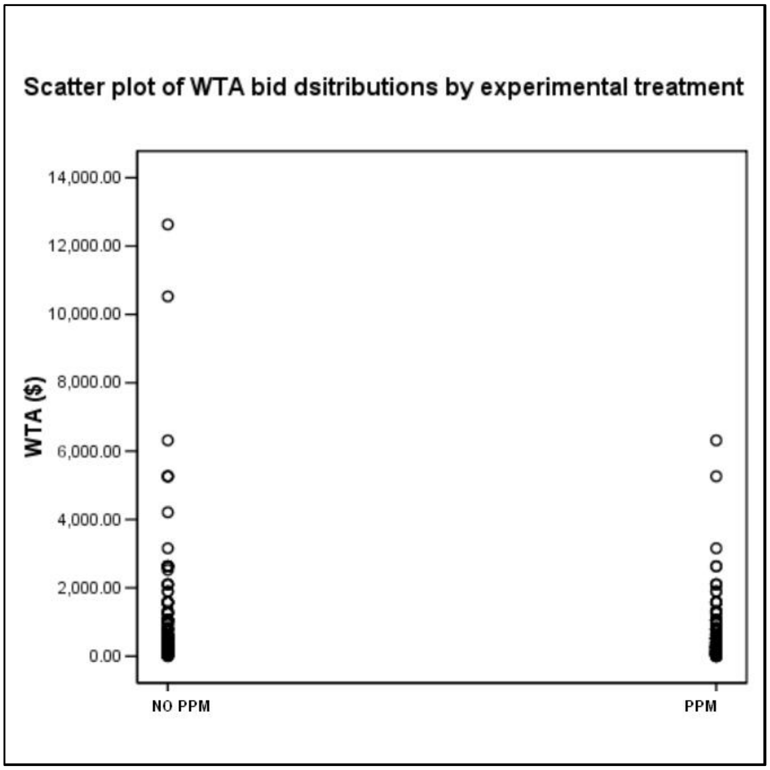

Figure One – plot of WTA treatments