Research article

Farmers' willingness to pay for alternative resource management practices in the Bale Eco-Region, Ethiopia: An application of choice experiment

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ABSTRACT

The purpose of this study is to investigate the preferences of people in the Bale Eco-Region (BER) for better ecosystem services and to calculate their mean Willingness to Pay (WTP) for selected attributes of conservation practices to maintain watershed's ecosystem functions, using a choice modeling approach. Results from reforestation attributes revealed that the average WTP for reforestation characteristics were 3,053 ($145.38), 2,516 ($119.83), and 1,827 ($87) Ethiopian Birr (ETB)/year for higher, medium, and low impact improvement scenarios respectively, to midland communities. Lowland respondents' mean WTP for exclosure attributes were estimated at 882 ($42), 1,558 ($74.19), and 2,383 ($113) ETB yearly for low, medium, and high impact improvement scenarios respectively. This indicates that respondents from both lowland and midland communities are willing to spend a substantial amount of resource and time (measured in terms of money) on to improve ES in the BER. The study provides valuable input to carry out a cost-benefit analysis of possible interventions conserving natural resources in the BER. Moreover, using this study was an important step for initiating the process of Payment for Ecosystem Services in the BER where local communities, in Ethiopia and beyond could contribute to rehabilitating Ecosystem Services.

1. Introduction

The Bale Eco-Region (BER) represents the largest area of Afro-alpine habitat on the African continent. Its endowment with high biodiversity resources was a reason for establishing the Bale Mountains National Park in 1970. Around 30 million people living both in the BER within Ethiopia and beyond (Somalia and Northern Kenya) are estimated to directly or indirectly depend on several Ecosystem Services (ES) of the BER (Mohammed, 2013). However, driven by the growing pressure of both people and livestock, the BER is degraded and its ecosystem functions are extremely disturbed (Reducing Emissions from Deforestation and forest Degradation (REDD+), 2014).

The BER has a total woodland area of 1.8 M ha, which represents 47% of the total area (International Water Management Institute(IWMI), 2016). Out of this, around half a million hectares (14% of BER) is labelled as forest area and other areas are classified as woodlands and areas covered with Erica plants. Forest degradation is severe in Ethiopia (World Bank, 2015) and between 1986 and 2009, annual deforestation in the Bale Mountains ranged from 1% to 7% depending on local conditions, with an average rate of 3.7% across the BER (Dupuy, 2009 cited in

Watson, 2013). This is almost four times the 1% country-wide average forest loss reported by FAO (2010). Deforestation and forest degradation in the BER are caused by conversion into farmland, recurrent wild fire, livestock overgrazing, and timber extraction, all in the context of poor law enforcement. This high deforestation in a BER leads to loss of biodiversity, acceleration of soil erosion and flooding, shortage of fodder, the decline in quality and quantity of water resources, the decline in the value of timber and Non-Timber Forest Product (NTFP), increasing emission of greenhouse gases and other issues (REDD+, 2014).

In response to the problem of land degradation, various interventions such as reforestation, exclosure, Soil and Water Conservation (SWC) are going on during the past decades expected to reducing soil erosion, conserving biodiversity, increase carbon sinks, stabilize water flow, improved production of timber and non-timber products, increase fodder availability, etc. Those interventions were not successful, however, in the study area, as in other areas, because community preference was not taken into account while designing programs, among other reasons. Undertaking various interventions, to enhance ES are important economic decisions. These interventions could be successful, if they are based, either explicitly or implicitly, on society's values. The reason

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behind ecosystem valuation is to investigate the complexities of socio-ecological relationships, specify how human decisions would influence ES values, and to convey these value changes in monetary units that allow community for their inclusion in public decision-making processes (Mooney et al., 2005). Economic valuation can be helpful, by providing a way to explain and place priorities for programs, policies, or actions that keep or bring back ecosystems and their services (for details Fisher et al., 2011). For the successful implementation of appropriate interventions to improve BER ecosystem benefits, the preference of the community who uses these ES should always be considered. There has been a limited amount of research done in Ethiopia on estimated WTP for the improved ecosystem benefits.

This study[1] is amongst the first ecosystem valuation study in Ethiopia using Choice Experiment (CE) with the aim of seeking to estimate farmers' WTP for alternative resource management practices to improve ES in BER. Research on the valuation of the ecosystem in the country has largely been limited to the estimation of WTP for the conservation of the national park, wetland, lake, using the Contingent Valuation Method (CVM) or to a combination of the CVM and CE valuation methods. For example, Abebe et al. (2014), Haroyu et al., (2016), Fitalew (2009), and Birhanu (2012) have valued the improvement of wetland quality, lake, and National park using different valuation techniques. The use of state of the art valuation technique, CE compared to various studies that used CVM, in measuring the marginal value of changes in various character-istics of environmental programs, as respondents get multiple chances to express their preference for a valued good over a range of payment amounts (Mogas et al., 2005). CE is more informative yielding useful input for management/policy lessons than CVM studies. Moreover, CE may minimize some of the response biases emanating from using CVM approach (Bateman and Jones, 2003; Loomis 2014).

The study provides valuable information for forest policy makers and donors concerning decisions of improving land use management in BER. It also laid the ground for formulating the modalities for implementation of payment for forest and land ecosystem services in the study area.

This paper focused on the midland and lowland parts of the BER. The specific objectives of this study were: i) to estimate the mean WTP and welfare benefits (compensating surplus) of improvements of the attri-butes of the ES; ii) to assess the variability of household preferences for the improvement of ES across different landscape positions (midland and low lands) in BER considering different ecosystem functions; iii) to compare the importance of ES attributes in terms of communities WTP for prioritization purposes and finally to suggest appropriate policy rec-ommendations which could help address problems related to ecosystems conservations in the BER.

Focus group discussion (FGD), expert advice and key informant in-terviews were used to fix the levels and choice of attributes, in the absence of enough biophysical data in the area. The study collected 3,200 choice sets from choice experimental setting from 200 randomly selected households.

The paper is structured into four sections. The section presents physical description of the study site, discussion of CE and other elici-tation approaches, presentation of sampling techniques, questionnaire and data collection methods, experimental design and empirical meth-odology. Section three presents the results and discussion, divided into presentation of summary statistics, econometric results, and MWTP for various attributes and estimates of compensating surplus and assessing the validity of the valuation exercise by exploring the statistical associ-ation between and socio-economic factors and choice attributes. The final part concludes and draws policy implications.

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[1] This paper is part of the "Valuing Alternative Resource Management Prac-tices to Improve Eco-System Services in the Midland and Lowland Communities in Bale Eco-Region: Application of Choice Modeling', which was supported by SHARE I project funded by the European Commission.

2. Materials and methods

2.1. Study site description

This study was conducted in the Bale zone, Oromia Regional National State of Ethiopia. As we can see from Figure 1, the region is located in the headwaters of the Wabe Shebelle and Genale-Dawa river basins. BER hosts globally important biodiversity including endemic and rare species. It is the largest Afro-alpine area in Africa, and home to half of the flagship global Ethiopian wolf population, nearly all Mountain Nyalas, and almost all populations of the giant molerat, and different amphibians and plants (REDD+, 2014). BER is the source of more than 40 springs and five major cross-country rivers, which provide year-round water to up to 30 million people in Ethiopia, Northern Kenya and the Republic of Somalia (Mohammed, 2013). It has a large forest cover that stores vast carbon and provides critical ecosystem goods and services to communities in the eco-region and beyond. The region covers an area of approximately 22,000 km², with a human population of about 3.3 million. It comprises about 16 woredas (districts) in the West Arsi and Bale Zones of Oromia National Regional State (REDD+, 2014). The rural population in the BER is directly dependent on their livelihoods on the forest and other natural resources, wherein the midland crop-livestock and in the lowland agro-pastoralism are dominant farming systems (IWMI, 2016). There is significant potential to improve the management of the BER to sustain and enhance conservation and the livelihoods of the local communities and beyond.

2.2. Measurement using choice modeling (CE)

Preferences of people for better ES and their WTP can be estimated by using CE. CE, also known as Choice Modelling (CM), finds its origins in Lancaster and Loomis (1966) that proposed the idea that a 'good' can be treated as the combination of a group of characteristics. In a CE re-spondents are presented with a series of alternatives, differing in terms of attributes and levels, and asked to choose their most preferred alterna-tive. A baseline alternative or a status quo scenario or 'do nothing' situ-ation, is included in each choice set (Bateman et al., 2002). The advantage of CE compared to the CVM is that CE does a better job in measuring the marginal value of changes in various characteristics of environmental programs which is the useful focus from a manage-ment/policy perspective. CE is more informative than discrete choice CVM studies as respondents get multiple chances to express their pref-erence for a valued good over a range of payment amounts. Moreover, CE may minimize some of the response difficulties found in CVM related to protest bids, strategic behavior, and yeah saying, to mention the major ones (Bateman et al., 2003; Loomis 2014) (detail will be presented below in section 2.4.).

Despite CE having various advantages compared to other valuation techniques such as the CVM, it is not itself free from problems. The common problem in CE is the cognitive burden created on the re-spondents while making choices involving (complex) alternative options with attributes and levels (Suknaya Das, 2019). To minimize the prob-lem, the study used an extensive literature review as was well as carried out FGD (ten household heads (farmers) from each kebele) and key informant interviews (15 experts from different offices) with experts from Bale Zone and district-level agricultural offices and local Non-Governmental organizations (NGO's) allowed the researchers to obtain insight into various ecosystem problems and the linkages between different ES, respondents' understanding of these problems, and recruitment of local and professional enumerators and their training to enable reliable and smooth conduct of the survey. Moreover, the ques-tionnaire was piloted using group farmers and did necessary changes after that. However, expressing the proposed level of attributes as per-centage changes to fix cut-off points, due to lack of biophysical data, was one of the limitations of this study. Moreover, welfare estimates from CE
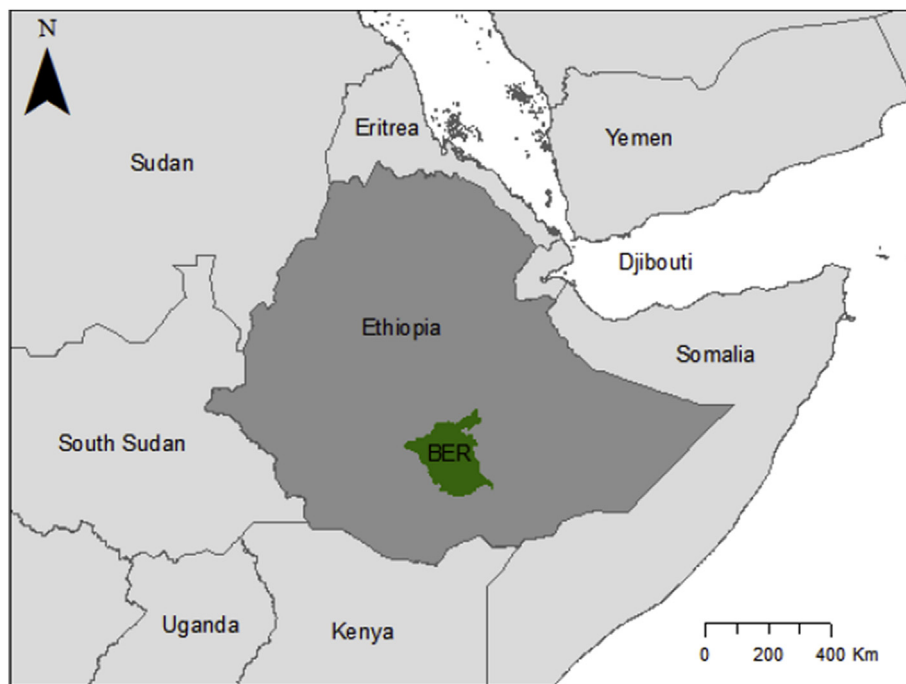
Figure 1. Map of the BER, IWMI unpublished

are sensitive to study design (Glenk et al., 2019), how the experimental design setup was chosen is explained below.

2.3. Sample selection and data collection

To gather farmers' WTP for alternative resource management practices in the BER and its attributes, the study employed multistage sampling techniques. Initially, from 16 districts located in BER, this study purposively selected Harena Buluk District (Figure 2), for having both communities living in midlands (2,300–1,300 masl) and lowlands landscape .≤1,300 masl) in the same watershed (hydrology).

In the second stage, one Kebele each (sub-district administrative unit in Ethiopia) was purposively selected from both midland and lowland agro-ecology. These kebeles are Kumbi from midland and Melka Arba from the lowland. In BER the elevation of midland community ranges between 1,300–2,300 m. a.s.l and lowland is below altitudes of1,300 m. a.s.l,. and the communities in these agro-ecologies practice mixed crop-livestock farming and predominantly agro-pastoralist system respectively, both heavily depending on the natural resources and the degradation of these resources hurt their livelihoods.

Calculation of the optimal sample size is rarely achieved in CE applications since this requires information about the value of parameter estimates a priori. This has lead to the development of several ad hoc rules regarding the selection of sample sizes for choice models. For example, Adamowicz (2001) suggests a minimum sample size of 50 respondents per survey block. Using this guideline and, based budget and time constraints, a total of 200 respondents (100 respondents from Kumbi and the other 100 respondents from Melka Arba) were randomly selected from a sample frame acquired from development agents (DAs) of the respective Kebeles using lottery method.

Face-to-face interview of the heads of households or housewives was chosen as a technique for eliciting data,. According to Kwak et al. (2007), a face-to-face interview is a preferred technique compared to telephonic interviews or e-mail, especially in the developing countries, because it provides the greatest scope for detailed questions and answers. The survey was conducted by using the local language Afan Oromo, using three enumerators and one supervisor who received 5 days of training. The survey was conducted from mid-April to Mid-May 2016.

2.4. Questionnaire development and elicitation method

To elicit WTP of the community for improved ES, we developed a CE questionnaire. In a CE respondents are presented with a series of alternative options, differing in terms of attributes and levels, and asked to choose their most preferred attribute, level and payment amount. A baseline alternative or a status quo scenario or 'do nothing' situation, is included in each choice set. The CE questions were accompanied by follow up questions to assess the validity of the valuation exercise. Questions on general perceptions and observations of respondents about the common ecosystem problems in the BER was also included. The questionnaire include questions about the socio-economic status of the respondents, including the respondent's age, gender, household income, marital status, occupation, number of dependents, and educational attainment.

Developing a CE questionnaire for this study involved the following three steps: i) identifying the interventions, defining the attributes for each intervention, ii) setting the level of each attribute for each intervention, and iii) setting the experimental design. In this paper, we focused on reforestation and exclosures recommended for midland and lowland households respectively.

During the data collection, each respondent for consent to be interviewed. However, the documentation of informed consent was not done. We explained the purpose of the study and assured them, as their response will be reported in summary form, ensuring anonymity of respondents. The study will draw major conclusions that could benefit policy making to improve natural resources management in BER. An ethics committee was not involved in approving the research work involving human subjects, as it was not required by the project.

2.4.1. Identifying the interventions, definitions of attributes and their levels

Identifying meaningful and important attributes of ES in BER to respondents and defining their levels is important in valuation of the study (Bernues et al., 2014). The existence of biophysical data is crucial for presenting to respondents the linkages between different ES, so the attributes and their levels could be easily understandable. In the absence of local biophysical data, however, the study has to build attributes and levels through literature reviews, consulting experts, and FGD, besides aiming to minimize cognitive burden of respondents.
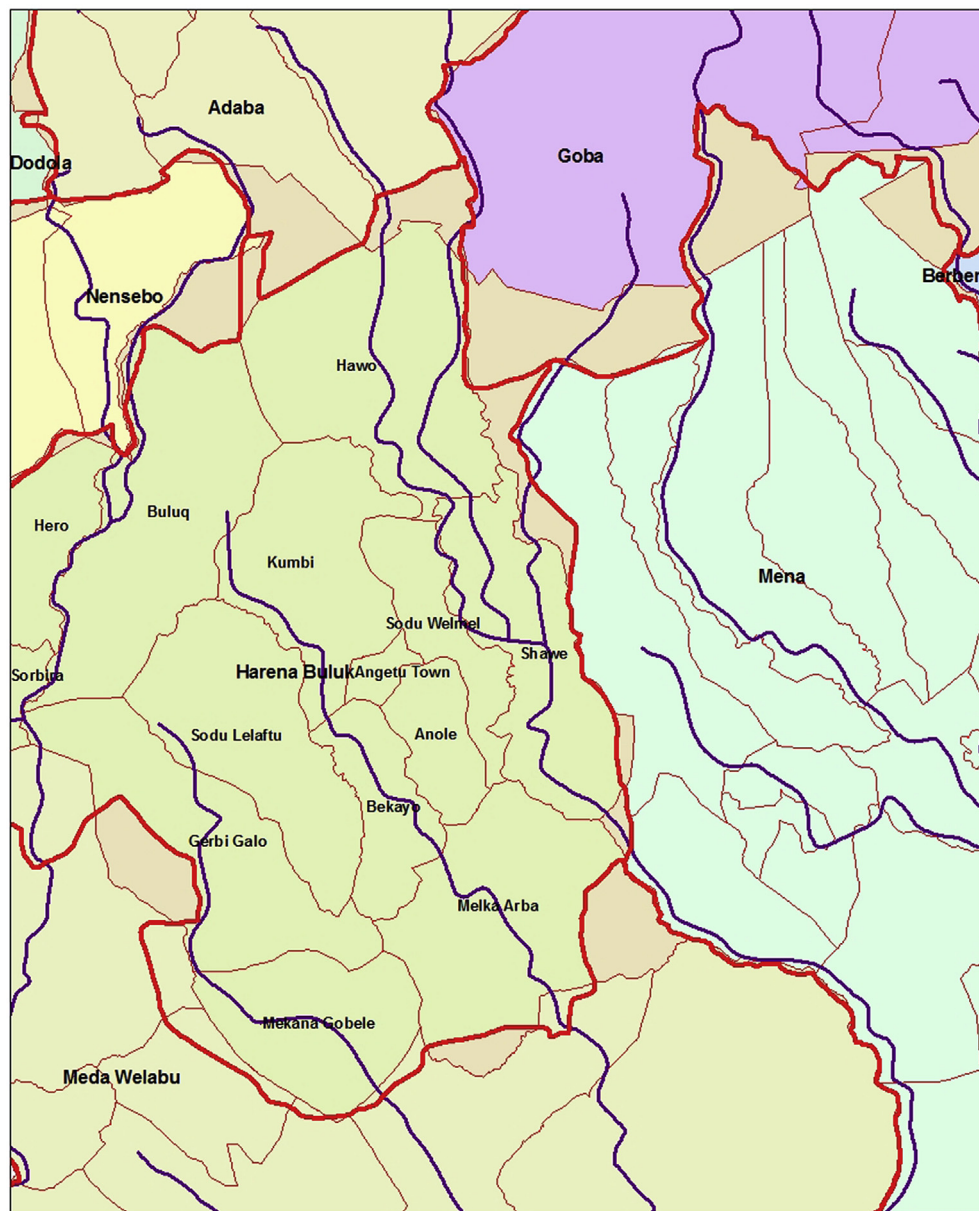
Figure 2. Map of the Harena Buluk and river network. Source: IWMI unpublished

Based on the information gathered from the literature review and semi-structured interviews, a total of five attributes including payment level were selected related to each of the two interventions necessary to rehabilitate ES in BER. To determine the payment levels, the farm household's transactions in monetary terms, the cost of reforestation per hectare, the opportunity cost of labor, and the benefits of these interventions were considered. Selected attributes and their levels are explained below.

A. Reforestation:

Undertaking reforestation is important to restore forest cover and improve its related ES. This intervention requires private and community involvement. Farmers may plant trees or practice agroforestry on farmland individually or may participate in community reforestation programs on communal lands in their area. Reforestation leads to enhanced biodiversity, reduces soil erosion and run-off (flooding), thereby reducing sedimentation of water infrastructure downstream, stabilize the water flow, increasing water availability for irrigation and domestic uses,

serve as a carbon sink, among other benefits (see Table 1). There is evidence that a reduction of forest cover amplifies flood events in developing countries (Bradshaw et al., 2007) as more rainfall directly turns into run-off instead of being slowed down or buffered by forests. The authors report that deforestation is the main cause of accelerated soil erosion and soil loss. This intervention was proposed for high land and midland communities in order to protect or restore forest cover.

B. Exclosures

Areas are closed for human and livestock activities to promote the natural regeneration of plants and reduce degradation of former communal grazing lands. The objective of this intervention is to improve ES and reversing biodiversity losses (Mekuria et al., 2011). Exclosures increase agricultural production by reducing soil erosion, improving vegetation cover; increases cut and carry of animal fodder, and improve CO_2 storage (Mekuria et al., 2011). Exclosures are more successful when applied with SWC measures, some enrichment with fodder trees (like Sasabania) and grasses, and watering points. Based on their importance

Table 1. Description of reforestation related attributes and levels used in the choice experiment.

Proposed intervention	Attributes	Status quo	Levels of attributes
Reforestation	Biodiversity (medicinal plants)	Declining biodiversity Count	Increased both fauna and flora species will be: 5%, 10% and 15%
	Soil erosion	Increasing soil erosion	The reduced soil erosion/ hectare will be: 5%, 10% and 20%
	Non-timber forest products	Decreasing non-timber products.	The proportion of improved non-timber forest product will be: 10%, 20%, and 30%
	CO_2 storage	Decreasing CO_2 storage	Increased CO_2 storage will be: 50%, 65% and 70%
	Payment level/ year	None (0)	Proposed annual payment by farmers: 400, 800 and 1,000 ETB

to the community in the area, we selected the following four major attributes related to exclosure (see Table 2).

2.4.2. Experimental design

The number of ecosystem management scenarios that can be generated from five reforestation and exclosure related attributes and all attributes with three levels was $3^5 = 243$. To maximize the amount of information, it would be important if all respondents could face possible attribute levels combinations according to their preferences.

Since full factorial design would be cognitively burdensome (Louviere et al., 2000) as well as time-consuming, fractional factorial design was used to ensure that all different attributes can be estimated independently (orthogonal) of each other. Finally, 4 choice sets for both interventions were built and presented to the respondents to choose the best option preferred from each choice set using KuTools in Excel.

Data collected from choice sets for both interventions, namely reforestation and exclosures, their levels and payment levels were coded in the cardinal-linear form. The status quo (business as usual) alternative scenario levels were coded as 0 for all attributes, estimation and analysis was done using Stata 12.0 software.

2.5. Econometric specification

We applied a Mixed Logit Model (MXL) because, unlike Multinomial and Conditional Logit Models, it does relax the Independent and Irrelevant Alternative (IIA) property and it explicitly accounts for individual heterogeneity (Hensher and Greene 2003; Hoyos 2010). MXL provides a simple way to generalize the Multinomial Logit Model (MNL) to permit

Table 2. Description of exclosure related attributes and levels used in the choice experiment.

Intervention	Attributes	Status quo	Levels of attributes
Exclosures	Reducing soil erosion	Increasing soil erosion	Reduced soil erosion will be: 5%, 15% and 20%
	Biodiversity	Declining biodiversity count	Increased number of fauna and flora will be: 5%, 15% and 25%
	Livestock feed availability	Declining livestock feed availability	The proportion of improved livestock feed availability will be:1.5 times, 2 times, and 3 times
	Exclosure with watering points	No construction of watering points	Construction of: 2, 3, and 5 watering points
	Payment level	None (0)	Proposed annual payment: 400, 500 and 750 ETB/year

the utilities of each alternative to be correlated (Cameron and Trivedi, 2005).

By relaxing the assumptions of the Conditional Logit Model (CLM), the random utility function in the Random utility model (RPL) model will take the following form (Birol et al., 2005):

$$U_{ij} \equiv V_{ij}(Z_j, S_i) + \varepsilon_{ij}(Z_j, S_i) = V(Z_i(\beta + \eta_i), S_i) + \varepsilon_{ij}(Z_j, S_i) \quad (1)$$

Where the respondent i receives utility U choosing alternative j from a choice set, C. utility is decomposed into a non-random component (V) and stochastic term (ε); and the indirect utility is assumed to be a function of the choice attributes (Z) with parameters (β), for socioeconomic characteristics, if they are included in the model, that may vary across respondents by a random component η due to preference heterogeneity. Thus, the probability of choosing alternative i in each of the choice sets will have the following form (Birol et al., 2006).

The probability that an individual n chooses alternative i from each choice set then presented as given Eq. (2) below:

$$P_{ij} = \frac{expV(z_j(\beta + \eta i), \quad Si))}{\sum expV(z_h(\beta + \eta i), \quad Si))} \quad (2)$$

From the mixed logit mode outputs, we calculated MWTP and Compensating Surplus (CS). MWTP is the amount of money respondents are willing to contribute to improved ES. It is calculated as the ratio of the coefficient for certain attributes to the estimated monetary coefficient. CS is the average WTP of respondents for changes from the status quo to alternative improved scenarios. It is estimated by calculating the difference between the values of the improved alternative options (V_i) from the value of the status quo (V_o) and multiplying this by the negative inverse of the coefficient for the payment attribute.

$$CS = -\left(\frac{1}{\beta \quad monetary \quad attribute}\right)(V_o - V_i) \quad (3)$$

Finally, MXL is estimated using a 'mixlogit' command programmed for Stata 12.0 following Hole (2007).

3. Results and discussions

3.1. Descriptive summary

The descriptive statistics for selected socio-economic variables of the sample respondents are presented in Table 3. About 95% of the respondents are male-headed households. The average respondents' age

Table 3. Descriptive statistics for selected socioeconomic variables of the sample respondents.

Variables	Description	Mean	Std. Dev
Age of the household head	Age of the respondent	36	9.25
Sex of the household head	1 if the respondent is male, and zero otherwise	0.95	0.23
Family size	The number of family members	6.0	1.81
Whether the head could read and write	1 if the respondent can read and write, and zero otherwise	0.30	0.46
Marital status	1 if respondent is married and zero other wise	0.96	0.18
Participating in non-farm sector	1 if the respondent participated in non-farm activities, and zero other wise	0.045	0.21
Farm size	The size of farmland respondent hold in timad	7.57	4.02
Income	Yearly respondent income in Ethiopian Birr	23239.42	16464.75

Source: own survey, 2016

was 36 years and 96% of them were married with a family size of 6 members. The average number of family size is much higher compared with the national 5.4 per household (CSA, 2012). The mean farm landholding was 7.57 timad (1 timad ≈0.25 ha), which is almost the same as the national figure. The result showed that 95% of the respondents' livelihood depended on agriculture, mainly mixed crop-livestock farming, dominated by rearing animals; only 4.5% of respondents participated in non-farm activity. The average yearly income of the respondent was about 23,239 Ethiopian birr per year, which is equivalent to about 1,106 USD[2]. This figure is a bit higher than the national figures because households in the area grow cash crops such as coffee, Khat (*Catha edulis*), etc. About 30% of sample respondents, household heads both female and male, could read and write. Regarding the education of respondents, 58% of them are illiterate, 39% are of primary education (1–8 grades) level, 2% are of secondary education (9–12) level, 0.08% are diploma, and 0.08% is degree complete.

Responses indicate that, in both agroecology 53.5 percent of the respondents practice both physical SWC (soil/stone bunds, terraces, cut-off drain, etc) and biological measures (like tree planting, agroforestry, grass planting, etc), while 17.5 and, 10 percent practice either physical or biological measures, respectively.

76 percent of midland respondents claimed that reforestation/afore-station is practiced in their area and from this 34 and 42 percent of the respondents respectively suggested reforestation takes place using single and diverse species. In the lowland, 88 percent of the respondents indicated that area exclosures are practiced in their area and only 47 percent of respondents confirmed area exclosures being practiced with enrichment (additional plantation) such as Moringa (*Moringa oleifera*), Nim tree (*Melia azedarach L.*), Wachu (*Acacia seyal*), Dadacha (Acacia Tortilis), etc.

3.2. Econometric results

The estimates of mixed logit models for reforestation and exclosure characteristics for midland and lowland are presented in Tables 4 and 5 respectively.

From the mixed logit mode outputs, we estimated MWTP and CS. MWTP is the amount of money respondents are willing to contribute to improved ES. It is calculated as the ratio of the coefficient for certain attributes to the estimated monetary coefficient. The results of MWTP for both reforestation and exclosure attributes are reported in Tables 6 and 7. CS is the average WTP of respondents for changes from the status quo to alternative improved scenarios. To estimate the respondents' compensating surplus for improvements in ES in the midland and lowland communities in BER over the status quo, nine improvement scenarios are proposed for both reforestation and exclosure program and the results are presented in Tables 8 and 9.

Table 4. Mixed logit results of reforestation attributes.

Variable	Coefficient	Standard error	P-value
Payment level	-0.00199	0.0056***	0.000
Biodiversity	-0.114	0.0348***	0.001
Soil erosion	0.0688	0.025***	0.005
CO_2 storage	0.065	0.025***	0.009
NTFP	0.063	0.017***	0.000

***, **, * significant at 1, 5, and 10 levels of significance.
+NTFP represent non-timber forest product attribute.
Source: Own survey, 2016

Table 5. Mixed logit results of exclosure characteristics (for lowland households only).

Variable	Coefficient	Standard error	P-value
Payment level	-0.107	− 3.06***	0.002
Soil erosion	2.589	3.16***	0.002
Biodiversity	1.773	3.03***	0.002
Livestock feed	29.966	3.16***	0.002
Water points	13.795	3.17***	0.002

***, **, * significant at 1, 5, and 10 levels of significance.
Source: Own survey, 2016

Table 6. Marginal Willingness to Pay (WTP) for reforestation attributes.

Variable	MWTP	Standard error	P-value
Biodiversity	-57.20	12.20***	0.00
Soil erosion	34.45	8.44***	0.00
CO_2 storage	32.62	15.43**	0.03
NTFP	31.59	15.43**	0.04

***, **, * significant at 1, 5, and 10 levels of significance.
Source: Own survey, 2016

Table 7. MWTP in ETB for exclosure attributes.

Variable	MWTP	Standard error	P-Value
Soil erosion	24.20	1.38***	0.00
Biodiversity	16.60	1.11***	0.00
Livestock feed	280	19.38***	0.00
Water points	129	1.83***	0.00

***, **, * significant at 1, 5, and 10 levels of significance.
Source: Own survey, 2016

3.3. Discussion and interpretation

The study estimated mixed logit results of reforestation and exclosure characteristics. As may be seen from Table 4, except biodiversity and payment level, all other reforestation characteristics in the choice experiment are positively and significantly related to the probability of choosing improving reforestation option. The coefficients of soil erosion, CO_2 storage, and NTFP are positive, as expected, implying that households' WTP for reforestation increases as its effect on reducing soil erosion, increasing CO_2 storage, and increasing NTFP is positive. The demand/WTP for ES (for that matter any good demanded) will decrease as price increases; the coefficient of payment level is expected to be negative. Even though the expected sign for biodiversity attribute was positive, we got a negative sign which is contrary to the results of other valuation studies (e.g., Birol et al., 2005). The negative sign of biodiversity coefficient implies improvement of this attribute reduces the utility (consumption) of the respondents as improving biodiversity attribute requires excluding community from using it. Since Bio-diversity is a global good, unless market mechanisms fully benefit the households, households may not value taking measures to improve it.

The MXL results related to exclosure is reported in Table 5. The coefficient for the payment level is negatively and significantly related as expected, in line with economic theory. Bio-diversity is positively related to choosing exclosure, perhaps indicating the effect of both natural regeneration and exclosure with enrichment. As indicated by Mekuria et al. (2011), exclosure enhances biodiversity through regenerating natural vegetation increasing feed availability. Positive and highly significant coefficients for improving livestock feeds availability and construction of watering points indicate that respondents give attention to

Table 8. Estimates of compensating surplus (CS) for attributes related to the reforestation program.

RRAI scenario	RR attributes				Compensating surplus(CS)	
	Biodiversity enrichment	Reducing soil erosion	Increasing CO$_2$ storage	Improving NTFP	ETB per year	Equivalent $ value
1	Low level	Low level	Low level	Low level	1,827	87
2	Low level	Low level	Low level	Medium level	2,142	102
3	Low level	Low level	Medium level	Low level	2,123	101
4	Low level	Medium level	Medium level	Medium level	2,516	119
5	Medium level	Medium level	Medium level	Medium level	2,831	134
6	Medium level	Medium level	Medium level	High level	2,994	142
7	Medium level	Medium level	High level	High level	3011	143
8	Medium level	High level	High level	High level	3029	144
9	High level	High level	High level	High level	3,053	145

Note: RRAI represents reforestation related attribute improvement.
RR represents reforestation related.
ETB represents Ethiopian Birr.
Source: Own survey, 2016

Table 9. Estimates of compensating surplus (CS) for attributes related to the Exclosure program.

ERAI scenario	ER attributes				Compensating surplus (CS)	
	Reducing soil erosion	Biodiversity enrichment	Improving livestock feed	Construction of watering point	ETB per year	Equivalent $ value
1	Low level	Low level	Low level	Low level	882	42
2	Low level	Low level	Low level	Medium level	1,011	48
3	Low level	Low level	Medium level	Low level	1,022	49
4	Low level	Medium level	Medium level	Medium level	1558	74
5	Medium level	Medium level	Medium level	Medium level	1,816	86
6	Medium level	Medium level	Medium level	High level	2,096	99
7	Medium level	Medium level	High level	High level	2,183	104
8	Medium level	High level	High level	High level	2,292	109
9	High level	High level	High level	High level	2,383	113

Note: ERAI represents Exclosure related attribute improvement.
ER represents Exclosure related.
ETB represents Ethiopian Birr.
Source: Own survey, 2016

improve these attributes due to the fact that the lowland area is highly vulnerable to drought, livestock feed availability and water is highly scarce. Positive and significant soil erosion attribute coefficient indicates that respondents have preferences to reduce soil erosion, because respondents perceive that soil erosion in lowlands is relatively high, compared to the highland and midland areas of BER.

From mixed logit output the study estimated MWTP which shows the amount of money respondents are willing to pay to improved ES in the study area. Maybe due to the expectation of decreasing current consumption from the improvement of this attribute (because it is considered as a global good), respondents are less willing to pay for the improvement of the biodiversity attribute. Alternatively, the design of reforestation, the choice of number of spices, could be an area of concern. Midland respondents are willing to pay 34.45 ($1.6), 32.62 ($1.55), and 31.59 ($1.5) ETB per year for improvement on soil erosion, CO$_2$ storage, and non-timber forest product, respectively. Respondents place a higher value on reducing soil erosion, expecting the improvement of soil erosion will enhance their productivity. Households have a significant WTP for enhancing carbon dioxide (CO$_2$) sequestration, implying that households may expect measures that increase forest coverage in the area would have a positive impact on CO$_2$ storage. This in turn increases household benefits from the carbon markets. The design and validation of the Bale Mountains Eco-region REDD + project were completed, distribution of benefits to individual households from global carbon markets are still

expected. Improving non-timber forest products had also a positive and significant WTP which indicates households expect that the improvement of these attributes will enhance their households' livelihoods.

As can be seen from Table 7, the marginal WTP for all four exclosure attributes included in the choice experiment are highly significant at a 95% significant level. Consequently, respondents are willing to pay 24, 16, 280, 129 ETB per year to reduce soil erosion, improve biodiversity enrichment, increase livestock feed availability, and exclosure with watering points respectively. Lowland communities place a higher value on livestock feed availability attributes followed by improving exclosure with the provision of watering points, expecting that improvement on both attributes will improve the productivity of their livestock, and thereby their livelihoods. According to the semi-structured interview, many respondents think that the Bale lowland is highly vulnerable to drought, and livestock feed and water is becoming highly scarce. This is why pastoralists travel long distances from lowlands to highland, including BMNP, in search of fodder and water for livestock during the dry season, and this immigration is becoming a major threat to the park (Gashaw, 2015).

In addition to MWTP the study also estimated CS which shows the average WTP of respondents for changes from the status quo to alternative improved scenarios. Table 8 indicates that there are welfare gains due to an improvement from the status quo situation. The midland

Table 10. Association between households' socio-economic characteristics and Reforestation attributes.

Socio-economic variables		Reforestation Attributes				Chi-square test Significance level(P-value)
		Improve biodiversity count	Reduce soil erosion	Increase CO2 storage	Improve non-timber forest products (NTF P)	
Sex:	Male	12	42	11	28	0.52
	Female	0	3	0	4	
Age:	18–34	8	17	7	16	0.041
	35–61	4	29	4	15	
Family Size	1–6	14	6	22	10	0.021
	7–9	10	4	20	14	
Read & Write:	Yes	5	4	14	2	0.03
	No	19	6	28	22	
Marital Status	Meried	22	10	41	24	0.266
	single	2	0	1	0	
Non-farm Income	No	24	10	42	24	0.55
	Yes	1	0	5	0	
Farm Size	1–9	18	5	25	14	0.027
	10–23	9	7	17	10	

Source: Own survey, 2016

Table 11. Association between households' socio-economic characteristics and exclosure attributes.

Socio-economic variables		Exclosure Attributes				Chi-square test Significance level(p value)
		Reduce soil erosion	Increases biodiversity count	Improve Livestock feed availability	Establish watering points	
Sex:	Male	21	10	42	23	0.083
	Female	1	0	2	2	
Age	18–34	7	7	15	12	0.004
	35–61	17	3	27	12	
Family Size	1–6	14	6	22	10	0.043
	7–9	10	4	20	14	
Read & Write	Yes	5	4	14	2	0.02
	No	19	6	28	22	
Marital Status	Meried	22	10	41	24	0.32
	Single	2	0	1	0	
Non-farm Income	No	24	10	42	24	0.18
	Yes	1	0	5	0	
Farm Size	1–9	18	5	25	14	0.024
	10–23	9	7	17	10	

Source: Own survey, 2016

respondent's mean WTP (compensating surplus) for reforestation program increases as we improve the status of ecosystems particularly the attributes of soil erosion, CO_2 storage, and NTFB value. Mean WTP for low impact improvement scenario (i.e. improvement scenario 1) is 1,827 ($87) ETB/year, and under the medium impact improvement scenario (i.e. improvement scenario 4) as high as 2,517 ($119.83) ETB/year. The Bale midland communities' average WTP in terms of labor and money for reforestation program increases to 3,053 ($145.38) ETB/year for a higher level (i.e. improvement scenario 9) of reforestation related attributes scenario The findings are, in general, supported by previous empirical studies (e.g. Birhanu, 2012) that the respondents show a positive WTP for better environmental scenarios compared to the status quo (business as usual). However, the magnitude and types of contributions vary considerably along with the characteristics of the resources and respondents. Our findings showed that understanding of the Bale midland community's preferences for reforestation related attributes would contribute to improving decision-making in favor of reafforestation, which may increase forest coverage and forest-related ES in the midlands of BER.

3.4. Association between households' socio-economic characteristics and choice of attributes

As indicated above, follow up questions were collected to explore the association between major households' socio-economic characteristics and choice of attributes by conducting chi-square test using Stata 12.0 software. The aim is to assess the validity of the valuation exercise. To do that, a simple cross tabulation was carried out between socio-economic variables like age, family size, read and write, and farm size and income reforestation and exclosure attributes. T Gemessa and Zander (2012) reported strong association between household characteristics, their endowments and constraints, and the level of development integration (in the areas of basic infrastructure and agricultural extension) and farmers' private valuation of crop variety attributes. In our case, the difference between group for these variables is significant (see Tables 10 and 11 below).

On the other hand, there is no difference with in group of three variables sex, marital status and off-farm income in selecting both reforestation and exclosure attributes. This is because as in most of the

country most of household heads is male (low female respondents was included), most of our respondents are married (low unmarried respond nets were included) and most of our respondents livelihoods depends on agriculture (low farmers who practice nonfarm income were included). The difference between group for the three variables is insignificant (see Tables 10 and 11 below).

4. Conclusion and policy implications

Increasing demand for agricultural land caused by population growth, both people and livestock, frequent wildfire, overgrazing, firewood/ charcoal production, etc are increasing deforestation and attendant impacts in reduction in ES in the BER. In the highland and midland excessive deforestation and soil erosion is affecting its ecosystem functions and has severe resource impacts downstream. In the lowland, where a pastoralist way of life is dominant, recurrent drought, land degradation and floods emerging from high and midland communities increases soil and biodiversity erosion and flooding in the downstream, critically affecting availability of water and feed resources. To reverse these problems, interventions public measures such as reforestation/afore-station, biological and physical SWC, in the highland and midland, and putting up exclosures, in the lowland, have been going on for the past decades. However those interventions were not successful as expected in the area. Successful implementation of NRM requires careful consideration of the preferences of the local community, including valuation of the ES, so that policymakers could make sound policy decisions. Management strategies that fully involve local communities at all stages of implementation, may help development planners and practitioners to address the problems associated with land degradation and reduction of ES. This study sought to analyse the preferences of the community in the BER for improved ecosystem benefits, and estimated their WTP using a choice modeling approach.

The findings of this paper confirm that across the BER most households are aware of the adverse impacts of human activities on the health and ecosystem functioning. The findings also indicate that communities are willing to contribute to alternative resource management practices (interventions) that improve ES in the area.

Midland respondents are willing to pay less for the improvement of biodiversity, which may be due to a lack of awareness of the benefits of preserving biodiversity or the design of the afforestation measures giving less attention to biodiversity. Mechanisms for increasing households' benefit from increasing biodiversity are worth thinking about in the BER and beyond. Midland respondents marginal WTP for improvement on soil erosion, CO_2 storage, and non-timber forest product were 34, 33, and 32 ETB per year respectively. Similarly lowland respondents mean WTP to reduce soil erosion, to improve biodiversity, livestock feed availability and combining exclosure with watering points were 24, 17, 280 and 129 ETB per year respectively.

Findings show that respondents' from both midland and lowland communities are willing to pay for alternative resource management practices to improve ES in the BER. The midland communities' compensating surplus (mean WTP) estimates, in terms of labor and money, for reforestation program were 1,827 ($87) ETB/year for low impact improvement scenario, 2,516 ($120) ETB/year for medium-impact improvement scenario and 3,053 ($145) ETB/year for a higher scenario. The lowland respondents' WTP 882 ($42), 1,558 ($74), and 2,383 ($113) ETB annually for low, medium and high impact scenarios respectively. While this estimates are of value for thei own sake, it should be noted that, given the complexity of ES and the spatial variation in terms of the benefits they provide as well as the level of demand they attract, the risk of their loss or degradation, the opportunities for enhancing them and the opportunity costs associated with supplying them, it is unlikely that mean WTP provide universal prices for specific services (DERA 2013). These valuation results could be considered as indicative, requiring further work, when designing and implementing PES in BER. The association between soco-economic factors and both

reforestation and exclosure attributes valuation conducted by Gemessa and Zander (household characteristics, their endowments and constraints, and the level of development integration (in the areas of basic infrastructure and agricultural extension) affect farmers' private valuation of crop variety attributes.

This study has important policy implications in environmental policymaking. Understanding the preferences of people in the BER for better ES and their WTP is critical for the sustainable development of the whole eco-region. Policymakers and stakeholders can use this valuable information as a relevant input to do a cost-benefit analysis of possible interventions to conserve NRM in the BER. The findings also point out that the majority of the respondents from both lowland and midland communities are willing to spend a substantial amount of resource and time (measured in terms of money) on reforestation and exclosure interventions to improve ES in the BER. Therefore, it is essential to redesign reforestation and exclosure schemes based on farmers WTP or gauging farmers'willingness to participate in these measures by contributing their labor.

Although the study gives insightful policy implications about the preferences of people in BER for better ES, it has some limitations. For instance, the study did not attempt to explore the linkages of ES between upstream and downstream communities. Establishing such linkages could be helpful for increasing awareness to intimate PES in the BER and beyond. We would like to suggest future research in establishing those linkages and design PES schemes following the principles outlined by (Wunder, 2005, 2015; Engel et al., 2008). The latest developments, undertaken by the government of Ethiopia, developing the policy framework for PES (EFCC, 2019) and developing a draft proclamation on PES (FDRE, 2019) are encouraging.

contributed to the completion of this study. All views and results of this study are only that of authors.

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