Research on World Agricultural Economy
https://journals.nasspublishing.com/index.php/rwae

REVIEW

The Economic Value of Forest Services in the Keffa Zone, Ethiopia: Discrete Choice Experiment Approach

Seyfe Fikre Hailu [1] **, *Stanley Osezua Ehiane*** [1,2*]

[1] *Department of Development Studies, University of South Africa (UNISA), P. O. Box 392, Unisa, Pretoria 0003, South Africa*

[2] *Department of Political and Administrative Studies, University of Botswana, Gaborone PMB 0022, Botswana*

ABSTRACT

The value of forests encompasses both direct market benefits and non-market advantages related to nature conservation. The value of forests, including timber, lumber, pulp, and paper, is exchanged through markets. However, many of the benefits of forests do not pass through the market. The study was carried out to estimate the non-market economic value of forest resources in the Keffa Zone, Ethiopia. To address the objective, a cross-sectional research survey was conducted among 343 households, with face-to-face interviews serving as the primary data collection method. The study was conducted on five forest attributes: harvested forest products, rainfall attraction, soil conservation, tourism-generated employment, and the use of the forest for future generations, representing the non-market value of the forest. The discrete choice experiment estimate, based on multinominal logistic regression, was used to analyse the data and estimate the economic value of the forest. The study estimates that households would pay an average of $7.71/year/hectare for forest conservation to achieve 20% more additional rainfall and water availability. The households are also willing to pay an average of $2.32/year/hectare for the forest's conservation to avoid 20% soil loss. The households in Keffa would annually pay an average of $9.10/year/hectare and $1.31/year/hectare for the forest's conservation, receiving 10% and 20%, respectively, more tourism-generated

*CORRESPONDING AUTHOR:
Stanley Osezua Ehiane, Department of Development Studies, University of South Africa (UNISA), P. O. Box 392, Unisa, Pretoria 0003, South Africa; Department of Political and Administrative Studies, University of Botswana, Gaborone PMB 0022, Botswana;
Email: stanleyeheiane@yahoo.com

ARTICLE INFO
Received: 3 October 2024 | Revised: 29 October 2024 | Accepted: 31 October 2024 | Published Online: 2 September 2025
DOI: https://doi.org/10.36956/rwae.v6i4.1361

CITATION
Hailu, S.F., Ehiane, S.O., 2025. The Economic Value of Forest Services in the Keffa Zone, Ethiopia: Discrete Choice Experiment Approach. Research on World Agricultural Economy. 6(4): 82–95. DOI: https://doi.org/10.36956/rwae.v6i4.1361

income and employment. The estimated results suggest that the local community supports the conservation of the forest, and households are willing to contribute considerable resources for the proposed conservation programme in the study area.

Keywords: Forest Valuation; Discrete Choice Experiments; Willingness to Pay; Keffa Zone; Ethiopia

1. Introduction

The day-to-day activities of humans depend on forest resources. Forests are one of Ethiopia's significant natural endowments. The country's forests occupy 17 million hectares (approximately 15.7% of its total surface area) [1], and are inhabited by close to 10% of its total population [2]. Recent assessments indicate that the forest sector's contribution has increased from 8% to 12% of the national GDP [1]. The forest resources maintain slope stability, flood protection, stabilise the microclimate, and support the game reserve. In addition, forest resources are also used for food production, tourist attractions, carbon sequestration, recreation, and biodiversity conservation.

While forest resources provide significant benefits to humanity, their rapid depletion is increasingly evident. For instance, Ethiopian forests suffered a mean annual net forest loss of 73,000 hectares per year between 2000 and 2013 [3]. The trend in Ethiopia today is to protect the remaining natural forests for their various social, economic, and environmental values [4]. In 2015, the Ethiopian government initiated a programme to increase forest coverage from 15.7% in 2015 to 30% by 2030 [5]. The remaining forest coverage is limited to the southeastern and southwestern parts of the country.

The Ethiopian government affirms that the calculations of the economic value of the protective and environmental services provided by forests are vitally important for making well-informed public policies on forest management and development, as well as for increasing public social welfare and well-being [5]. Previous studies on forest resources have focused mainly on the key factors responsible for deforestation [6–9]. The high rate of deforestation is largely attributed to inadequate evaluation and the market's failure to value unpriced forest ecosystems [8,9]. A study carried out in Belete Gara forest, located in the southwestern part of the Ethiopia, revealed that households' socioeconomic factors, mainly landholding size, and the weak implementation of forest policies contributed to further depletion of forest conservation [3].

Forest resources are non-excludable social goods, vital for the day-to-day activities of human beings; yet, there are no markets that accurately reflect their value [10]. The concept of value underscores the set of human preferences. Consequently, economic value functions as a link between an entity and various human preferences, measuring the amount of sacrifice made by individuals to obtain other goods, services, or states of the world [11].

Forest resources are recognised to have several values, including intrinsic, economic, ecological, cultural, and aesthetic value. Forest resources have economic value as they are a scarce resource and capable of generating human welfare [12]. The decision on the management and conservation of forest resources depends on economic criteria such as the demand for agricultural land or the demand for exporting forest products to earn foreign exchange [13]. Undervaluation of those welfare-enhancing resources introduces an inherent distortion in resource allocation. Currently, more emphasis is placed on direct use value; however, most of the benefits of forests are not quantified in terms of economic value [14,15].

The Keffa Zone is known as the origin of the Arabica coffee gene pool. The place represents the last primary forest cover in Ethiopia. The area covers 56% of Ethiopia's forest resources [16]. However, the forests in the Keffa Zone are subject to rapid depletion and deforestation. For example, the coffee forests of the Kefa districts are experiencing alarming deforestation at annual rates of up to 9% [16]. Therefore, it is becoming increasingly important to identify and evaluate the benefits of forests due to the increased pressure on natural resources. In light of this, it is important to exam-

ine the local communities' preferences and willingness to contribute resources to the forest conservation programme in the study area. Previously, limited research has been conducted to investigate the causes of deforestation, such as family size and landholding size, as well as the weak implementation of forest conservation policies in relation to forest resource conservation [3,16]. Moreover, the households' preference for forest conservation depends on their willingness to accept (WTA) relative to coffee production, the number of livestock, and the use of forest products. Family size and education were the main factors influencing respondents' WTA [17].

Similarly, the research on the non-use value of forests in southwestern Ethiopia, in particular the Keffa Zone, was carried out using the contingent valuation method (CVM) with limited forest resource attributes [3,18]. However, CVM has been criticised for its stand-alone binary choice task [19–21]. On the other hand, the discrete choice experiment (DCE) allows respondents to make a discrete choice between two or more alternatives in a choice set [11]. The main objective of this study is to estimate the non-marketed economic value of forest resources in the Keffa Zone, Ethiopia, through the application of the DCE. In line with this, the study uncovered the household's willingness to pay for forest conservation in relation to the attributes of harvested forest products, soil conservation, rainfall and water attrition, tourism-generated employment, and the use of the forest for future generations.

2. Forest Resource Valuation Method

The non-use value forest has been the subject of studies worldwide through different valuation methods [9,10,15]. Among the valuation methods used, the revealed preference (RP) and stated preference (SP) methods had a relatively superior advantage when applied in environmental resource analysis [22,23]. The application of the RP method is useful for analysing data from actual market transactions, while SP can be applied to the non-market attributes of environmental services [19]. The SP method consists of the contingent valuation method and the discrete choice experiment, in which respondents indicate their willingness to pay for specific attributes [11]. In CV surveys, people are presented with a hypothetical change in the provision of goods or services and are asked to state their WTP (or WTA) for the change [15,24]. The CV elicits individual expressions of value from respondents for specified increases or decreases in the quantity or quality of a non-market good [23]. At the same time, DCE involves asking individual respondents to choose among alternative bundles of non-market goods, which are described in terms of their attributes, including a hypothetical price [23]. The CV is often used to refer to a specific elicitation technique, namely the stand-alone binary choice task [20]. While DCE involves something more than a single choice set and allows, in contrast to CV, the estimation of both the marginal value of changing attributes and the total [24].

3. Material and Methods

3.1. Study Area

The study was conducted in the forestry area within the Keffa Zone, located in the southwestern part of Ethiopia. The study area was 454 km away from the Ethiopian capital, Addis Ababa, and lies between latitudes 6°24' to 7°70' north and longitudes 35°69' to 36°78' east. The Keffa Zone is known as the birthplace of Arabica coffee, boasting rich biodiversity and diverse array of plant and animal species. The total area of the district is 10.636 km^2, of which 47% of the area is covered by forest [25]. The landscape is characterised by numerous rivers of varying sizes, and features a diverse topography that includes flat plateaus, rolling hills, mountainous terrain, forests, and steep slopes [25].

Although the Keffa Zone is known for its dense forest, three forest locations have covered over 90% of the forest area. These forest locations are Bonga Forest, Boginda Forest (located in Gewata wereda), and Mankira Forest (located in Decha wereda) [25]. Therefore, the study was carried out in the three forest locations as indicated in **Figure 1**.

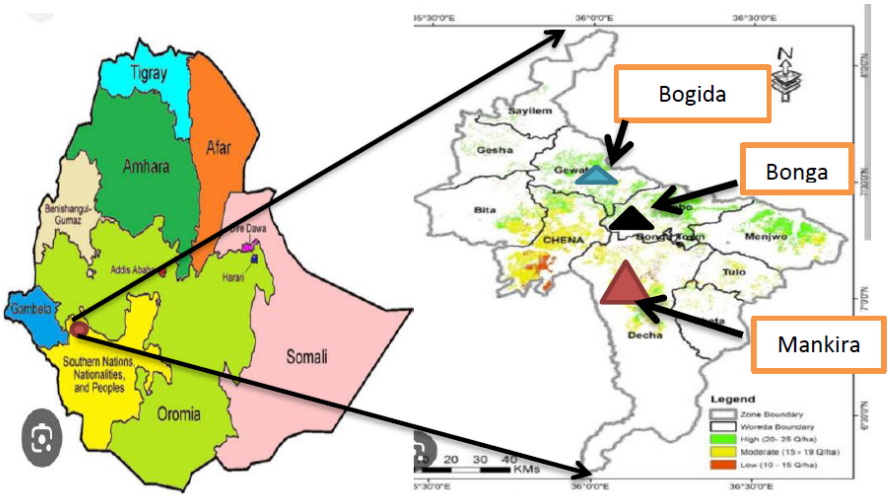

Figure 1. Maps of the study area.

Source: Keffa Zone Administration Office.

3.2. Data Source

The study used the primary data set collected from households in the Keffa Zone. Survey units are households that reside within a 10-km radius of the forest edge. Although the recent statistics on households residing in the district, specifically around the forest, were not defined, it was estimated that approximately 1,000 households used to live around the forest[25]. Bearing this in mind, the required sample determined by using household sample size estimation formula[26]. The study sample estimated by using a 95% confidence interval, with a margin of error (ME) of 0.05, p (expected prevalence) = 0.8. Thus, based on the proposition the final sample size of 355 households was targeted in the study.

The required sample size is determined based on the following Equation (1):

$$ME = z\sqrt{p(1-p)/n} \quad n = \frac{z^2 * p(1-p)}{ME^2} \qquad (1)$$

While n = sample size, z = confidence interval, p = expected prevalence, ME = margin of error

The total number of questionnaires distributed was 355 (including a 10% non-response rate) across all three forest locations. The sample size for each selected forest location was determined based on previous study, which indicated that there were 145 households living in the Boginda forest area, approximately 170 households in the Mankira forest area, and 250 households in the Bonga forest[25]. The sample size from each forest location was selected using the proportional sampling technique. Accordingly, 91, 107, and 157 sample households were selected from Bogida, Bonga, and Mankira forest locations, respectively. Once the sample size was determined, the households were selected randomly for the discrete choice experiment. Face-to-face interviews were conducted to collect data from the sample households. Data collection was carried out in November 2020.

3.3. Design and Attribute Selection

The attributes selected for a discrete choice experiment should fulfil the following requirements: Attributes must be (a) relevant to demand, (b) policy-relevant, and (c) measurable[6]. Identifying the attributes of the forest that the locals attaches the greatest importance. In light of this, the researcher carried out a pilot test, key informant interviews, and document reviews to identify the attributes in the study area. A pilot study was carried out on 20 households to identify the attributes and design the choice task. During the pilot test, the households were asked to pick (rank) which of the forest services they attached more to their day-to-day activities. Moreover, the researcher consulted the local forest administration regarding the forest attributes. In line with attribute selection, appropriate labels for the attached non-use forest services were carefully stud-

ied. After consulting with the Ethiopian Forestry Policy Programs and the local forest conservation office, the study proposed increasing forest coverage from its current share by up to 60%. The share of forest coverage used in the study does not necessarily represent the actual programme implemented by the administration, but it is consistent with the forestry programme in Ethiopia [5]. The study on hand used six attributes to improve the forest value with varying levels, as shown in **Table 1**.

Table 1. Attribute design and level.

Attribute	Function of Forest	Level Quantity
Harvested forest products (HFP)	Use of forest products for different purposes (years wait to get harvested forest products).	1. No, I do not want to wait[a] 2. 1–3 years 3. 4–7 years 4. 8 and above
Attraction of rainfall (AR)	The forest is also used for conservation of water and attraction of rainfall (change by new forest).	1.No change[a] 2. 20% change 3. 40% change 4. 60% percentage
Soil conservation (SC)	The forest is used as a way of protecting soil erosion and degradation (change by new forest).	1.No change[a] 2. Decrease soil loss by 25% 3. Decrease soil loss by 50% 4. Stop soil loss
Tourism-generated employment (TGE)	The forest is used as a source of income through tourism-generated employment.	1.No change 2. Income would be high by 20% 3. Income would be high by 40% 4. Income would be high by 60%
Use of forest by future generations (FG)	The forest is considered an asset to be transferred to future generations.	1.Yes 2. No[a]
Forest conservation payment	Household ability to pay for forest conservation	1. 10$/ hectare/year 2. 15$/hectare/year 3. 20$ hectare/year 4. above 25$/hectare/year

Note: [a] indicates status que.

3.4. Model Specification

The DCE was used to gain an understanding of individuals' preferences by observing their choices. The Random Utility Theory (RUT) explains the stochastic nature of utility maximisation in the context of choice behavior [6]. The DCE and RUT have a robust connection, as RUT explains the presence of randomness in individuals' choice behaviour, which forms the basis of the design and analysis of choice experiments [27]. The utility function can be expressed as a deterministic element and a random element (e). Deterministic elements consist of the attribute (X_j) and socioeconomic characteristics of the respondent (S_i) [27]. Therefore, the respondent's utility function can be expressed as Equation (2):

$$U_{ij} = (X_j, S_i) + e \quad (2)$$

More specifically, the utility function can be expressed as Equation (3) in linear form.

$$V_{ij} = \beta_{j0} + HFBXj1 + ARXj2 + SCXj3 + TGEXj4 + FGXj + PaymentXjn(3) \quad (3)$$

Where $\beta j0$, is the constant value which captures the observable average effect, X_{ji} represents the attribute.

The coefficient of the linear function estimation is only possible based on the assumption of random components of the model. A typical assumption is that these stochastic components are distributed independently and identically (IID). This leads to the use of multinomial logit (MNL) models to determine the probabilities of choosing one over the other [13]. Therefore, the study applied the MNL model to calculate the probability of choosing one option over the other. Moreover, the respondent's willingness to pay for maintaining the current status quo of improvement in the choice of attributes can be defined based on the marginal WTP calculation.

The marginal WTP measures are given by the ratio

of two parameters as presented in Equation (4).

$$\text{WTP} = -\left(\frac{\beta\text{attribute}}{\beta\text{price}}\right) \quad (4)$$

3.5. Statistical Significance Tests

DCE is an application of the value characteristics theory, combined with the random utility theory [6]. The assumptions are made about the random component of the model. A typical assumption is that these stochastic components are distributed independently and identically (IID).

Multinomial logit models assume that the choices are consistent with the assumption of the independent from irrelevant alternative (IIA) property [28]. The assumption states that, for any individual, the ratio of the choice probability of any two alternatives is entirely unaffected by the systematic utilities of any other alternative. DCE can be tested for this property. If the assumption of IIA is violated, the standard random utility model can no longer be applied [19].

The study on hand tests for IIA is based on the hypothesis specified as:

H_0. *Odds (outcome h versus outcome j) are independent of any other alternative.*

H_1. *Two alternative outcomes are affected by the other alternative.*

The assumption of independence of irrelevant alternative (IIA) was tested using the Hausman test, and the result indicates that the assumption of IIA was not violated [chi2 (14) = -28.69]. Despite it being unusual, a negative outcome of the Hausman test may still be taken as support for the Null hypothesis [29].

The summary of the sampled households from each forest location is presented in **Tables 2**, **3** and **4**. Additionally, the appropriateness of the model was tested by using several testing mechanisms. Since the multinomial logit model applied the response factors and categorised them into the current situation (statuesque), improved situation A (alternative 1) and improved situation B (alternative 2). The study proposed a 20% increment in forest coverage as the first alternative and a 40% increment of forest coverage in the second alternative.

Table 2. Location of sample households.

Residence	Frequency	Percentage
Bonga	116	33.8
Mankira	110	32.1
Boginda	117	34.1
Total	343	100

Source: Survey result, 2020.

Table 3. Sample household descriptive statistics.

	Variable	MeanN=343	Standard Deviation	Minimum	Maximum
Total	Age	45.61	15.63	20	89
	Family size	5.6	2.5	1	15
Male (N=318)	Age	45.8	15.9	20	89
	Family size	5.7	2.5	1	15
Female (N=25)	Age	43.6	11.7	20	65
	Family size	4.4	2.1	10	10

Source: Survey result, 2020.

Table 4. Household head literacy.

Sex of the hh Head	Illiterate (%)	Literate (%)	N	Pearson chi2
Male	42.8	57.2	318	Pearson chi2= 582.6
Female	72	28	25	Pr = 0.000***
Total	45	55	343	

Note: *** indicates statistically significant at 1%.
Source: Survey result, 2020.

Moreover, scope sensitivity is also an empirical test used to ensure whether WTP estimates from two (or more) valuation scenarios (say, A and B) with different levels of environmentally good provisions are statistically different[30]. The scope sensitivity test is based on the hypothesis:

$\mathbf{H_0}$. $\beta_{scope} = 0$ $\mathbf{H_1}$. $\beta_{scope} \neq 0$

The hypothesis implies that failure to reject the null hypothesis would indicate scope insensitivity. The study carried out a scope sensitivity test, and the results are presented in the results and discussion section. The researcher utilised SPSS version 20 and STATA 16 for data analysis.

4. Results and Discussion

4.1. Descriptive Analysis Result

The study carried out data collection from 355 households from three forest locations in the Kefa zone, of which 343 households were used for the analysis. The summary of the sampled households from each forest location is presented in **Table 2**.

Table 2 shows that 33.8% of the sample households were obtained from the Bonga Forest, while the remaining 32.1% and 34.1% of the sample households were from Mankira and Boginda Forest locations, respectively.

As revealed in **Table 3**, the average age of the heads of households is 43.6 years, and the average age of the male heads of household is 45.8 years. The average household size among the study population in the three forest areas is 5.6 people per household.

As shown in **Table 4**, 45% of the sample population was illiterate. The level of illiteracy was higher among female household heads (72%) than among male household heads (42.8%).

4.2. Model Estimation

In addition to the descriptive analysis, the econometric analysis used for this section presents the MNL regression result. The econometric models used here are based on the econometric theory and specifications developed in the methodology sections. This section presents the estimation of the model's results, being a marginal willingness to pay with a 95% confidence interval for each attribute. **Table 5** reports the estimated model, **Table 6** and **Table 7** presents the marginal willingness to pay and 95% confidence interval for different alternatives.

Table 5. Model estimation.

	(2)	**(3)**
Variables	**Improved Situation A (20%)**	**Improved Situation B (40%)**
Payment	−0.120 (0.163)	−0.0831 (0.157)
HFP	−0.0801 (0.138)	0.433*** (0.134)
AR	0.265 (0.173)	0.641*** (0.166)
SC	−0.278* (0.155)	0.231 (0.150)
TGE	1.093*** (0.155)	1.308*** (0.151)
FG	−0.0480 (0.135)	0.307** (0.130)
Constant	0.137 (0.752)	−4.343*** (0.765)
Observations	343	343 LR chi2(12) = 410.86 Prob > chi2 = 0.0000 Log likelihood = −1253.6674 Pseudo R2 = 0.1408

Note: The current situation is used as a base category, Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Survey result, 2020.

Table 6. Average WTP estimates for each attribute (Test for scope insensitivity).

	(1)	(2)	(3)
Attribute	**Statuesque**	**Improved Situation A**	**Improved Situation B**
HFP	−0.009* (0.005)	−0.07*** (0.010)	0.08*** (0.011)
AR	−0.02** (0.006)	−0.05*** (0.012)	0.07*** (0.012)
SC	−0.002 (0.005)	−0.075*** (0.011)	0.07*** (0.012)
TGE	−0.05*** 0.0067	−0.014 (0.001)	0.064*** (0.009)
FG	-0.01 (0.005)	−0.05*** (0.011)	0.057*** (0.011)
Payment	0.004 (0.006)	−0.016 * (0.011)	0.003 (0.012)

Note: (I) derived from MNL model, (II) Standard errors are in parentheses, (III) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Mean willingness to pay estimation.

	(2)	(3)
Variables	**Improved Situation A**	**Improved Situation B**
HFP	−0.67 (−3.84 , 2.51)	−5.22 (−8.56, −1.86)
AR	2.21 (−1.64, 6.04)	7.71 (1.63, 13.78)
SC	−2.32 (−4.59, −0.04)	0.23 (−1.63, 7.19)
TGE	9.1 (4.11, 14.1)	1.31 (13.67, 17.8)
FG	-0.4 (−2.79, 1.99)	0.31 (1.12, 6.23)

Note: The first and last values in brackets represent the 95% confidence interval limits, and the values on top represent the corresponding point estimates.
Source: Survey result, 2020.

All coefficients have the expected sign, except the attribute of soil conservation under improved situation A. The coefficients of soil conservation were found to be negative and significant at 10% significance level. Similarly, under improved situation A, the attribute of forest in tourism generation income was found to be positive and significant at a 1% significance level. The coefficients of conservation payment were found to be negative in both improved situations, which imply that household forest conservation demand diminishes as forest conservation payment increases. Households are sensitive to changes in the price of forest conservation.

Under the improved situation B of forest conservation, the coefficients of all attributes have the expected signs. The coefficients of harvested forest product (HFP), attraction of rainfall (AR), and tourism-generated employment (TGE) were found to be positively significant at the 1% level. Moreover, the coefficients for future generations were also found to be positive and significant at 5% significance level. These results indicate that under the improved situation B (a 20% increase in forest conservation), the benefits provided by the forest in terms of forest products, rainfall attraction, tourism-generated income, and benefits to future generations would be more lucrative compared to the current situation. The coefficients of the conservation payment were found to be negative, as expected, but they are insignificant.

The harvest forest product attributes were found to be significantly positive under improved situation B compared to the current situation. The coefficient (β = 0.433) indicates that households obtained more utility

and satisfaction from the improved forest B in terms of the forest products harvested. The harvested products could include timber and timber products, as well as extraction of forest resources as a raw material for industry. The household utility from the improved forest situation B was only 0.43 units higher than the current situation. The result showed that households in the forest area are directly or indirectly dependent on the collection and harvesting of forest products. Similarly, many rural households depend on forest resource extraction for their livelihood, which means that households were found to be interested in forest conservation for survival.

4.3. Marginal Willingness to Pay (WTP) Estimate

Table 6 reports the mean marginal WPT and the confidence interval for each attribute under improved situations A and B. The marginal willingness to pay (WTP) as a point estimate for each attribute corresponds to the average or maximum amount that the surveyed population would be prepared to pay annually and indefinitely for one unit improvement in the attribute. The value reported in WTP is based on the November 2020 exchange rate ($1 = 36.2 ETB) and is reported in terms of the United States Dollar.

Table 7 presents the separate WTP estimates for harvested forest products, rainfall attraction, soil conservation, tourism-generated employment, and the value of using the forest by future generations. The results of separate WTP for harvested forest products and rainfall attraction are statistically significant for all labels. Similarly, the estimation of the WTP for soil conservation, tourism-generated employment, and the use of the forest for future generations were found to be statistically significant, indicating an improvement in forest coverage. Most estimates of average WTP are statistically significantly different from zero, implying that increasing their provision impacts welfare. Hence, households prefer spatially focused improvements to forest resource coverage.

The marginal willingness to pay for the attribute of harvested forest products was found to be negative for the improvement in forest coverage of forest resources. The marginal WTP was found to be US$ -0.67/year/hectare and US$ -5.2/year/hectare for additional improved situations A and B, respectively. As the years of waiting for an increase in forest products, increasing forest coverage by 10% in each situation decreases household utility. The possible reason might be that an increase in forest coverage is possible at the expense of agricultural land, and the households may have to convert their arable land into forest areas if the return obtained from the forest takes longer. Moreover, the attribute of the harvested forest product was measured in terms of the maximum number of years that the households could wait to get the forest products. As the number of years required to obtain forest products increases, the willingness of households to wait or their utility declines. A negative marginal WTP for the attribute indicates that the average individual would be better off with a reduction in the attribute.

People recognise the benefit of forests in providing, improving, and maintaining water availability. The result indicates that the attribute of rainfall attraction and water availability was found to be positive and significant at the 1% level under improved situation B (increased forest coverage up to 40%). The result indicated that compared to maintaining the current situation, improving forest conservation by about 20% would increase water availability and rainfall attraction by 0.64% more than the current level. The previous study also showed that, households recognise the forest service in enhancing human welfare by maintaining and improving water quality, as well as attracting rainfall [31,32]. On the other hand, people are blind to forest ecosystem services in watershed offers [10]. Households in the study area pay close attention to the forest ecosystem service for its role in attracting rainfall and ensuring water availability.

The WTP result is also positive, indicating that households are willing to pay to obtain better rainfall attraction and water availability (US$7.71/year/hectare) by improving forest conservation by up to 20%. Despite the willingness of households to pay for forest services in terms of rainfall and water availability was found statistically significant, it was found below the expectation [32]. This indicates that the households recognise the forest ecosystem service in water retention and rainfall attraction.

Forest benefits in soil loss protection are signifi-

cantly recognised by rural households. An additional forest increment significantly reduces the amount of soil loss. The attributes for soil loss protection and soil conservation were negative and significant for improved situation A. The utility of households decreases due to additional soil loss resulting from the loss of forest cover. Consequently, the households believe that improved forest conservation by only 10% may not be sufficient to protect 20% of the soil loss. Local people would experience a loss of welfare equivalent to US$2.32/year/hectare for each unit of soil loss resulting from such forest conservation practice.

The coefficient for the tourism-generated employment attribute was also found to be positive and significant for both the improved situation (A and B) of forest conservation. The coefficients of TGE (β = 1.09 and β = 1.31) indicate that the households' utilities were found to be more than the current situation by 1.09 and 1.31 units for the improved situations A and B, respectively. The result reaffirm that Forests provide a wide range of provisioning and cultural services, as well as employment opportunities for the people living around forest areas [31].

The marginal willingness of the households to pay for the attribute of tourism-generated employment was found to be US$ 9.1/year/hectare and US$ 1.31/year/hectare for each additional unit of forest conservation in situations A and B, respectively. The result reaffirm that forest contribution for residents is more important than that of non-resident owners due to the non-market role of forests in terms of employment opportunities for tourists [7]. The household WTP was found to be positive, and a possible reason could be that tourism employment drives alternative livelihood activities (other than agricultural activities) for households, which decreases pressure on the forest.

The other important attribute of forest conservation is the sustainable use of resources for future generations. There is always a trade-off between current consumption and the needs of future generations. Forests provide an even more important ecosystem service to future generations in terms of water retention, carbon storage, soil conservation, and biodiversity conservation [6]. The regression result indicates that the future generation coefficient for improved situation B was found to be positive (β = 0.307) and significant at the 5% level. The result indicates that households derive more utility from forest conservation for future generations by increasing forest coverage by approximately 20%. The households believe that the forest provides more benefits to future generations than their current consumption, and their willingness to pay was found to be US$ 0.3/year/hectare for improved forest conservation.

Finally, the payment vehicle was found to be negative but insignificant. The result indicates that as the forest conservation payment increases, the households' utility decreases and they become less interested in the forest ecosystem service. The result also confirms that high forest conservation payment decreases the households' utility from forest ecosystem services and the households' marginal willingness to pay would be negative [33].

5. Conclusion and Recommendation

The study focused on the economic valuation of forest resources in forestry districts, targeting households as the primary population. Overall, the study has found that households residing in forest areas consider the non-use value of forests to be more beneficial in terms of soil loss protection, rainfall attraction, and tourism-based employment opportunities.

1. Soil Loss Protection: Forests play a crucial role in protecting against soil loss. Rural households recognise this benefit, and research indicates that even a 10% improvement in forest conservation may not be enough to prevent a 20% loss of soil. The economic impact of soil loss is significant, with households potentially losing welfare equivalent to $2.32/year/hectare for each unit of soil lost. In conclusion, forests are vital for safeguarding against soil erosion, a fact that is well acknowledged by rural households. However, the findings suggest that even a modest enhancement in forest conservation efforts, such as a 10% improvement, may be insufficient to avert substantial soil loss, projected at 20%. This underscores

the urgent need for more robust and effective conservation strategies to protect forest ecosystems and, consequently, the livelihoods of rural communities reliant on healthy soil for agriculture and overall well-being. Enhanced forest management not only preserves soil quality but also supports the economic stability of these households, highlighting the interconnectedness of environmental health and community welfare.

2. Tourism-Generated Employment: The study highlights a positive correlation between forest conservation and employment opportunities generated by tourism. The coefficients for TGE suggest that households derive more utility from improved forest conservation situations. This indicates that residents value the employment opportunities provided by forests more than non-residents. In conclusion, the study reveals a significant positive correlation between forest conservation and the employment opportunities created by tourism. The findings indicate that households derive greater utility from enhanced forest conservation, emphasising that residents place a higher value on the job prospects associated with healthy forest ecosystems compared to non-residents. This highlights the critical role that sustainable forest management plays not only in preserving natural resources but also in fostering economic development within local communities. Strengthening conservation efforts can lead to increased employment opportunities, thereby enhancing the overall well-being of residents and promoting a sustainable tourism model that benefits both the environment and the local economy.
3. Sustainable Resource Use: The concept of sustainability is emphasised, with a focus on the trade-off between current consumption and benefits for future generations. Households are willing to invest in forest conservation for the sake of future generations, as indicated by a positive coefficient ($\beta = 0.307$) for improved situation B. The WTP for this attribute is \$0.30/year/hectare. In conclusion, the findings underscore the importance of sustainability, particularly in the context of forest conservation and its long-term benefits for future generations. The positive coefficient ($\beta = 0.307$) for improved situation B indicates that households recognise the value of investing in conservation efforts, demonstrating a willingness to contribute financially at a rate of \$0.30/year/hectare. This willingness to pay reflects a collective commitment to striking a balance between current consumption and the need to preserve natural resources for the benefit of future generations. Ultimately, these insights highlight the potential for fostering sustainable practices that not only protect the environment but also align with the values and priorities of local communities.
4. Payment Vehicle: Interestingly, the study found that as the cost of forest conservation increases, household utility decreases, suggesting that higher payments can lead to reduced interest in forest ecosystem services. This finding aligns with previous research indicating that high costs can deter households from valuing forest conservation.

In summary, the findings underline the economic importance of forests in providing soil protection, generating employment through tourism, and promoting sustainable resource use, while also highlighting the challenges associated with the costs of conservation efforts.

Finally, the households demonstrate a positive preference for improved forest conservation practices, recognizing the forests' roles in attracting rainfall, conserving soil, generating tourism-related employment, and utilising resources for future generations. Furthermore, forest management needs to meet the interests of local communities. Therefore, an intervention is needed to improve forest conservation based on societal interest, such as community-based forest resource management and participatory forest management.

Based on the findings, the following recommendations are made:

Households value the forest service for its role in soil conservation, improving the soil quality, and retaining water. Therefore, the households' efforts should be promoted by implementing agroforestry practices, which will help the households integrate trees into agri-

cultural systems. This practice enhances soil fertility, reduces erosion, and improves water retention.

Promote eco-tourism initiatives that leverage the value of forest ecosystems while ensuring that local communities benefit economically. This can include guided tours, wildlife observation, and cultural experiences that highlight the importance of forests.

Invest in training programmes for residents to equip them with the skills needed for jobs in the tourism sector. This can include hospitality training, tour guiding, and environmental education.

Foster partnerships between local communities and tourism operators to create job opportunities that directly benefit residents. This collaboration can also enhance the visitors' experience by providing authentic local insights.

Develop marketing campaigns that promote the unique natural and cultural assets of the area to attract more visitors, thereby generating increased employment opportunities linked to forest conservation.

Establish programmes that educate households about the long-term benefits of investing in forest conservation, emphasising its impact on future generations and overall community welfare.

Design programmes that allow households to contribute financially to conservation efforts based on their willingness to pay. This could include a small annual fee for forest maintenance or participation in conservation projects.

Integration of Conservation into Local Policies: Advocate for local policies that prioritise sustainable resource use and forest conservation, ensuring that these principles are embedded in regional development plans.

By implementing these recommendations, stakeholders can enhance forest conservation efforts, protect against soil loss, create employment opportunities through tourism, and promote sustainable resource use, thereby contributing to the well-being of the communities and the health of forest ecosystems.

Author Contributions

Writing—original draft preparation, S.F.H.; writing—review and editing, S.O.E. All authors have read and agreed to the published version of the manuscript.

Funding

This work was supported by Bonga University grant number 690/20.

Institutional Review Board Statement

The current research was carried out in accordance with the ethical considerations of Bonga University, Ethiopia. The Ethical Clearance number is BURD690/20.

Informed Consent Statement

The researchers provided participants with consent forms, clearly explaining the purpose of the study. The researchers allowed participants to take their time to review the consent form to ensure understanding and address any questions. Researchers reassured them that participation was optional and that they could withdraw or decline to participate in completing the questionnaires.

Data Availability Statements

Not applicable (this manuscript does not report data generation or analysis).

Acknowledgement

The author acknowledges financial support from Bonga University.

Conflicts of Interest

I declare that the authors have no competing interests as defined by Discover or other interests that might be perceived to influence the results and/or discussion reported in this paper.

References

[1] FAO, 2020. Global forest resource assessment: report, Ethiopia. Food and Agriculture Organization of the United Nations: Rome, Italy.

[2] FAO, 2010. Global forest resource assessment: country report Ethiopia. Forestry Department, Food and Agriculture Organization of the United Nations: Rome, Italy.

[3] Abdeta, D., Ayana, A.N., Bekele, Y., 2023. Willingness to pay for forest conservation: evidence from a contingent valuation survey analysis in Southwest Ethiopia. Global Ecology and Conservation. 46, e02551. DOI: https://doi.org/10.1016/j.gecco.2023.e02551

[4] Moges, Y., Zewudu, E., Sisay, N., 2010. Ethiopia forest resources: current status and future management options in view of access to carbon finances. Ethiopian Climate Research and Networking and United Nations Development Programme (UNDP).

[5] MoEFCC, 2017. Strategic environmental and social assessment (SESA) for the implementation of REDD+ in Ethiopia. Ministry of Environment, Forest and Climate Change: Addis Ababa, Ethiopia.

[6] Diafas, I., 2014. Estimating the economic value of forest ecosystem services using stated preference methods: the case of Kakamega forest, Kenya [PhD Thesis]. Goettingen, Germany: Georg-August-University.

[7] Nordlund, A., Westin, K., 2011. Forest values and forest management attitudes among private forest owners in Sweden. Forests. 2(1), 30–50. DOI: https://doi.org/10.3390/f2010030

[8] Babulo, B., Muys, B., Mathijs, E., 2006. Economic valuation methods of forest rehabilitation in exclosures. Journal of the Drylands. 1(2), 165–170.

[9] Negasi, S., Hishe, H., Annang, T., et al., 2018. Forest cover change, key drivers and community perception in WujigMahgoWaren forest of northern Ethiopia. Land. 7(1), 32. DOI: https://doi.org/10.3390/land7010032

[10] Tao, Z., Yan, H., Zhan, J., 2012. Economic valuation of forest ecosystem services in Heshui Watershed using contingent valuation method. Procedia Environmental Science. 13(2011), 2445–2450. DOI: https://doi.org/10.1016/j.proenv.2012.01.233

[11] Kerr, G.N., Sharp, B.M.H., 2010. Choice experiment adaptive design benefits: A case study. Australian Journal of Agricultural and Resource Economics. 54(4), 407–420. DOI: https://doi.org/10.1111/j.1467-8489.2010.00507.x

[12] DeShazo, J.R., Carson, R.T., Schwabe, K.A., et al., 2015. Designing and implementing surveys to value tropical forests. Journal of Tropical Forest Science. 27(1), 92–114.

[13] Hanley, N., Mourato, S., Wright, R.E., 2001. Choice modelling approaches: a superior alternative for environmental valuation? Journal of Economic Surveys. 15(3), 436–455.

[14] Barnes, J.I., MacGregor, J.J., Nhuleipo, O., et al., 2010. The value of Namibia's forest resources: preliminary economic asset and flow accounts. Development Southern Africa. 27(2), 159–176. DOI: https://doi.org/10.1080/03768351003740373

[15] Riera, P., Signorello, G., Thiene, M., et al., 2012. Non-market valuation of forest goods and services: good practice guidelines. Journal of Forest Economics. 18(4), 259–270. DOI: https://doi.org/10.1016/j.jfe.2012.07.001

[16] Stellmacher, T., 2013. Local forest governance in Ethiopia: between legal pluralism and livelihood realities. ZEF Working Paper Series. No. 110. Center for Development Research (ZEF), University of Bonn: Bonn, Germany.

[17] Assfaw, A., 2023. Assessing land owner farmers willingness to participate in reforestation project in Ethiopia. Journal of Forest Research. 9(4), 244.

[18] Seifu, T., Batu, M.M., Alemu, A., 2017. Economic valuation of natural forest: the case of Sheka Forest. Journal of Resources Development and Management. 37, 30–38.

[19] Czajkowski, M., Hanley, N., 2009. Using labels to investigate scope effects in stated preference methods. Environmental and Resource Economics. 44(4), 521–535. DOI: https://doi.org/10.1007/s10640-009-9299

[20] Hausman, J., 2012. Contingent valuation: From dubious to hopeless. Journal of Economic Perspectives. 26(4), 43–56.

[21] Hoyos, D., 2010. The state of the art of environmental valuation with discrete choice experiments. Ecological Economics. 69(8), 1595–1603. DOI: https://doi.org/10.1016/j.ecolecon.2010.04.011

[22] Carson, R.T., 1997. Contingent Valuation Surveys and Tests of Insensitivity to Scope. In: Kopp, R.J., Pommerehne, W.W., Schwartz, N. (eds.). Determining the Value of Non-Marketed Goods. Springer: Dordrecht, Netherlands. pp. 127–163. DOI: https://doi.org/10.1007/978-94-011-5364-5_6

[23] Bishop, J.T., 1998. The economics of non-timber forest benefits: an overview. Development, EEP Gatekeeper. GK 98-01, November 1998.

[24] Johnston, R.J., Boyle, K.J., Adamowicz, W.V., et al., 2017. Contemporary guidance for stated preference studies. Journal of the Association of Environmental and Resource Economists. 4(2), 319–405. DOI: https://doi.org/10.1086/691697

[25] Riechmann, D., 2007. Literature survey on biological data and research carried out in Bonga area,

Kafa. Introduction of sustainable coffee production and marketing complying with international quality standards using the natural resources of Ethiopia (Unpublished report).

[26] Cochran, W.G., 1977. Sampling Techniques, 3rd ed. Wiley: New York, NY, USA.

[27] Freeman, A.M. III, Herriges, J.A., Kling, C.L., 2014. The Measurement of Environmental and Resource Values: Theory and methods, 3rd ed. Resources for the Future Press: Washington, DC, USA.

[28] Adamowicz, W., Hanley, N., Wright, R.E., 1998. Using choice experiments to value the environment. Environmental and Resource Economics. 11, 413–428. DOI: https://doi.org/10.1023/A

[29] Vijverberg, W., 2011. Testing for IIA with the Hausman-McFadden test. IZA Discussion Papers No. 5826. Institute for the Study of Labor (IZA): Bonn, Germany.

[30] Kipperberg, G., Dugstad, A., Lopes, A.F., et al., 2024. Scope effects in stated preference research: from construct validity to economic significance. ResearchGate. 1–52. DOI: https://doi.org/10.13140/RG.2.2.32171.62248

[31] Ayenew, B., Tesfay, Y., 2015. Economic valuation of forest ecosystems service's role in maintaining and improving water quality. Economics. 4(5), 71–80. DOI: https://doi.org/10.11648/j.eco.20150405.11

[32] Mashayekhi, Z., Panahi, M., Karami, M., 2010. Economic valuation of water storage function of forest ecosystems: a case study of Zagros Forests, Iran. Journal of Forestry Research. 21, 293–300. DOI: https://doi.org/10.1007/s11676-010-0074-3

[33] Brey, R., Riera, P., Mogas, J., 2007. Estimation of forest values using choice modeling: an application to Spanish forests. Ecological Economics. 64(2), 305–312. DOI: https://doi.org/10.1016/j.ecolecon.2007.07.006