The Value of Endangered Forest Elephants for Local Communities in a Conservation Landscape

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Abstract

This paper seeks to determine and characterize the social and cultural preferences for Endangered Forest Elephants' (EFE) conservation in the Congo Basin's Tridom Landscape. Using data from a 2014 stratified random face-to-face survey with 1035 households in 108 villages, we combining both Double Bounded Dichotomous choice (DBDC) and Open-Ended (OP) elicitation formats to better assess the willingness-to-pay (WTP) for EFE's conservation. We find that local households are willing to pay monthly CFA1139.4 (€1.74) to avoid EFE's extinction. That's annually CFA753.9 million (€1.15 million) for the overall inhabitants. Indigenousness positively influences the WTP for EFE's conservation. Spatial data suggest that local communities prefer elephant far from their crops. The existence of Human-Elephant Conflict is neutral on preferences for elephant conservation. Therefore, our study suggests that local communities would engage in biodiversity preservation, when the public benefit from conservation comes with private benefits like Human-Elephant Conflict avoidance.

Keywords: Forest Elephant Extinction, indigenous people, Contingent Valuation, WTP, Interval Regression Model, Double-Hurdle Model.
JEL Classification : Q 57, 29, C24

1. Introduction

Forest Elephant (*Loxodonta Africana cyclotis*)[1] poaching in Tropical Africa is a major threat for the dynamics of this iconic species. In 2011, the Congo Basin's forest elephant population was less than 10% of its potential size and occupying less than 25% of its potential range (Blake et al., 2007; Maisels et al., 2013; Martin and Stiles, 2000). The Tri-national Dja-Odzala-Minkebe's cross-border landscape (Tridom), spanning Cameroon, Congo (R), and Gabon, reckoned to have ecological and biodiversity uniqueness and hosting the most important population of forest elephant in the world, with the highest density in the Minkébé National Park (MNP). The MNP lost more than 11,000 individuals between 2004 and 2012, which account for more than 50% of the 2004 population (Maisels et al., 2013). Despite the ivory trade ban under CITES to protect the African elephant (Van Kooten, 2005), the current growing demand of ivory for jewelry, leisure and Asian medicine, as well as the increasing deforestation and land pressure are the main drivers of its devastating decline. It is evident that elephant is much appreciated for this materialistic and provisioning service. However, it contributes also to achieve ecological equilibrium as well as to the provision of social and cultural services.

Forest elephant can be considered as a flagship species, as its protection implies the protection of other species in the same ecosystem. Indeed, it disseminates the seeds of important tropical fleshy fruits trees over long distances and contributes to building nature's household through regeneration of these tree species in the Congo Basin (Beaune et al., 2013; Blake et al., 2009; Wang, 2008). For instance, *Baillonella toxisperma* (moabi), a traditional multiple-use species for Bantu and Baka villagers in the Tridom has become an endangered species because of its high commercial value in the wood market, while it contribute significantly to balance forest people food's diet. Indeed, fruits and almonds eaten raw and its oil is used for cooking, for disease treatment as well as beauty treatment. By disseminating its seeds, forest elephant contributes to the restoration of the forest and therefore indirectly contribute to carbon storage. Hence, elephant conservation is in accordance with the REDD+ policy which is emerging as an important framework for forest conservation. Forest elephants help improve the forest habitats and thus restore the ecological services of the forest (ecosystem regulating services).

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[1] There are two subspecies of elephants: Forest elephant and Savannah elephant. This paper focus on forest elephant

Moreover forest elephant populations are crucial for the cultural identity of indigenous Baka ethnic group. Their main rituals are practiced after the elephant hunt. The most important are the *"yeli"* and the *"jengi"* ceremonies. *"Yeli"* is the female ritual and *"Jengi"* is the male ritual (Kent, 1996). The traditional hunting of elephants is also the most important spiritual and religious event for this population. The hunting brings together dispersed groups, all having specific responsibilities, e.g. the vital contribution of women to the mystical preparations for a safe hunting. Only the oldest Baka is permitted to kill elephants and they undergo a rigorous preparation, learning from experienced hunters over many years before having the permission of killing elephants. Once killed, the elephant is celebrated for many days and nights in a complex series of ritual feasts and celebrations until all the meat is consume (Lewis, 2002). Therefore, elephant participates to maintaining a spiritual enrichment, cultural identity and knowledge of the Baka community. This cultural service implies that elephant extinction has an opportunity cost in terms of loss of cultural values (Garrod and Willis, 1999). *Figure 1* shows a synoptic description of ecosystem services and the Economic Total Value of elephant in the Tridom landscape. Considering the importance of forest elephants for the ecological, cultural and socio-economic equilibria, notwithstanding

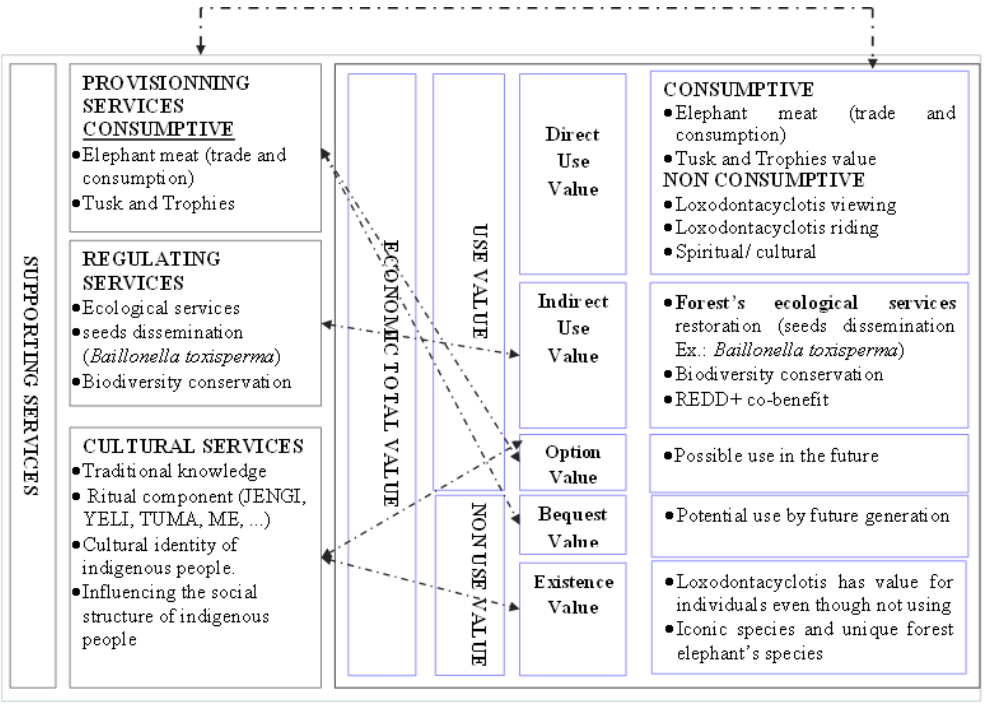

Figure 1: Ecosystem Servives and Total Economic Value of Forest Elephants(Adapted from Brahic and Terreaux (2009); MEA (2005)).

some possible cases of crops damage by Elephant (Human-Elephant Conflict), the extinction of EFE would severely and directly affect local and indigenous welfare. Considering the interdependence between elephant, *Baillonella toxisperma* and rural communities stated above, "nature too would seem to lose" (Tisdell, 1990). This would lead to irreplaceable costs to the Tridom society and makes EFE's conservation a priority for biodiversity conservation decisions. In addition the social value of biodiversity is unknown, and thus, the potential impact of the loss of biodiversity on social wellbeing is not recognised (Turpie, 2003). Assessing the economic value of the ecosystem services associated to the presence of elephants for the local communities will contribute to significant information to policy makers and conservation managers. This could potentially increase the awareness of the importance of biodiversity conservation. Therefore, the key question addressed by this paper is the following: "***what is the local households' WTP to avoid elephant's extinction***?"

A large body of research has contributed to enriching the literature on the economics of endangered species conservation (Barbier et al., 2013; Bishop, 1978; Bulte and Kooten, 2002; Kremer and Morcom, 2000; Tisdell et al., 2002). However, only a few research papers have been assessing the indirect use value, the bequest value and the existence value of elephant (Bandara and Tisdell, 2003a, 2005, 2003b), although this iconic species plays an important role in terms of socio cultural and ecological integrity (Blake et al., 2009; Lewis, 2002).

Bandara and Tisdell (2001) used data from a face-to-face CV study of a sample of 300 urban residents in Colombo (Sri Lanka) to assess the WTP for elephant conservation. Their assessment allowed distinguishing between users' and non-users' values of Asian elephant. The respondents who have at least once used elephant facilities were willing-to-pay Rs.137.38 (€2.05) while the non-users were willing-to-pay Rs. 82.96 (€1.24) for elephant conservation with an average of pay Rs. 110.17 (€1.65) per month. The results reveal that urban residents are willing-to-pay for elephant conservation because they want to secure the existence of elephant (non-use value) and because presence of elephants has a use value, i.e. their

importance for recreational and tourism. They also found that the probability of a positive WTP is significantly and positively influenced by pro-conservation attitude as well as higher income (Bandara and Tisdell, 2004). They found that the total WTP is sufficient to compensate an annual crop damage value.

While a small number of research papers investigate farmers' valuation of the use value (Smith and Sullivan, 2014), as well as the option value and the non-use values, of Asian savannah elephants (Bandara and Tisdell, 2003a, 2004, 2003b; Vredin, 1997), no research has addressed the value of EFE for local and indigenous communities. The application of CV in developing countries is growing; however, the present study is the first to measure the value of EFE for local and indigenous communities in Central Africa and, in particular, in the Tridom landscape. Besides, this paper considers the role of landscape factors like the distance between the households location and the nearest area of elephant concentrations (Protected Areas), the elephants' density of the protected areas and the households' land ownership on the WTP. This analysis is possible due to the collection a new not previously exploited dataset obtained by face-to-face interviews and with 1035 geo-localised households using GPS.

The purpose of our study is to calculate the WTP of the local and indigenous households for EFE's conservation and to analyse the factors that influence its value. We test four hypothesis. First, the extinction of forest elephant can lead to a significant net loss in the household's welfare. Secondly, the WTP for elephant conservation changes with the distance of the household's location to the nearest protected areas. The effect of the distance may be positive or negative. Indeed, following the distance decay's hypothesis, the WTP declines as the distance increases between the respondent location and the site providing the environmental services (Bateman et al., 2006; Loomis et al., 2000; Schaafsma et al., 2013). However, the distance to the protected area can be considered as an indicator of elephant scarcity. Therefore, assuming a decreasing marginal utility of forest elephant presence, household heads living close to a protected area with higher elephant density would be likely to express lower marginal WTP for elephant's conservation. Third, the presence of Human-Elephant Conflicts is expected to reduce the WTP for elephant conservation. Fourth, the WTP is significantly influenced by the indigenousness status of households as their cultural services such as traditions and religious practices lie on elephant existence Knowledge about the spatial and ethnic differences in WTP may be used for the design of spatially explicit and culturally adapted conservation policies. The following sections present a case study of the Congo Basin Tridom Landscape' EFE (section 2), the methodology used (section 3), results (section 4) and discussion and conclusion(section 5).

2. Case study: The Tridom Landscape's EFE in the Congo Basin

Our assessment applies a CV survey to measure local households' WTP for avoiding reduction and loss of forest elephant population in the Tridom.

The Tridom is a cross-border conservation landscape covering a geographical area of 191 541 km^2, representing 7.5% of the total area of the Congo Basin Tropical Forests in central Africa. It was created in 2005 by an agreement between Cameroon, Gabon and Congo governments, as one of "the twelve Congo Basin Forest Partnership (CBFP) priority landscapes". The agreement is targeting the promotion of long-term biodiversity and protected area's system conservation, a rational use of natural resources and a sustainable development, including poverty reduction. It encompasses 10 protected areas representing 37 498 km^2. Four of these are located in the Cameroon segment (BoumbaBek, Kom, Mengame, Nki and Dja Biosphere reserve), three in the Gabonese segment (Minkébé, Mwagne and Ivindo National Parks) and two in the Congolese segment (Odzala and Lossi National Parks). Between the protected areas, there is a livable inter zone representing 40,000 km^2. The Tridom landscape includes rich and diversified flora and fauna, abounding high commercial value timber species. It houses the largest population of forest elephants in the world with a highest elephant density in the Minkébé National Park. It also has a relative high density of other large mammals such as buffalo, bongos, giant pangolin and gorillas. The human population density is between 1-7.9 inhabitants / km^2 and is currently growing due to resource exploitation (Ngoufo et al, 2012). The Tridom inter zone is home to numerous economic activities, including forest management, rural agriculture, hunting, traditional and industrial mining as well as fishing and gathering non-timber forest products.

The field work was carried out in the Cameroon and Gabon segments as shown in *figure 2*. Both segments are inhabited by more than 43 tribes, dominated by Bantu, while there is a minority group of the indigenous Baka tribe (AppendixB.1). The paper uses data from a representative face-to-face survey with a random and stratified sample of 1035[2] households. The total number of households is approximately 65140. The survey lasted 8 full months between December 2013 and July 2014, in 108 villages representing all the 26 administrative units of the Cameroonian and the Gabonese part of landscape (AppendixB.2). The villages visited are spread over nearly 27,000 km^2, which is 2/3 of the landscape livable inter-zone. The random sampling of households in the villages was based on the village inhabitants' register held by the chief of the

[2]The sample size required at a confidence level of 95% (typical value of 1.96) is 384.

village. The interviews lasted between 1 to 3 h. In addition, there were evening visits in the various households surveyed to

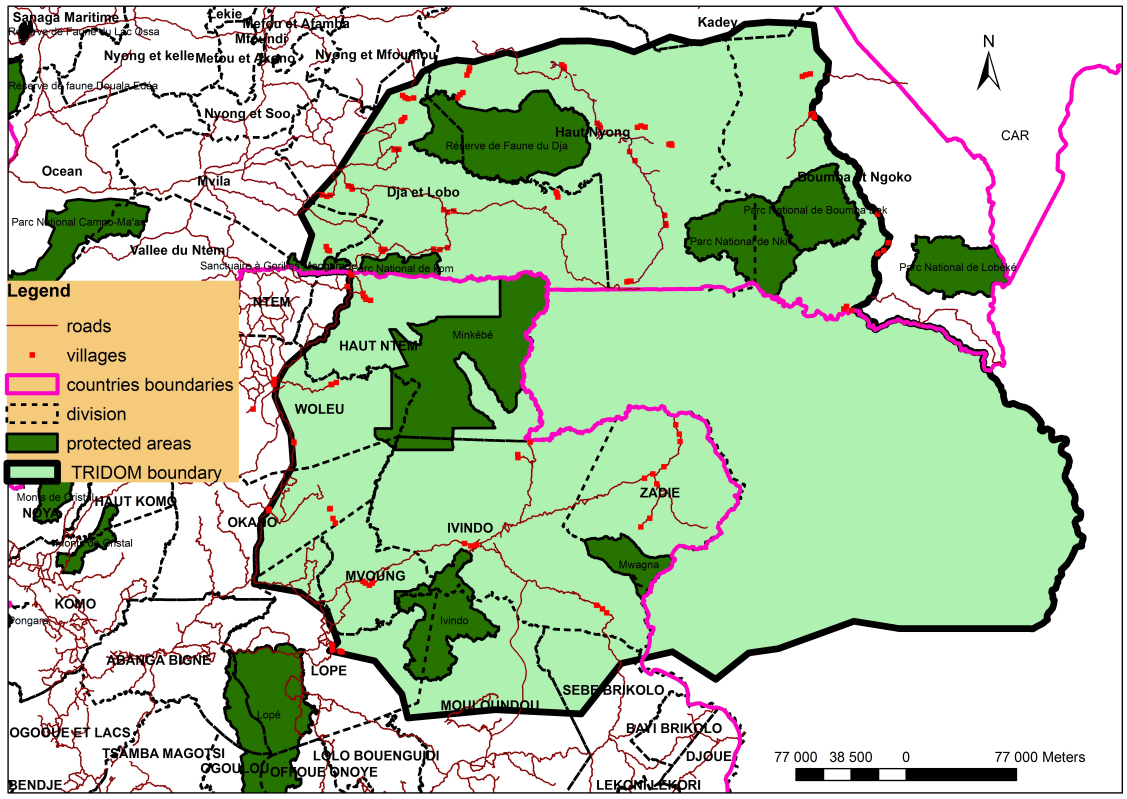

Figure 2: The Study Area

quantifying and measuring daily production. The survey was supervised by the first author. Ten Masters Students selected after five training seminars participated as surveyors. Every village provided us with at least two local translators in the case that the household head could not communicate in French. Every household was geo-localized with a GPS.

3. Methodology: Combining Open-Ended and Closed-Ended CV methods

3.1. Overview of CV methods

A main distinction between different CV approaches is OE format and closed-ended mechanisms, or Discrete Choice Contingent Valuation (DCCV)(Cameron and James, 1987). In OE the respondents are asked to specify their WTP, while in close-ended; respondents are asked to choose whether or not to pay a specified amount (Kealy and Turner, 1993).

Notwithstanding the level of information respondents are provided with, the predicted WTP may be unstable with respect to the different elicitation format (Brown et al., 1996). Indeed, DCCV and OE mechanisms may yield significantly different preferences for public goods due to the differences in incentives for strategic behaviour (Kealy and Turner, 1993). We use both mechanisms to approximate the true WTP. The main types of DCCV approaches consist of the single and the double (multiple) bounded dichotomous choice (DBDC) (Carson, 1985; Hanemann and Kanninen, 1999; Hanemann, 1985). In DBDC the respondents, after having been asked one DCCV question, are asked a second DCCV question which depends on the answer to the first.

We first apply the DBDC model proposed by Hanemann (1985) and Carson (1985). The advantage of the DBDC to the single bounded DC is that we get more information from the respondents. It is therefore asymptotically more efficient than the single bounded method developed by Alberini (1995); Bishop and Heberlein (1979); Haab and McConnell (2002); Hanemann et al. (1991). However, the DBDC is more complicated to implement and requires more advanced econometric approaches for analysing the data. Furthermore, the answer to the first question when using the DBDC may sometimes be inconsistent with the response to the second bid and may contribute to lowering the WTP (Hanemann et al., 1991; Herriges and Shogren, 1996).However, a good starting points has the benefit of preparing and encouraging the respondents to reveal their maximum WTP (Bateman et al., 2008; Brouwer and Martin-Ortega, 2012; Fischhoff and Furby, 1988; Frew, 2010a).

Our methodological approach is to combine DBCD format and OE format. Once the starting points are well defined, the use of the DBDC in a first stage is expected to yield the best bases for an OE question. In fact, standing alone OE suffers often from a high share of protestors as the respondents have difficulties with value of a given service or good that they are not used to value (Bateman et al., 2011; Brouwer and Martin-Ortega, 2012; Zeiler and Plott, 2004). According to the "discovered preference hypothesis", executing the DBDC yields repetition and experience and therefore, helps the convergence towards stable and theoretically consistent preferences (Bateman et al., 2008; Zeiler and Plott, 2004). Hence, following Bateman et al. (2008), the DBDC format may be considered as a "learning design" that could help to reduce the preference anomalies under the OE format. Using the DBDC before the OE can also help reduce the non-response rates as the closed-ended questions are normally considered easier. By asking the OE format question we get more information from the respondent, in particular, where the respondent either answer yes to both amount or no to both amount. In these cases their WTP is unbounded using the DBDC. Furthermore, Mahieu et al. (2012b) have shown that using an OE follow-up question after a DC elicitation format help elicit the maximum amount an individual would definitely pay.

3.2. Survey design

The CV questions were imbedded in a questionnaire addressing the characteristics of the households, their behavior and motivations. The CV first described the socio-economic and ecological attributes of elephant, as well as the potential change in sociocultural services associated with a possible extinction of elephant given the fact that forest elephants are only present today in the Congo Basin. Respondents were asked to state their preferences for the entire bundle of services provided by forest elephants. This is because addressing the single service separately leads to double-counting. For instance, the existence value will insure the bequest value, as well as the option value (Bandara and Tisdell, 2003a; Loomis and Larson, 1994).

Next, we proposed the following hypothetical scenario, given that we are valuing a non-market good without implicit market. "*Considering the trend to extinction of forest elephants, if action is not taken quickly, this multiple-use iconic species will disappear in the next few years. To stop this tendency to extinction and make the species abundant, the Tridom Regional Project Management Unit can develop a 10 years elephant conservation's program that aims to seize weapons currently used by poachers and to effectively fight against cross-border poaching by: (1) creating joined checkpoints at the landscape scale, (2) recruiting more young people in the villages, involving them in a communication network to improve the anti-poaching control strategy and prevent Human-Elephant Conflicts*". Then each respondent was asked whether *he was willing to contribute to the program by paying some monthly amount if the Regional Management Unit demands financial support of all the inhabitants of the village?* The payment vehicle presented was the direct cash payment in secure funds and housed at the Tridom program. This mean of payment is the most familiar, credible and feasible according to the economic situation in the landscape.

To minimizing the "Yea saying", the "Nay saying" bias[3] and the starting point bias, (1) we asked each respondent to consider his monthly income, his sources of income, and the usual monthly expenditure; (2) we asked each respondent to be realistic, making assured that he could actually pay the stated monthly amount for the next 10 years before he answered. Furthermore, the respondents were randomly assigned to one of six starting bids developed and validated during two pretest steps with 40 households in four villages (Meyomessi, Oveng, Kongo and Mbieleme) of two subdivisions of the study area using an OE elicitation format (Boyle and Bishop, 1988). A lower bid was presented to those who gave a negative answer to the starting bid, and a higher bid to those who gave a positive answer. The bid cards structure is presented in AppendixA.1.

After the double bounded elicitation format, the respondents were assigned an OE question, asking the maximum amount they would be willing to pay for forest elephant conservation. We finally introduce follow-up questions that examine reasons for zero observations to be able to identify protest bidders in the data base before estimation (Arrow et al., 1993).

3.3. Theoretical model specification

Household preferences for forest elephant conservation in the Tridom can be described by a random utility model developed by McFadden (1973) and formalized by Manski (1977) and Hanemann et al. (1991). The indirect utility function is given by:

$$U_{ij} = V_{ij}(Y_i - a, E(a), X_i) + \varepsilon_{ij} \tag{1}$$

In (1), $j = 1 \wedge a > 0$ if the household i accepts to pay an amount a or , $j = 0 \wedge a = 0$ otherwise. Y_i is the household head's income, V_{ij} is the deterministic component of the utility function, measuring the indirect utility for the respondent i, in the state j, X_i is vector of socioeconomic and geographical characteristics influencing households preferences, ε_{ij} is the

[3]The Yea-sayers and Nay-sayers are the respondents who try to please or to counter the interviewer without considering the specific amount they are asked about (Carson and Hamenann, 2005; Frew, 2010b)

unobserved random component of the utility function. This function is supposed to be increasing and concave in available income Y_i as well as in the level of elephant protection $E(a)$. The household head i will then accept to pay if:

$$U_{i1} > U_{i0}, \Longleftrightarrow (V_{i1}(Y_i - a, E(a), X_i) + \varepsilon_{i1}) > (V_{i0}(Y_i - 0, E(0), X_i) + \varepsilon_{i0}) \tag{2}$$

A household would be willing to contribute to EFE's conservation if doing so provide him with greater utility than not paying. Therefore, the maximum WTP_i of the household head i can be expressed in (3).

$$(V_{i1}(Y_i - WTP_i, E(WTP_i), X_i) + \varepsilon_{i1}) = (V_{i0}(Y_i - 0, E(0), X_i) + \varepsilon_{i0}) > 0 \tag{3}$$

3.4. Econometric model specification

Applying the random WTP formulation of the random utility model suggested by Lopez-Feldman (2012) and Barrena et al. (2014), originally formulated by Cameron (1988) the WTP can be modeled:

$$WTP_i(X_i, \mu_i) = X_i'\beta + \mu_i \tag{4}$$

In (4), WTP_i represents the willingness to pay vector of the i^{th} respondent, X_i is a vector of explanatory variables, β is a parameter vector and μ_i a normally distributed error term.

In the following, we specify four econometric models, using both DBDC and OE elicitation procedures described above. The first two models are Variants of the Interval Regression model (IRM) initial proposed by Hanemann et al. (1991) for the analysis of DBDC data. The latter two models are corner solution models, i.e. the Tobit model and the Cragg's Truncated Normal Double-Hurdle Model (DHM).

3.4.1. Interval regression models

First we estimate the standard interval regression(IRM1) model based on the data from the DBDC elicitation format. We estimate the model with and without zero-bid protesters. In our questionnaire, zero-bid protesters are identified as zero-bidders who may have a true positive WTP but stated zero WTP in the OE question. Jorgensen and Syme (2000); Strazzera et al. (2003) and Halstead et al. (1992) recommend dropping them from the dataset only if they are similar to the other respondents. Indeed, the socio-demographic characteristics do not differ significantly between zero-bid protesters and the non-protesters see *Table 2*. By excluding the zero-bid protesters we assume that, on average, they have similar preferences as the non-protestors. Protest bidders are identified using follow up questions.
In the standard application of the IRM (DBDC), a respondent who refuses to pay the lowest bid ("no/no" respondents) is left-censored at the lowest bid. If the respondent accepts both bids, the true WTP is right-censored at the upper bid.
The IRM is adapted to account for point data. By applying the OE format responses in the cases where the respondents reply "no/no" or "yes/yes" under the DBDC format, this help reduce significantly the share of unbounded intervals. Our hypothesis is that combining the two data sets increases the statistical efficiency (Haab and McConnell, 2002; Mahieu et al., 2012a).

We apply follow-up questions to identify respondents that may have negative WTP of the proposed conservation scenario. It is assumed that a respondent may have a negative WTP if stating zero WTP in the OE question and replying in a follow-up question that elephants are considered a cost[4]. We estimate the modified interval regression model (IRM1)assuming that respondents who consider elephants as a cost after effectively facing a Human-Elephant Conflict and have stated a zero WTP in the OE question may effectively have negative WTP. This is implemented by left-censoring at zero. The remaining zero-respondents to the OE format are considered as true zero bidders and are integrated as point data. These respondents' main motives for zero WTP are that *"I cannot afford to pay for elephant conservation"; "I do not have any benefit from elephants", "I do not see any problem if they disappear"*. The second estimation of the IRM left-censors the households who expressed a possible loss in utility with the presence of elephants and who do not necessarily face Human-Elephant Conflict. This model is the Interval Regression Model with expected negative Preferences (IRM2).

The stadard IRM or DBDC model described above yields four possible interval outcomes with respect to the "yes/yes", "yes/no", "no/yes" and "no/no" answers. The added value of the adapted Interval Regression Model (IRM) is that, in addition to the output formats of the DBDC, it account for point data. Hence, *Table 1* present various possible specification of the dependent variable.
[1]"no/no" respondents who respond 0 to the OE and who faced or expect to face crop damage by elephants.

[4]The motive stated by these respondents is that, "elephants are a cost for me because they destroy my crops".

Table 1: Various specifications of the dependent variable

	Data	First Bid (FB)	Secondary Bid (SB)	OE
"no/no" and WTP ≥ 0	a_i^{OE}	a_{ij}^s	a_{ij}^l	$a_i^{OE} \geq 0$
"no/no" and WTP < 0[1]	$[-\infty, 0[$	a_{ij}^s	a_{ij}^l	0
"yes/yes"	a_i^{OE}	a_{ij}^s	a_{ij}^u	$a_i^{OE} \geq a_{ij}^u$
Intarval "no/yes"	$[a_{ij}^l, a_{ij}^s[$	a_{ij}^s	a_{ij}^l	$a_i^l \leq a_{ij}^{OE} \leq a_{ij}^s$
Interval "yes/no"	$[a_{ij}^s, a_{ij}^u[$	a_{ij}^s	a_{ij}^u	$a_i^s \leq a_{ij}^{OE} \leq a_{ij}^u$

Where a_{ij}^s , a_{ij}^l and a_{ij}^u represent the starting point, the lower and the upper bids, respectively of the j^{th} random bid card assigned to the i^{th} household. According to *Table 1*, the probability for the i^{th} household to be willing to pay an unobserved amount belonging to one of the various intervals defined above is given by:

$$\begin{aligned} P^{lc} &= P\left(\mu_i < 0 - X_i'\beta\right) = \Psi\left(0, \beta\right) \\ &= \Psi\left(\frac{0 - X_i'\beta}{\sigma}\right) = \Psi\left(\frac{-X_i'\beta}{\sigma}\right) \end{aligned} \tag{5}$$

$$\begin{aligned} P^{id} &= P\left(FB_i \leq X_i'\beta + \mu_i < SB_i\right) \\ &= \Psi\left(SB_i, \beta\right) - \Psi\left(FB_i, \beta\right) \\ &= \Psi\left(\frac{SB_i - X_i'\beta}{\sigma}\right) - \Psi\left(\frac{FB_i - X_i'\beta}{\sigma}\right) \end{aligned} \tag{6}$$

Where $\Psi(*, \beta)$ is the cumulative normal distribution function. Equation (5) stands for the left-censored (lc) data, representing the Zero bidders who face or expect fo face crop damage by elephants. Equation (6) stands for the interval data (id) data, representing the no/yes and yes/no respondents to the DBDC format. In this equation, FB_i is the first bid or the starting point a_{ij}^s and SB_i is the secondary bid, taking as value a_{ij}^l or a_{ij}^u for the "no/yes" or "Yes/no" respondents respectively

Stewart (1983) suggests using the maximum likelihood technic when estimating the IRM. Hence, following Wooldridge (2012), the log likelihood function can be given by:

$$\begin{aligned} \ln(L(\beta)) = &\sum_{i=1}^{N} b_i^{lc} \ln\left[\Psi\left(\frac{-X_i'\beta}{\sigma}\right)\right] \\ &+ \sum_{i=1}^{N} b_i^{id} \ln\left[\Psi\left(\frac{SB_i - X_i'\beta}{\sigma}\right) - \Psi\left(\frac{FB_i - X_i'\beta}{\sigma}\right)\right] \\ &+ \sum_{i=1}^{N} \frac{1}{2} b_i^{OE}\left[\left(\frac{a_i^{OE} - X_i'\beta}{\sigma} + \ln 2\pi\sigma^2\right)\right] \end{aligned} \tag{7}$$

The first element of (7), accounts for left-censored at zero observations. The second element accounts for interval data ("no/yes" and "yes/no"). The last element account for "no/no" or "yes/yes" respondent willing to pay $a_i^{OE} \geq 0$ amount. In (7), b_i^{lc}, b_i^{id} and b_i^{OE} are dummy variables indicating the household head's situation.

3.4.2. Corner solution models

We estimated the determinants of the WTP using only the OE data. Even though there are 169 households in the DBDC replying "no/no" but giving a positive WTP in the OE question there still remains a non-trivial proportion of population that did not state positive preferences for forest elephant conservation. These zeros may represent a true zero as the respondent may not have any utility proposed conservation scenario or they cannot afford to pay for the conservation. A stated zero WTP can also be because they have a negative WTP but are only asked to state a positive WTP. Alternatively, they may have a positive (or negative) utility of elephant conservation but refuse to reveal their preferences, e.g. because they may find it difficult to put a value on such asset (Mitchell and Carson, 1993). If some of household heads stating a zero WTP in fact had a negative WTP of conservation the entire possible range of the overall respondents' preferences for elephant conservation is not observed. In this case, the dependent variable is a corner solution outcome (Cameron and Trivedi, 2005; Wooldridge, 2010). Econometric models coping with corner solution outcomes include Type I Tobit model (Tobin, 1958), Heckman selection or incidental truncation model (Heckman, 1979) and the Cragg's DHM (Cragg, 1971).

In the Tobit model, the likelihood of participation and the intensity of participation (for elephant conservation) are determined in the same way using the same covariates. This assumption is not generally reasonable (Katchova and Miranda, 2004). For example, in our case the households living very far from a protected area with high elephant density may be less likely to participate in elephant conservation and those participating pay greater amounts as they are often close to urban areas. Furthermore, Tobit model does not remain consistent under heteroscedasticity (Amemiya, 1984; Brooks, 2014). The DHM gives the option of separating the parameterization of both decisions under the conditional independence assumption on participation and intensity's drivers (Burke, 2009; Solomon and Bekele, 2014; Wooldridge, 2010). The Cragg's DHM allows heteroscedasticity in the Second Hurdle without conceding model misspecification in the First Hurdle (Burke, 2009). The paper considers both the traditional Tobit model and the Cragg's DHM and compares the two. As the Tobit model is nested within the Cragg's alternative, the following specifies only the Cragg's model. The First Hurdle, or participation decision d_i, and the Second Hurdle that explains the intensity of participation (Y_{2i}) are defined as follows:

Participation equation

$$Y_{1i}^{*} = X_{1i}\alpha + \varepsilon_i \tag{8}$$

Threshold participation equation :

$$d_i = \begin{cases} 1 & \text{if } Y_{1i}^{*}>0 \\ 0 & \text{otherwise} \end{cases} \tag{9}$$

Observed Contribution intensity:

$$Y_{2i}^{*} = X_{2i}\gamma + \mu_i \tag{10}$$

Threshold contribution intensity :

$$Y_{2i} = \begin{cases} Y_{2i}^{*} & \text{if } Y_{2i}^{*}>0 \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

In (8), (9), (10), (11), Y_{1i}^{*} is a latent value and d_i equals to 1 if the household participates with a positive amount for EFE's conservation or 0 otherwise; X_{1i} is a vector of socio-demographic and geographical covariates, α a vector of coefficients and ε_i is the *iid* error term. Y_{2i}^{*} is the household's latent contribution for EFE's conservation, X_{2i} is the vector of socio-demographic and geographical covariates that drives the intensity of payment, γ the vector of coefficients and μ_i is an *iid* error term.
Following Moffatt (2005), the DHM log-likelihood function is specified as following:

$$\begin{aligned} \ln(L) = & \sum_{Y_{2i}=0} \ln\left[1 - \psi\left(X_{1i}\alpha\right)\Psi\left(\frac{X_{2i}\gamma}{\sigma_i}\right)\right] \\ & + \sum_{Y_{2i}>0} \ln\left[\frac{1}{\sigma_i}\psi\left(\frac{Y_{2i} - X_{2i}\gamma}{\sigma_i}\right)\Psi\left(\frac{X_{1i}\alpha}{\sigma_i}\right)\right] \end{aligned} \tag{12}$$

In (12), $\psi(*)$ and $\Psi(*)$ are probability density functions and cumulative normal distribution functions. The first element represents the non-participants and the second represents the summation over observed positive contribution for EFE's conservation. The expression σ_i is the standard errors or the value of σ for each observation. If $\frac{\alpha}{\sigma_i} = \gamma$, and $X_{1i} = X_{2i}$ then, the Tobit model and the Truncated DHM are mathematically identical. For a detailed presentation of both models, see Cragg (1971) and Wooldridge (2010).

Following Burke (2009), this paper considers three values of interest to characterize the households' likelihood as well as their intensity of participation for EFE's conservation. The first is the Partial Effects of the covariates on the probability of participation, the second and the third are the Partial Effects of the covariates on the Conditional and the unconditional expected preferences derived using the maximum likelihood outcome achieve from the Truncated DHM.

Partial Effects of the covariates j on the probability of participation:

$$\frac{\partial P\left(Y_1^{*} > 0 \mid X_1\right)}{\partial X_{1j}} = \alpha_j \psi\left(X_1\alpha\right) \tag{13}$$

Partial Effects of the covariates on the Conditional expected preferences

$$\frac{\partial E\left(Y_2 \mid Y_{2i}>0, X_{2i}\right)}{\partial X_{1j}}=\gamma_j\left[1-\lambda\left(\frac{X_2\gamma}{\sigma_i}\right)\left(\frac{X_2\gamma}{\sigma_i}+\lambda\left(\frac{X_2\gamma}{\sigma_i}\right)\right)\right] \tag{14}$$

Partial Effects of the covariates on the unconditional expected preferences

$$\frac{\partial E\left(Y_2 \mid X_1, X_2\right)}{\partial X_{1j}}=\alpha_j\psi\left(X_1\alpha\right)\left\{X_2\gamma+\sigma\lambda\left(\frac{X_2\gamma}{\sigma_i}\right)\right\}+\Psi\left(X_1\alpha\right)*\gamma_j\left[1-\lambda\left(\frac{X_2\gamma}{\sigma_i}\right)\left(\frac{X_2\gamma}{\sigma_i}+\lambda\left(\frac{X_2\gamma}{\sigma_i}\right)\right)\right] \tag{15}$$

In 13 and 15 , α_j is an element of α that appears as the coefficient on X_1. In 14 and 15 , γ_j is an element of γ that appears as the coefficient on X_2 ; $\lambda=\psi\left(X_1\alpha\right)/\Psi\left(X_1\alpha\right)$ is the Inverse Mills Ratio.

We considered the Heckman selection model allowing for dependence in the error terms of the two participation and contribution equations (Martínez-Espiñeira, 2006). However, our tests indicated no significant dependence and the results of the Heckman selection model are not presented.

4. Results

4.1. Variables Description and Descriptive Statistics

Table 2 describes the independent variables used in the various econometrics models, as well as descriptive statistics. From the 1035 household head surveyed, 99 (9.6%) were excluded as protestors leaving a sample of 936 of non-protestors.

The indigenous Baka, known as an ethnic minority group, represented 5% of the households. Their way of life is highly linked to elephant existence. The main activity or the type of land-use may also influence the household's preferences for forest elephant conservation. Among the 936 respondents, 19% make cash crop (Cocoa) their main use of land, 41% are small scale farmers, producing crop for subsistence and small scale trading. 3% of the households use forest land for traditional gold mining. The respondents using forest for hunting and gathering represent 15% of the sample, 3% work either in a biodiversity conservation organisation, either in the forest administration, or in a forest concession management. Among the remaining respondents, 9% work for other administrations, and 10% practice animal husbandry, fisheries, and trade.

Table 2: Descriptive statistics

Variable	Description of the household heads' characteristics	Without Protest (n=936)	Protest bidders (n=99)	Overall obs. (n=1035)	Comparison test
		Mean (Std)	Mean (Std)	Mean(Std)	Chi 2 (1) <3,84 [t-test (5%, 1033)] <1,96
sex	1 if male and 0 otherwise	0.76 (0.42)	0.77 (0.42)	0.76 (0.42)	0.007
age	age in years	48.29 (14.68)	50.79 (13.52)	48.53 (14.59)	[-14.07]
hsize	household size	6.43 (4.05)	7.02 (3.90)	6.49 (4.04)	[-0.0194]
EDUCATION LEVEL	1 if at least secondary school, 0 otherwise	0.55 (0.50)	0.68 (0.47)	0.56 (0.50)	6.21
MONTHLY EXP.	monthly expense	46604 (59463)	59792 (68242)	47865 (60446)	[-2.40E+19]
INDIGENOUSNESS	1 if indigenous BAKA (Pygmies) 0 otherwise	0.05 (0.22)	0.03 (0.17)	0.05 (0.21)	0.77
SMALL FARMER	1 if small scale farmer, 0 otherwise	0.41 (0.49)	0.42 (0.50)	0.41 (0.49)	0.09
TRAD GOLD MINER	1 if traditional gold miner, 0 otherwise	0.03 (0.16)	0.00 (0.00)	0.03 (0.16)	2.82
HUNTHER GATHERER	1 if hunter-gatherer 0 otherwise	0.15 (0.36)	0.09 (0.29)	0.15 (0.36)	2.81
FMU OR FOREST AD	1 if works in the forest adm. or a FMU	0.03 (0.18)	0.02 (0.14)	0.03 (0.18)	0.48
OTHER ADMIN	1 if works in other administration	0.09 (0.28)	0.10 (0.30)	0.09 (0.29)	0.16
HUM/ELEPH CONFLICT	1 if Human-Elephant Conflict, 0 otherwise	0.28 (0.45)	0.23 (0.42)	0.27 (0.45)	0.88
LAND TENURE	land area (ha) ownership	4.32 (5.32)	5.36 (4.32)	4.42 (5.24)	[-0.09.73]
DIST_NAREA	The distance to the nearest protected area (km)	28.98 (22.26)	27.60 (22.14)	49.06 (493.20)	[40.17]
ELEPHANTDENSITY	elephant density of the nearest protected area	0.94 (0.84)	0.83 (0.72)	0.93 (0.83)	[0.01.51]

Experiences of conflicts with elephants may have a negative impact on the welfare of the households and thus on their preferences for EFE's conservation. Indeed, some conflicts have been reported by 259 households (28%) with about CFA 28 140 that's €43 damage cost per household. This cost is rigorously calculated as it is typically registered by the households for the purpose of compensation by the decentralised administrations. However, no household has yet received any compensation.

The customary land tenure, the distance of the respondent to the nearest protected area and the proximity to a relatively high elephant density protected area are also considered as variables that can influence the preferences of the respondent for elephant conservation. The two first of these three variables were determined using a GPS and the ArcMap software. Indeed, the customary land tenure consists of the area of land owned by a household. This variable was generated using a tracking with GPS to capture the exact area. About 70% of the households own between 0.1 and 5 ha, 8% do not have access to land,

29% own between 5 and 15 ha, 3% own between 15 and 25 ha. There are a few household heads owning between 25 and 57 ha.

With regard to the proximity to a (relatively-high-elephant-density) protected area, elephant density in the various protected areas are considered as a continuous variable (this variable was determined using the UICN elephant Data base). *Table 3* gives the structure of 936 answers to the DBDC questions where identified protest bidders are excluded. As expected, the frequency of "yes" and "yes/yes" respondents decreases with the starting bid. On average 56% were "no/no". Among the remaining, the WTP stated by 18.4% were somewhere in the interval between the lower bid and the starting bid (6.5%) and between the starting bid and the upper bid (11.9%). About 25.4% were willing to pay more that the higher bid.

Table 3: Answers to Bids

Bid cards $a^s/a^l/a^{u1}$	Bid cards Statistics		Yes to a^s	No to a^s	Ansews to bids		Perc.(%)	
	Freq	Perc.			YY	NY	YY	NY
					YN	NN	YN	NN
1000/500/1500	191	20%	46%	54%	56	15	5.98	1.60
					31	89	3.31	9.51
1500/1000/2000	161	17%	47%	53%	53	5	5.66	0.53
					22	81	2.35	8.65
2000/1500/2500	148	16%	34%	66%	33	14	3.53	1.50
					18	83	1.92	8.87
2500/1000/3000	163	17%	33%	67%	40	5	4.27	0.53
					13	105	1.39	11.22
3000/1500/3500	115	12%	38%	70%	31	10	3.31	1.07
					3	71	0.32	7.59
3500/2000/4000	158	17%	31%	56%	25	12	2.67	1.28
					24	77	2.56	10.36
Total	936	100%			238	61	25.43	6.52
					111	526	11.86	56.20

[1] a^s = Statring bid; a^l = Lower bid; a^u=Upper bid

Table 4 shows the outcome summary with respect to the various econometric models estimated. The DBDC model without protesters left-censors all the "no/no" observation that is 56.2% of the sample, it considers 43.8% of positive preferences. The OE format assigned to the respondent after the DBDC yielded 578 positive stated WTP, that's 61.75% of the respondents. As corollary, the information level on the forest community preferences has improved considerably in two ways.

Table 4: Dataset description (in percent)

	DBDC Standard IRM		Tobit	Double-Hurdle		IRM + point data	
	Total (1035)	Without Protestors (936)		First Hurdle	Second Hurdle	IRM 1	IRM 2
Left Censored data	60,4	56,2	38.20	-	0.00	2.90	11.10
Right Censored Data	23	25,4	0.00	-	0.00	0.00	0.00
Interval Data	16,6	18,4	0.00	-	0.00	18.20	18.20
Point data	0	0.00	61.80	100	61.80	79.00	70.70
Truncated at zero	-	-	0.00	-	38.20	-	-
Total	100	100	100	100	100	100	100

Among the household heads responding "no/no" to the DBDC question, that is 56.2% of the sample surveyed, 18% stated a positive WTP in response to the OE question and 25.4% were willing to pay more than the higher bid. The follow-up questions allowed 104 households replying a zero WTP because they considered elephants could be cost for the household and of these, 27 households had experienced crop damage by elephants in the past.

4.2. Econometric results

4.2.1. Predicted WTP for EFEś conservation and extrapolation.

The last two rows of *Table 5* present the estimated unconditional and conditional WTP using the various models. Both rows suggest that preferences change across different techniques. The first two columns show the results based on the standard DBDC model with and without including the zero-bid protesters. As expected, the predicted WTP is improved when zero-bid protesters are removed. Indeed, the remaining respondents are assumed to be representative of the population,

as they have almost the same characteristics compare to zero-bid protesters. The removal of the protesters leads to an increase in the monthly predicted WTP from CFA 368.84(€0.56) to CFA 742.92 (€1.13) per household

Even if corner solution models produced higher conditional and unconditional expected WTP for EFE's Conservation, CFA 2081.84 (€3.17) and CFA 1326.87 (€2.02) respectively, we avoid considering these value because they are less representative of the population. Indeed, the conditional expected WTP in the Second Hurdle does not account for the non-trivial share of respondent who did not state positive preferences for forest elephant conservation, while the Tobit model does not distinguish among the zero-bidders.

The IRM1 produced a monthly predicted WTP of CFA 1245.66(€1.89). This model left-censors only the 27 households who experienced both Human-Elephant Conflict with crop damage. The IRM2 left-censors the 104 households who had experienced elephant-related cost, as well as those who stated potential-elephant related costs as reason for a zero bid. This model generated CFA 1138.17 (€1.74) as the predicted WTP, that is an annual amount of CFA 13658 (€20.82) per household.

To estimate the expected aggregate WTP for the population living in both Cameroonian and Gabonese's segments of the Tridom for elephant conservation, as the sampling of respondents was random and representative, the simple transferring point estimate is used. It produces robust aggregate with fewer bias compared to benefits function transfer approach (Bandara and Tisdell, 2004; Brouwer and Spaninks, 1999; Loomis et al., 2000).

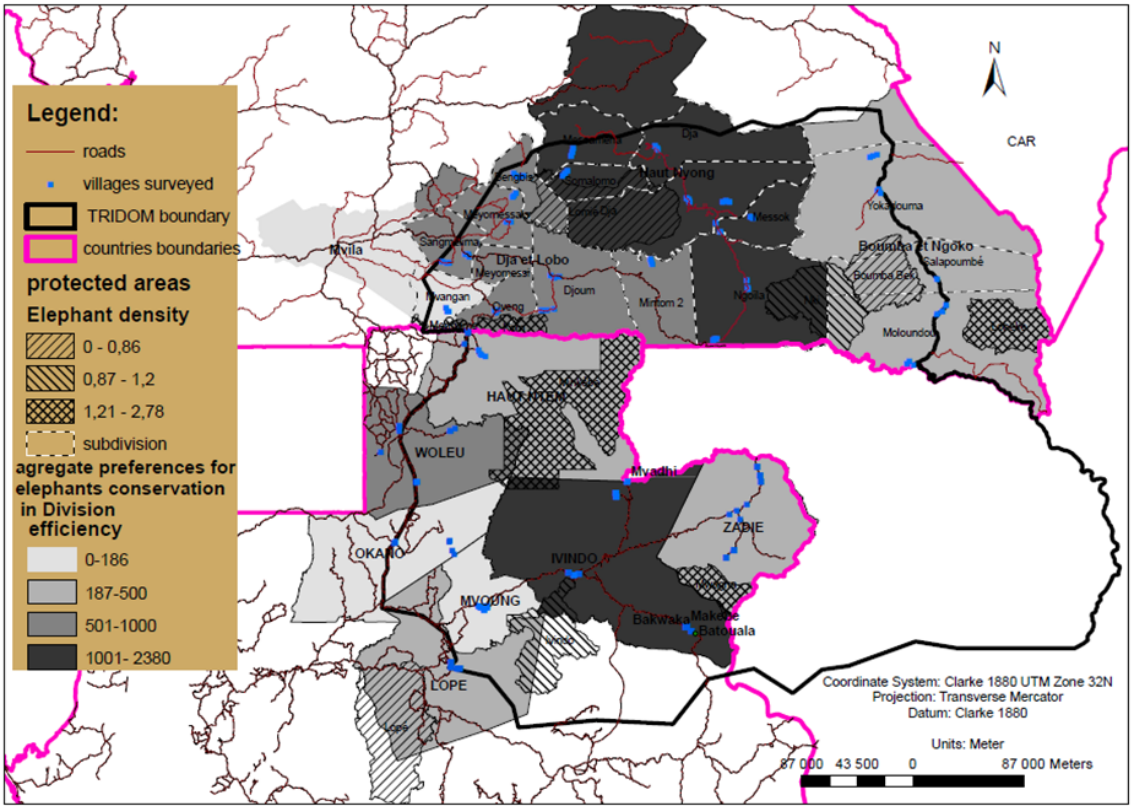

Figure 3: Aggregate WTP ($*10^6 CFA$) by division and elephants densities in protected area

The aggregate population size in both segments of the Tridom is 418,855 inhabitants (Bucrep, 2010; Gabon, 2010). Considering the mean household size of the sample (6.43), the number of households is around 65141. The monthly WTP of the overall population is CFA 74.14 million (€113,000), that is annually equal to CFA 889.7 million (€1.36 million). Considering the current 2.4% population growth rate (World Bank) and a 3% discount rate, the Tridom local and indigenous households the net present value is CFA 8.67 billion (€13.2 million) for the proposed 10 years elephant conservation program. According to the high population density, as shown in *figure 3*, the Haut-Nyong, the "Dja et Lobo" and the "Boumba et Ngoko" in Cameroon expressed the greatest aggregate WTP for elephant conservation, respectively, CFA 2380 million, CFA 2287 million and CFA 1139 million (AppendixA.2). Among the Gabonese subdivisions, the "Ivindo", the "Woleu" and the "Haut-Ntem" expressed the greatest WTPs, respectively, CFA 769 million, CFA 528 million and CFA 380 million.

4.2.2. Drivers of participation, decisions' intensity and impact of covariate change

The drivers of the households' participation decision and intensity of participation are analysed in the Tobit and DHM. Applying a log-likelihood test, we test if the more general DHM can be reduced to the Tobit model, see for example

Katchova and Miranda (2004). The calculated $L-statistic-2*(DHMLL\check{}TobitLL)=178$ is greater than the $\chi^2(13)$ at the five per cent critical value (27.69). This outcome shows that the data do not support the more restricted Tobit model. Indeed, the participation and the size of the contribution to elephant conservation cannot be examined using a one-step parametrization. In addition, both decisions are not explained by the same covariates. The household heads activities influence the participation decision, yet they do not influence the intensity of participation. These variables are removed from the Second Hurdle, as the restricted model provides smaller Akaike Information Criterion compared to the model with all the covariates.

The change in preferences intensity with respect to an incremental change in a covariate is analysed using partial effects in *Table 6*.

Table 5: Coefficients Estimates

Predictors	CLOSE-ENDED		OPEN-ENDED - CORNER SOLUTION MODELS				COMBINING DBDC and OE	
	DBDC Overall sample	DBDC without Protestors	Tobit model	Heteroscedastic Double-Hurdle Estimates			IRM 1 : + effective Negative Utility	IRM 2 : + Potential Negative Utility
				1^{st}Hurdle	2^{nd} Hurdle	Het.		
	Coef. (Std)	Coef. (Std)	Coef. (Std)	Coef. (Std)	Coef. (Std)	Coef. (Std)	Coef. (Std)	Coef. (Std)
AGE	-28.476***	-24.444***	-22.153***	-0.008**	16.136	-20.297**	-13.373***	-15.855***
	(8.938)	(8.537)	(7.482)	(0.003)	(15.671)	(8.669)	(4.786)	(5.325)
EDUCATION LEVEL	814.450***	966.276***	639.181***	0.296***	2204.333***	-678.365***	337.981***	405.907***
	(261.024)	(251.769)	(197.365)	(0.092)	(643.792)	(247.065)	(117.385)	(130.888)
MONTHLY EXP.	0.007***	0.009***	0.00784***	6,00E-07	-0.005**	0.022***	0.007***	0.006***
	(0.002)	(0.002)	(0.002)	-8,00E-07	(0.011)	(0.005)	(0.001)	(0.001)
INDIGENOUSNESS	1678.716***	1684.426***	881.164**	0.417**	2802.750***	-1002.568***	580.169***	629.073***
	(536.186)	(512.805)	(347.409)	(0.210)	(666.533)	(283.159)	(209.415)	(225.923)
SMALL FARMER	66.121	53.891	181.726	0.126	-	-	53.789	84.957
	(289.733)	(281.481)	(218.536)	(0.103)			(142.599)	(152.844)
TRAD GOLD MINER	2516.476***	1993.225***	1776.781**	0.660**	-	-	1310.554**	1385.737**
	(774.178)	(722.910)	(686.945)	(0.305)			(595.34)	(611.959)
HUNTHER GATHERER	497.433	419.813	406.523	0.195	-	-	209.180	224.920
	(388.632)	(373.119)	(280.632)	(0.141)			(177.173)	(191.492)
FMU OR FOREST AD	1880.433	1665.085***	1408.703***	0.962***	-	-	767.973**	849.319**
	(665.502)**	(639.716)	(456.845)	(0.304)			(378.348)	(381.100)
OTHER ADMIN	1102.013	1012.012**	868.687**	0.418**	-	-	472.233*	514.322*
	(450.792)	(440.923)	(355.409)	(0.177)			(274.521)	(291.193)
LAND TENURE	469.118*	569.682**	589.087***	0.177*	-8663.312	2960.953*	350.103***	360.581**
	(264.529)	(257.990)	(211.915)	(0.096)	(7696.3)	(1642.55)	(133.111)	(143.537)
HUM-ELEPH CONFLICT	-43.790	-61.491	48.305	-0.013	-1394.463	905.122**	-131.466	0.664
	(267.087)	(257.591)	(202.818)	(0.098)	(1231.3)	(452.839)	(138.767)	(139.280)
DISTANCE*DENSITY	2.152	0.942	-0.763	-0.001	7.398**	0.315	-0.342	-0.588
	(2.509)	(2.421)	(1.911)	(0.001)	(2.890)	(2.409)	(1.153)	(1.279)
INTERCEPT	334.306	391.343	336.557	0.298	-1956.741	2553.671***	1132.088***	1054.191***
	(561.368)	(535.129)	(393.581)	(0.196)	(1203.5)	(582.020)	(286.764)	(301.033)
/lnsigma	-	-	-	-	-	-	7.518***	7.580***
							(0.133)	(0.131)
SIGMA								
_CONS	3017.586	2814.215	2582.161	-	-	-	1841.317	1959.043
	(198.43)	(183.290)	(314.105)				(244.970)	(257.955)
Number of obs	1035	936	936	936			936	936
Left-censured	-	-	358	-			27	104
Uncensored	-	-	578	-			739	662
Right-censored	-	-	0	-			0	0
Interval Data	-	-	-	-			170	170
Wald chi2(13)	73.92	81.09		55.39			89.12	84.67
F(13, 923)	-	-	6.2	-			-	-
Prob >chi2	0.000	0.000	0.000	0.000			0.000	0.000
Pseudo R2	-	-	0.0092	-			-	-
Log likelihood	-1070.67	-1012.31	-5624.67	-5535.857			-7008.259	-6439.55
Unconditional WTP	368.84	742.92	1326.873				1245.66	1138.17
Conditional WTP			2081.839					

Legend: * p<0.1; ** P<0.05; *** P<0.01

Drivers of participation and decisions' intensity

The α coefficients of the First Hurdle in the fourth column of *Table 5* state that the likelihood to participate to the elephant conservation's program is negatively influenced by the age and positively influenced by the education level, the indigenousness status, some specific activities such as traditional gold mining, having a job in a forest management unit, in forest administration or other administration and the land tenure of the household heads.

Some of the covariates have conflicting effect on both decision to participate (First Hurdle) and intensity od participation decision (Second Hurdle). This also motivate the choice of the double parametrization technic under the DHM. Indeed, as a household head becomes one year older, he is less likely to participate to the elephant conservation's program; yet, the variable age does not influence the intensity of participation.

The higher the education level of the household head, the higher the probability to participate as well as the intensity of participation to EFE's conservation. The positive influence of education suggests some positive feedback of education on environmental awareness.
The effect of working in a forest management unit or a forest conservation NGO is positive which basically means some sort of virtuous circle of environmental preservation: increasing the importance of forest protection also increases the awareness of households for biodiversity protection.

Impact of change in covariate Drivers of participation and decisions' intensity

The impact of change in covariate on the decision to participate is measured using the marginal effect of covariate in the First Hurdle, see the first column of *Table 6*. While, the conditional and the unconditional average partial effect on the intensity of participation are derivred from the Second Hurdle, see the second and the third columns respectively of *Table 6*.

Table 6: Partial Effects

Predictors	Partial Effect on prob(participation)	Conditional Average Partial Effect on E(WTP)	Unconditional Average Partial Effect on E(WTP)
AGE	-0.003	4.648	-3.036
EDUCATION LEVEL	0.107	635.031	615.652
MONTHLY EXP.	2.29E-07	-0.001	0.0004
INDIGENOUSNESS	0.151	807.42	813.368
SMALL FARMER	0.046		-1431.913
TRAD GOLD MINER	0.239		-260.821
HUNTHER GATHERER	0.071		0.491
FMU OR FOREST AD	0.348		93.277
OTHER ADMIN	0.152		487.291
LAND TENURE	0.064	-2495.752	143.959
HUM-ELEPH CONFLICT	-0.005	-401.721	709.561
DISTANCE*DENSITY	-4.14E-04	2.131	308.764
UNCONDITIONAL WTP		1326.873	
CONDITIONAL WTP		2081.839	
Inverse Mills Ratio		1.344296	

Indeed, one unit increase in the age of the household head will generate an approximately decrease of 0.3 percentage point of the probability to participate in the program. Observing the unconditional average partial effect in the third column simultaneously with the first two columns of *Table 6*, it appears that the overall effect of being one year older is a decrease by CFA 3.04 as the negative effect on participating is dominating the positive conditional average partial effect.
When a household head succeeds to reach secondary school, the probability of participation increases by 10.7 percentage points. This would leed to an average partial increase of the expected payment for EFE's conservation by CFA 635 given that the household heads participates. The unconditional expected contribution for EFE's conservation increases by CFA 615.6 compared to a household head who has not been in the secondary school.
The likelihood to participate to such a program would increase respectively by 15.1; 23.9; 34.8 and 15.2 percentage points if the household head is a Baka pygmy, a traditional gold miner, forest administration and other administration worker, respectively.
Conditional on the agreement to participate, an additional indigenous household head would pay additional CFA 807.4. Unconditional on the agreement to participate, when the household head is an indigenous Baka the WTP increases by CFA 813.4 compared to the rest of the population. Finally, the household heads would pay additional CFA 2.13 to have an additional elephant per hectare in the protected areas that are far from their crops.
When the household head has been in the secondary school, the unconditional expected contribution for EFE's conservation increases by CFA 615.6 compared to a household head who has not been in the secondary school. Unconditional on the agreement to participate, when the household head is an indigenous Baka the WTP increases by CFA 813.4 compared to the rest of the population.

5. Discussion and conclusion

The above estimates provide four major outcomes with respect to the hypothesis stated above. The extinction of Loxodonta cyclotis can lead to a significant net loss in the household's welfare. In point of fact, the predicted monthly WTP by

household head is CFA 1138.17 (€1.74). This value is close to the results found by Bandara and Tisdell (2005). Indeed, they found that the respondents in general were willing to pay Rs. 110.17 (€1.65) per month for elephant conservation. The corresponding net present value over 10 years is CFA 8.67billion (€13.2 million). The underlying assumption of this result is that, the 10 years hypothetical elephant conservation's program is effective in terms of reducing poaching as well as preventing Human-Elephant Conflict, and thus, offsetting the damage faced by local people. In case the policy does not succeed to prevent Human-Elephant Conflict, the local people demand for elephant conservation remains non-negligible. Indeed, considering the CFA 28140 (€43) annual mean damage incurred by the 27.7% of the sampled households, the net benefit for the overall population in both the Tridom segments is CFA 3.73 billion (€5.68 millions). In other words, the present benefits of the ten years' hypothetical scenario will be greater than the present value of crop damage by elephants. This result suggests that, conditional on the implementation of the hypothetical scenario, EFE's conservation is socially beneficial. It may also indicates the possible tolerance by the farmers of the presence of elephants in their agricultural fields.

Two outstanding results are that, the variable resulting from crossing distance and the protected area's elephant density as well as the monthly expense does not influence the households' decision to participation, while they significantly and positively drive the intensity of participation. The positive sign of the first tells-us that, local communities prefer elephant but far from their crops. Referring to the second hypothesis, considering distance as an indicator of scarcity holds compare to the distance decay assumption. The Tridom Regional Management Unit should promote elephant mobility corridors and these corridors should be raised far from local and indigenous people area of interest in forest.

Furthermore, unlike the third hypothesis, the estimates show that the existence of Human-Elephant Conflict doesn't influence neither the households' decision to participate nor the intensity of their preferences. Beside, households with more access to land are more likely to contribute to the conservation's program. Theoretically, households with more access to land would be more likely to face Human-Elephant Conflict and thus, they would be less likely to contribute to such a program. The relevance of these results is that, local and indigenous people feel their concerns in terms of offsetting Human-Elephant Conflict adequately addressed by the hypothetical scenario. This result makes the implementation of the proposed hypothetical scenario very important as it simultaneously (1) insures the preservation of a public good (endangered forest elephant) as well as the relative ecosystem services and (2) improves private benefits by preventing Human-Elephant Conflict. Therefore, our study suggests that local communities can be willing to engage in biodiversity preservation, when the public benefit from conservation comes along with private benefits related to the avoidance of Human-Elephant Conflict.

As expected in the fourth hypothesis, the indigenousness (Baka pigmies) has a positive and significant influence on the household's preferences. Baka pigmies are likely to pay greater amounts. This information is important as it extinction would lead to a severe threat on spiritual enrichment, cultural identity as well as the way of life of the Baka Pygmies minority ethnic group. This result has the effect of highlighting the concerns about the forthcoming negative impact of the loss of biodiversity on social wellbeing and consequently, increasing the incentives for elephant conservation.

Finally, the analysis of the unconditional as well as the conditional partial effects on the expected preferences of local and indigenous household heads stated a positive feedback of better education. The various governments in the Tridom landscape should create favourable conditions to improve education at local scale and encourage inhabitant to reach at least secondary school.

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7. References

Alberini, A., 1995. Efficiency vs bias of willingness-to-pay estimates: bivariate and interval-data models. Journal of environmental economics and management 29 (2), 169–180.
URL ac.els-cdn.com/S009506968571039X/1-s2.0-S009506968571039X-main.pdf?_tid=ca4eb382-3eb8-11e5-b2ca-00000aab0f01&acdnat=1439140089_5d26b2acd9a5ba69ab20f7619f363fd2

Amemiya, T., 1984. Tobit models: A survey. Journal of econometrics 24 (1), 3–61.
URL http://ac.els-cdn.com/0304407684900745/1-s2.0-0304407684900745-main.pdf?_tid=ed025dfc-3eb8-11e5-a616-00000aacb362&acdnat=1439140147_a6e051d28f7e9d664b419c96ad526bf2

Arrow, K., Solow, R., et al., 1993. Report of the noaa panel on contingent valuation.
URL http://www.darrp.noaa.gov/economics/pdf/cvblue.pdf

Bandara, R., Tisdell, C., 2001. Conserving asian elephants: economic issues illustrated by sri lankan concerns. Tech. rep.
URL http://espace.library.uq.edu.au/view/UQ:215166/WP59.pdf

Bandara, R., Tisdell, C., 2003a. Comparison of rural and urban attitudes to the conservation of asian elephants in sri lanka: empirical evidence. Biological Conservation 110 (3), 327–342.
URL http://ac.els-cdn.com/S0006320702002410/1-s2.0-S0006320702002410-main.pdf?_tid=4a620614-3eb9-11e5-8284-00000aab0f01&acdnat=1439140304_cd46b12d63ae8d8c7956c86a5c879346

Bandara, R., Tisdell, C., 2004. The net benefit of saving the asian elephant: a policy and contingent valuation study. Ecological Economics 48 (1), 93–107.
URL http://ac.els-cdn.com/S0921800903002635/1-s2.0-S0921800903002635-main.pdf?_tid=3312fcf2-3eb9-11e5-a5f7-00000aab0f6b&acdnat=1439140265_79b291ddf321a53e02845022e5d6d39f

Bandara, R., Tisdell, C., 2005. Changing abundance of elephants and willingness to pay for their conservation. Journal of Environmental Management 76 (1), 47–59.
URL http://ac.els-cdn.com/S0301479705000526/1-s2.0-S0301479705000526-main.pdf?_tid=1de7e9dc-3eb9-11e5-bf44-00000aacb362&acdnat=1439140229_f5a60a39a2f22aa610eec4b1760537dc

Bandara, R., Tisdell, C. A., 2003b. Use and non-use values of wild asian elephants: A total economic valuation approach. Sri Lanka Journal of Economics (4), 3–30.
URL http://ageconsearch.umn.edu/bitstream/48961/2/WP80.pdf

Barbier, E. B., Burgess, J. C., Swanson, T. M., Pearce, D. W., 2013. Elephants, economics and ivory. Vol. 3. Routledge.

Barrena, J., Nahuelhual, L., Báez, A., Schiappacasse, I., Cerda, C., 2014. Valuing cultural ecosystem services: Agricultural heritage in chiloé island, southern chile. Ecosystem Services 7, 66–75.
URL http://ac.els-cdn.com/S2212041613001022/1-s2.0-S2212041613001022-main.pdf?_tid=be2f683e-3eb9-11e5-8eae-00000aacb360&acdnat=1439140498_810c93cc98ee44c09873d0410e6b99b8

Bateman, I. J., Burgess, D., Hutchinson, W. G., Matthews, D. I., 2008. Learning design contingent valuation (ldcv): Noaa guidelines, preference learning and coherent arbitrariness. Journal of environmental economics and management 55 (2), 127–141.
URL http://ac.els-cdn.com/S009506960700109X/1-s2.0-S009506960700109X-main.pdf?_tid=cebcde0c-3eb9-11e5-925c-00000aab0f26&acdnat=1439140526_cbf712021a6c3d21eb9110bb3ab9db5d

Bateman, I. J., Day, B. H., Georgiou, S., Lake, I., 2006. The aggregation of environmental benefit values: welfare measures, distance decay and total wtp. Ecological Economics 60 (2), 450–460.
URL http://ac.els-cdn.com/S092180090600187X/1-s2.0-S092180090600187X-main.pdf?_tid=f739cc14-3eb9-11e5-bf44-00000aacb362&acdnat=1439140594_15b3669950571385a12d327a92b06561

Bateman, I. J., Mace, G. M., Fezzi, C., Atkinson, G., Turner, K., 2011. Economic analysis for ecosystem service assessments. Environmental and Resource Economics 48 (2), 177–218.
URL http://download.springer.com/static/pdf/1/art%253A10.1007%252Fs10640-010-9418-x.pdf?originUrl=http%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%2Fs10640-010-9418-x&token2=exp=1439141730~acl=%2Fstatic%2Fpdf%2F1%2Fart%25253A10.1007%25252Fs10640-010-9418-x.pdf%3ForiginUrl%3Dhttp%253A%252F%252Flink.springer.com%252Farticle%252F10.1007%252Fs10640-010-9418-x*~hmac=2d9ee1d3cb67385564955af5c2bab8f730f673b8faf9565276e7a9381b2af6e1

Beaune, D., Bretagnolle, F., Bollache, L., Hohmann, G., Surbeck, M., Fruth, B., 2013. Seed dispersal strategies and the threat of defaunation in a congo forest. Biodiversity and conservation 22 (1), 225–238.
URL http://www.eva.mpg.de/fileadmin/content_files/primatology/bonobo/pdf/Beaune_et_al_in_press.pdf

Bishop, R. C., 1978. Endangered species and uncertainty: the economics of a safe minimum standard. American journal of agricultural economics 60 (1), 10–18.
URL http://www.jstor.org/stable/pdf/1240156.pdf

Bishop, R. C., Heberlein, T. A., 1979. Measuring values of extramarket goods: Are indirect measures biased? American journal of agricultural economics, 926–930.
URL http://www.jstor.org/stable/pdf/3180348.pdf

Blake, S., Deem, S. L., Mossimbo, E., Maisels, F., Walsh, P., 2009. Forest elephants: tree planters of the congo. Biotropica 41 (4), 459–468.
URL http://hdl.handle.net/1893/19674

Blake, S., Strindberg, S., Boudjan, P., Makombo, C., Bila-Isia, I., Ilambu, O., Grossmann, F., Bene-Bene, L., de Semboli, B., Mbenzo, V., S'hwa, D., Bayogo, R., Williamson, L., Fay, M., Hart, J., Maisels, F., 04 2007. Forest elephant crisis in the congo basin. PLoS Biol 5 (4), e111.
URL http://dx.doi.org/10.1371%2Fjournal.pbio.0050111

Boyle, K. J., Bishop, R. C., 1988. Welfare measurements using contingent valuation: a comparison of techniques. American Journal of Agricultural Economics 70 (1), 20–28.
URL http://www.jstor.org/stable/pdf/1241972.pdf

Brahic, É., Terreaux, J.-P., 2009. Évaluation économique de la biodiversité: méthodes et exemples pour les forêts tempérées. Éd. Quae.

Brooks, C., 2014. Introductory econometrics for finance. Cambridge university press.

Brouwer, R., Martin-Ortega, J., 2012. Modeling self-censoring of polluter pays protest votes in stated preference research to support resource damage estimations in environmental liability. Resource and Energy Economics 34 (1), 151–166.
URL http://www.sciencedirect.com/science/article/pii/S092876551100039X/pdfft?md5=be1ad4cba36b20a90670b683d01b198b&pid=1-s2.0-S092876551100039X-main.pdf

Brouwer, R., Spaninks, F. A., 1999. The validity of environmental benefits transfer: further empirical testing. Environmental and resource economics 14 (1), 95–117.
URL http://www.ucl.ac.uk/cserge/Brouwer%20and%20Spaninks%201999.pdf

Brown, T. C., Champ, P. A., Bishop, R. C., McCollum, D. W., 1996. Which response format reveals the truth about donations to a public good? Land Economics, 152–166.
URL http://www.jstor.org/stable/pdf/3146963.pdf

Bucrep, 2010. Rapports de présentation des résultats définitifs du 3e recensement général de la population et de l'habitat. Tech. rep., Cameroonian Central Bureau of Census and Population Studies.

Bulte, E., Kooten, G. C., 2002. Downward sloping demand for environmental amenities and international compensation: elephant conservation and strategic culling. Agricultural Economics 27 (1), 15–22.
URL http://ageconsearch.umn.edu/bitstream/177544/2/agec2002v027i001a003.pdf

Burke, W. J., 2009. Fitting and interpreting cragg's tobit alternative using stata. Stata Journal 9 (4), 584.
URL http://ageconsearch.umn.edu/bitstream/143014/2/sjart_st0179.pdf

Cameron, A. C., Trivedi, P. K., 2005. Microeconometrics: methods and applications. Cambridge university press.
URL http://www.centroportici.unina.it/centro/Cameron&Trivedi.pdf

Cameron, T. A., 1988. A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by censored logistic regression. Journal of environmental economics and management 15 (3), 355–379.
URL http://ac.els-cdn.com/0095069688900083/1-s2.0-0095069688900083-main.pdf?_tid=14ebffde-3f7d-11e5-bf81-00000aab0f6b&acdnat=1439224396_83d36387e3c532309559d10a0dfe61f3

Cameron, T. A., James, M. D., 1987. Efficient estimation methods for" closed-ended" contingent valuation surveys. The review of economics and statistics, 269–276.
URL http://www.jstor.org/stable/pdf/1927234.pdf

Carson, R. T., 1985. Three essays on contingent valuation. University of California, Berkeley.

Carson, R. T., Hamenann, M., 2005. Contingent valuation. In: Maler, K.-G., Vincent, J. R. (Eds.), valuing environment changes. Handbook of environmental Economics. Elsevier, Ch. 17, p. 822 to 936.
URL https://msuweb.montclair.edu/~lebelp/richardcarsoncontingentvaluationhandbook.pdf

Cragg, J. G., 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrica: Journal of the Econometric Society, 829–844.
URL http://www.jstor.org/stable/pdf/1909582.pdf

Fischhoff, B., Furby, L., 1988. Measuring values: a conceptual framework for interpreting transactions with special reference to contingent valuation of visibility. Journal of risk and uncertainty 1 (2), 147–184.
URL https://www.cmu.edu/dietrich/sds/docs/fischhoff/MeasuringValuesCFInterpret.pdf

Frew, E., 2010a. Benefit assessment for cba studies in healthcare: A guide to carrying out a stated preference willingness to pay survey in healthcare. In: McIntosh, E., P. Clarke, E. F., Louviere, J. (Eds.), Applied Methods of Cost-Benefit Analysis in Health Care. Handbooks in Health Economic Evaluation. Oxford University Press, Ch. 7, pp. 119–138.

Frew, E., 2010b. Benefit assessment for cba studies in healthcare using cv methods. In: McIntosh, E., P. Clarke, E. F., Louviere, J. (Eds.), Applied Methods of Cost-Benefit Analysis in Health Care. Handbooks in Health Economic Evaluation. Oxford University Press, Ch. 6, pp. 97–118.

Gabon, 2010. Population census report. Tech. rep., Gabon.

Garrod, G., Willis, K. G., 1999. Economic valuation of the environment: methods and case studies. Edward Elgar Cheltenham.

Haab, T. C., McConnell, K. E., 2002. Valuing environmental and natural resources: the econometrics of non-market valuation. Edward Elgar Publishing.

Halstead, J. M., Luloff, A., Stevens, T. H., et al., 1992. Protest bidders in contingent valuation. Northeastern journal of agriculture and resource economics.
URL http://ageconsearch.umn.edu/bitstream/29000/1/21020160.pdf

Hanemann, M., Loomis, J., Kanninen, B., 1991. Statistical efficiency of double-bounded dichotomous choice contingent valuation. American journal of agricultural economics 73 (4), 1255–1263.
URL http://www.jstor.org/stable/pdf/1242453.pdf

Hanemann, W. M., Kanninen, B., 1999. The statistical analysis of discrete-response cv data. Valuing Environmental Preferences. Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries, 302–441.

Hanemann, W. M. e. a., 1985. Some issues in continuous and discrete response contingent valuation studies. Northeastern Journal of Agricultural Economics 14 (1), 5–13.
URL http://ageconsearch.umn.edu/bitstream/28928/1/14010005.pdf

Heckman, J. J., 1979. Sample selection bias as a specification error. Econometrica 47 (1), 153–162.
URL http://faculty.smu.edu/millimet/classes/eco7321/papers/heckman02.pdf

Herriges, J. A., Shogren, J. F., 1996. Starting point bias in dichotomous choice valuation with follow-up questioning. Journal of environmental economics and management 30 (1), 112–131.
URL http://ac.els-cdn.com/S009506969690008X/1-s2.0-S009506969690008X-main.pdf?_tid=d6fa81f0-3f81-11e5-b129-00000aacb35e&acdnat=1439226439_c56564049c11c00e4709efe2e99b2bd1

Jorgensen, B. S., Syme, G. J., 2000. Protest responses and willingness to pay: attitude toward paying for stormwater pollution abatement. Ecological economics 33 (2), 251–265.
URL http://ac.els-cdn.com/S0921800999001457/1-s2.0-S0921800999001457-main.pdf?_tid=56d321e6-414b-11e5-9c87-00000aab0f6c&acdnat=1439422934_06db98673b03c6714367474bceccdb8e

Katchova, A. L., Miranda, M. J., 2004. Two-step econometric estimation of farm characteristics affecting marketing contract decisions. American Journal of Agricultural Economics 86 (1), 88–102.
URL http://www.jstor.org/stable/pdf/3697876.pdf

Kealy, M. J., Turner, R. W., 1993. A test of the equality of closed-ended and open-ended contingent valuations. American Journal of Agricultural Economics 75 (2), 321–331.
URL http://www.jstor.org/stable/pdf/1242916.pdf

Kent, S., 1996. Cultural diversity among twentieth-century foragers: An African perspective. Cambridge university press.

Kremer, M., Morcom, C., 2000. Elephants. American Economic Review, 212–234.
URL https://msuweb.montclair.edu/~lebelp/PSC643IntPolEcon/KremerElephantsAER2000.pdf

Lewis, J., 2002. Forest hunter-gatherers and their world: a study of the mbendjele yaka pygmies of congo-brazzaville and their secular and religious activities and representations. Ph.D. thesis, University of London.
URL http://discovery.ucl.ac.uk/18991/1/18991.pdf

Loomis, J., Kent, P., Strange, L., Fausch, K., Covich, A., 2000. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent valuation survey. Ecological economics 33 (1), 103–117.
URL http://ac.els-cdn.com/S0921800999001317/1-s2.0-S0921800999001317-main.pdf?_tid=da6dd912-3f82-11e5-81c3-00000aab0f27&acdnat=1439226874_8018a9a591509ccaa9aff0affe434808

Loomis, J. B., Larson, D. M., 1994. Total economic values of increasing gray whale populations: results from a contingent valuation survey of visitors and households. Marine Resource Economics, 275–286.
URL http://www.jstor.org/stable/pdf/42629085.pdf

Lopez-Feldman, A., 2012. Introduction to contingent valuation using stata. MPRA Paper (No. 41018 (2012)).
URL http://mpra.ub.uni-muenchen.de/41018/2/MPRA_paper_41018.pdf

Mahieu, P.-A., Riera, P., Giergiczny, M., 2012a. Determinants of willingness-to-pay for water pollution abatement: a point and interval data payment card application. Journal of environmental management 108, 49–53.
URL http://ac.els-cdn.com/S0301479712002332/1-s2.0-S0301479712002332-main.pdf?_tid=21b408b8-3f84-11e5-947a-00000aacb35f&acdnat=1439227424_9fe5d0b4ea47c655f46c4dcfda6a5e56

Mahieu, P.-A., Riera, P., Giergiczny, M., 2012b. The influence of cheap talk on willingness-to-pay ranges: some empirical evidence from a contingent valuation study. Journal of environmental planning and management 55 (6), 753–763.

Maisels, F., Strindberg, S., Blake, S., Wittemyer, G., Hart, J., Williamson, E. A., Abaa, R., Abitsi, G., Ambahe, R. D., Amsini, F., et al., 2013. Devastating decline of forest elephants in central africa. PLoS One 8 (3), e59469.
URL http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0059469&representation=PDF

Manski, C. F., 1977. The structure of random utility models. Theory and decision 8 (3), 229–254.

Martin, E. B., Stiles, D., 2000. The ivory markets of Africa. Save the Elephants Nairobi.
URL http://savetheelephants.org/wp-content/uploads/2014/03/2005MarketsofEurope.pdf

Martínez-Espiñeira, R., 2006. A box-cox double-hurdle model of wildlife valuation: The citizen's perspective. Ecological Economics 58 (1), 192–208.
URL http://ac.els-cdn.com/S092180090500306X/1-s2.0-S092180090500306X-main.pdf?_tid=e6377bf2-3f84-11e5-b5dc-00000aacb35e&acdnat=1439227753_d62e9b7eaa208222e6f769a075786e82

McFadden, D., 1973. Conditional logit analysis of qualitative choice behavior.
URL http://eml.berkeley.edu/reprints/mcfadden/zarembka.pdf

MEA, 2005. Ecosystems and human well-being. Vol. 5. Island Press Washington, DC.

Mitchell, R. C., Carson, R. T., 1993. Current issues in the design, administration, and analysis of contingent valuation surveys. University of California at San Diego, Economics Working Paper Series.
URL http://econweb.ucsd.edu/~rcarson/papers/CVDesign.pdf

Moffatt, P. G., 2005. Hurdle models of loan default. Journal of the operational research society 56 (9), 1063–1071.
URL http://www.jstor.org/stable/pdf/4102199.pdf

Schaafsma, M., Brouwer, R., Gilbert, A., van den Bergh, J., Wagtendonk, A., 2013. Estimation of distance-decay functions to account for substitution and spatial heterogeneity in stated preference research. Land economics 89 (3), 514–537.
URL http://le.uwpress.org/content/89/3/514.full.pdf

Smith, H. F., Sullivan, C. A., 2014. Ecosystem services within agricultural landscapes farmers' perceptions. Ecological Economics 98, 72–80.
URL http://ac.els-cdn.com/S0921800913003637/1-s2.0-S0921800913003637-main.pdf?_tid=9e30e918-3f86-11e5-b5dd-00000aacb35e&acdnat=1439228493_bc6de06eca75ca517abc6723846d501b

Solomon, T., A. T., Bekele, A., 2014. Adoption of improved wheat varieties in robe and digelutijo districts of arsi zone in oromia region, ethiopia: A double-hurdle approach. African Journal of Agricultural Research 9 (51), 3692–3703.
URL http://www.academicjournals.org/article/article1418646360_Solomon%20et%20al.pdf

Stewart, M. B., 1983. On least squares estimation when the dependent variable is grouped. The Review of Economic Studies 50 (4), 737–753.
URL http://darp.lse.ac.uk/PapersDB/Stewart_(REStud_83).pdf

Strazzera, E., Genius, M., Scarpa, R., Hutchinson, G., 2003. The effect of protest votes on the estimates of wtp for use values of recreational sites. Environmental and resource economics 25 (4), 461–476.

Tisdell, C., 1990. Economics and the debate about preservation of species, crop varieties and genetic diversity. Ecological Economics 2 (1), 77–90.
URL http://ac.els-cdn.com/092180099090014L/1-s2.0-092180099090014L-main.pdf?_tid=a80bae2c-3f87-11e5-b23e-00000aacb361&acdnat=1439228938_071ccb4804d7132a51d935ae618923ac

Tisdell, C., et al., 2002. The economics of conserving wildlife and natural areas. Edward Elgar Publishing Ltd.

Tobin, J., 1958. Estimation of relationships for limited dependent variables. Econometrica: journal of the Econometric Society, 24–36.
URL http://www.sonoma.edu/users/c/cuellar/econ411/Tobin.pdf

Van Kooten, G. C., 2005. Elephant economics in the rough: Modelling ivory trade.
URL http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.379.207&rep=rep1&type=pdf

Vredin, M., 1997. The African elephant: Existence value and determinants of willingness to pay. Umeaa Univ.

Wang, B. C., 2008. Impacts of Hunting on Seed Dispersal in a Central African Tropical Forest. ProQuest.

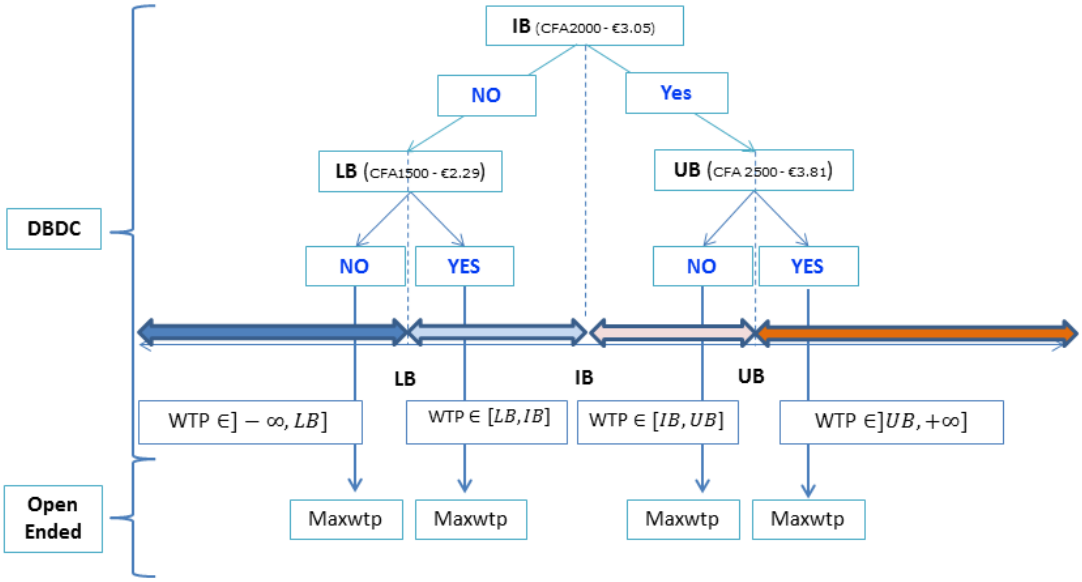
Wooldridge, J., 2012. Introductory econometrics: A modern approach. Cengage Learning.
URL http://down.cenet.org.cn/upfile/28/2014840494167.pdf

Wooldridge, J. M., 2010. Econometric analysis of cross section and panel data. MIT press.

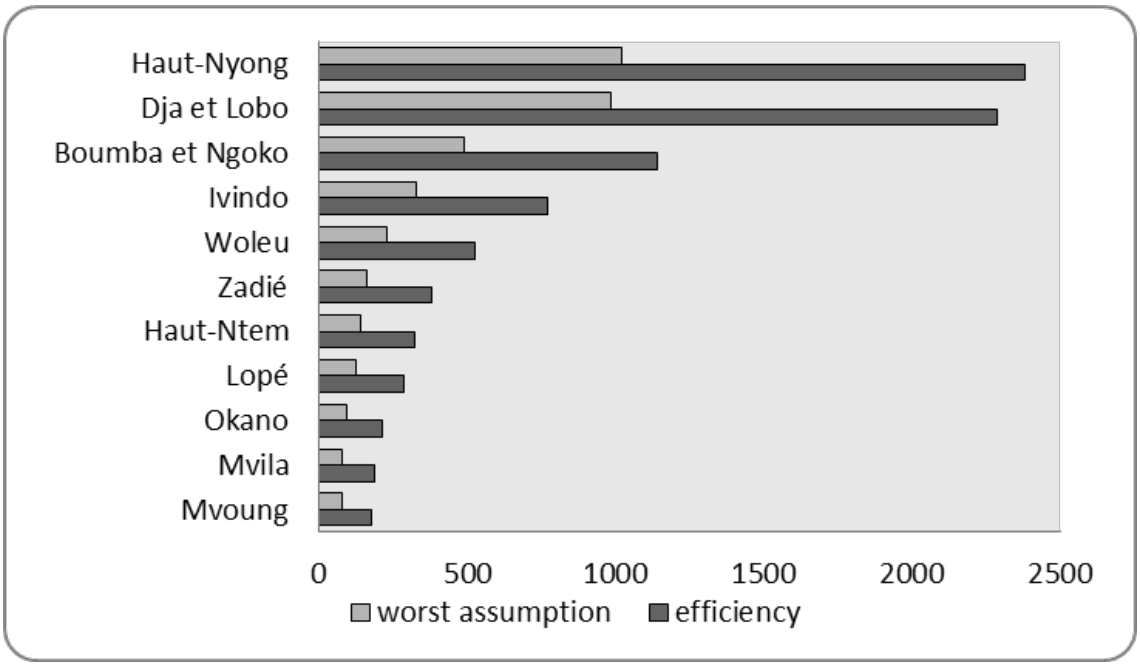
Zeiler, K., Plott, C. R., 2004. The willingness to pay/willingness to accept gap, the endowment effect, subject misconceptions and experimental procedures for eliciting valuations. American Economic Review.
URL http://www.jstor.org/stable/pdf/4132728.pdf

AppendixA. Figures

AppendixA.1. Bids tructure



*AppendixA.2. Aggregate WTP of Tridom local population for elephant conservation (10^6 * CFA)*



AppendixB. Tables

AppendixB.1. Ethnic Representivity

	Freq.	Percent	Cum.
Baka	47	5.02	5.02
Fang-Beti-Bulu	369	39.42	44.44
Bangando	34	3.63	48.08
Kota et Bakota	64	6.84	54.91
Mahongwe	40	4.27	59.19
Kounabembe	20	2.14	61.32
Mvong Mvong et Mpumpong	22	2.35	63.68
Djem	65	6.94	70.62
Badjoue	66	7.05	77.67
Migration, Yambassa, Bamoun...	59	6.30	83.97
Nzime	61	6.52	90.49
20 other etchnics	89	9.51	100.0
Total	936	100.00	

AppendixB.2. Spatial Representivity

	Divisions	Subdivision	Freq.	Percent	Cum.
CAMEROONIAN SEGMENT					
South	DJA ET LOBO	Sangmelima	47	5,02	5,02
		Meyomessala	53	5,66	10,68
		Bengbis	22	2,35	13,03
		Meyomessi	27	2,88	15,91
		Djoum	48	5,13	21,04
		Oveng	33	3,53	24,57
		Mintom	17	1,82	26,39
	MVILLA	Mvangan	20	2,14	28,53
Est	HAUT NYONG	Ngoyla	58	6,2	34,73
		Lomie	52	5,56	40,29
		Messamena	32	3,42	43,71
		Somalomo	43	4,59	48,3
		Dja	32	3,42	51,72
		Messock	43	4,59	56,31
	BOUMBA ET NGOKO	Mouloundou	46	4,91	61,22
		Yokadouma	50	5,34	66,56
		Salapoumbe	25	2,67	69,23
GABONNESE SEGMENT					
Ogooue Ivondo	IVINDO	Makokou	29	3,1	72,33
		Batouala	20	2,14	74,47
		Mvadhi	14	1,5	75,97
		Makebe Bakouaka	20	2,14	78,11
	LA ZADIE	Mekambo	42	4,49	82,6
	LA LOPE	Booue	30	3,21	85,81
	LA MVOUNG	Ovan	19	2,03	87,84
Woleu Ntem	HAUT-NTEM	Minvoul	35	3,74	91,58
	WOLEU	Oyem	56	5,98	97,56
	OKANO	Mitzic	23	2,46	100
	Total		936	100	