CME LIVE OPEN ACCESS

Journal of Earth & Environmental Waste Management

Research Article

Estimation of Restoration Costs Using Contingent Valuation Method for Plantation Forests in the Upper Hare-Baso River Catchment of Gamo Highlands, Southwestern Highlands of Ethiopia.

Genesha Mada[*1], Agena Anjulo[2] and Abren Gelaw[3]

*[*1]Department of Geography & Environmental Studies, Arba Minch University, Arba Minch, Ethiopia.*

[2]Ethiopian Environment and Forestry research Institute, Addis Ababa, Ethiopia.

[3]Environment & Natural Resource Management, Department of Geography & Environmental Studies, Arba Minch University, Arba Minch, Ethiopia.

Corresponding Author: Genesha Mada, Department of Geography & Environmental Studies, Arba Minch University, Arba Minch, Ethiopia.

Received: 2023 Nov 02 **Accepted:** 2023 Nov 21 **Published:** 2023 Dec 01

Abstract

The study aimed to set “a new valuation metrics” to compensate the degraded plantation forests via the choice method, daily laborer vs. money. The people in the catchment were poor agrarian and relied on nonagricultural economic activities and ecosystem services of plantation forests, and caused for degradation. However, none of degradation state, restoration prices and willingness of users to restore the degraded plantation hadn’t assessed and valued interms of money and other metrics. The purposive sampling was implemented to select kebeles while simple random sampling methods was applied to drawn the sampled respondents. The utility difference model was used so as to rank from dichotomous pay data; the correlation coefficient was applied to estimate the relationship between their willingness to restore and socioeconomic backgrounds; multinomial regression model was used to predict the likelihood of socioeconomic backgrounds of users and minimum willingness to accept restoration costs. The respondents had a demand for restoring the degraded plantation forests via money and daily laborer. However, more than half of respondents ranked to compensate in terms of daily labor [51.3%; significant at $P<0.05$], while the remaining were via money [48.7%; significant at $P<0.05$]. The multinomial regression model results predict that if the number of people who are not write and read, economically poor and medium, and age group of adults in the target population increases, there will be an increase in demand to compensate via daily laborers. If people have primary education, high school, and certified, are economically rich; the age group of young and old increases, there will have an increase in demands to compensate [restore] in terms of money. To concluded that implementing different accounting metrics likely to increase the opportunity of restoration capability and incorporating users regardless of socioeconomic background difference although further testing of different restoration cost metrics is interesting.

Keywords: Change of ES Services; Contingent Valuation; Gamo Highlands; Money and Daily Laborer; Plantation Forests; Willingness to Accept [WTA].

1. Introduction

Few environmental goods are bought and sold in the marketplace [European Environment Agency [EEA]], while others are not [Millennium Ecosystem Accounting [MA]] [1, 2]. Therefore, for economists to move beyond an analysis of the cost-effectiveness of providing a specified level of a particular environmental good, it is necessary to have some way of estimating the value of different types of ecosystems and their status or conditions [3]. Such values are most naturally expressed in monetary terms although other metrics are possible [4-6].

Therefore, ecosystem services that are not traded in a market should have alternative metrics to establishing a price in line with other economic accounting methods [European Environment Agency [EEA],]. In this context, there are many methods to account for that focus on direct and indirect uses [5]. For instance, the estimation of direct and indirect use prices [values] of ecosystem can be obtained by either estimating preference parameters as "revealed" through behaviors related to some aspect of the amenity or using "stated" information concerning preferences for the goods [7, 8].

The stated preference approach has come to be known as "contingent valuation" as the "valuation" estimate obtained from preference information given by respondents [9, 10]. It is said to be "contingent" on the details of the "constructed market" for the environmental good put forth in the survey by users [11, 12]. However, depending on the valuation of the ecosystem services approach and the design of valuation exercise, the approaches may not take full account of the negative impacts on economic and other human-induced changes, particularly degradation [12-15].

To overcome such limitations, some valuation metrics are needed either to compute the combination of nonmarket and market goods and/or residuals through contingent information [1, 14]. in this regard, most of the forest product researchers have used contingent valuation techniques to estimate nonmarket ES services and changes but have not fully quantified the degradation of ecosystem services in terms of money than other metrics despite it is interesting in order to corporate users regardless of their socioeconomic background's variations [3, 4, 9, 16, 17]. For instance, "the poor users have demand to pay/compensate for degraded environments despite the scarcity of money", and that is likely to exclude them who have ambition despite incapability of payment in the monetary terms [14, 17].

Although numerous studies have been conducted in Ethiopia on the values of ecosystem goods and services insignificant studies have quantified ecosystem amenities via the stated preference approach [contingent valuation method], particularly for degradation restoration prices using money and other metrics [9, 18, 19]. Moreover, the stated preference data based contingent valuation method that applied on the community plantations, watershed irrigation, and wetland ecosystem has limited from the perspective of degradation restoration accounting [pricing] [20]. In other terms, the plantation forest degradation is usual in Ethiopia despite the investigations of restoration cost was less overwhelmingly investigated, and studies were concerned economic valuation and production potentials [21, 22].

The plantation forests are established on the communal grazing land of Surra and Maze mountains in the mid-1980's as part of the Ethiopian highland plantation expansion project [23, 24]. Experiences to the catchment indicates that since then (planted) the plantation forests were degraded due to illegal logging, overgrazing, permanent raking of litter, encroachment of forest fringe people, and mass perishing of people during transition period despite none of them had assessed its conditions and restoration prices using money and other metrics [25].

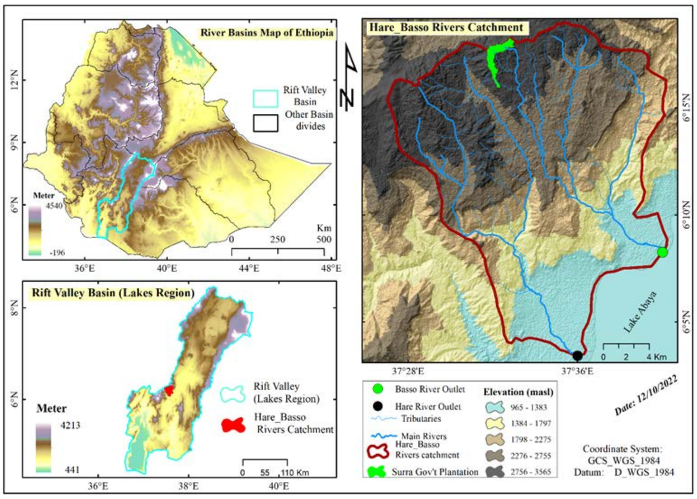
For example, different forest-related studies conducted in the catchment, however, almost all of them haven't accounted the restoration costs to rehabilitate degraded ecosystems via money or other metrics [26, 27]. The purpose of this paper is to give users a competitive advantage to maintain degraded ecosystem goods and services of plantation forests other than money, and to develop inclusive restoration cost metrics regardless of their socioeconomic background differences. The scope of the study was to assess the demand of consumers to restore deteriorated ecosystems via money and daily laborer metrics. Its main aim was to set "new valuation metrics" to restore/maintain degraded forests via willingness to accept [WTA] data of users.

2. Materials and Method

2.1. Study Area Descriptions

Altitudinally, the upper Hare-Baso River catchment is located between 2,329 and 3,442masl; astronomically is located between $6^{0}15'0''$ N-$6^{0}22'0''$ N latitude and $37^{0}28'0''$ E-$37^{0}38'0''$ E longitude [Fig 2]; the relative location is under Qogota, and Chencha Zuria woreda [woreda: is the second smallest administrative level in Ethiopia] of Gamo zone in Southern Ethiopia.

The physiographic feature of the area is part of rugged terrain of Gamo highlands that extended north to south with rising elevation up to 4200masl, Mt. Gughe, the highest peak in the southwestern physiographic features of Ethiopia [28]. Predominantly, upper Hare-Baso river catchment comprises two mountain peaks namely Maylo and Surra, and are seen above the surrounding lands. Mountain Maylo is the watershed divide of Hare-Deme while mountain Surra is the watershed divide of Baso-Hare and Baso-Deme.



Source: own design via ArcGIS 10.5, 2021.

Figure 1: The physical Map of Hare-Baso River Catchment.

According to updated Koppen's major climate classification system, the agroclimate of the study area is tropical highland climate [mountain climate type] represented by capital letter 'H' [29], and locally named as dega [28, 30]. The mean annual rainfall of the area varies from 1,100 to 1,300mm, and receives bimodal rainfall [31]. The first rainfall season is from March to April while the second is from June to August [32]. The average minimum and maximum temperature of the area is 18^0 C and 23^0 C respectively [33].

The types of soil for the upper Hare-Baso rivers catchment is allotted under region 20, and that is part of the moistest southwestern highland of Ethiopia. The soil of region 20 is a part of the relief that dominated by basaltic parent rock [30]. The soils of red and fairly deep dominant Eutric-nitosol is associated with Humic-cambisols, Vertisols, Ferralsols and Acrisols are originated from basaltic parent rocks [FAO-UNESCO] [34].

The old and historic settlement of people in the catchment depleted natural forests [35]. The natural forest, except in sacred places, has dwindled due to population pressure caused increment for demand of arable land, fuel wood and house construction materials [33]. Although natural forests on private lands are almost depleted, and one can see here and there the patches of natural forests in the pocket areas, and are found on graveyards, meeting places [Dubusha] and others sacred sites [26]. Hill tops in the catchment are covered by Afromontane grasses and permanently grazed [32].

The remainder indigenous tree species found in the area were Arundinaria alpina and Juniperus procera [35]. However, the coverage of plantation forests such as individual woodlots, community plantation, and government plantations had been substituting the natural forests [26]. For example, the government plantation forests of exotic tree species were established during the Dergue era by donation of United Nation Sudano-Sahelian Office [UNSO], African Development Fund [ADF], and World Bank [WB] as part of Ethiopian highlands' plantation project [24]. Consequently, in the upper Hare-Baso river catchment, two major government plantation forests were established in 1980's notably Maze and Surra government plantations as part of Ethiopian highland plantation forest expansion project [23, 24].

The main economic activities of the upper Hare-Baso river catchment was mixed high land farming on degraded and highly fragmented farmlands [31]. Hence, the economic condition of the people in the catchment was food insecure and is said to be one of the foods inconfident areas in the Southern region [SNNPRS] of Ethiopia (United States AID [USAID] [36]. The farm sizes are extremely marginal and per capita holding is less than 0.25 hectare [37]. Tilling using hoe is dominant over oxen plough because of the scarcity of grazing land and high land fragmentation [32, 38, 39]. Since it is tropical highland agroclimatitc region the dominant highland crops growing are root crops and cereal; major cereal crops growing in the catchment are viz. barley, wheat, peas and beans while the root crops are potato, enset [Enset ventricosum], and qolxo [sisume]. Enset is the staple foodstuff in the area and part of subsistence agriculture [29, 38-40].

The raising of livestock is an integral part of the economy and is practiced by tethering at homesteads and gates as well as free grazing at the communal grazing lands and governmental plantations [32]. The dominant highland livestock reared are sheep, horses and cattle [41]. The nonagricultural economic activities practiced in the catchment were petty trade, weaving and collecting of BLTs [32, 42]. Weaving with its long history in the area is dominant livelihood supporting practice [37]. Moreover, the introduction of apple fruit [suitable for tropical highland climate] is becoming hope to improve income for the rural poor people [43, 44].

3. Methodology

3.1. Sampling Designs

Sampling Techniques: The three kebeles [kebele: is the lowest administrative unit of Ethiopia] were purposely sampled due to proximity to the plantation forests. Because more proximity to the ecosystem intensively uses and relies on ecosystem services, and thus Masho, Dalo, and Ote kebeles were selected. Household heads [HHHs] were the target population, followed by senior members of the households in the time of data collection. Finally, a random sampling technique was used to select sample households from three sample kebeles [45, 46].

Sample Size: The sample size was determined by Yemane's formula of 1967. Theoretically, the Yemane's formula is stated as follows:

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Hence, n = number of sample sizes, N = total population (small plots within a large plot), and e = sampling error. Hence, the sample size for this study was 271 household heads (Table 1).

Table 1: Sampled Kebeles and Number of Household Heads.

No.	List if sample kebeles	Number of household heads			Sample Sizes		
		Male	Female	Total	Male	Female	Total
1	Masho	210	33	243	67	11	78
2	Ote	241	5	246	78	2	80
3	Dalo	244	107	351	79	34	113
Total		695	145	840	224	47	271

Source: Chencha Zuria Woreda Finance and Economy Development Office's (FEDO) population issues coordinating and implementing sector (2019).

Proportional Sampling: The proportionality of the sample population among sampled kebeles was affected by the number of household heads, and therefore, by considering this the proportionality was determined by using Kothari (Eq 2) (Table 1), and theorized as follows (Kothari, 2004) [47]:

$$n_i = \frac{N_i}{N} * n \qquad (2)$$

where n_i is the proportion of strata x; N_i is the total population of each stratum; N is the total population of all sample kebeles; and n is the sample size of the entire population.

3.2. Data Collection

The socioeconomic data, particularly the economic status, were acquired based on locally generated economic status classification criteria [45]. Because economic status and classification is localized according to the people's perception of that region, and internationalized according to the international economic status classification standards [48, 16]. Depending on this, the economic status of the households of sample kebeles were arranged under rich, medium and poor using locally accepted economic status indicating attributes [indicators] like a number of bamboo sheath corrugated hats [locally qata Keetha], sheet corrugated mud houses [qorqoro keetha], the amount of enset [E. ventricosum] at homesteads, occupation [government jobs], and income sources [combined works such as weaving, trading and cultivating] [39].

For example, the household own big bamboo sheath corrugated houses integrated with sheet corrugated and dense enset at homestead is rich; bamboo sheath corrugated houses and dense enset at homestead or sheet corrugated mud houses with cereal crops residual corrugated small hats with dense enset at homestead is economically medium, and those who has small cereal crops residual corrugated hats with sparse enset at homestead is poor [38, 39]. Thus, the economic status, ages and educational background data of respondents were collected concurrently with elicitation [ranking and selecting of money and labor] using questionnaires.

The questionnaires had three parts: part one- socioeconomic backgrounds; part two- the ranking for willingness to accept [WTA] in terms of money and day labor; part three- questions of bidding of the maximum and minimum willingness to accept interms of money and daily laborer [4]. Before data collection using face-to-face closed-ended interviews, the initiation for the interviewee was stated deeply enables to understand the intention of valuation using money and daily labor [12].

Later on, the socioeconomic status, ranking of payment metrics [money and daily labor], and bidding interms of money and daily labor were forwarded to elicit their minimum willingness to accept in descending order (Murphy et al., 2017). The monetary payments stated were ETB200-150-100-50-0 per year and 5-4-3-2-1 for daily labor/yr by considering the socioeconomic status and the educational backgrounds of the users. Because contingent valuation is determined by economic status and educational backgrounds of the users [9].

The maximum willingness to accept of "daily laborers" was converted into a daily wage/ETB [Ethiopian birr] based on the community's amount of daily wage for a day labor. The baseline point was per day wage for a man who was digging/tilling on hand using a hoe for agricultural farmlands, and was ETB 100. This was preferred because of the usual practice of digging/tilling per day for money in the upper Hare-Baso River catchment. Therefore, a day labor [tilling] was converted into ETB100 [$1= ETB52 in July/2022], and accepted for this study.

3.3. Model Selection and Fitness

The utility difference model is used as the basis for estimating minimum willingness to accept [WTA] from dichotomous pay data [money vs. daily laborer] [13]. We assumed that respondents directly derive utility from raking of litter, grazing, and illegal logging and degraded the plantation. In addition, the respondent's indirect utility function contained an observably stochastic element [e.g., aesthetic value, pure water, erosion reduction] [49].

Hence, the respondent's indirect utility function theoretically expressed as follows (Eq 3):

$$V(y, T) \qquad (3)$$

where income is denoted by y, and T is a binary variable denoting which metrics will pay for, for instance money or daily laborer. A respondent willingness to accept a given price (metric) to restore the degraded plantation forests as long as the difference in paying capability (dV) between money and daily laborer and for poor people daily laborer is positive (Eq 4): hence,

$$dv=\{V_{AK}(y-P_{AK}, T_{Ak})=\varepsilon_{AK}\}+\{V_{CH}(y-P_{CH},T_{CH})+\varepsilon_{CH}\}>0 \quad (4)$$

where P_{AK} and P_{CH} denote the willingness to pay for money and daily labor, respectively. ε_{AK} and ε_{CH} are the corresponding stochastic terms [analyzed statistically but not predicted precisely]. Here, the examination of the equation indicates that P_{AK} and dV are negatively correlated.

The utility difference model yields a logit specification when the probability of a "yes" response (in this case choosing daily laborer) is specified as the cumulative distribution function of a standard logistic variate (Eq. 5) [13, 49]:

$$\text{Prob (yes)} = (1+ \theta^{-dV})^{-1} \quad (5)$$

dV was selected for a linear specification, as this specification is consistent with the utility difference model and yields a close-ended expression for the WTA. The linear specification results in dV being dependent on income and educational background.

Consequently, the following logit equation [other demographic factors are excluded for clarity] (Eq 6):

$$\text{WTA (pay)} =B_0+ B_1{*}\text{Bid} \quad (6)$$

where WTA is the respondents ranking [money vs. daily laborer] response to the WTA question, and bid is the metrics (amount of money vs. daily laborer) respondents are asked to pay for daily labor (Eq 6).

The simplifying assumption is that one in the sample would prefer the money to the daily laborer if the maximum bidding amount were very low and vice versa (Eq. 7).

$$\text{MeanWTA} = \frac{1}{B_1} * \text{in}(1+\theta^{B_0}) \quad (7)$$

where B_1 is the absolute value of the estimated coefficient on the bid amount, B_1 is either the estimated amount if there are no additional independent variables or the sum of the estimated coefficients plus the sum of all other independent variable coefficients multiplied by their means [13].

Model Selection [Correlation]: The correlation coefficient indicates the relationship between socioeconomic background and preferences for money and per day laborer metrics. The Pearson product-moment correlation coefficient [Pearson's r] with one tail was executed to investigate the relationship between variables (Eq. 8) [46]. Therefore, the correlation [relationship] model is theoretically denoted as follows:

$$r = \frac{Cov_{xy}}{s_x s_y} \quad (8)$$

r = Pearson's correlation
Cov_{xy}=covariance of variables X and Y.
$1s_x s_y$ = variable X and Y (Sxy).

Models Selection [Multinomial Regression]: The multinomial regression model (Eq. 9) was used to manipulate the effect of the number of predictors [socioeconomic backgrounds of people] on the outcome variables [WTA in terms of money vs daily labor] [46, 50]. Wald's statistics and odds ratios were implemented to predict the effect of predictors on the outcome variables (Field, 2009) [46].

Models Selection [Multinomial Regression]: The multinomial regression model (Eq. 9) was used to manipulate the effect of the number of predictors [socioeconomic backgrounds of people] on the outcome variables [WTA in terms of money vs daily labor] [46, 50]. Wald's statistics and odds ratios were implemented to predict the effect of predictors on the outcome variables (Field, 2009) [46].

$$Y' = a+b_1 x_1+ b_2 x_2+ \ldots + b_k k_k \quad (9)$$

Hence, the log-likelihood was applied to assure the fit of model (Eq. 10) and (Eq. 11).

The fit of the model was tested by log-likelihood using R and R2, and the results fell (vary) between –1 and 1 [50].

$$= \pm\sqrt{\left(\frac{\text{Wald-(2-df)}}{\text{-2LL(original)}}\right)} \quad (10)$$

df = degree of freedom -2LL (log-likelihood) = original model

$$\text{log-liklihood} = \sum_{i=1}^{N}[Y_{i\ln(P(Yi))+(1-Y_i)\ln(1-P(Y_i}))] \quad (11)$$

Fit of Model [Multinomial Regression]: Before analyzing models, its fitness should be investigated [50]. In this regard, the analyzed model was assessed as follows (Table 1). The labelled variables, not in the equation, tell us that the residual chi-square statistic is 148.324, which is significant at p <.05 [it labels these statistics]. At this stage of the analysis, the value of -2Log Likelihood [-2LL] should be less than the value when only the constant was included in the model because lower values of -2LL indicate that the model is predicting the outcome variable more accurately and, in this case, the applied model [multinomial regression] was better infer the likelihood (Table 2) [51].

Accordingly, the constant of -2LL = 162.310 (Table 2), and to determine the fitting of model the socioeconomic backgrounds of the respondents should be decreased or increased to 162.310, and hence the respondent's socioeconomic backgrounds is deceased to 148.324 (<162.310). This demonstrates that the model is better in prediction [46].

Table 2: The Model Fitting Information of the Multinomial Regression.

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log-Likelihood	Chi-Square	Df	Sig.
Intercept Only	310.634			
Final	162.310	148.324	24	.000

Source: First-hand data computed using SPSS version 20.0

4. Results and Discussion

4.1. Socioeconomic Backgrounds

The age group of respondents [Table 2] demonstrates that young age [15 to 45] was the majority [74%]; adult age [46 to 64] was 16.7%, and old age [> 64] was 9.3%. The number of young respondents was approximately 3/4th of the total respondents, while the combined number of adults and old age was approximately 1/4th of the respondents. Regarding educational levels, not read and write was the majority [66.5%], followed by primary education levels. Primary education level encompassing "writing and reading" [21.8%], and trained [certified] was 1.4%.

Regarding the economic status of the respondents, 36.6% was poor, and 25% was lied on medium economic status while 33.8% of the respondents was fall under rich. Both poor and medium were approximately 3/5th of the total respondents since economic status discrepancies were insignificant between them. Some of the community members, particularly those with poor and medium economic backgrounds, relied on petty trades and raking of litter [37]. For instance, the poor Addis Ababa women relied on the raking of litter on a daily basis [21, 22].

In the study area [upper Hare-Baso river catchment], weaving is traditional nonagricultural economic activities, and practicing at home and away from home in big cities like Addis Ababa [42]. Regarding weaving economic activities, half of male respondents were practicing weaving and had dual economic activities, notably farming and weaving [47.6%], farming and trade [16.6%], and the remaining was relied on a single economic activity [farming, 35.8%].

The dual economic activities of weaving and trade were 2/3 [64.2%] of all respondents, while only farming was 1/3 [35.8%] [Table 3]. People who depend on dual economic activities earn better income than those who depend on one economic activity [52]. These results demonstrate that the socioeconomic backgrounds of the community are characterized by less education, poor economic status, and engagement in mixed economic activities [Table 3].

Table 3: The socioeconomic Backgrounds of the Sample Population.

Socioeconomic backgrounds	Lists	Frequency	Percent	Total
Age group	15-45	211	74	271
	46-64	48	16.7	
	>64	12	9.3	
Economic status	Rich	96	33.8	271
	Medium	71	25	
	Poor	104	36.6	
Educational level	Not read and write	189	66.5	271
	Primary	62	21.8	
	High school	16	5.6	
	Got training	4	1.4	
Economic activities	Only farming	97	35.8	271
	Farming and trade	45	16.6	
	Farming and weaving	129	47.6	

Source: field survey (2021)

4.2. Ranking for Money and Daily Labor

The "utility difference model" was used as the basis for estimating maximum willingness to accept [WTA] from dichotomous choice data; money and daily laborer metrics. Assume that respondents derive demand to accept [WTA] for rehabilitation of degraded plantation forests because of the benefits viz. litter and fodder, and illegally logged wood poles [13]. However, the respondent's indirect utility function contained an unobservable stochastic element such as aesthetic value, pure water, clean air, and considered by the model. The respondent's indirect utility function represented by almost all respondents indicates that the plantation forests had formal economic importance [grazing and collecting litter], and illegally acquired house building materials such as split wood and poles.

Table 4 depicts that maximum WTA was ETB200, and the minimum was ETB50. In terms of the daily laborer, the maximum willingness to accept was 5 days, and its monetary equivalent extended to ETB500 per year.

Table 4: Ranking in Terms of Money Item and Daily Laborer.

CVM	Bidding	Frequency	Percent
WTA-money	200	28	21.2
	150	37	28
	100	34	25.8
	50	33	25
Total	-	132	100
WTA-labor	5 days	2	1.4
	4 days	47	33.8
	3 days	52	37.4
	2 days	31	22.3
	1 day	7	5.0
Total	-	139	100

Source: the field data computed via SPSS version 20.

The statistical data in Table 4 show that 132 and 139 respondents ranked money and daily labor annually, respectively. For example, 28 and 37 respondents drew out ETB200 and 150 and were below the average. The maximum and minimum WTA in terms of daily labor [5 and 1 days] were the smallest, while 4 and 3 were approximately 71% of all elicited days [Table 4]. The poor are highly relied on ES services and causes degradation [22].

4.3. Model Based Analysis

Correlation Coefficient: The Pearson's correlation coefficient output of SPSS version 20.0 in Table 5 below comprises the value of Pearson's r between two variables, and the correlation coefficients were between -1 and 1 [46]. The one-tailed is the significance of each correlation [the correlation is significant with p <.001 or p <.005] and the number of cases [N] contributing to each correlation [N = 135].

The results in Table 5 depict that 139 [51.3%] of the sample population ranked minimum WTA in terms of daily labor, while 132 [48.7%] of them were elicited money. The values r of economic background, namely, educational level, are positively correlated with WTA in terms of money and significant at the .01 level [r =.703.722; p <.001]. The WTA for a given price [metric] is the difference in paying capability among different metrics and to whom buying capabilities are positively correlated [13].

Table 5: Correlation of Socioeconomic Characteristics and WTA in Terms of Money Vs labor/day

WTA money/labor	Correlation	Economic backgrounds of respondents		
		Age	Economic Status	Educational level
WTA money	Pearson Correlation	-.587	.703	.722
	Sig. (1-tailed)	.000	.000	.000
	N	132	132	132
WTA labor	Pearson Correlation	.346	-.038	-.521
	Sig. (1-tailed)	.000	.000	.000
	N	139	139	139
**p= Correlation is significant at the 0.01 level (1-tailed).				

Source: First-hand data obtained through data acquiring tools and computed using SPSS version 20.0

The value 'r' of age is negatively correlated to money and correlates with significance at the 0.01 level [r= -.587; p <.001]. Similar research results state that of 531 participants, approximately 3/4 had better in economic backgrounds, and the remaining did not, despite different factors [15]. Hence, the majority of respondents participated to compensate via money, while the others did not.

Despite the significance of correlation [positively], some of the correlation coefficients are medium and seem to measure different things. There is large to medium collinearity, and the education level is positively and relatively more strongly correlated [r =.722, p <.001] to WTA in terms of money than other items, and the age level is negatively but weakly correlated to WTA in terms of money [r = -.587, p <.001]. The correlation coefficients' values r of economic status and educational level negatively correlate to WTA in terms of a daily laborer, and they correlate negatively significantly at the 0.01 level [r = -.038, -.521; p <.001] [46]. The correlation coefficient values r of age level correlate positively with significance at the 0.01 level [r = -.346; p <.001].

Similar studies address that those with better in education and economic backgrounds are better at participating to conserve the ecosystem than others [11]. Accordingly, the results state that the correlation level of peoples with socioeconomic backgrounds among age, economic status, and education level with corresponding WTA in terms of the daily laborer are moderately correlates. Moreover, the WTA in terms of daily laborer strongly but positively correlates with education level, while economic status weakly and negatively correlates (Table 5).

4.4. Multinomial Regression

The Wald statistics coefficient [Wald] for the prediction of WTA in terms of money and daily labor is different from zero (Table 6).

Table 6: The Parameters Estimate Different Predictors using Two Outcomes, WTA Money and Daily Labor.

Willing to accept (WTA)		B (SE)	Std.	Wald	Df	Sig.	Exp(B)	95% Confidence	
								Lower	Upper
Money	Intercept	5.196	4.431	1.375	1	.241			
Age	Young	-.320	3.269	.010	1	.922	1.726	.001	439.789
	Old	.382	3.897	.010	1	.922	1.465	.001	3038.082
Econ. Status	Medium	-.219	3.604	.004	1	.952	.803	.001	938.244
	Poor	-.013	4.286	.000	1	.997	.987	.000	4392.418
Educ. Back.	Certified	.579	13.223	.002	1	.965	1.785	.001	
	High S.	1.064	6.547	.026	1	.871	2.897	.001	1083183.
	primary	.708	3.823	.034	1	.853	2.030	.001	3646.761
Labor	Intercept	5.611	4.430	1.604	1	.205			
Age Level	Adult	.293	3.267	.008	1	.929	1.340	.002	809.008
Econ. Status	Medium	.204	3.604	.003	1	.955	1.227	.001	1434.415
	Poor	.014	4.287	.000	1	.997	1.014	.000	4521.503
Educ. Back.	Zero Educ.	-.672	3.825	.031	1	.861	1.511	.000	920.182

Willing to accept (WTA)		B (SE)	Std.	Wald	Df	Sig.	Exp(B)	95% Confidence	
								Lower	Upper
Money	Intercept	5.196	4.431	1.375	1	.241			
Age	Young	-.320	3.269	.010	1	.922	1.726	.001	439.789
	Old	.382	3.897	.010	1	.922	1.465	.001	3038.082
Econ. Status	Medium	-.219	3.604	.004	1	.952	.803	.001	938.244
	Poor	-.013	4.286	.000	1	.997	.987	.000	4392.418
Educ. Back.	Certified	.579	13.223	.002	1	.965	1.785	.001	
	High S.	1.064	6.547	.026	1	.871	2.897	.001	1083183.
	primary	.708	3.823	.034	1	.853	2.030	.001	3646.761
Labor	Intercept	5.611	4.430	1.604	1	.205			
Age Level	Adult	.293	3.267	.008	1	.929	1.340	.002	809.008
Econ. Status	Medium	.204	3.604	.003	1	.955	1.227	.001	1434.415
	Poor	.014	4.287	.000	1	.997	1.014	.000	4521.503
Educ. Back.	Zero Educ.	-.672	3.825	.031	1	.861	1.511	.000	920.182

Source: computed from raw data using SPSS version 20.0

This assumes that the predictors [x] make a significant contribution to the predicted outcome [Y] variables. If the regression coefficient [b] is large, the standard error tends to become overstated, and the resulting Wald statistic is underestimated [46, 51]. Therefore, data from this study seem to indicate that having the intervention (or not) is a significant predictor of whether the socioeconomic backgrounds of the respondents affect the WTA via money or daily laborer metrics. This is because the significance of Wald statistics is less than.05 (Table 6).

The odds ratio [Exp[B]] [the proportionate change of predictors] shows the results of odds in both outcomes, money and daily labor (Table 6). The odds ratio values of age except "adult", economic status of rich and educational background except "cannot read and read" are greater than 1 for money. Except for cannot read and read, old and young age class and rich economic status, the odds ratio is less than 1 for daily laborers. These results imply that if the value of the odds ratio is greater than 1, the increase in predictors enables an increase in the probability of outcome variables occurring and vice versa [46].

To conclude, the minimum WTA in terms of money increases to compensate for the degraded plantation forests if the young and old age, rich in economic status, and high school level and trained of the community members increase and vice versa. The findings of previous studies indicated that highly educated and higher income members of the community tend to be more involved in environmental and conservation activities through a willingness to pay in terms of money.

The results show that compensation through daily labor increases when the age groups of adults, economically medium and poor, and educationally cannot write and read, and vice versa. These results reversely align with 'highly educated and high income owned people' actively involved in environmental and conservation behavior, and conservation activities [11, 53]].

5. Findings and Conclusion

This study assessed effective restoration metrics by incorporating all users regardless of their socioeconomic background variations. The study results prove that the respondents had demand for restoring the degraded plantation forests via money and daily laborer metrics. For instance, more than half of respondents ranked to compensate in terms of daily labor [51.3%; significant at $P<0.05$], while the remaining were via money [48.7%; significant at $P<0.05$]. Particularly, daily laborer is more correlated to restore the degraded plantation forest ecosystem than money.

The odds ratio values of age except "adult", economic status of rich and educational background except "cannot write and read" are greater than 1 for money. Except for not read and write, old and young age class and rich economic status, the odds ratio is less than 1 for daily laborers. Accordingly, the multinomial regression model predicts that if the number of people who are educationally not writing and reading, economically poor and medium, and age group of adults in the target population increases, there will be an increase in demand to compensate via daily laborers.

If people have primary education, high school, and trained [certified]; economically rich; the age group of young and old increases, there will be an increase in demands to compensate in terms of money. To conclude that incorporating users regardless of socioeconomic background discrepancies is likely to increase the opportunity of restoration capability by extending their choices, particularly, in poor agrarian community like Upper Hare-Baso River catchment despite detail investigation is needed by extending other accounting metrics.

Recommendations

Based on findings, it is possible to recommend the following points: diversifying the restoration cost metrics in addition to money is better incorporate the users regardless of socioeconomic and cultural background variation while pricing the degradation restoration. Hence, the researchers should use different restoration cost accounting metrics than only use money to investigate willingness of users to value and restore. Because, it can more or less incorporate the individual by considering multitudinal variation in economic, social and cultural backgrounds.

Acknowledgement

My completion of this research could not have been accomplished without the support of Arba Minch University, Arba Minch Teachers Education College, my advisers, classmates, and data collectors. Hence, I would mention my thank for all who encouraged, supported, and sponsored for the achievement.

References

1. European Environment Agency. (2010). Ecosystem Accounting for the Cost of Biodiversity Losses: The Case of Coastal Mediterranean Wetlands, EEA Technical Report No. 3/2010. Luxembourg: Office for Official Publications of the European Communities.
2. Assessment, M. E. (2005). Ecosystems and human well-being (Vol. 5, p. 563). Island Press, Washington, DC.
3. FREEMAN III, A. M. (1992). The measurement of environmental and resource values. Resources for the Future.
4. Carson, R., & Hanemann, M. (2005). Chapter 17- contingent valuation (eds.). North Holland: Elsevier publisher (B.V.).
5. Ansink, E., Hein, L., & Hasund, K. P. (2008). To value functions or services? An analysis of ecosystem valuation approaches. Environmental Values, 17(4), 489-503.
6. Costanza, R, deGroot, R., Grasso, M., & Limburg, K. (1997). The value of the world's ecosystem services and natural capital. Journal of Nature, (387), 253–260.
7. Managi, S. & Kumar, P. (2018). Measuring Progress Towards Sustainability 2018: Measuring Progress Towards Sustainability (eds). New York: Routledge.
8. Fisher, B., & Turner, R. K. (2008). Ecosystem services: classification for valuation. Biological conservation,

Ciatation: Mada, G., Anjulo, A., Gelaw, A. (2023). Estimation of Restoration Costs Using Contingent Valuation Method for Plantation Forests in the Upper Hare-Baso River Catchment of Gamo Highlands, Southwestern Highlands of Ethiopia. Journal of Earth & Environmental Waste Management. 1(1), 1-11.

141(5), 1167-1169.
9. Mekonnen, A., Köhlin, G., & Carlsson, F. (2004). Contingent valuation of community plantations in Ethiopia: a look into value elicitation formats and intra-household preference variations. rapport nr.: Working Papers in Economics, (151).
10. Gatto, P., Vidale, E., Secco, L., & Pettenella, D. (2014). Exploring the willingness to pay for forest ecosystem services by residents of the Veneto Region. Bio-based and Applied Economics Journal, 3(1050-2016-85751), 21-43.
11. Joo, R. J. (2011). Public Willingness to Pay for Ecosystem Services: Water Quality in the Triangle region, North Carolina.
12. Mellmann, N. (2017). Re-evaluating the contingent valuation method as a standard method for monetary valuation of ecosystem services.
13. Hanemann, W. M. (1989). Welfare evaluations in contingent valuation experiments with discrete response data: reply. American journal of agricultural economics, 71(4), 1057-1061.
14. O'Connor, M. (2007, March). Towards a working framework for the accounting of environmental degradation. In 11th Meeting of the London Group on Environmental Accounting Johannesburg (pp. 26-30).
15. Shang, Z., Che, Y., Yang, K., & Jiang, Y. (2012). Assessing local communities' willingness to pay for river network protection: A contingent valuation study of Shanghai, China. International Journal of Environmental Research and Public Health, 9(11), 3866-3882.
16. Maloutas, T. (2007). Socio-economic classification models and contextual difference: The 'European Socio-economic Classes'(ESeC) from a South European angle. South European Society & Politics, 12(4), 443-460.
17. Murphy, M. B., Mavrommati, G., Mallampalli, V. R., Howarth, R. B., & Borsuk, M. E. (2017). Comparing group deliberation to other forms of preference aggregation in valuing ecosystem services. Ecology and Society, 22(4).
18. Weldesilassie, A. B., Frör, O., Boelee, E., & Dabbert, S. (2009). The economic value of improved wastewater irrigation: A contingent valuation study in Addis Ababa, Ethiopia. Journal of Agricultural and Resource Economics, 428-449.
19. Emiru, R., & Gemechu, A. (2017). Valuing the benefits of recreational wetland ecosystem: an application of contingent valuation and travel cost methods: the case of Boye recreational wetland, Jimma zone, Oromia National Regional State, Ethiopia. Journal of Resources Development and Management, 29, 78-99.
20. Tamire, C., Elias, E., & Argaw, M. (2022). A systematic review of ecosystem services assessments, trends, and challenges in Ethiopia. Watershed Ecology and the Environment.
21. Haile, F. (1991). Women fuelwood carriers in Addis Ababa and the peri-urban forest: Report to International Development Research Centre (IDRC) and National Urban Planning Institute (NUPI). International Labour Office, Geneva, CH.
22. Olsson, T. (2005). Social and environmental issues on the removal of fuelwood and litter from Eucalyptus stands around Addis Abeba, Ethiopia.
23. Mehari, A. (1997). Establishing fuelwood plantation and fire wood tree crop performance on the highlands of Ethiopia: The case of Eucalyptus globulus Labill. ssp globulus.
24. Gil, L., Tadesse, W., Tolosana, E., & Lopez, R. (2010). Eucalyptus species management, history, status, and trends in Ethiopia. Agricultural Research, 15, 17.
25. Bekele, M. (2011). Forest plantations and woodlots in Ethiopia. In Afr. For. Forum Work. Pap. Ser (Vol. 1, pp. 1-51).
26. Daye, D. D., & Healey, J. R. (2015). Impacts of land-use change on sacred forests at the landscape scale. Global Ecology and Conservation, 3, 349-358.
27. Tegene, A. S., Gamo, F. W., & Cheche, S. S. (2018). Woody vegetation composition, structure, and community types of Doshke forest in Chencha, Gamo Gofa zone, Ethiopia. International Journal of Biodiversity, 2018.
28. Hurni, H. (1998). Agroecological Belts of Ethiopia Explanatory notes on three maps at a scale of 1:1,000,000. Addis Ababa, Ethiopia: Soil Conservation Research Programme, Centre for Development and Environment.
29. Kottek, M., Grieser, J., Beck, C., Rudolf, B., & Rubel, F. (2006). World map of the Köppen-Geiger climate classification updated.
30. Alias, E. (2016). Soils of the Ethiopian highlands: geomorphology and properties.
31. Bayu, T. Y. (2015). Socio-cultural and Policy related constraints to women's land right: a case study from Gamo highland, SW Ethiopia. Humanities and Social Sciences, 3(4), 149-154.
32. Ogato, A. (2006). Indigenous common Grazing Land Management in Chencha Wereda, South Ethiopia (Doctoral dissertation, Addis Ababa University).
33. Assefa, E., & Hans-Rudolf, B. (2017). Indigenous resource management practices in the Gamo Highland of Ethiopia: challenges and prospects for sustainable resource management. Sustainability Science, 12, 695-709.
34. Food and Agriculture Organization-UNESCO. (1997). Soil map of the world 1:5000000. Vol. 6. Africa. Faris, France: UNESCO.
35. Teshome, Y. (2016). Land use Dynamics and challenges of Enset (Ensete ventricosum) agriculture in the upper reaches of Baso-Deme watershed, Gamo Highland, SW Ethiopia. Global Journal of Interdisciplinary Social Sciences, 5(3), 20-28.
36. USAID, E. S. N. (2005). Nationalities and Peoples Region (SNNPR) Livelihood Zone Reports: SNNPR Follow-On to Regional Livelihoods Baseline Study. United States Agency for International Development, Chemonics International.
37. Adem, M. S. (2017). Environmental knowledge, attitude and awareness of farmers in chencha woreda, gamo gofa zone, South Ethiopia. International Journal of Scientific and Research Publications, 7(1), 69-76.
38. Freeman, D. (2015). Techniques of happiness. Values of Happiness, 109.
39. Samberg, L. (2016). Farmers' firm grip on diversity. Farming Matters, 32(2), 32-34.
40. Jackson, R. T. (1969). Report of the Oxford University

expedition to the Gamu highlands. Report of the Oxford University expedition to the Gamu highlands.
41. Helina, T., & Emily, S. (2012). Spatial Analysis of Livestock Production Patterns in Ethiopia; Development Strategy and Governance Division, International Food Policy Research Institute – Ethiopia Strategy Support Program II, Ethiopia, working paper 44. Addis Ababa: FDRE Minister of Agriculture.
42. Mathiszig, L. (2014). The dorze weavers of Ethiopia. Textile, 12(2), 180-187.
43. Girmay, G., Menza, M., Mada, M., & Abebe, T. (2014). Empirical study on apple production, marketing and its contribution to household income in Chencha district of southern Ethiopia. Scholarly journal of agricultural science, 4(3), 166-175.
44. Admasu, T. G., & Jenberu, A. A. (2022). TheImpacts of Apple-based Agroforestry Practices on the Livelihoods of Smallholder Farmers in Southern Ethiopia. Trees, Forests and People, 7, 100205.
45. Dudeja, P., Bahuguna, P., Singh, A., & Bhatnagar, N. (2015). Refining a socio-economic status scale for use in community-based health research in India. Journal of Postgraduate Medicine, 61(2), 77.
46. Flerd, A. (2009). DISCOVERING STATISTICS USING SpSS 3rd ed.
47. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
48. Chinta, A., Srivatava, B. K., Eshwar, S., Jain, V., Rekha, K., & Swamy, M. N. (2016). Overview of socio-economic status scales in India. International Journal of Innovative Research in Dental Sciences, 1(2), 6.
49. Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. American journal of agricultural economics, 66(3), 332-341.
50. Bluman A., 2009. Elementary statistics: step by step approach, 7th edition. McGraw-Hill Companies, USA.
51. Howell, D. (2010). Statistical Methods for Psychology (7th ed.). Canada: Nelson Education, Ltd.
52. Lemenih, M., & Bongers, F. (2010). The role of plantation forests in fostering ecological restoration: experiences from East Africa. Degraded Forests in Eastern Africa. Management and Restoration. Earthscan, London, 171-219.
53. Gray, D. E. (2021). Doing research in the real world. Doing research in the real world, 1-100.