

ECONOMIC VALUATION OF ECOSYSTEM SERVICES AND COMMUNITY SUPPORT FOR CONSERVATION IN THE YAYO COFFEE FOREST BIOSPHERE RESERVE, SOUTHWESTERN ETHIOPIA

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ABSTRACT: The Yayo Coffee Biosphere Reserve (YCBR) in southwestern Ethiopia, a UNESCO-recognized site, harbors globally significant wild Arabica coffee genetic resources, biodiversity, and vital ecosystem services. Despite its economic and ecological importance, the reserve faces pressures from deforestation, agricultural expansion, and limited conservation funding. This study quantified the economic value of YCBR's ecosystem services and assessed community willingness to pay (WTP) and willingness to work (WTW) for its conservation. A cross-sectional survey of 300 respondents across four kebeles employed the Contingent Valuation Method to elicit monetary and labor contributions. Provisioning services, notably freshwater (87%), medicinal plants (74%), and food resources (63%), were most recognized, alongside substantial awareness of regulating, cultural, and supporting services. The mean annual WTP was ETB 435 (USD 3.82), while 62% expressed WTW, with tree planting as the preferred volunteer activity. Logistic regression identified income, education, gender, awareness, and association membership as significant predictors of WTP, while WTW was more likely among men, residents closer to the reserve, and those with lower formal education. Policy recommendations emphasized stricter protection laws (72%), greater community involvement (65%), and ecotourism development (59%). Findings highlighted the potential for hybrid conservation strategies integrating modest financial contributions with structured, role-differentiated volunteer programs. Coupling community engagement with legal enforcement, participatory governance, and sustainable livelihood initiatives, particularly coffee-linked ecotourism can enhance both ecological integrity and local well-being. This integrated approach offers a practical pathway to securing the long-term conservation of YBR while fostering community ownership and socio-economic resilience.

Keywords/phrases: Contingent Valuation Method, Payment for Ecosystem Services, Rural livelihoods, Wild Arabica coffee

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INTRODUCTION

The Yayo Coffee Forest Biosphere Reserve (YBR), located in the Illubabor Zone of southwestern Ethiopia, is one of six UNESCO designated biosphere reserves in the country (UNESCO, 2017). Covering approximately 167,000 hectares, the reserve is globally recognized as a primary center of origin and genetic reservoir of wild *Coffea arabica* L., a species that supports the livelihoods of millions of people around the world and contributes significantly to Ethiopia's national economy through export earnings and employment (Aerts et al., 2016; Davis et al., 2019). Beyond its importance to the global coffee industry, YBR is home to a rich diversity of plant and animal species, making it a critical hotspot for biodiversity conservation at both regional and international levels (Senbeta et al., 2022). At the same time, the reserve plays a vital role in sustaining local livelihoods, particularly in rural communities where dependence on forest resources is high, creating a strong connection between ecological health and human wellbeing (Duguma et al., 2024).

The ecosystem services provided by YBR can be clearly understood through the four categories identified in the Millennium Ecosystem Assessment (MEA) (2005). Provisioning services such as freshwater, wild foods, timber, and medicinal plants directly support household subsistence and income generation. Regulating services, including carbon sequestration, climate regulation, erosion control, and water purification, help maintain environmental stability at both local and global scales (Fenta et al., 2023). Cultural services are reflected in ecotourism opportunities, spiritual values, and traditional practices such as Ethiopia's coffee ceremony, which highlight the deep cultural connections between communities and the forest landscape. Supporting services, including soil formation, pollination, and biodiversity maintenance, form the ecological foundation that sustains agricultural productivity and ensures long term ecosystem resilience. For

communities that depend on coffee and other forest resources, these services are not only ecological in nature but also represent essential economic safety nets and opportunities for improving livelihoods.

Despite their wide-ranging benefits, many ecosystem services remain largely invisible in conventional economic systems because they are not traded in formal markets. As a result, they are often undervalued or overlooked in policy and decision-making processes. Economic valuation helps to address this challenge by assigning measurable value, whether monetary or non-monetary, to ecosystem services, making their contributions more visible and easier to compare with alternative land use options (Costanza et al., 1997; TEEB, 2010; Pascual et al., 2022). In this regard, the Contingent Valuation Method has become a widely used approach for estimating the value of non-market environmental goods. By presenting individuals with carefully designed hypothetical scenarios, this method allows researchers to capture how much people are willing to contribute toward the conservation or improvement of ecosystem services.

Within this framework, two closely related concepts are particularly important, Willingness to Pay and Willingness to Work. Willingness to Pay refers to the maximum amount of money individuals are willing to contribute for the conservation or improvement of ecosystem services, reflecting how they perceive and value these benefits in economic terms. However, in rural settings such as YBR, where household incomes are often limited, financial contributions alone may not fully reflect the extent of community support. This makes Willingness to Work, which represents the time and labor individuals are willing to contribute voluntarily, equally important. Volunteer labor can play a significant role in conservation through activities such as tree planting, forest monitoring, and soil conservation. In many cases, it provides a practical and

culturally appropriate way for communities to participate in conservation efforts, especially when financial resources are constrained.

Considering both Willingness to Pay and Willingness to Work together offers a more complete picture of community support and opens up opportunities for designing hybrid conservation strategies that combine financial contributions with organized volunteer efforts. Such approaches are increasingly recognized as effective in resource constrained settings, where relying solely on external funding is often not sufficient to sustain conservation in the long term. By incorporating both monetary and labor-based contributions, policymakers can design conservation models that are more inclusive, flexible, and better aligned with local socio-economic conditions.

However, despite its ecological and economic importance, YBR is currently facing growing pressures that threaten its long-term sustainability. Rapid deforestation, agricultural expansion particularly the encroachment of coffee cultivation into core conservation zones, and population growth are contributing to habitat fragmentation and the degradation of ecosystem services (Tolessa et al., 2017; Duguma et al., 2024; Fenta et al., 2023). Although the reserve benefits from UNESCO recognition, the enforcement of conservation regulations remains weak, and financial resources for management are often limited and unreliable (Mekonnen et al., 2022; Abate et al., 2021). These challenges underline the urgent need for more sustainable financing mechanisms and stronger community engagement in conservation efforts.

In Ethiopia's rural context, successful conservation is closely linked to active community participation. Local households rely heavily on provisioning services such as water, forest foods, and medicinal plants, yet formal conservation budgets are not sufficient to ensure their protection over time (Bekele et al., 2020; Tadesse and Woldemariam, 2023). As a result, community

contributions, both financial and labor based, become essential for bridging the gap between policy objectives and practical implementation (Gebreselassie et al., 2020; Alemayehu et al., 2022). While previous studies conducted in YBR and similar landscapes have examined land use change, biodiversity conservation, and general ecosystem service values for example Tolessa et al. (2017) and Senbeta et al. (2022), they have largely focused on biophysical assessments or general perceptions. There is still limited empirical evidence that quantifies the economic value of ecosystem services from the perspective of local communities while also examining both Willingness to Pay and Willingness to Work as complementary forms of conservation support.

This study seeks to address this important gap by applying the Contingent Valuation Method to estimate the economic value of ecosystem services in YBR, while at the same time assessing community willingness to contribute through both financial payments and voluntary labor. By integrating Willingness to Pay and Willingness to Work, the study provides a more comprehensive understanding of how communities value and support conservation. It also highlights the potential for developing hybrid financing mechanisms that reflect the socio-economic realities of the area.

Ultimately, the findings of this study are intended to inform the design of equitable and context specific conservation strategies that balance ecological sustainability with local livelihood needs. By explicitly linking ecosystem service valuation with Willingness to Pay and Willingness to Work, the study contributes to a deeper understanding of how community-based conservation can be effectively implemented in biosphere reserves such as YBR, where both ecological significance and economic constraints are strongly interconnected.

METHODOLOGY

Study Area

The Yayo Biosphere Reserve (YBR) is located in the Illubabor Zone of Oromia Regional State, southwestern Ethiopia, about 500 km from Addis Ababa. Geographically, it lies between about 8°10' to 8°30' N latitude and 35°30' to 36°00' E longitude. It covers approximately 167,000 hectares and is recognized by UNESCO-MAB program for its global ecological significance as a center of origin and genetic diversity for wild Arabica coffee (*Coffea arabica* L.). The reserve features a landscape mosaic of montane forests, semi-forest coffee systems, and agricultural lands, structured into core, buffer, and transition zones. Ecologically, it harbors high levels of biodiversity, including endemic plant and animal species, while socio-economically, it sustains rural communities that depend heavily on both forest products and agricultural livelihoods.

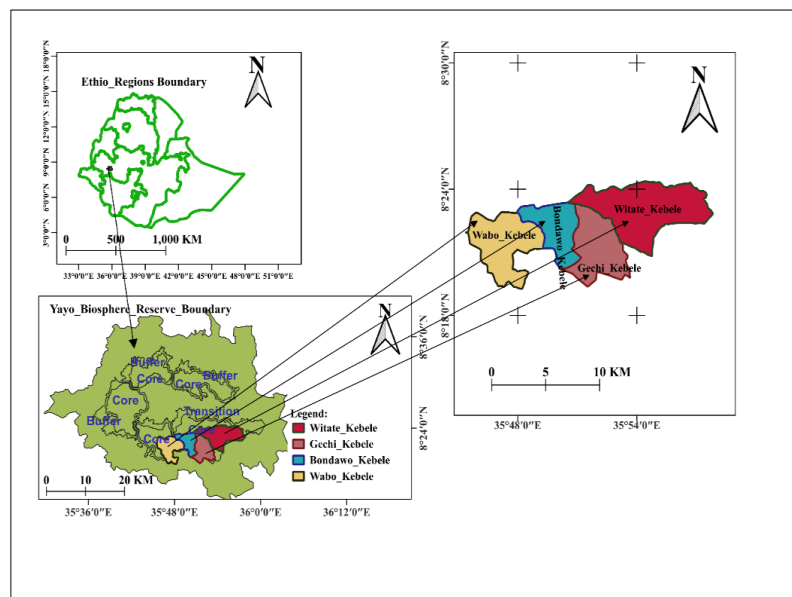


Figure 1. Map of Yayo Biosphere Reserve, Oromia, Southwestern Ethiopia

Research Design and Sampling Strategy

This study employed a cross-sectional survey design, which collects data at a single point in time to capture prevailing socio-economic conditions, community perceptions, and conservation attitudes. This design is suitable for valuation studies because it allows comparisons across groups while minimizing time and resource constraints.

The four kebeles Gechi, Wutete, Wabo, and Bondawo were purposively selected to represent variation in proximity to the Yayo Biosphere Reserve's core and buffer zones, dependence on forest ecosystem services, and exposure to conservation interventions. This purposive selection ensured that both communities living closer to the forest and those farther away were included, thereby capturing diverse perspectives.

Within each kebele, a stratified random sampling approach was employed to ensure proportional representation of key stakeholder categories. Strata were defined by livelihood type (e.g., farmers, small business owners, wage workers) and community roles (e.g., households, local leaders, government officials). From each stratum, respondents were randomly selected to minimize bias. A total of 75 respondents per kebele were included, giving a final sample of 300 respondents.

The sample size was determined using Cochran's (1977) formula for proportion estimates, with a 95% confidence level and a 5% margin of error. An initial sample size of 384 was obtained, which was then adjusted for the finite population of the study kebeles using the finite population correction (FPC), resulting in a final target of 300 respondents. This balance between statistical rigor and practical feasibility ensured that the sample was both representative and analytically robust.

Data Collection

Primary data were collected using a structured questionnaire administered through face-to-face interviews in the local language. This approach aimed to reduce literacy-related bias and ensure clear responses. The questionnaire included both socio-economic information and views on conservation, organized into six sections. The first section focused on the demographic and socio-economic details of respondents, including age, gender, education, and main sources of income. The second section evaluated awareness of the Yayo Biosphere Reserve (YBR). This assessment included familiarity with the reserve, its perceived importance, and knowledge of management rules. The third section looked at the economic benefits that households gain from the reserve, covering both market and non-market values. In the fourth section, respondents identified and evaluated ecosystem services based on the Millennium Ecosystem Assessment framework, which included provisioning, regulating, cultural, and supporting services. The fifth section measured Willingness to Pay (WTP) and Willingness to Work (WTW) for conservation through the Contingent Valuation Method (CVM). Participants were presented with a hypothetical conservation fund and volunteer program and asked to declare the maximum financial contribution or number of workdays they would be willing to commit each year. Finally, the sixth section asked respondents to suggest policy recommendations that could improve conservation outcomes in the YCBR.

Data Analysis

Survey data were coded and analyzed using Stata version 15, combining descriptive and inferential approaches. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize respondents' demographic and socio-economic characteristics, awareness of YBR, perceived benefits, and recognition of ecosystem services.

Qualitative responses on policy recommendations were analyzed thematically to capture recurring patterns, priorities, and suggestions for improving conservation governance.

To estimate the economic value of ecosystem services, the Contingent Valuation Method was applied using the open ended responses obtained from respondents. The mean Willingness to Pay was calculated as the average of the stated monetary contributions among respondents willing to pay. Aggregate Willingness to Pay was then estimated by multiplying the mean Willingness to Pay by the total number of households in the study area, providing an estimate of the overall monetary value of ecosystem services.

Similarly, Willingness to Work was analyzed by calculating the average number of labor days respondents were willing to contribute annually. This was further aggregated across households to estimate the total labor contribution, which represents a non-monetary value of ecosystem services and an important form of conservation support in resource constrained settings.

To examine the determinants of community support, binary logit regression models were employed for Willingness to Pay and Willingness to Work, coded as 1 for willing and 0 for not willing. Independent variables included demographic characteristics such as age, gender, education, and household size, socio economic factors such as income and livelihood type, and perception related variables including awareness of YBR, recognition of ecosystem services, and membership in local associations.

Model robustness was assessed using multicollinearity diagnostics through Variance Inflation Factor values, as well as goodness of fit measures including the Hosmer Lemeshow test, Pseudo R square, and chi square statistics. In addition, t tests and analysis of variance were used to

compare group differences. This comprehensive approach ensured both statistical rigor and meaningful interpretation of the results.

Model Specification

The study employed a binary logit regression model to identify the socio-economic and perceptual factors influencing community support for conservation. The dependent variables were Willingness to Pay (WTP) and Willingness to Work (WTW), coded as 1 = willing and 0 = not willing. Independent variables included demographic factors (age, gender, household size, education), socio-economic factors (income, livelihood type), and perception-related variables (awareness of YBR, recognition of ecosystem services, membership in local associations). The model estimates the probability P_i that respondent i is willing to contribute as:

$$\text{Logit}(P_i) = \ln(P_i / (1 - P_i)) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + \epsilon_i \quad (1)$$

Where β_0 is the intercept, $\beta_1 \dots \beta_k$ are coefficients for the explanatory variables $X_{1i} \dots X_{ki}$, and ϵ_i is the error term.

RESULTS AND DISCUSSIONS

Demographic Characteristics of Respondents

Table 1 summarizes the demographic characteristics of the 300 respondents surveyed across four kebeles. The gender distribution was nearly balanced, with 54% male and 46% female participants. The age range indicated that most respondents (69%) were between 18 and 45 years old, which represents the working-age population relevant for volunteer-based conservation efforts. In terms of educational attainment, the largest share of respondents had completed secondary education (39%), which was higher than those who completed primary education (28%). A smaller proportion of respondents held a bachelor's degree (18%), while 15% reported

having no formal education. Overall, respondents with at least primary or secondary education constituted the majority of the sample, indicating a relatively moderate level of literacy in the study area. This variation in educational attainment provides an important basis for analyzing differences in awareness of ecosystem services, as well as willingness to pay and willingness to participate in

Table 1. Demographic profile of survey respondents (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	162	54.0
	Female	138	46.0
Age group	Below 18 years	18	6.0
	18–30 years	108	36.0
	31–45 years	99	33.0
	46–60 years	60	20.0
	Above 60 years	15	5.0
Education level	No formal education	45	15.0
	Primary	84	28.0
	Secondary	117	39.0
	Bachelor's degree	54	18.0

Source: Survey data, 2025

Awareness and Perceptions of the Yayo Biosphere Reserve

Table 2 summarizes the respondents' awareness and perceptions of the Yayo Biosphere Reserve (YBR). Respondents demonstrated high levels of familiarity with YBR, with 68% reporting being “very familiar” and 22% “somewhat familiar,” while only 10% were not familiar. The primary perceived benefits included biodiversity conservation (85%), water source protection

(78%), and tourism/recreation potential (65%). Major threats identified were deforestation (72%), agricultural expansion (65%), and lack of funding (52%). These findings indicated strong community awareness of both the ecological value of the reserve and the challenges it faces, providing a solid foundation for conservation engagement strategies.

Table 2. Awareness levels and perceptions of benefits and threats related to YBR (N = 300)

Variable	Category	Frequency (n)	Percentage (%)
Familiarity with YBR	Very familiar	204	68
	Somewhat familiar	66	22
	Not familiar	30	10
Top perceived benefits	Biodiversity conservation	255	85
	Water source protection	234	78
	Tourism and recreation	195	65
Perceived threats	Deforestation	216	72
	Agricultural expansion	195	65
	Lack of funding	156	52

Source: Survey data, 2025

Recognition of Ecosystem Services

Recognition of ecosystem services means acknowledging the tangible benefits humans receive from nature, such as supporting, cultural, regulating and provisioning or clean air, water filtration, pollination, and climate regulation, and incorporating this value into policy and economic decisions(Fig.2).

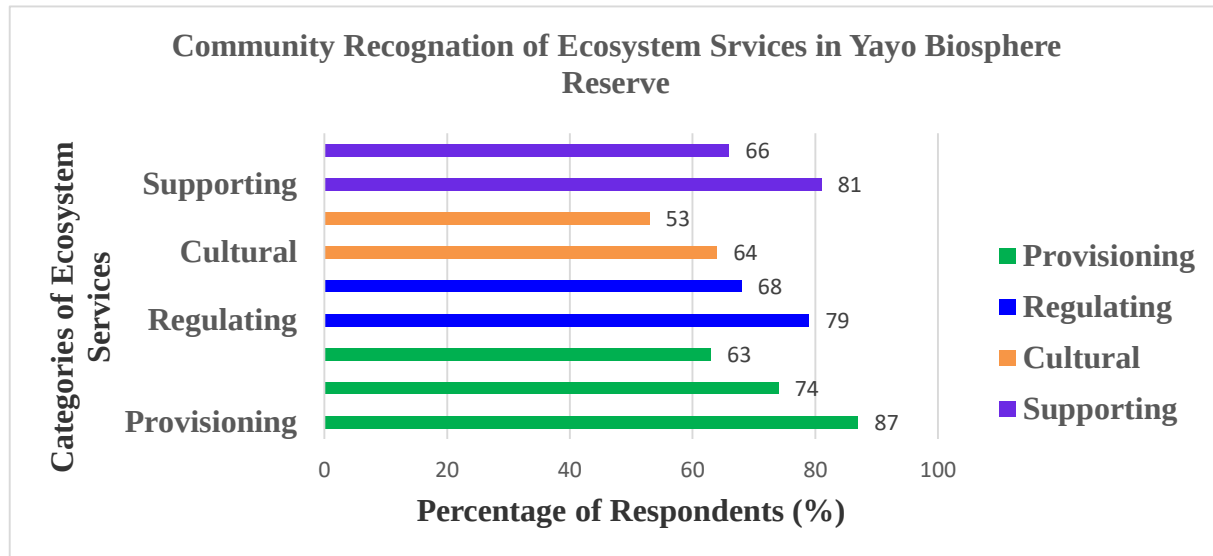


Figure 2. Community Recognition of Ecosystem Services in Yayo Coffee Biosphere Reserve
Source: Survey data, 2025

Table 3 presents respondents' recognition of ecosystem services provided by the Yayo Biosphere Reserve (YBR). Across all categories, provisioning services were the most widely recognized, with freshwater supply at 87% ranked highest overall. This makes sense since local households depend on rivers and springs in the YBR for domestic and agricultural use. Medicinal plants were acknowledged by 74% of respondents, reflecting ongoing reliance on traditional medicine in rural areas. Food resources, including wild fruits, honey, and occasional bushmeat, were recognized by 63%, further showing the reserve's contribution to food security.

In the regulating services category, 79% of respondents identified climate regulation, suggested a growing awareness of the forest's role in moderating local temperatures and rainfall patterns. Air and water purification, recognized by 68%, indicates that communities understand the connection between forest cover and environmental quality.

Cultural services received moderate recognition. Tourism and recreation were noted by 64%, ranking higher than cultural heritage at 53%. This may reflect the limited development of structured ecotourism programs, alongside a continued appreciation for local traditions, sacred sites, and cultural practices tied to the landscape.

Among supporting services, biodiversity and habitat provision scored very high at 81%, showed that communities value the YBR's role in maintaining wildlife and plant diversity. Pollination services, recognized by 66%, were especially notable in a coffee-growing region where both wild and managed pollinators are essential for production.

Overall, the results showed that while provisioning services dominate local recognition due to their direct benefits for livelihoods, there is significant awareness of regulating and supporting services. This understanding could help promote a more complete view of conservation benefits.

Table 3. Recognition of key ecosystem services in Yayo Coffee Forest Biosphere Reserve (N = 300)

Category	Ecosystem Service	Percentage (%)	Frequency (n)
Provisioning	Freshwater supply	87	261
	Medicinal plants	74	222
	Food resources (e.g., wild fruits, bush meat, honey)	63	189
Regulating	Climate regulation	79	237
	Air and water purification	68	204
Cultural	Tourism and recreation	64	192
	Cultural heritage (sacred sites, traditional practices)	53	159
Supporting	Biodiversity/habitat provision	81	243

Pollination (wild & agricultural crops)	66	198
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Source: Survey data, 2025

Willingness to Pay (WTP) and Willingness to Work (WTW)

Table 4 summarizes respondents’ willingness to pay (WTP) and willingness to work (WTW) for conservation of the Yayo Biosphere Reserve (YBR). The mean annual WTP was ETB 435 (USD 3.82), with a median of ETB 400, and 58% of respondents expressed willingness to contribute financially. When interpreted relative to the average monthly income (ETB 3,200), the mean WTP represents approximately 1.1% of annual household income, indicating a meaningful contribution within a low-income rural context. Although modest in absolute terms, this reflects a positive economic valuation of ecosystem services. In terms of non-monetary contributions, 62% of respondents were willing to participate in conservation activities through labor. The most preferred activities included tree planting (42%) and trail maintenance (32%), followed by awareness campaigns (29%). These findings highlight that labor contributions constitute an important component of ecosystem service valuation, rather than only complementing financial contributions. When aggregated across households, both WTP and WTW suggest the potential for a hybrid conservation financing mechanism, combining small financial contributions with structured volunteer programs.

Table 4. Willingness to Pay and Willingness to Work for YBR conservation (N = 300)

Variable	Category / Statistic	Value
WTP (annual)	Mean (ETB)	435
	Mean (USD*)	3.82
	Median (ETB)	400

WTW participation	Willing to volunteer	186 respondents (62%)
	Not willing to volunteer	114 respondents (38%)
Top volunteer activities	Tree planting	126 respondents (42%)
	Trail maintenance	96 respondents (32%)
	Awareness campaigns	87 respondents (29%)

Source: Survey data, 2025, *USD values calculated using the average exchange rate during the survey period.

Policy Recommendations from Respondents

Table 5 presents community-identified strategies to strengthen conservation of the YBR. Respondents emphasized stronger legal protection (72%), increased community participation in decision-making (65%), and the development of ecotourism (59%). These preferences are consistent with the valuation results, where both WTP and WTW indicate strong community support for conservation. The emphasis on participatory governance reflects the importance of institutional trust, while ecotourism reflects recognition of ecosystem services as income-generating assets. Overall, the responses indicate a preference for integrated conservation approaches, rather than isolated interventions.

Table 5. Community-recommended policy actions for YBR conservation (N = 300)

Policy Recommendation	Frequency (n)	Percentage (%)
Stricter protection laws	216	72
Greater community involvement in decision-making	195	65
Development of ecotourism	177	59

Source: Survey data, 2025

Summary of Descriptive Statistics

Table 6 summarizes the key socio-economic and perception variables used in the analysis. On average, respondents were willing to pay ETB 435/year (~USD 3.82/year) for YBR conservation, with a median of ETB 400. A majority (58%) expressed willingness to pay (WTP), and 62% indicated willingness to work (WTW) through volunteer activities. Mean monthly income was ETB 3,200, and the average education level was 7.4 years of schooling. Slightly over half of respondents were male (54%), with an average age of 35.6 years and household size of 5.3 members. The average distance to YBR was 8.7 km, with most respondents (90%) aware of YBR's conservation importance and two-thirds (66%) belonging to a local association. High awareness levels (90%) and strong association membership (66%) indicate favorable conditions for community-based conservation financing and participation.

Table 6. Descriptive statistics of variables used in WTP and WTW analysis

Variable	Mean	Std. Dev.	Min	Max	% / Notes
WTP (ETB/year)	435	118.4	150	800	Median = 400
WTP (USD/year)	3.82	1.04	1.32	7.02	Based on avg. exchange rate
WTP Binary (1 = Yes)	0.58	0.49	0	1	58% willing to pay
WTW Binary (1 = Yes)	0.62	0.49	0	1	62% willing to volunteer
Income (ETB/month)	3,200	1,050	900	6,800	—
Education (years of)	7.4	3.2	0	16	—
Gender (1 = Male)	0.54	0.5	0	1	—
Age (years)	35.6	11.2	18	65	—
Household size	5.3	1.9	2	10	—
Distance to YBR (km)	8.7	4.3	0.5	18	—

Awareness (1 = Aware)	0.9	0.3	0	1	—
Membership in local association	0.66	0.47	0	1	—

Source: Survey data, 2025

Econometric Data Analysis Results

This section presents the results of binary logit regression models used to identify factors influencing households' willingness to pay (WTP) and willingness to work (WTW) for conservation of YBR. The WTP model demonstrates moderate explanatory power (Pseudo $R^2 = 0.267$), which is acceptable for cross-sectional household data. Statistical significance is reported using standard thresholds ($p < 0.05$, $p < 0.01$, $p < 0.001$), ensuring robustness and reliability of the estimates.

Determinants of Households' Willingness to Pay (WTP)

Table 7 highlights that income significantly affects households' willingness to pay for the conservation of the Yayo Biosphere Reserve (YBR). Specifically, each additional 1,000 ETB in monthly income increases the chance of willingness to pay (WTP) by 54%. This means that households with more financial resources are more likely to contribute money to conservation efforts. This positive relationship is consistent with neoclassical economic theory, where environmental goods are considered normal goods, meaning demand increases as income rises. The positive link between income and WTP also aligns with findings from other conservation studies, which indicate that households with more disposable income can allocate resources to environmental projects (Abdeta, 2023; Tadesse et al., 2022). Financial capacity emerges as an important factor for voluntary conservation support. It shows the need for payment plans that consider local income levels.

Education also significantly influences WTP. The findings revealed that each additional year of schooling raises the odds of WTP by 20%. This supports the concept of human capital theory, where education enhances individuals' knowledge and preferences toward public goods such as environmental conservation. Education improves understanding of ecosystem services and the value of biodiversity, which can boost motivation to provide financial support for conservation (Chala et al., 2021; Abdeta, 2023). This highlights the importance of environmental education programs as tools to promote community involvement and encourage sustainable behaviors.

Gender differences were noticeable, with men being 41% more likely than women to pay for conservation. This gap may reflect traditional household roles in rural Ethiopia, where men usually control finances and make decisions, while women's roles may be limited by less access to income (Abdeta, 2023; Gebremedhin & Swinton, 2021). This finding highlights the need for inclusive conservation programs that actively engage women, possibly through specific awareness campaigns or micro-conservation projects that lower financial barriers.

Household size had a negative impact on WTP, with each additional member reducing the odds by 12%. Larger households might face tighter budgets, prioritizing immediate needs over voluntary contributions to conservation (Tadesse et al., 2022). This finding emphasizes the importance of considering household economic pressures when creating payment-for-ecosystem-services schemes to ensure fairness and practicality.

The distance to YBR negatively affected WTP, with each additional kilometer from the reserve decreasing the likelihood of contributing by 18%. This suggests that households closer to the reserve see more direct benefits from conservation, such as access to forest products, water, or eco-tourism opportunities. In contrast, those farther away may see fewer tangible benefits (Chala

et al., 2021). Thus, targeting conservation programs based on location may improve participation rates and the effectiveness of community contributions.

Awareness and social networks significantly boost WTP. Households that know about YBR and its ecological importance are more than twice as likely to pay (odds ratio = 2.21), and being part of local associations raises WTP by 72%. This shows that environmental knowledge and community involvement strengthen commitment to conservation. Educational campaigns, participatory planning, and utilizing local associations can be effective strategies to increase financial support for conservation initiatives (Abdeta, 2023; Gebremedhin & Swinton, 2021).

Finally, age had a minimal effect on WTP, indicating that willingness to support conservation is fairly consistent across age groups. This suggests that outreach efforts can broadly target households without needing to focus on specific age demographics.

Table 7. Logit Regression Results – Willingness to Pay (WTP)

Variable	B	Std. Error	z-value	p-value	Odds Ratio
Income (1000 ETB)	0.432	0.112	3.86	0.000***	1.54
Education (years)	0.186	0.065	2.86	0.004**	1.20
Gender (Male=1)	0.341	0.170	2.01	0.044*	1.41
Age (years)	0.011	0.014	0.78	0.435	1.01
Household size	-0.125	0.058	-2.16	0.031*	0.88
Distance to YBR (km)	-0.198	0.045	-4.40	0.000***	0.82
Awareness (1 = Aware)	0.792	0.276	2.87	0.004**	2.21
Membership in association	0.543	0.211	2.57	0.010**	1.72
Constant	-1.987	0.652	-3.05	0.002**	—

Model Fit: Log-likelihood = -162.4, Pseudo R^2 = 0.267, N = 300, Significance codes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Source: Authors' survey data analysis, 2025

Determinants of Households' Willingness to Work (WTW)

Table 8 presents the results of the logistic regression analysis for factors influencing willingness to work (WTW) for conservation in the Yayo Biosphere Reserve (YBR). The analysis of WTW shows that gender is the most important factor in determining whether someone is willing to volunteer for conservation activities in the Yayo Biosphere Reserve (YBR). The odds ratio for males is 1663.16, which is remarkably high. This indicates that men are much more likely to participate in manual labor than women. This trend reflects significant gender differences in labor roles in the study area, where men usually take on physically demanding tasks while women often focus on managing the household and caregiving responsibilities. Similar patterns have been seen in rural Ethiopia, where gender roles influence participation in community-based conservation programs (Gebremedhin & Swinton, 2021; Chala et al., 2021).

Education had a strong negative connection with WTW, with an odds ratio of 0.007. This suggests that higher education levels significantly lower the likelihood of volunteering for manual work. More educated individuals often prefer to contribute to conservation through financial support, organizational involvement, or advocacy rather than physical labor. Additionally, educated households may see higher opportunity costs in terms of time, leading them to emphasize income-generating activities over unpaid work (Abdeta, 2023). This indicates that education changes how people engage rather than their willingness to support conservation.

Distance from YBR had a minor negative effect on volunteering. Each additional kilometer slightly lowers the chance of participation. Households closer to the reserve likely see more

direct benefits from its conservation, such as access to forest products, ecosystem services, or job opportunities. These benefits motivate their involvement (Tadesse et al., 2022). In contrast, households farther away may notice fewer tangible benefits, which reduces their incentive to engage in labor-intensive conservation efforts.

Awareness showed positive trends. Knowledge about the reserve and its ecological importance appears to encourage volunteering. Households that recognize the benefits of YBR are more likely to contribute their labor. This highlights the importance of environmental education and outreach programs in encouraging community participation (Chala et al., 2021).

Finally, income had little impact on WTW. This means that financial capacity does not greatly influence the decision to volunteer. Unlike willingness to pay (WTP), which is heavily affected by income, volunteering is mainly shaped by social, spatial, and gender factors. This finding emphasizes that contributions of manual labor depend less on economic ability and more on proximity, perceived benefits, and social norms related to gender and community roles.

Table 8. Logit Regression Results – Willingness to Work (WTW)

Variable	Odds Ratio
Income	~1.000
Education level	0.007
Male	1663.157
Distance (km)	0.984
Awareness	0.697
Constant	31,409

Source: Authors' survey data analysis, 2025

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The study found that communities near the Yayo Coffee Forest Biosphere Reserve (YCBR) strongly recognize the reserve's various ecosystem services. These include provisioning, regulating, supporting, and cultural services. Freshwater resources and biodiversity are the most notable. Respondents expressed positive willingness to pay (WTP) in cash, though volunteer labor (WTW) emerged as the most scalable and immediate form of support. Logit regression analysis revealed that WTW is significantly influenced by gender, distance from YBR, awareness, and education, with men more likely to participate, a slight decline in participation with increased distance, a positive effect of environmental awareness, and differentiated contribution patterns by education level.

Conclusion

A hybrid conservation-finance strategy is most suitable for YBR's socio-ecological context. The analysis reveals distinct drivers for monetary and labor-based contributions among local communities. Willingness to pay (WTP) is most strongly influenced by income and awareness, followed by education and distance, reflecting the role of economic capacity and environmental knowledge in shaping financial support for conservation. In contrast, willingness to work (WTW) is dominated by gender, alongside education and proximity, indicating that labor participation is primarily shaped by social norms and opportunity costs rather than financial capability. This approach combines modest cash contributions where feasible with structured, role-differentiated volunteer programs that convert strong local stewardship into regular on-the-ground conservation work. Embedding these programs within stronger legal protections, participatory governance, and ecotourism-linked livelihood opportunities will enhance both

durability and equity. By integrating financial incentives with meaningful volunteer roles, the reserve can leverage community engagement while sustaining ecosystem services and local livelihoods.

Recommendations

- **Community-Based Conservation Contributions:** Establish a Payment for Ecosystem Services (PES) scheme where households can contribute either small annual payments or labor days. This will provide flexibility for poorer families.
- **Strengthen Awareness & Education Programs:** Launch community-wide conservation education through schools' clubs, farmer cooperatives, and religious institutions to improve understanding of ecosystem benefits.
- **Promote Coffee Certification and Eco-Labeling:** Expand certification schemes such as shade-grown, organic, and fair-trade coffee to strengthen conservation-linked income opportunities for local communities. These certification programs can create market incentives for sustainable forest management while enhancing the value of coffee produced within the Yayo Coffee Forest Biosphere Reserve. Revenue generated through certified coffee markets should be partly reinvested in local development initiatives and ecosystem management activities, thereby supporting both forest conservation and community livelihoods.
- **Adopt Gender-Sensitive Approaches:** Offer flexible options for women, such as home-based nurseries and forest product businesses, to ensure fair participation in conservation.

- Rebuild Institutional Trust & Capacity: Strengthen local cooperatives and kebele administrations with transparent fund management and community participation in decision-making.
- Support Alternative Livelihoods: Promote income diversification (beekeeping, ecotourism, coffee value chain improvements) to reduce reliance on forest clearing.
- Establish a Conservation Endowment Fund: Create a multi-source financing mechanism combining household contributions, coffee premiums, and donor support for long-term ecosystem management.

ACKNOWLEDGEMENT

This research was fully funded by the Ethiopian Biodiversity Institute (EBI). The authors gratefully acknowledge the Institute for providing the financial resources and institutional support necessary to undertake this study. Data collection was carried out by researchers from the Ethiopian Biodiversity Institute, whose dedication and field expertise significantly contributed to the successful completion of this work.

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