Understanding the nexus between forest dependence and willingness to pay for forest conservation: case of forest dependent households in Kenya

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Abstract

Purpose – Forests support human livelihoods and mitigate against climate change, yet they are at a risk of irreversible loss due to high degradation rates. The success of forest conservation mechanisms depends on involvement and support by forest dependent communities. In this paper, the authors assess forest dependent household's willingness to pay (WTP) labour or cash for a conservation programme seeking to restore degraded forestland in Mount Elgon Forest, Kenya.

Design/methodology/approach – Data were collected from 919 households in Mt Elgon forest reserve, Kenya. A double bounded contingent valuation approach was used to examine households' WTP and an ordered probit model to estimate the determinants of WTP.

Findings – The findings of the study show a higher WTP for conservation through labour days (12 days/month, equivalent to 1800 KES/month) compared to cash (KES 450/month). Forest dependence has a significant influence on households' willingness to support conservation activities. A higher WTP was observed amongst households with higher vulnerability (high shocks value, low asset value and those in the poorest wealth categories) implying that they are more willing to contribute for forest conservation.

Originality/value – While emerging literature on WTP for forest conservation is growing, few studies have paid attention on the influence of forest dependence on WTP for forest conservation. There are limited studies on use of in-kind contribution as a payment vehicle for WTP. The study's findings show a high WTP in form of labour suggesting the importance of embracing in-kind contribution as a mechanism of supporting forest conservation in contexts of developing countries.

Keywords Contingent valuation, Ecosystem restoration, Willingness to pay, Forest dependence

Paper type Research paper

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1. Introduction

Globally, forest ecosystems provide a wide range of services that offer social, economic and ecological benefits (FAO and UNEP, 2020). Despite their value, these ecosystems are facing a risk of irreversible loss due to high rates of degradation (FAO, 2015, 2018). While forest degradation is a global problem, the rate of loss is particularly high in sub-Saharan Africa (SSA) where forest cover declined by 5% between 1990 and 2015, compared to a 1% global decline (FAO, 2018). The level of forest degradation in Kenya, during the same period was even higher (estimated at 6.6%) (FAO, 2018).

In order to reverse the rising trend in forest degradation, different forms of participatory forest management (PFM) approaches are being promoted. PFM approaches work by allowing forest authorities to incorporate local governments and communities in forest management decision making (FAO and PROFOR, 2011). The idea is that greater involvement of communities can improve local decision-making and enhance equitable utilisation, conservation and livelihood outcomes (Okumu and Muchapondwa, 2020). However, despite evidence that PFM approaches confer rights and incentives for local communities to manage and benefit from public forests, participation in many PFM schemes in developing countries is low (Mbeche *et al.*, 2021).

Consequently, incentive-based mechanisms that pay local communities either in-kind or in-cash to participate in conservation of degraded ecosystems are being promoted (FAO, 2014; Pagiola *et al.*, 2016; Shapiro-Garza *et al.*, 2020). However, many of the incentive-based conservation programs are heavily reliant on donor support (Bakaki and Bernauer, 2016) which raises questions on their sustainability in the face of reduced donor funding (Huwyler *et al.*, 2014). To address this challenge, some countries are promoting voluntary contributions for conservation by communities surrounding the forest ecosystems, not only as a way of showing commitment, but also ensuring sustainability of these interventions (Bakaki and Bernauer, 2016; Gordillo *et al.*, 2019). Such arrangements have been implemented in conservation of various natural ecosystems such as watersheds, wetlands and forests (Escobar *et al.*, 2013). However, the ultimate success of these efforts (voluntary contributions for conservation) lies on local communities' willingness to pay (WTP) for conservation (Aseres and Sira, 2020; Bakaki and Bernauer, 2016).

In Kenya, the country's principal forest legislation, the Forest Conservation and Management Act (2016) and its predecessor, the Forest Act (2005) entrench community participation in forest conservation through Community Forest Associations (CFAs). CFA, a registered community organisation made up of people residing adjacent to a forest, is accorded a legal responsibility for co-management after signing a management agreement with Kenya Forest Service (KFS), the agency in charge of protected forests (Kairu *et al.*, 2018). Upon signing the agreement, these communities enjoy forest user rights (including but not limited to fuel wood collection, extraction of non-timber forest products such as honey and herbal medicine and grazing), which are hypothesised to motivate them to continue conserving the resources they depend on (Mbeche *et al.*, 2021). The Forest Legislation also confers a number of benefit-sharing arrangements (such as monetary or in-kind payments) to incentivise CFA members to participate in forest conservation (Waruingi *et al.*, 2021). Thus, the forestry legal framework in Kenya provides for opportunities for communities to make certain voluntary contributions (not limited to time, to establish forest plantations, silvicultural practices and forest patrols or cash to facilitate the management activities) for improved forest conditions.

While there is growing literature on people's WTP for natural resource conservation in the developing world, majority of the documented studies focus on Latin America (Pagiola *et al.*, 2005, 2016; Gelcich *et al.*, 2013; Dardanoni and Guerriero, 2021; Escobar *et al.*, 2013; Bakaki and Bernauer, 2016; Gordillo *et al.*, 2019) and Asia (Kong *et al.*, 2014; Solikin, 2017; Lamsal *et al.*, 2015; Pham *et al.*, 2018; Casiwan-Launio *et al.*, 2011; Pham *et al.*, 2018). In SSA, there is also an emerging but growing literature on WTP for watersheds (Kagombe *et al.*, 2019;

Ndetewio *et al.*, 2013; Nyongesa *et al.*, 2016; Endalew *et al.*, 2020), wildlife reserves (Aseres and Sira, 2020; Pedroso and Kung, 2019) with a limited focus on forest ecosystems (Bamwesigye *et al.*, 2020; Tilahun *et al.*, 2011; Diafas, 2014; Okumu, 2017).

The emerging but growing literature on WTP for forest conservation show that socioeconomic and institutional variables have an important influence (Pedroso and Kung, 2019; Lamsal *et al.*, 2015; Kassahun *et al.*, 2020; Diafas, 2014; Bakaki and Berneur, 2016). However, few studies have paid attention to the influence of forest dependence on WTP for forest conservation (Gatiso, 2019; Gordillo *et al.*, 2019; Pham *et al.*, 2018). Forest dependence is defined as the activities of forest product collection and consumption that constitute a key livelihood strategy used to meet household needs (Nerfa *et al.*, 2020). Assessing the influence of forest dependence on WTP for conservation in the context of high rates of forest degradation in regions where communities are highly dependent on forests is important for informing forest-based poverty alleviation strategies. Forest dependent communities are likely to suffer considerable loss of ecosystem services, if degradation continues unabated (FAO and UNEP, 2020).

Most of the documented literature also focus on cash payments as a mechanism to estimate households WTP (Gordillo *et al.*, 2019; Pham *et al.*, 2018; Pedroso and Kung, 2019; Okumu, 2017). However, limiting the assessment of WTP to only be in form of cash for rural communities dependent on natural resources, may fail to capture households' actual valuation of environmental amenities (Ivehammar, 2009). Moreover, most of these forest dependent households have a low per capita income (below $1.25) which is often inadequate to meet their daily needs (World Bank, 2013). In light of the foregoing, non-cash payment vehicles such as labour days (Casiwan-Launio *et al.*, 2011; Endalew *et al.*, 2020; Kassahun *et al.*, 2020) and work meals (Diafas, 2014) could provide an appropriate measurement of WTP in regions where households are cash-constrained (Solikin, 2017). The evidence linking WTP with choice of payment vehicle is important for design of forest conservation programs in the context of pervasive cash constraints affecting many households in developing countries.

This study assesses the level and determinants of WTP for forest conservation amongst forest dependent households in Kenya, using Mt Elgon Forest, a key water catchment area and major rainwater repository as a case study (Russell *et al.*, 2017). Specifically, we focus on two research questions:

RQ1. How does WTP for forest conservation vary by forest dependence, mode of payment (cash or labour), household context and previous involvement in forest conservation?

RQ2. What are the determinants of WTP amongst forest dependent households?

This study makes two important contributions. First, the study contributes to empirical evidence on people's WTP for conservation in the Kenyan forestry context, an area that has received little attention to date (Diafas, 2014; Okumu, 2017). Further the study assesses how WTP varies with forest dependence and household attributes. Understanding the variations in WTP across the characteristics of forest communities is critical to inform design of community conservation programs that suit the different needs of local people. Second, the study makes a methodological contribution by going beyond WTP estimation using a cash vehicle to include labour as a payment option. Use of an in-kind payment vehicle considers that most rural households face liquidity constraints and thus, estimation using cash would mask critical non-monetary contributions from forest dependent households (Gibson *et al.*, 2016).

2. Materials and methods

2.1 Conceptual framework

The study focuses on forest dependent communities who are key users of ecosystem services from forests. Forest communities depend on forest ecosystems for social, economic and

cultural functions yet, they are likely to suffer considerable loss of ecosystem services, if degradation continues unabated (FAO and UNEP, 2020). The ecosystem services provided by forests such as water regulation and provision of non-timber products are key pathways through which a household's utility is impacted. Forest conservation is therefore important to guarantee present and future supply of forest outputs in light of the high risks associated with the on-going and potential degradation of forest ecosystems.

In this study, the analysis of households' involvement in conservation follows the household utility maximisation framework (Singh *et al.*, 1986). Under the framework, households are assumed to make decisions to maximise utility subject to a set of constraints that may include income and time resources (Singh *et al.*, 1986). The solution of the utility maximisation problem, represents the household optimal choices of livelihood options (such as forest extraction and farm and off farm activities) and demand functions for outputs and factors of production, which may include resources involved in forest conservation (time, labour and income).

The forest dependent household's utility can be framed as a function of the ecosystem services (ES) that a household is able to access, its consumption of all other goods/or services represented by income (M) and the time resource (τ) (as shown in Equation 1).

$$U = f(ES; M; \tau) \tag{1}$$

Therefore, a household will compare utility associated with engaging in conservation activities for improved forest conditions (ES = 1) and the utility associated with the business-as-usual case (no efforts towards forest conservation (ES = 0). The household will contribute cash or labour, if the maximal utility (V_C) associated with conservation (improved forest conditions) is at least higher than the utility associated with no involvement in conservation (V_{NC}) as depicted in Equation (2).

$$V_C(ES = 1; M; \tau) \geq V_{NC}(ES = 0; M; \tau) \tag{2}$$

Our underlying assumption is that households with higher forest dependence are more likely to be interested in forest conservation and would therefore, be willing to pay (in-kind or in-cash) for conservation of the ecosystem. This hypothesis is premised on the view that forest dependent households derive higher utility from forest ecosystems and continued degradation would negatively affect their livelihoods. According to Kenya's forestry policy framework, local communities can contribute to forest conservation through a number of ways including; being involved in nursery establishment, control of forest fires, border patrols and tree planting (Republic of Kenya, 2015; Yego *et al.*, 2021). In the context of limited resources, the choice to participate in these activities involves a number of synergies and trade-offs, given that there are different livelihood options that can be pursued by the household including; crop and livestock production in own farm and off-farm labour activities. Whether a household will actually participate in forest conservation or not, can ideally be uncovered by its WTP for the aforementioned forest management activities. WTP reflects the maximum contribution (cash or in-kind) that an individual is willing to pay to obtain an improvement in the quality of a good or service. WTP therefore, presents a better framing for studying the involvement of communities in conservation (which typically represents an improvement in forest conditions) compared to WTA which implies the minimum amount that individuals are willing to accept to cope with a deterioration in environmental quality (Carson, 2000; Florio and Giffoni, 2020; Ateka *et al.*, 2021).

WTP assessment approaches can broadly be categorised into revealed and stated preference techniques (Tietenberg and Lewis, 2006; Perman *et al.*, 2003). In the revealed preference approach, participants bid for real products (Shee *et al.*, 2020), and hence can provide unbiased estimates of WTP. On the other hand, stated preference approach asks people to state their

values, rather than inferring values from actual choices, as is done with the "revealed preference" methods (Alberini and Cooper, 2000). We utilised the stated preference approach to obtain estimates of forest conservation WTP amongst forest dependent households in Kenya – since market data on ecosystem services is hardly available.

2.2 WTP elicitation technique

Estimation of WTP for conservation was achieved using contingent valuation method (CVM). The CVM approach has previously been applied in measurement of WTP for public goods such as ecosystems and environmental programs (Florio and Giffoni, 2020). CVM accounts for both the use and non-use values and individuals can rank their preferences by stating an ideal value for the ecosystem services (Perman *et al.*, 2003). The approach involves asking respondents if they would accept to pay a specified cash amount or labour (bid) to obtain a change in environmental services such as better forest conditions (Johnston *et al.*, 2017). Assessing WTP for conservation in Mt Elgon Forest in Kenya, therefore adds to the body of literature on valuation of environmental goods and services in the developing world.

We utilised the double bounded format of WTP which asks if the household would accept to pay some initial bid amount. Depending on the response to the first bid, a follow-up bid with a higher or lower bid amount is administered. Respondents who answer yes to the initial bid, are presented with a higher bid and vice versa. The follow-up bid helps to improve precision (less biased) of the WTP estimates (Johnston *et al.*, 2017; Taylor, 2006). Similarly, in comparison to the single bounded approach, the double bounded elicitation is considered to be more superior since it provides additional information concerning an individual's WTP (Hanemann *et al.*, 1991). In order to address the gaps in existing literature (Gordillo *et al.*, 2019; Lamsal *et al.*, 2015; Pham *et al.*, 2018), we use both cash and labour bids as measurements of household's WTP for forest conservation.

The study considered five treatments (bids) (Table 1), consistent with the socio-economic context of the forest-dependent communities. These bids were informed and validated through five key informants and six focus group discussions. A major criticism of CVM is starting point bias (Carson, 2000; Taylor, 2006), which was overcome by randomly assigning the respective bids to the respondents, depending on whether a household was willing to contribute cash or labour for forest conservation.

The WTP scenario was presented as follows during survey administration.

> Based on the benefits and services you derive from the forest, and if forest services were to be availed at a fee or you were required/expected to contribute labour for forest conservation, would you be willing to pay fee or contribute labour for conservation of the forest? (0 = Not willing, 1 = WTPC (willingness to pay cash), 2 = WTCL (willingness to contribute labour).

In this article, we place specific focus on forest dependence, which denotes the use and reliance on a forest ecosystem as a livelihood strategy (Nerfa *et al.*, 2020). In this study, we

Bid	WTPC KES[a]/month Initial, higher, lower	WTCL Labour days/month Initial, higher, lower
Bid 1	75, 150, 37.5	2, 4, 1
Bid 2	175, 350, 87.5	5, 10, 3
Bid 3	250, 500, 125	7, 14, 4
Bid 4	310, 620, 155	9, 18, 5
Bid 5	420, 840, 210	12, 24, 6

Note(s): [a]KES denotes the Kenyan currency, i.e. Kenyan shilling equivalent to about 0.01 USD at time of survey

Table 1. Bid values administered for the dichotomous choice question

measure forest dependence using a number of indicators or covariates, including (1) involvement in forest extraction – this indicator covers the aspect of access to the forest and collection of forest products for subsistence or commercial reasons amongst households. Collection of forest products is a livelihood strategy for these communities, likely to inform their contribution to forest conservation; (2) previous involvement in conservation programs (PFM participation) – this variable measures a household's willingness and commitment to continue their involvement in collective forest conservation activities while enjoying forest user rights. PFM participation allows households to derive a set of benefits from the forest, which is an important forest dependence dimension; (3) number of forest products extracted – This variable infers the intensity or extent to which households engage in forest extraction. A higher number of forest products extracted would imply a higher level of forest dependence which is likely to influence their contribution to forest conservation; and (4) value of all forest products extracted – This variable also indicates the intensity of benefits accumulated from forest products. A high value of products extracted would likely provide an incentive for a household to contribute to forest conservation. All these variables point to reliance on forests in one aspect or another hence informing their inclusion in the study.

2.3 Study area

The study was conducted in Mount Elgon Forest ecosystem, a transboundary area lying between Kenya and Uganda. The ecosystem is a key water catchment for Lake Turkana and Victoria in Kenya, Lake Kyoga in Uganda and a number of rivers, including; Suam River, Nzoia River and Malakisi River (Kenya Water Towers Agency, 2018). Mt Elgon is also one of Kenya's major "water towers" – mountainous regions and highlands that function as a repository for rainwater, before gradually releasing it (the water) to the rivers and springs (Kenya Water Towers Agency, 2018). The Kenyan side of the ecosystem is situated within Bungoma and Trans-Nzoia counties. The ecosystem was chosen as it hosts communities highly reliant on forest resource extraction. Mount Elgon has suffered a threat of uncontrolled exploitation of endangered tree species, largely attributed to increased human activity and limited awareness on the value of conservation and protection of the water tower (Russell *et al.*, 2017). Figure 1 shows a map of the study area.

2.4 Data collection

The study was conducted in two phases. During the first phase, we conducted five key informant interviews (KIIs) which were complimented with six focus group discussions (FGDs) to develop broad understanding on conservation efforts in the study area, the importance of ecosystem services and forest dependent people's WTP for conservation efforts. KIIs comprised of officers from Kenya Forest Service, CFAs and individuals from the local communities. The FGDs involved 10–15 people who live close to the forest margin and who were either members of forest user groups or non-members. Participants for the FGDs were identified with the help of CFA leaders and forest officers. FGDs and KIIs were also used to validate the values of the WTP bids in addition to firming up the sampling strategy.

In the second phase, the study utilised a three-stage process for household survey data collection. In the first stage, three forest stations – Kimothon, Saboti-Socio and Kaberwa – were selected, which represented administrative divisions within Mt Elgon forest region. In the second stage, 30 villages located within a radius of 5 kilometres [1] from the forest edge were selected randomly. The research team then worked with village heads to generate a list of households. In the third stage, 924 households from the village lists were randomly selected for interview. The sampled respondents were then informed about the purpose of the study and requested to take part. Other than the information provided to the selected households on the importance of participating in the survey, no monetary or in-kind incentive was given to the

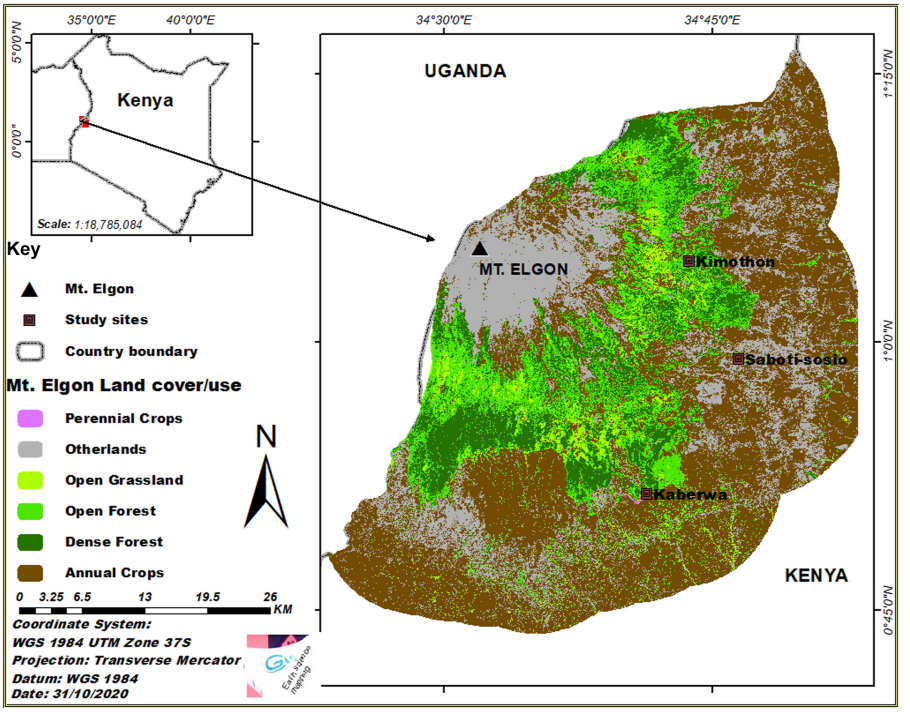

Figure 1.
Map showing Mt Elgon forest, Kenya

respondents. Of the selected households, five declined to take part in the survey due to other engagements which resulted in a sample of 919 respondents representing a 99% response rate. Data collection was done with the assistance of experienced and well-trained enumerators. The survey was administered to the household heads, or in absentia, their spouse or any adult household members with the exercise lasting between one to two hours. Data collection was carried out between November 2018 and January 2019. Pretesting was done with 32 households before administration of the actual survey instrument to test its suitability.

The survey tool collected data over a recall period of one year on household demographics (gender, age, household size and education level of household head), household assets (land, livestock and overall asset value), household incomes and expenditure, household risks and costs associated with forest conservation and their WTP for conservation either by cash (WTPC) or labour (WTCL). In addition, the survey collected data on institutional attributes (such as group membership) and forest related variables (such as forest incomes, distance to forest edge, involvement in forest extraction, ownership of private forests and perception of forest cover change over five-year period). Data on number of forest products extracted and absolute value of these products were also collected to represent indicators of forest dependence. The definition of the variables and their measurement is shown in the Appendix.

2.5 Estimation strategy and empirical models used in estimating WTP

The analysis of WTP in this study follows three stages. The first stage employed descriptive analysis to summarise characteristics of surveyed households and the variations in WTP responses by forest dependence and household context. The descriptive statistics using means and percentages are categorised into household participation in forest extraction or

otherwise (one of the forest dependence indicators) and comparison between groups is done using independent *t*-test. In the second stage, the study estimates WTP values amongst households. Using the double bounded procedure, each respondent was assigned a random initial treatment (bid) t_i^1 which represents the amount of money (in KES) or number of days (for labour) that the household would be willing to contribute for forest conservation per month. The respondents were further asked about a follow-up bid t_i^2 that was lower if a household accepted the initial bid, or higher if the household rejected the initial bid.

Since WTP in this study takes a multiple response variable that assumes an intrinsic order, an ordered qualitative response model is used. The WTP for forest conservation is specified as:

$$WTP_i(X_i\varepsilon_i) = (X_i\beta) + \varepsilon_i \tag{3}$$

where WTP_i is the unobserved WTP based on X_i, a vector of covariates likely to influence a household's WTP (household demographics, farm characteristics, institutional attributes and forest dependence), β is a vector of parameters which were estimated showing the relationship between covariates and WTP, while ε_i represents the standard error term (Verbeek, 2012).

WTP is not directly observed, therefore, a range of WTP was identified based on the respondent's answer to the bids offered. Based on the responses to the initial and follow-up bids, the WTP for each household willing to pay for forest conservation could fall under one of the following categories (Khainga *et al.*, 2018; Verbeek, 2012).

C_1: $t_i^2 \leq WTP_i < \infty$, Both bids accepted

C_2: $t_i^1 > WTP_i < t_i^2$, Initial bid accepted but second bid rejected

C_3: $t_i^2 \leq WTP_i < t_i^1$, Initial bid rejected but second bid accepted

C_4: $0 < WTP_i < t_i^2$, Both bids rejected

The specifications were estimated using the ordered probit model where

$$C_1\text{: Pr} = \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) \tag{4}$$

$$C_2\text{: } Pr = \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) \tag{5}$$

$$C_3\text{: } Pr = \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) \tag{6}$$

$$C_4\text{: } Pr = 1 - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) \tag{7}$$

Maximum likelihood estimation method is used to estimate β and σ (Lopez-feldman, 2012) using the log likelihood function as shown in equation (8):

$$lnL = \sum_{C1} ln\left(\Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) + \sum_{C2} ln\left(\Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) + \sum_{C3} ln\left(\Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right)\right) + \sum_{C4} ln\left(1 - \Phi\left(X_i'\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) \tag{8}$$

C_1, C_2, C_3, C_4 assume value zero or one based on each forest dependent household's responses, that is only one part in equation (8). Φ represents the standard normal distribution function. This estimation is done using stata's *doubleb* command (Lopez-feldman, 2012).

The empirical mean WTP was estimated in two steps. First, the model was estimated using intercept only, excluding all explanatory variables, which characterises the unconditional distribution of forest dependent households. Further, WTP estimation is done based on indicators of forest dependence (forest extraction, PFM participation) and household context (gender and wealth categories). In the second step, the model was estimated with covariates denoted using vector X in equation (3). The coefficients estimated were interpreted as determinants of WTP for forest conservation.

3. Results and discussion

3.1 Descriptive analysis

This section present results of the descriptive analysis. In the results (Table 2), we present a comparison of differences between participants and non-participants in forest extraction – which is one of the indicators of forest dependence. The results reveal that households involved in forest extraction were more likely to have younger household heads, lower education levels but larger farms and more livestock. Consistent with the existing literature, non-participating households had lower off-farm incomes and asset values (FAO, 2018). As expected, forest-dependent households were more likely to be involved in PFM by being members of a forest user group. The participants were also more likely to perceive a negative change in forest cover (almost 40% compared to around 25% for households not involved in forest extraction. Together with expected benefits from PFM, negative perceptions on forest cover changes are more likely to influence households' willingness to contribute towards forest conservation.

3.2 Household willingness to pay for conservation

The results in Table 3 show that the majority of surveyed respondents (74.3%, $n = 919$) were willing to contribute either labour or cash to support forest conservation activities. The reasons given by respondents who were not willing to contribute towards forest conservation include; perception that conservation is the role of the government (36.9%), high participation costs (32.6%), perceived limited need for forest services (17.4%), old age (5.9%), lack of finances (4.2%) and lack of interest in the program (3.0%). Overall, forest dependent households (based on participation in forest extraction) showed a higher willingness to contribute towards conservation. Forest dependence is correlated with improved access to alternative livelihood options which could explain the higher WTP for conservation (Tuan *et al.*, 2014). The proportion of male-headed households' willing to contribute towards forest conservation was remarkably higher compared to their female-headed counterparts. In many developing countries, women tend to face more time and resource constraints than men, which may explain the differences in the WTP for conservation facing women (González and Martin, 2007).

In the elicitation technique, respondents who expressed willingness to support forest conservation were presented with a bid, randomly drawn from a set of five treatments based on their preferred payment option – cash or labour (as shown in Table 1). Responses per bid are presented in Table 4. The results show that 88.4% of the respondents were willing to pay the initial bid for cash compared to 91.6% who were willing to contribute the initial bid for labour.

Further, our results show that, of the respondents that were willing to contribute towards forest conservation, a higher proportion was willing to contribute labour (69.7%) compared to

Variables	Full sample (N = 919) Mean	SD	Forest extractors (N = 683) Mean	Forest non-extractors (N = 236) Mean	p-value
Age	46.4	13.6	45.57	47.19	0.071
Gender 1 = male	87.8		87.6	88.0	0.854
Marital status 1 = married	88.5		88.1	88.9	0.700
Household size	6.2	2.2	6.24	6.10	0.347
Education level: Primary	66.7		70.1	63.4	0.030
Secondary	30.5		29.0	31.9	0.336
Tertiary	2.8		0.9	4.7	0.000
Migration status 1 = Native	79.5		78.3	80.8	0.348
Own land size	2.7	1.9	2.79	2.55	0.048
Livestock number	9.8	10.1	10.64	8.89	0.009
Asset value (KES)	24,315.2	48,495.6	20,544.33	27,964.86	0.020
Wealth categories: Wealthiest	33.4		32.4	34.7	0.458
Middle wealth	33.3		35.5	31.7	0.225
Poorest	33.3		32.2	33.6	0.637
Total income (KES)	106,660.3	165,328.6	97,386.2	11,5636.49	0.094
Household expenditure (KES)	141,664.5	91,368.9	137,937.32	14,5271.86	0.224
Off-farm income	53,887.8	129,842.0	42,470.55	64,938.30	0.009
Shocks value	31,286.7	50,768.7	31,575.62	31,007.09	0.865
Distance to the market (Km)	3.1	2.9	3.22	3.05	0.361
Extension	51.6		54.2	49.0	0.117
FUG membership 1 = yes	50.6		61.5	40	0.000
Participation in PFM 1 = yes	52.0		63.1	41.1	0.000
Road distance	14.1	8.4	13.74	14.46	0.198
Distance to forest (Km)	2.6	2.4	2.53	2.63	0.526
No. of extracted forest products	1.01	0.03	1.01	–	–
Value of forest products extracted	13180.4	3445.6	13180.4	–	–
Perception change in forest cover 1 = increased	31.6		38.1	25.3	0.000
Forest access	79.3		96.9	62.2	0.000

Note(s): p-value based on independent t test; 0.01 significance at 1%, 0.05 significance at 5% 0.1 significance at 10%

Table 2. Summary statistics of household characteristics

cash (30.3%). The high number of households opting to contribute labour could be attributed to the high level of liquidity constraints facing rural households in developing countries (Gibson *et al.*, 2016; Ateka *et al.*, 2021). Consistent with our findings, Casiwan-Launio *et al.* (2011) found that a higher proportion of households surveyed for conservation of a marine fishery reserve in the Philippines (80%) were willing to pay for work compared to 20% who were willing to pay cash. Endalew *et al.* (2020) also reported a higher WTP labour (80.3%) compared to WTP cash (68.3%) for conservation of Church forests in Ethiopia.

In order to derive WTP estimates for conservation, the dichotomous responses were regressed against their respective bid amounts as shown in equation (3) (excluding explanatory variables). The results (Table 5), reveal that the mean WTCL was approximately 12 days, while the mean WTPC was KES 450 per month. The labour contribution, if converted into cash, based on the average daily wage rate [2] (average of KES 150/day) would amount to

Variables Willingness to pay for forest conservation		Responses to WTP Yes ($N = 683/74.3\%$) %	 No ($N = 236/25.7\%$) %	 *p*-value
Forest extraction	Yes	76.9	23.0	0.068
	No	71.7	28.3	
PFM participation	Participant	85.1	14.9	0.000
	Non-participant	62.7	37.3	
Wealth category	Wealthiest	79.9	20.1	0.006
	Middle wealth	74.7	25.3	
	Poorest	68.5	31.5	
Gender	Male	75.4	24.5	0.033
	Female	66.1	33.9	

Note(s): *p*-value based on independent *t* test; 0.01 significance at 1%, 0.05 significance at 5% 0.1 significance at 10%

Table 3. Variation in WTP responses by forest dependence and household context

Bids for WTPC	Yes, Yes $N = 86$ %	Yes, No $N = 97$ %	No, Yes $N = 23$ %	No, No $N = 1$ %	Total $N = 207$ Freq
Initial and second bid	*41.5%*	*46.9%*	*11.1%*	*0.5%*	*207*
Bid 1 (75,150, 37.5)	28.9%	62.2%	8.9%	0	45
Bid 2 (175, 350, 87.5)	36.0%	60.0%	4.0%	0	50
Bid 3 (250, 500, 125)	52.6%	36.8%	10.5%	0	57
Bid 4 (310, 620, 155)	37.8%	40.5%	18.9%	2.7%	37
Bid 5 (420, 840, 210)	61.1%	16.7%	22.2%	0	18
Bids for WTCL	Yes, Yes $N = 199$ %	Yes, No $N = 237$ %	No, Yes $N = 39$ %	No, No $N = 1$ %	Total $N = 476$ Freq
Initial and second bid	*41.8%*	*49.8%*	*8.2%*	*0.2%*	*476*
Bid (2, 4, 1)	36.4%	59.3%	4.3%	0	140
Bid (5, 10, 3)	37.0%	59.1%	3.9%	0	127
Bid 3 (7, 14, 4)	41.4%	44.8%	12.6%	1.2%	87
Bid 4 (9, 18, 5)	54.9%	35.2%	9.9%	0	71
Bid 5 (12, 24, 6)	50.9%	29.4%	19.6%	0	51

Table 4. Distribution of responses to the double bounded bids for WTP

KES 1,800 a month or KES 21,600/year (approx. USD 216). Annually, the mean WTPC is about KES 5,400 (approx. USD 54) for each household. Comparatively, the WTP results show that the mean annual WTCL value is about four times the annual value for WTPC. Overall, the WTCL values (Figure 2) indicate a high desire amongst households to give a considerable share of their time endowment to support forest conservation activities.

The higher rates observed for WTP based on contribution of labour could be attributed to lower opportunity costs of time amongst rural households in developing countries, which makes them to under value their time compared to cash (Casiwan-Launio *et al.*, 2011). Another explanation might be associated with market imperfections that could restrict substitution amongst different resource endowments. For example, liquidity constraints amongst households are likely to compel respondents to offer in-kind payments rather than cash-based options (Gibson *et al.*, 2016). The high WTCL could also be a result of genuine willingness to

offer their time for engagement in conservation on consideration of the benefits associated with an improved forest ecosystem. The results compare well with Tilahun *et al.* (2011) who found that annual WTP in Ethiopia for forest conservation was higher (USD 24.90) amongst households preferring to contribute labour compared to those willing to give cash (USD 6.42). Casiwan-Launio *et al.* (2011) also found the mean willingness to work was three times the value of the cash WTP for sustainability of a marine fishery reserve in the Philippines. Similarly, Solikin (2017) also found the mean WTCL to be 8.15 times higher than the WTPC for a program seeking to avoid deforestation and forest degradation in Segah watershed, Indonesia.

3.3 WTP variations across gender, wealth and forest dependence indicators

Table 5 shows results of disaggregated WTP estimations based on indicators of forest dependence (forest extraction, PFM participation) and household context (gender and wealth categories).

Consistent with our priori expectation, findings in Table 5 reveal that households engaged in forest extraction were willing to contribute more in-cash or in-kind for forest conservation. The observation is consistent with the hypothesis that forest dependent households could be willing to contribute more towards forest conservation since they stand to suffer higher loss of ecosystem services, if forest degradation continues unabated (FAO and UNEP, 2020). FGDs indicated that households who engaged in forest extraction regularly benefited from various services and forest products including grazing, fuelwood, vegetables, honey, wild

Table 5.
Mean WTPC and WTCL for overall and specific categories

Variable		WTCL per month Mean	Std. Err	$p > z$	WTPC per month Mean	Std err	$p > z$
Overall		*12.462*	0.432	0.000	*450.461*	22.414	0.000
Forest extraction	Yes	12.781	0.598	0.000	488.19	35.668	0.000
	No	12.00	0.630	0.000	437.633	27.622	0.000
PFM participation	Yes	12.977	0.572	0.000	485.803	36.476	0.000
	No	11.636	0.647	0.000	445.659	31.171	0.000
Wealth category	Wealthiest	12.603	0.845	0.000	483.179	31.044	0.000
	Middle wealth	13.492	0.807	0.000	391.309	35.361	0.000
	Poorest	10.979	0.659	0.000	531.216	66.156	0.000
Gender	Male	12.728	0.455	0.000	464.278	24.006	0.000
	Female	10.915	1.339	0.000	379.067	53.205	0.000

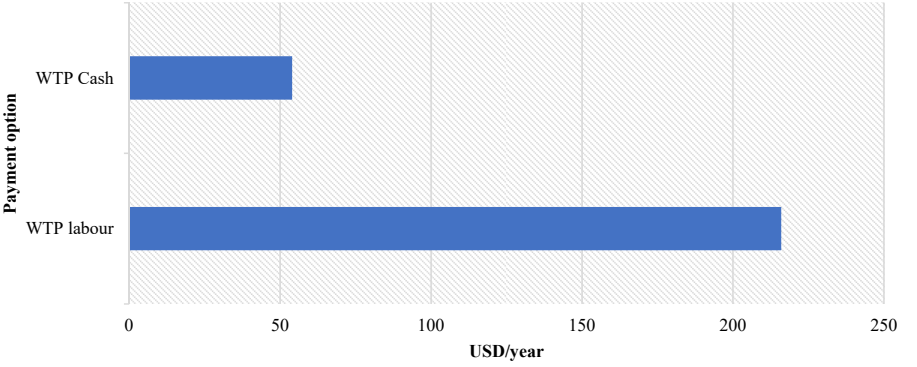

Figure 2.
Annual WTP estimates based on payment options

fruits and other non-timber products. Extraction of forest products supports the livelihoods of forest dependent communities to a considerable extent which may inform a higher WTP.

As shown in Table 5, involvement in previous conservation programs (PFM participation) was associated with willingness to contribute towards forest conservation. The mean monthly WTCL for PFM members was 13 labour days compared to 11 labour days for the non-participants. Similarly, higher monthly mean WTPC is observed for PFM members (KES 485.80) compared to the non-participants (KES 445.65). Membership in PFM allows households to engage in forest-based livelihood improvement activities such as bee-keeping and tree nursery establishment. Participation in PFM can also enable members to identify the vulnerability associated with forest degradation (including the adverse effects of climate change). Such benefits are likely to inform households' willingness to contribute more for forest conservation (Arnold *et al.*, 2011; Tuan *et al.*, 2014). A similar finding was found in Ethiopia where forest group members understood their responsibility for maintenance and rehabilitation of neighbouring forests. Thus, their involvement in collective action positively influenced labour contribution for forest conservation and management practices (Gatiso, 2019). Our findings are also consistent with Lamsal *et al.* (2015) who found that households with prior involvement in conservation practices at the Ghodaghodi Lake Complex, Nepal were likely to contribute more for conservation compared to those who had not been involved in conservation.

Results on WTPC and WTCL were also disaggregated by wealth categories. Interestingly, the findings show that the poorest households were willing to make higher contributions in both cash and labour compared to the wealthier households. Poorer households have a higher dependency on forests for their livelihoods which could explain their higher willingness to contribute towards forest conservation. This observation is consistent with Gatiso (2019) who found that most of the poor households in rural Ethiopia generated a substantial income from forests compared to their wealthier counterparts – and were therefore more willing to engage in forest conservation.

Our findings also show that male-headed households had higher mean WTP cash and contribute labour in comparison with the female-headed households. FGDs and KIIs showed, that women in the study area face time poverty due to their higher involvement in productive (e.g. farm labour, fuelwood collection, food preparation) and reproductive duties (e.g. childcare) which would constrain their physical availability to offer labour days for conservation activities. Further, the lower values from female-headed households could be explained by their limited access to productive assets such as land. In contrast, Oduor *et al.* (2016) found that female-headed households had a higher WTP for conservation of Nyando wetlands, Kenya than their male-headed counterparts. In Nyando, women exhibited a higher dependence on wetland products than men since they are more directly involved in provision of food to the household through harvesting of wetland goods. They are thus regarded as the primary users of wetland resources which could explain their incentive to contribute more for its conservation.

3.4 Determinants of WTP

The results of the ordered probit model are presented in Table 6; column one on WTCL and column two on WTPC. The results indicate that forest dependence reflected in the level of benefits (number and value of forests products extracted) had a positive influence on forest extraction. While a higher resource endowment had negative influence on WTP, household vulnerability (e.g. through level of shocks or being poor) and high transaction costs had a positive influence on households WTP.

As shown in Table 6, the number of forest products extracted and the value of forest products extracted positively influence a household's WTP towards forest conservation.

Variable	WTCL Coefficient	WTCL Std. error	WTCL $p > z$	WTPC Coefficient	WTPC Std. error	WTPC $p > z$
Forest dependence indicators and values						
No. of extracted forest products	0.716*	0.385	0.063	−34.467	30.116	0.252
Value of forest products extracted (KES)	0.000	0.000	0.368	0.007*	0.004	0.057
Participation in PFM	0.449	0.839	0.593	62.805	46.249	0.174
Forest extraction	0.183	0.865	0.832	65.898	48.279	0.172
Household demographics						
Age	0.018	0.031	0.556	−0.438	1.819	0.810
Migration status	1.364	1.015	0.179	136.672***	48.818	0.005
Gender	1.682	1.348	0.212	83.212	61.240	0.174
Primary education	1.399	0.880	0.112	31.367	44.869	0.485
Tertiary education	1.018	3.037	0.737	181.623**	88.347	0.040
Institutional						
Extension	2.859***	0.835	0.001	−21.469	43.697	0.623
Perception on forest cover change	−0.940	0.871	0.281	−77.822*	44.729	0.082
Distance to nearest market	–	–	–	32.959***	10.291	0.001
Socio-economic attributes						
Log of asset value	−0.790**	0.313	0.012	6.086	15.131	0.687
Log shocks	0.231**	0.105	0.028	−1.128	5.046	0.823
Poorest category	−1.453	1.015	0.152	91.428*	49.434	0.064
Wealthiest category	−0.986	1.099	0.370	11.477	55.909	0.837
Livestock number	0.072	0.047	0.123	1.361	2.156	0.528
Log expenditure	–	–	–	58.744	35.722	0.100
Log total income	–	–	–	6.932	11.077	0.531
Constant	10.966**	3.926	0.005	−808.307*	447.043	0.071

Note(s): Log likelihood = −694.343, Wald = 44.46 number of observations = 476; (WTCL)
Log likelihood = −273.39, Wald = 52.61 number of observations = 207; (WTPC)
*, ** and *** denote level of statistical significance at 10% level, 5% level and 1% level, respectively; Results presented are for the WTP estimation with inclusion of explanatory variables

Table 6.
Parameter estimates for ordered probit model for WTCL and WTPC

The number and value of forest products extracted indicates a higher level of benefits which may motivate households to support conservation in order to guarantee their continuous supply (Lamsal *et al.*, 2015). Similarly, degradation of forests is likely to result in livelihood loss for forest-dependent households which further explain their higher WTP (Gatiso, 2019). Similar findings have been reported in Jordan where collection of forest products such as wild plants positively influenced WTP for forest services (Al-Assaf, 2015). These findings suggest that households involved in forest extraction have a higher likelihood to contribute both in-cash or labour for conservation of the resource.

The results in Table 6 also show that a higher WTPC was observed amongst native households of Mt Elgon compared to immigrants. Previous studies have shown that natives are more likely to appreciate the value the forest by virtue of their long stay in the area, therefore explaining their higher WTP for forest conservation (Okumu and Muchapondwa, 2020). However, Tilahun *et al.* (2011) reports contrasting findings in Ethiopia where households that had lived in the forest area for longer years were less likely to accept higher bids for conservation compared to the settlers. They reported that immigrants offered higher WTP bids because degradation was the main push factor for their migration and were therefore ready to contribute to support conservation practices. The study findings also showed that respondents who had attained higher education had a higher WTPC for

conservation practices. This is consistent with Pham *et al.* (2018) and Tilahun *et al.* (2015) who found a higher WTP for mangrove restoration in Vietnam and frankincense forest conservation in Ethiopia amongst households with higher education levels.

With regard to institutional variables, the findings show that access to extension and perception of forest cover change had a positive influence on WTP. Extension has an important role in providing information on climate smart agriculture which may explain the positive influence on WTP for forest conservation. This finding is consistent with Shee *et al.* (2020) who found a positive effect of access to extension services on farmers WTP for improved agricultural technologies in Tanzania. Access to extension could be perceived as a platform that allows households to be risk tolerant and be more inclined to adopt new agricultural and conservation practices.

A positive perception of changes in forest cover over the five years preceding the study was associated with a lower WTPC. This finding is in line with our priori expectation that households who perceived a positive change in forest cover would be reluctant to contribute to conservation. Conversely, households who perceived a negative change in forest cover were for likely to pay for forest conservation. The positive influence of perceptions on environmental and climatic change on willingness to contribute for conservation has also been reported in other studies. In Brazil, perception of deforestation positively influenced peoples' willingness to contribute for conservation (Bakaki and Bernauer, 2016). In Vietnam, household's attitude to future climate change scenarios positively influenced their contribution to mangrove forest restoration (Pham *et al.*, 2018).

Our findings also reveal that the high value of shocks experienced had a positive influence on a household's WTCL while high asset value negatively influenced WTCL. High shocks and low asset values are associated with a household's vulnerability, therefore explaining the positive influence on a household's willingness to participate in conservation programs. In addition, a high WTPC was observed across households in the poorest wealth category. Forests provide resources that act as safety nets in case of shocks, especially for poorer and more vulnerable households which in part explain their willingness to contribute for conservation. Gatiso (2019) and Yego *et al.* (2021) report that a majority of the rural poor and in particular, forest-dependent households, generate a substantial income value from natural resources, which might influence their WTP for conservation activities. Thus, to reduce vulnerability, poorer households will be inclined to contribute more labour and cash for conservation programs.

On average, the distance to the market was positively associated with a household's WTPC. This may be explained by the fact that households staying far from markets face higher transaction costs in accessing certain products or services which means that they have to rely more on forest commodities to fill this gap. Thus, reliance on forest products may in part explain their high willingness to contribute for conservation.

4. Conclusion and policy recommendations

This study sought to determine households' WTP for forest conservation in Mount Elgon Forest ecosystem in Kenya, a region characterised by high forest dependence and a history of degradation of forestry ecosystems. We empirically estimated households' WTP for forest conservation, using data from a contingent valuation survey, based on two payment options (cash and labour days). Our findings indicate that while the majority of the respondents (74.3%) were willing to contribute for forest conservation, the annual mean value of WTP for in-kind contributions of labour (USD 216) were significantly higher than estimates for cash payments (USD 54). The considerable difference in WTP across the two payment options highlights the importance of considering alternative mechanisms in the measurement of value for ecosystem services and design of conservation programs.

Based on the various forest dependence indicators applied in the study (involvement in forest extraction, value of forest products extracted and number of forest products extracted), we conclude that forest dependence significantly influences a households' willingness to support forest conservation activities. The higher WTP amongst forest dependent households could be explained by the importance of forests in sustaining their livelihoods. Conversely, households who were less dependent on forests were generally more resource endowed and less vulnerable to shocks – characteristics which increased their opportunity costs and therefore dissuaded them from engaging in forest conservation.

These findings have three important implications on the long-term sustainability of conservation programs in developing countries. First, government and non-governmental organisations implementing conservation programs should consider in-kind contributions (such as labour days as opposed to emphasis on cash only) from local communities as viable mechanism of supporting forest restoration. Second, the paper has demonstrated the importance of considering differences in household characteristics and contexts (e.g. extent of forest dependence) in designing environmental conservation programs. The implication is that programs which differentiate the costs of participation based on household resource characteristics have the potential to include the poor and vulnerable households who derive most of their livelihoods from these ecosystems. Third, this study has demonstrated that it is possible to loop in local communities to actually contribute to conservation which would have a positive effect on their own livelihoods. This is an important finding in the context of many developing countries where forests continue to be degraded and in the face of reduced external funding.

The study has important implications for future research. Further studies estimating WTP will need to consider choice of payment vehicles since this appears to have an influence on WTP. While this study considered two alternative vehicles (cash and labour), future studies could consider other options proposed in the literature such as meal days. Similarly, in view of community heterogeneity, there might be variations in preferences for different conservation options such as tree nursery establishment, tree planting and management and protection of existing forest through patrol activities. Thus, future research could explore how households' WTP varies across different conservation options. This understanding might uncover trade-offs across these preferences which would help in providing insights on future designs of specific community conservation models.

Notes

1. The Participatory Management Rules (Republic of Kenya, 2015) define beneficiaries of incentive-based conservation as households residing within a 5-km radius of the forest edge.
2. Average wage rate obtained from field data-focus group discussions and key informant interviews (2018–2019).

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Appendix

Variables	Description	Expected sign
Household demographics		
Age	Age of household head in years	–
Gender	Gender of household head 1 = male 0 = Female	+
Marital status	Household head married or otherwise 1 = Married	+
Household size	Number of members in a household	+
Education level: Primary	Highest education level attained by household head	+
Secondary		+
Tertiary		+
Migration status	Native or immigrant 1 = native 0 = immigrant	+
Own land size	Total land size of the household in acres	–
Livestock number	Number of livestock owned	+
Asset value (KES)	Value of all assets owned in KES	+
Wealth categories: Wealthiest	Household wealth group as per income tertiles	–
Middle wealth		–
Poorest		+
Total income (KES)	Total household income derived from all sources	+
Household expenditure (KES)	Yearly household expenditure on food, non-food, medical and social expenses in KES	+/–
Off-farm income	Income from all non-farm sources in KES	–
Shocks value	Value of three main self-reported shocks suffered by household over the past one year in KES	+
Distance to the market (Km)	Distance to the nearest market in Km	+
Extension	Household received extension services in the past year 1 = yes 0 = no	+
FUG membership	Membership to a forest user group 1 = yes 0 = no	+
Participation in PFM	Participation in participatory forest management 1 = yes 0 = no	+
Distance to market (Km)	Distance to nearest market in Km	+
Forest-related variables		
Distance to forest (Km)	Distance to nearest forest edge in Km	+
Forest extraction	Involvement in collection of forest products such as vegetables, fruits, honey, medicinal herbs and grass for animals/grazing rights 1 = yes 0 = No	+
No. of extracted forest products	Total count of all forest products extracted by a household	+
Value of forest products extracted	Total value of all forest products extracted by a household in KES	+
Perception change in forest cover	Household's perception of forest cover change over last 5 years 1 = increased 0 = otherwise	–
Forest access	Entry into the forest for extraction, recreational or educational purposes 1 = Had access 0 = No access	+

Table A1. Description of variables used in the study with expected effect sign

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