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Article

Estimating the Recreational Value of Volcanic-Slope Agricultural Landscapes Using Avidity-Corrected Travel Cost Models

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Abstract: Volcanic-slope agricultural landscapes provide both productive and recreational functions, yet their economic value remains underexamined, particularly in developing countries where many such areas operate as informal destinations. This study estimates recreation demand and consumer surplus for a volcanic-slope agricultural landscape in Indonesia, focusing on Selo and Cepogo on the saddle between Mount Merapi and Mount Merbabu. Using an on-site intercept survey of 100 visitors conducted in June–July 2024, annual visit frequency is modeled as a function of generalized travel cost, including time. To address the sampling problems inherent in on-site surveys, namely zero truncation and endogenous stratification, four count-data models are estimated: zero-truncated Poisson, negative binomial models, and their avidity-corrected counterparts. Across specifications, visitation declines with higher travel cost and increases strongly with perceived landscape attractiveness, while substitute sites reduce repeat visits, indicating a competitive regional recreation market. Correcting for avidity and overdispersion improves model fit and yields more conservative welfare estimates. Bootstrapped consumer surplus remains positive and substantial across specifications, with a preferred benchmark of approximately 435 thousand IDR per trip and 1,517 thousand IDR per individual annually. Although based on a modest sample, the findings show that volcanic-slope agroecosystems can generate measurable recreation benefits and that correcting on-site sampling bias is important for credible welfare estimation and local landscape governance.

Keywords: travel cost method; endogenous stratification; zero truncation; agricultural landscapes; cultural ecosystem services; volcanic slopes; consumer surplus; informal tourism

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1. Introduction

Agricultural landscapes are increasingly recognized not only as sites of production, but also as sources of cultural ecosystem services (CES) such as recreation, aesthetic enjoyment, and place-based meaning. Yet their economic value remains underexamined in many developing-country settings, especially where landscapes attract visitors without being planned or managed as formal tourist destinations. This gap is particularly important for volcanic-slope agricultural landscapes. In such settings, the visible qualities that attract visitors are inseparable from ecological and managerial practices that sustain farming on steep, disturbance-prone terrain. Estimating the recreational value of these landscapes therefore matters not only for tourism appraisal but also for wider debates on landscape stewardship, rural livelihoods, and multifunctional land use.

Volcanic-slope agricultural landscapes emerge from an unusual combination of high agricultural potential and recurring disturbance, producing scenery that is both dynamic and highly legible to visitors (De Bauw et al., 2016; Ligot et al., 2023; Saputra et al., 2022). Steep elevation gradients generate abrupt microclimatic transitions over short distances, enabling diversified crop portfolios such as horticulture, agroforestry, and mixed smallholder systems, while simultaneously increasing vulnerability to slope instability, erosion, and episodic ashfall (De Bauw et al., 2016; Purwaningsih et al., 2020; Saputra et al., 2022; Sarmiento-Soler et al., 2022). The resulting fine-grained mosaics of fields, hedgerows, forest patches, agroforestry, and settlement nodes are not only productive but also visually distinctive and closely tied to water and soil regulation (Purwaningsih et al., 2020; Saputra et al., 2022). In many tropical volcanic uplands, these landscapes are underpinned by volcanic-ash soils, commonly Andisols, whose mineralogy composition supports high yields but also demands careful management of fertility, cover, and erosion risk (Auxtero et al., 2004; Parfitt, 2009; van Ranst et al., 2004). Evidence from Java further suggests that intensive horticulture can alter soil biological indicators and long-run soil quality, implying that the scenic and recreational qualities of these landscapes depend on continued stewardship rather than arising automatically from production alone (Griffin, 2019; Kashyap et al., 2023; Moeskops et al., 2010, 2012).

This stewardship dimension is important because agricultural landscapes are increasingly conceptualized as multifunctional social-ecological systems that generate nonmarket benefits alongside food and fiber. A growing body of research shows that agricultural landscapes can provide meaningful cultural ecosystem services, especially aesthetic enjoyment and recreation, and that these benefits are strongly influenced by landscape structure, accessibility, and visitor perception (Assandri et al., 2018; de las Heras et al., 2024; Mameno et al., 2024; Plieninger et al., 2013, 2015; van Berkel & Verburg, 2014; van Zanten et al., 2016; Yue et al., 2025). This literature has established that heterogeneity, crop-forest mosaics, terraces, and iconic vistas can generate real welfare benefits, but it also remains uneven (Assandri et al., 2018; Cetin et al., 2021; van Berkel & Verburg, 2014). Much of the evidence is drawn from formally recognized recreational settings or more general agricultural landscapes, while volcanic-slope farming landscapes in developing countries remain far less studied. In particular, the Indonesian case is important because volcanic uplands are simultaneously productive, environmentally fragile, and increasingly integrated into short-break tourism circuits. What remains insufficiently understood is the extent to which these "working landscapes" generate measurable recreational welfare and how that value should matter for management.

A related valuation literature supports monetizing the nonmarket benefits produced by managed agroecosystems and organizing them within a total economic value perspective relevant for land-use decisions. Recent studies have valued ecosystem services at the agricultural landscape scale and shown that managed agroecosystems can generate benefits that are not captured by commodity output alone (Fleischer & Tsur, 2000; Kaleji et al., 2025; Mameno et al., 2024; Shahimoridi et al., 2024; Song et al., 2020). For the present study, this literature is useful because it clarifies that recreational value should not be treated as incidental. At the same time, it leaves an important gap. Most existing studies do not focus on volcanic-slope agricultural landscapes where recreation is tightly bundled with regulating and supporting services such as soil conservation, runoff control, vegetation management, and terrace maintenance. In such contexts, tourism growth, agricultural intensification, and ecological stewardship are closely intertwined. Valuation is therefore useful not simply because it produces a monetary estimate, but because it helps reveal whether the recreational benefits of landscape maintenance are economically meaningful enough to inform real management choices.

This question becomes even more relevant because many volcanic-slope scenic sites function as destinations without centralized planning or unified management. Informality here does not mean the absence of organization altogether; rather, destination functions are distributed across multiple actors and micro-practices, including parking provision, food stalls, roadside photo spots, informal guiding, and small-scale accommodation. Research on informal tourism entrepreneurship shows that these activities often operate across blurred formal-informal boundaries, while unequal access to capital can shape who benefits and who is excluded from decision-making (Çakmak et al., 2018). In rural Indonesia, tourism-village studies likewise suggest that customary institutions and community strategies may substitute for, or complement, formal destination governance where rules are socially embedded, and resources are shared (Rosalina et al., 2023). These insights suggest that volcanic-slope agricultural landscapes should be treated not only as agricultural production spaces, but also as destination systems with measurable visitation flows, welfare effects, and governance challenges.

Two contemporary forces are accelerating the transition from "working landscape" to "visited landscape." First, social-media imagery can reveal and amplify aesthetic demand by transforming particular landscape configurations into widely shared visual icons, thereby strengthening the link between landscape structure and cultural value (Gosal & Ziv, 2020; Tieskens et al., 2018). Second, social-media-motivated travel can trigger rapid increases in visitation and behavioral pressure even where sites were not originally designed for tourism, creating practical management problems in open-access environments (Siegel et al., 2023). Under these conditions, the recreational benefits and pressures associated with visitation are often overlooked by assessments that focus narrowly on crop output or a limited set of biophysical indicators. Travel cost methods are well-suited to this setting because they infer value from observed trip behavior even when access is free or entrance fees are absent, weakly enforced, or institutionally fragmented (Blaine et al., 2015; Cetin et al., 2021; Mäntymaa et al., 2021; Menendez-Carbo et al., 2020; Qiu & Fan, 2016; Tyllianakis, 2024; Van Sandt & McFadden, 2022). Existing studies also suggest that recreation benefits in agricultural landscapes can be economically meaningful rather than marginal to rural land-use decisions (Fleischer & Tsur, 2000; Kaleji et al., 2025; Mameno et al., 2024; Song et al., 2020).

The significance of the present study can be clarified at three levels. First, the research question is important because volcanic-slope agricultural landscapes generate visible and experiential benefits that are likely to affect welfare, yet these benefits are rarely measured in economic terms. Second, the study is necessary because current evidence says relatively little about informal, working agricultural landscapes in Indonesia, where tourism, farming, and ecological risk intersect. Third, the study is feasible because recurrent visitation to such landscapes can be observed directly and modeled using travel cost methods adapted to the realities of on-site survey data. In this sense, the paper addresses not only a substantive gap in the literature but also a practical need for evidence that can support more balanced decisions about access, stewardship, and benefit sharing.

Accordingly, the objective of this paper is to estimate recreation demand and consumer surplus for a volcanic-slope agricultural landscape conceptualized as an informal tourist destination, and to draw out the management relevance of these nonmarket benefits for stewardship and destination governance. Because data in emerging destinations are typically collected through on-site intercept surveys at viewpoints, farm cafés, and roadside pull-offs, the observed sample includes visitors only and is more likely to intercept frequent visitors than infrequent ones. This creates two well-known econometric problems: zero truncation, because non-visitors are unobserved, and endogenous stratification, because frequent visitors are oversampled. If these features are ignored, the estimated travel-cost relationship may be biased, and welfare measures may be overstated (Amoako-Tuffour & Martínez-Espiñeira, 2012; Hindsley et al., 2011; Martínez-Espiñeira & Amoako-Tuffour, 2008; Shaw, 1988). The paper therefore applies travel-cost models that explicitly address these sampling issues. In doing so, it contributes in three ways: it extends recreation-demand valuation to a distinctive volcanic-slope agricultural landscape in Indonesia; it shows why correcting for on-site sampling bias matters for credible welfare estimation; and it links those welfare estimates to practical questions of landscape stewardship, benefit sharing, and governance in informal destination economies.

2. Methods

2.1. Study Area Rationale: Altitude, Risk, Seasonality

The study focuses on Selo and Cepogo sub-districts in Boyolali Regency, Central Java, Indonesia. These areas were selected because they lie on the steep saddle between Mount Merapi and Mount Merbabu, creating an unusually sharp altitude gradient over a short distance. This gradient produces a clearly differentiated sequence of farming landscapes, ranging from terraced high-elevation vegetable systems in Selo to more gently contoured areas in Cepogo, where forage production and smallholder dairy farming become more prominent. The site therefore offers strong ecological and visual contrasts within a single volcanic landscape system.

The area is also relevant because agriculture is practiced under conditions of recurrent environmental risk. Local livelihoods are shaped by fertile volcanic soils, steep slopes, and periodic disturbance associated with one of Indonesia's most active volcanic zones. In this sense, the landscape is not only a biophysical product of volcanic geomorphology, but also a social product maintained through adaptation, local knowledge, and long-standing farming practices (Brata et al., 2021; Lavigne et al., 2008). These features make the area particularly suitable for examining how agricultural stewardship and perceived landscape quality may support recreation demand.

A further reason for selecting the site is its clear seasonal dynamism. Cropping patterns shift across the annual cycle, with dry-season and wet-season production creating a changing but still legible working landscape. This seasonal rhythm reinforces the relevance of the site for a recreation-demand study because visitors encounter not static scenery, but a managed agricultural mosaic shaped by cropping decisions, environmental constraints, and conservation-minded practices (Irham et al., 2022; Moreira et al., 2024; Waha et al., 2020).

2.2. Survey Design

This study applies the individual travel cost method to estimate the recreational value of a volcanic-slope agricultural landscape in Selo and Cepogo. Data were collected through an on-site intercept survey, a common approach in travel cost studies because it directly targets actual users of the site (Landry et al., 2016; Martínez-Espiñeira & Amoako-Tuffour, 2008). This design is especially appropriate in informal destinations such as the present case, where no entrance gate, visitor register, or official attendance statistics exist. However, on-site sampling also has implications for inference. All individuals sampled are visitors, and the trip variable is recorded only for positive counts.

Face-to-face interviews were conducted using a structured questionnaire during June-July 2024. The questionnaire recorded annual trip frequency, travel cost components, time use, perceived landscape attractiveness, substitute-site information, and basic socio-demographic characteristics. A total of 100 respondents were interviewed. Because no formal sampling frame was available, respondents were selected using accidental or convenience sampling at relevant stopping points such as viewpoints, roadside areas, and agricultural visitor nodes.

The sample size is modest for travel cost estimation and should therefore be interpreted with appropriate caution. In particular, the estimates are best understood as site-specific evidence rather than as population-wide measures that can be aggregated mechanically beyond the study context. At the same time, the sample remains informative because it captures actual visitors in an emerging informal destination where visitation is real but not administratively recorded. For this reason, the study is suitable for estimating recreation demand and comparing alternative count-data specifications, while broader generalization should be reserved for future work using expanded and repeated samples.

2.3. Variables and Measurement

The dependent variable is the annual number of visits made by individual i, denoted v_i, measured as the reported number of trips to the site in the last 12 months. The key "price" variable is generalized travel cost per trip, denote τ_i. Following standard practice in travel cost studies, τ_i is constructed from out-of-pocket expenses and the opportunity cost of time (Shaw, 1988).

Perceived landscape quality is measured by a visitor rating of agricultural landscape attractiveness, denoted q_i. This variable captures the aesthetic and experiential dimension of the agricultural landscape, which is central in valuation studies of agricultural amenities. In addition, to reduce the risk that observed demand simply reflects the absence of alternatives, the analysis also controls for whether respondents could point to a reasonable substitute destination, capturing the availability of outside options that may limit repeat visitation.

A set of individual characteristics is included to control for heterogeneity in preferences and constraints. Let z_i denote a vector of controls, including age, gender, years of schooling, marital status, household income, and residency status (resident of Boyolali Regency vs non-resident). Because income is recorded in brackets, we use the mid-point of each bracket (Table 1) as an approximately continuous proxy for monthly income in the estimation.

Table 1. Variable definition and descriptive statistics (N = 100).

Variable		Description	Mean	Standard Deviation	Min	Max
1.	VISITS	Number of visits per person in one year	3.470	2.634	1	15
2.	TC	Round-trip travel cost per visit per person, including transport expenses and other trip-related costs including the opportunity cost of travel/visit time. Measured in IDR 1,000.	383.098	553.491	38	3,575
3.	AGL	Agricultural landscape attractiveness, based on visitor rating (1–5, higher = more attractive).	3.740	0.664	3	5
4.	SUB	Substitute site (=1 if a substitute recreational site was identified by the respondent)	0.460	0.501	0	1
5.	AGE	Age (years).	37.460	11.390	17	64
6.	FEM	Gender dummy (1 = female, 0 = male).	0.650	0.479	0	1
7.	EDU	Years of schooling (years).	13.110	2.892	6	18
8.	MAR	Marital status dummy (1 = married, 0 = not married).	0.840	0.368	0	1
9.	INC	Mid-point of four average monthly income brackets in IDR 1 million	2.545	1.339	1	5
10.	RSD	Local residence dummy (1 = resides in Boyolali Regency; 0 = non-local).	0.390	0.490	0	1

2.4. Conceptual Foundation

Recreation demand is derived from a utility-maximization problem in which an individual allocates resources between general consumption and trips to the site. Following Fleischer and Tsur

(2000), the agricultural landscape travel cost setting used in earlier work, landscape quality (q_i) and a substitute site shifts utility from visitation, implying systematic changes in trip demand even after accounting for generalized travel cost. The choice problem is

$$\max_{v_i \geq 0,\, c_i \geq 0} U_i\left(c_i, v_i; q_i\right) \quad s.t. \quad c_i + \tau_i v_i \leq m_i, \tag{1}$$

where c_i denote the consumption v_i denote the number of visits made by a person i in one year of all other goods. m_i represents income and τ_i is generalized travel cost per trip. This framework implies that expected visits should decline as generalized travel cost rises and increase when perceived landscape quality improves, holding other factors constant.

2.5 Construction of Generalized Travel Cost

Generalized travel cost combines monetary expenses and time costs. Time cost is valued using the reservation wage or usual hourly earnings:

$$time\ cost_i = w_i \times (t_i^{travel} + t_i^{onsite}) \tag{2}$$

where w_i is the reservation wage (usual hourly earnings), t_i^{travel} is travel time, and t_i^{onsite} is the time spent at the destination. The generalized cost (τ_i) then takes form:

$$\tau_i = money\ cost_i + time\ cost_i \tag{3}$$

This construction is consistent with the travel cost literature in which time is treated as a real resource cost of recreation, and it is particularly relevant in mountainous volcanic landscapes where travel and on-site durations can be substantial. In the baseline specification, we value travel and on-site time at the individual's stated (or implied) hourly earnings; as a robustness check, welfare is re-computed under alternative time-valuation fractions to confirm that qualitative conclusions are unchanged.

2.6 Econometrics: Truncation and Endogenous Stratification

Because the survey is conducted on-site, the observed sample is drawn from visitors only, not from the full population of potential visitors. If these features are ignored, estimated demand may appear less price-sensitive than it really is, and consumer surplus may be overstated. As a result, the observed trip counts are strictly positive $(v_i \geq 1)$, so standard count-data models that assign positive probability to zero trips are not fully consistent with the sampling process. This issue is commonly treated as zero truncation in single-site recreation demand estimation (Shaw, 1988). In addition, on-site intercept surveys typically do not sample visitors uniformly. Individuals who take more trips are more likely to be intercepted, which creates endogenous stratification (avidity bias) unless the likelihood is adjusted appropriately (Englin & Shonkwiler, 1995). Empirical applications emphasize that ignoring these features can materially affect the estimated travel-cost coefficient and welfare measures (Curtis, 2002; Hynes et al., 2017).

The recreation demand function is specified through the conditional mean of annual visits. Let τ_i denote generalized travel cost per trip, q_i denote perceived landscape aesthetics, and z_i denote a vector of observed visitor attributes. The conditional mean is modeled using an exponential link:

$$\mu_i = E[v_i|\tau_i, q_i, z_i] = exp\left(\alpha + \beta_\tau \tau_i + \beta_q q_i + \sum_{k=1}^{K} \delta_k z_{ik}\right),\ \beta_\tau < 0 \tag{4}$$

The parameter β_τ is central for valuation because it captures how expected visits respond to changes in generalized travel cost. Since the survey is conducted on-site, observed trip counts satisfy $v_i \geq 1$. Accordingly, μ_i is interpreted as the latent (population) mean implied by covariates under the count process, while the mean trips in the observed on-site sample are obtained by conditioning on positive counts (e.g., under Poisson $\mathrm{E}[v_i|v_i \geq 1, x_i] = \mu_i/1 - \exp\left(-\mu_i\right)$). This distinction matters for interpretation, but the travel-cost semi-elasticity driving welfare remains governed by β_τ.

Under a Poisson baseline, the probability of observing $v_i = v$ conditional on $v_i \geq 1$ is the zero-truncated Poisson probability mass function:

$$\Pr(v_i = v \mid v_i \geq 1, \mu_i) = \frac{e^{-\mu_i}\mu_i^v}{v!(1 - e^{-\mu_i})}, \quad v = 1, 2, 3, \ldots \quad (5)$$

Parameters in (4)–(5) are estimated by maximum likelihood. However, recreation trip data often exhibit overdispersion (variance exceeding the mean), so a zero-truncated Negative Binomial (NB) specification is also estimated. In the NB model, the conditional mean remains μ_i as in (4), but the variance is allowed to exceed the mean according to:

$$\mathrm{Var}(v_i|\cdot) = \mu_i(1 + \kappa\mu_i), \kappa > 0 \quad (6)$$

Truncation is handled by conditioning the NB distribution on positive counts:

$$\Pr(v_i = v \mid v_i \geq 1) = \frac{\Pr_{NB}(v_i = v|\mu_i, \kappa)}{1 - \Pr_{NB}(v_i = 0|\mu_i, \kappa)}, v = 1, 2, 3, \ldots \quad (7)$$

where $\Pr_{NB}$ denotes the standard Negative Binomial probability mass function. In practice, model selection between the truncated Poisson and truncated NB specifications is guided by evidence of overdispersion and by information criteria, since mis-specifying dispersion can influence both the travel-cost sensitivity and the implied welfare measures (Englin & Shonkwiler, 1995).

The on-site sampling design also implies endogenous stratification. The probability of observing an individual in the sample is proportional to their number of trips. Following the on-site recreation-demand literature (Blaine et al., 2015; Englin & Shonkwiler, 1995; Shaw, 1988), this is represented by a size-biased (trip-weighted) likelihood. Formally, if the population trip-count probability is $f(v_i|\mu_i, \kappa)$, then the on-site sampling mechanism implies:

$$\Pr_{\text{on-site}}(v_i = v) = \frac{v f(v|\mu_i, \kappa)}{\mu_i}, v = 1, 2, 3, \ldots \quad (8)$$

Because the on-site likelihood is trip-weighted, individuals with $v_i = 0$ have zero sampling probability, so truncation is inherent, and the remaining adjustment corrects the over-representation of avid visitors among those with positive trips. This adjustment is important because it recovers parameters that are consistent with the underlying population demand rather than the trip-weighted on-site sample. The practical relevance of this correction is well illustrated in applied recreation settings, including angling demand, where truncated NB models with endogenous stratification are used for welfare estimation (Curtis, 2002). More recent work also shows how the avidity correction can be extended to more flexible dispersion structures such as generalized negative binomial formulations (Landry et al., 2016). Equation (8) implies that estimation is based on a trip-weighted likelihood, so the recovered parameters reflect underlying population demand rather than the mechanically trip-heavy composition of the on-site sample. With this corrected demand in hand, the next subsection translates the estimated travel-cost sensitivity into welfare measures by computing consumer surplus from the implied trip demand curve.

2.7. Welfare Measurement: Consumer Surplus

The recreational value of the site is derived from the estimated trip demand by measuring the surplus that visitors obtain beyond what they pay in generalized travel cost. The valuation step converts the estimated recreation demand into welfare measures. The economic value of access is captured by consumer surplus, defined as the area under the trip demand curve with respect to travel cost. In general form, individual consumer surplus is:

$$CS_i = \int_{\tau_i}^{\infty} \mathrm{E}[v_i|\tau_i, q_i, z_i] \, d\tau \quad (9)$$

Under the exponential mean equation (4) and $\beta_{tau} < 0$, this integral yields a closed form:

$$CS_i = \frac{\mu_i}{-\beta_\tau} \quad (10)$$

A convenient summary is consumer surplus per trip:

$$CS^{trip} = \frac{1}{-\beta_\tau} \quad (11)$$

Finally, the framework supports the valuation of changes in landscape quality. Consider an improvement from q_i^0 to q_i^1, while holding travel cost and attributes fixed. The implied welfare gain is:

$$\Delta CS_i = CS_i\,(q_i^1) - CS_i(q_i^0) = \frac{\mu_i(q_i^1) - \mu_i(q_i^0)}{-\beta_\tau} \tag{12}$$

These expressions make the conceptual link explicit. Improved agricultural landscape quality increases expected visits, and the magnitude of the welfare gain is scaled by the sensitivity of visitation to travel cost.

3. Results

3.1. Sample Characteristics and Trip Motivations

Table 1 shows that visitation to the volcanic-slope agricultural landscape is both meaningful and unevenly distributed across visitors. The site does not appear to attract only one-time curiosity trips; rather, it supports repeated use, with respondents reporting an average of 3.47 visits per year (SD = 2.63). At the same time, the considerable variation in annual trips suggests that the landscape differs in its appeal and accessibility across individuals. A similar heterogeneity emerges in generalized travel cost. While some respondents reach the site with relatively modest time and monetary burdens, others incur substantially higher costs, as reflected in the mean generalized travel cost of IDR 383.10 thousand per trip and a large standard deviation of IDR 553.49 thousand. This wide dispersion is substantively important because it indicates that the site draws visitors from a geographically and economically diverse catchment area, while also providing the variation needed to identify the travel-cost demand relationship in a credible way (Czajkowski et al., 2019; Tyllianakis, 2024).

Visitors also tend to evaluate the landscape positively. The mean attractiveness score is 3.74 on a 1–5 scale (SD = 0.66), indicating generally favorable perceptions of the agricultural scenery, yet not such uniformity that quality differences become empirically irrelevant. This pattern is important for the logic of the analysis. It suggests that the site is not visited merely because it exists or because it is conveniently located; rather, visitors appear to respond to differences in how attractive they perceive the landscape to be. In this sense, perceived quality is likely to be more than a descriptive attribute. It is plausibly one of the mechanisms through which the landscape generates repeat visitation.

The socio-demographic profile further suggests that this is a socially broad but regionally outward-looking recreation setting. Respondents are predominantly of working age, with an average age of 37.45 years, and the sample has a distinctly family-oriented character, as reflected in the relatively high proportions of women (65%) and married individuals (84%). Educational attainment averages 13.11 years of schooling, while income is concentrated mainly in the lower-to-middle categories: 35% of respondents report a monthly income below IDR 2 million, 29% fall in the IDR 2–3 million range, and 21% belong to the highest category of above IDR 4 million. These patterns indicate that the site is not an exclusive leisure destination for affluent households, but one that is accessible to a fairly broad domestic visitor base. At the same time, only 39% of respondents reside in Boyolali Regency, implying that most visitors come from outside the immediate locality. Taken together, these descriptive results suggest that the landscape functions as a wider regional recreation destination, attracting visitors with different travel burdens, different socio-economic backgrounds, and different propensities to return. This pattern aligns with the wide travel-cost spread typically associated with heterogeneous demand across visitors (Tyllianakis, 2024; van Berkel & Verburg, 2014).

Thematic evidence from Tables 2 and 3 provides insight into the underlying drivers of visitation patterns and perceived quality. Reported reasons for visiting indicate that the destination offers more than rural scenery; it is also a site for active engagement with farming landscapes. Agritourism and farming observation are the primary motivations, supplemented by leisure trips, photography or content creation, and the pursuit of calm and reflection. This combination aligns with the concept that agricultural landscapes generate cultural ecosystem services-particularly recreation, aesthetic enjoyment, and place-based meanings-that attract visitors from beyond the local area (van Berkel & Verburg, 2014). The experience outcomes reinforce that interpretation.

Table 2. Reasons for visiting agricultural landscapes (N = 83).

Reason Theme	Percentage
1. Agrotourism and farming observation	20%
2. Leisure trip	12%
3. Photography and content creation	12%
4. Relaxation, healing, and reflection	12%
5. Shopping for fresh produce and culinary	10%
6. Education, research, and fieldwork	7%
7. Cool climate and clean air escape	5%
8. Outdoor exercise and exploration	5%
9. Slow travel, stopover, and avoiding crowds	5%
10. Nostalgia and village/social life	5%
11. Creative inspiration	5%
12. Helping/volunteering/assisting	2%

Table 3. Experiences obtained from visiting agricultural landscapes (N = 83).

Experience Theme	Percentage
1. Learning and practical insight	52%
2. Scenic beauty and photo-worthy moments	22%
3. Calm, relaxation, and mental refresh	11%
4. Warm togetherness and social connection	7%
5. Physical refresh and clean air	5%
6. Fresh produce and culinary enjoyment	1%
7. Creativity and inspiration	1%
8. Appreciation, pride, and gratitude	1%

The dominant reported experience is learning and practical insight, suggesting that visitors often leave with a concrete understanding of crops, farm routines, and rural livelihoods rather than only passive enjoyment. Educational and experience-based benefits are frequently emphasized in agritourism research as a central pathway through which farm visits create value and shape satisfaction and future intentions (Chen et al., 2020; Tang et al., 2022). At the same time, scenic beauty and photo-worthy moments appear prominently as outcomes, matching the relatively high attractiveness scores in Table 1 and indicating that perceived landscape quality is likely tied to visual appreciation and the "shareability" of the setting. The presence of togetherness/social connection among reported experiences also fits the sample profile (high shares of married and female respondents) and supports the view that the Merbabu-slope agricultural landscape functions as a hybrid recreation space—simultaneously a living landscape for learning, a scenic environment for aesthetic enjoyment, and a setting for family and social time (Tang et al., 2022; van Berkel & Verburg, 2014).

The quantitative data are enriched by qualitative responses. For instance, one visitor noted, "Walking through these terraced fields, I learned how farmers prevent erosion on steep slopes—it's not just scenery but a lesson in sustainability." Such quotes transform abstract concepts like "cultural ecosystem services" into tangible experiences, underscoring why perceived attractiveness drives demand. Another respondent shared, "The peace here helps me reconnect with nature," highlighting the emotional value beyond recreation.

3.2. Recreation Demand Models

Table 4 reports four count-data specifications that reflect common features of on-site recreation surveys: a zero-truncated Poisson (TP), a zero-truncated negative binomial (TNB), a truncated endogenously stratified Poisson (TSP), and a truncated endogenously stratified negative binomial (TSNB). Across all models, the travel-cost coefficient is negative and precisely estimated (β_{TC} =

−0.0016 to −0.0023; p-value < 0.01), confirming a downward-sloping demand for visits. As generalized trip cost rises, visitation falls. This is the core revealed-preference result on which the travel cost method depends, and it indicates that even in an open-access setting with no formal entrance fee, visitors still face meaningful economic constraints through travel expenses and time costs.

Table 4. Estimation results.

Variable	(1) Zero-truncated Poisson (TP)	(2) Zero-truncated Negative Binomial (TNB)	(3) Truncated and endogenously stratified Poisson (TSP)	(4) Truncated and endogenously stratified negative binomial (TSNB)
TCOST	−0.0016***	−0.0019***	−0.0020***	−0.0023***
	(0.0004)	(0.0004)	(0.0005)	(0.0005)
AGL	0.5254***	0.5407***	0.6336***	0.6394***
	(0.1007)	(0.1047)	(0.1190)	(0.1208)
SUB	−0.3615***	−0.3936***	−0.4342***	−0.4783***
	(0.1260)	(0.1353)	(0.1507)	(0.1575)
AGE	−0.0062	−0.0057	−0.0074	−0.0064
	(0.0085)	(0.0085)	(0.0101)	(0.0098)
FEM	−0.1659	−0.1595	−0.2005	−0.1819
	(0.1535)	(0.1562)	(0.1831)	(0.1829)
EDU	−0.0220	−0.0165	−0.0262	−0.0153
	(0.0247)	(0.0253)	(0.0298)	(0.0293)
MAR	0.2338	0.2351	0.2804	0.2712
	(0.2224)	(0.2246)	(0.2632)	(0.2601)
INC	0.1447**	0.1457**	0.1734**	0.1690**
	(0.0594)	(0.0609)	(0.0710)	(0.0710)
RSD	−0.1307	−0.0900	−0.1546	−0.0779
	(0.1830)	(0.1735)	(0.2176)	(0.1967)
Constant	−0.1899	−0.3167	−0.7929	−1.0977*
	(0.4696)	(0.5352)	(0.5644)	(0.6559)
ln(α)				
Constant		−2.4607***		−1.5982***
		(0.5927)		(0.4697)
Statistics				
Log-likelihood	−175	−173	−176	−171
N	100	100	100	100
pseudo-R^2	0.2195	0.1612	0.2526	0.1703
χ^2	86.33	84.29	91.32	90.18
AIC	3.704	3.687	3.716	3.643

A notable result is that the travel-cost coefficient becomes more negative once endogenous stratification is addressed in the TSP and TSNB models. This implies that demand is more price-sensitive after correcting for the over-representation of frequent visitors in the on-site sample. Substantively, this is important because it confirms that avidity is not merely a technical concern. If frequent visitors are more likely to be intercepted and this is ignored, the estimated demand curve may appear artificially flatter than it really is, which in turn tends to inflate welfare estimates. The pattern in Table 4 therefore supports the methodological choice to go beyond simple truncation-only models and is consistent with both theoretical expectations and prior evidence in recreation economics.

Perceived agricultural landscape attractiveness (AGL) is positive and highly robust (β_{AGL} = 0.525–0.620; p-value < 0.01). Interpreted as incidence-rate ratios (IRR), a one-point increase on the 1–5 attractiveness scale is associated with roughly 69–86% more visits (IRR ≈ 1.69–1.86), holding other factors constant. This indicates that repeat visitation is strongly quality-driven. The result is also consistent with the earlier descriptive evidence, where visitors emphasized learning, scenic beauty, calmness, and photo-worthy moments as important parts of the experience. In this setting, terraces, crop mosaics, rural scenery, and the overall experiential quality of the landscape are not merely background conditions; they are central components of what visitors value and consume.

The substitute-site indicator (SUB) is negative and significant in every specification (β_{SUB} = −0.359 to −0.476; p-value < 0.01), implying about 30–38% fewer visits when respondents report an alternative site (IRR ≈ 0.70–0.62). This result indicates that the destination operates within a broader regional recreation market in which visitors compare available options rather than behaving as if they face a unique site with no alternatives. This strengthens the credibility of the demand estimates because it shows that visitation responds not only to travel cost and perceived quality, but also to the existence of competing outdoor experiences. In practical terms, it suggests that maintaining comparative advantage through stewardship and basic visitor-support conditions may be as important as expanding infrastructure.

Income (MID) is positive and statistically significant throughout (β_{MID} = 0.145–0.180; p < 0.05), suggesting visits behave as a normal good in this setting. In contrast, age, gender, education, marital status, and residence show small coefficients and remain statistically weak across specifications, indicating that (conditional on generalized travel cost and perceived landscape quality) visit frequency is not sharply segmented by these demographics in this sample. This does not imply that such characteristics are unimportant in every context, but within this sample their effects appear limited once generalized travel cost, perceived landscape attractiveness, and substitute availability are taken into account. The strongest and most consistent drivers of visitation are therefore price, quality, and alternatives.

Model diagnostics favor accounting for both overdispersion and onsite-sampling selection. Overdispersion is supported by the negative binomial results: ln(α) is significant in both NB-based models, rejecting the equidispersion restriction embedded in Poisson. Fit statistics also improve once avidity is addressed: TSNB has the highest log-likelihood (−171) and the lowest AIC (3.643), making it the preferred specification among the four. This provides a clear basis for selecting a benchmark welfare estimate rather than treating all models as equally persuasive. The econometric message is therefore straightforward: once trip overdispersion and the over-sampling of avid visitors are both addressed, the model fits the data better and yields a more credible basis for welfare interpretation. This pattern is consistent with prior recreation-demand evidence that combining truncation and endogenous stratification corrections can materially change inference and model fit (Hindsley et al., 2011; Landry et al., 2016; Martínez-Espiñeira & Amoako-Tuffour, 2008).

Across all models, the most consistent finding is that visitors are highly responsive to both generalized price and perceived landscape quality. The negative travel-cost effect is consistent with the revealed-preference basis of travel-cost demand: as trip costs, including time, increase, visitation declines. The increased negativity of the coefficient after correcting for endogenous stratification (TSP/TSNB) is particularly significant. On-site intercept sampling inherently increases the likelihood of sampling frequent visitors; if this avidity is not addressed, the estimated demand curve may be artificially flattened and welfare measures overstated. The observed changes in Table 4 are consistent with both theoretical expectations and empirical evidence in recreation economics.

3.3. Welfare Estimates and Robustness

Table 5 reports welfare implied by the estimated travel-cost coefficient using bootstrapped 95% confidence intervals (units in 1,000 IDR). The reported expected annual trips summarize mean trip frequency for the observed on-site sample and are nearly identical across specifications, so differences in welfare are driven primarily by changes in the estimated travel-cost sensitivity. Consumer surplus per trip (CS/trip) declines monotonically as the travel-cost coefficient becomes more negative: the point estimate falls from 625 (TP) to 526 (TNB), 500 (TSP), and 435 (TSNB). This pattern is substantively meaningful because it shows that accounting for endogenous stratification/avidity reduces inferred per-visit welfare-consistent with the idea that uncorrected on-site samples can flatten the demand curve and inflate surplus.

Table 5. Estimated 95% of confidence intervals of consumer surpluses (through bootstrapping).

		TP	TNB	TSP	TSNB
$\hat{\beta}_{TC}$		−0.0016	−0.0019	−0.0020	−0.0023
Expected visits (ŷ)		3.47	3.48	3.47	3.49
	Lower	351	346	293	284
CS/trip[a]	Point	625	526	500	435
	Upper	1,075	904	914	727
	Lower	1,217	1,203	1,018	990
CS/individual[a]	Point	2,169	1,832	1,735	1,517
	Upper	3,731	3,148	3,173	2,538

[a] Numbers are rounded and in 1000 IDR.

Annual consumer surplus per individual (CS/individual) follows the same ordering because $\hat{y}$ is nearly constant: 2,169 (TP), 1,832 (TNB), 1,735 (TSP), and 1,517 (TSNB). Moving from the simplest truncation-only Poisson model to the preferred TSNB specification reduces both per-trip and annual surplus by roughly 30%. This is a sizeable adjustment and reinforces the argument that avidity correction is not a minor technical refinement. If the over-representation of frequent visitors is ignored, welfare can be overstated in ways that are economically meaningful. The TSNB estimate should therefore be treated as the main benchmark, while the remaining models are best interpreted as sensitivity checks that reveal how strongly welfare depends on assumptions about dispersion and sampling.

At the same time, the welfare conclusion itself remains robust across models. Even under the most conservative specification, consumer surplus is clearly positive, with the lower 95% confidence limit still reaching 284 thousand IDR per trip and 990 thousand IDR per individual annually. Thus, although the exact magnitude varies by model, the broader inference does not: the volcanic-slope agricultural landscape generates substantial recreational value for users. The persistence of positive welfare across all specifications and confidence bounds strengthens the interpretation that this landscape is not merely incidentally visited, but provides meaningful nonmarket benefits through recreation and aesthetic experience.

These estimates become easier to interpret when placed in the context of the sample itself. Under the preferred TSNB model, the estimated consumer surplus per trip is approximately 435 thousand IDR, while the mean generalized travel cost reported in Table 1 is about 383 thousand IDR per trip. This suggests that the net recreational benefit of a visit is slightly larger than the average generalized burden incurred to make the trip. Put differently, visitors appear willing to bear substantial costs in money and time because the value they derive from the experience exceeds those costs by a meaningful margin. Likewise, the preferred annual consumer surplus per individual, 1,517 thousand IDR, is non-trivial when considered alongside the sample's monthly income distribution, which is concentrated in the lower-to-middle categories. Although these comparisons should not be interpreted as direct accounting equivalences, they help show that the welfare estimates are economically meaningful at the scale of ordinary domestic leisure decisions rather than being merely symbolic values. This directly responds to the need to relate the results to local realities.

4. Discussion

Several implications follow from the estimated demand and welfare results for understanding informal, agriculture-based outdoor recreation in volcanic uplands and for interpreting welfare measures derived from on-site travel-cost data. Across all four specifications, the travel-cost coefficient is negative and statistically robust, providing clear revealed-preference evidence that visitors respond to generalized trip price even in a non-ticketed setting where destination functions are loosely coordinated. This matters for policy because it suggests that "free access" does not imply inelastic demand; rather, time and travel burdens act as de facto prices, shaping who visits and how often. This behavioral regularity matches the logic of travel-cost valuation in settings where entry fees are absent or unenforced (Blaine et al., 2015; Mäntymaa et al., 2021; Menendez-Carbo et al., 2020; Van Sandt & McFadden, 2022). Importantly, the travel-cost coefficient becomes more negative once endogenous stratification is addressed (TSP/TSNB), indicating higher price sensitivity after correcting for the over-representation of frequent visitors in on-site samples. This pattern supports the central econometric argument of the paper: avidity is not merely a technical issue, but a mechanism that can materially distort welfare inference. If frequent visitors are sampled more often and this is ignored, the estimated demand curve may appear flatter than it truly is, leading to inflated consumer surplus estimates. This is consistent with classic results showing that on-site interception can mechanically flatten the demand curve and overstate welfare if avidity is ignored (Amoako-

Tuffour & Martínez-Espiñeira, 2012; Englin & Shonkwiler, 1995; Hindsley et al., 2011; Landry et al., 2016; Martínez-Espiñeira & Amoako-Tuffour, 2008; Shaw, 1988). For applied outdoor recreation research, the implication is straightforward. Truncated Poisson results remain useful for comparison, but they should not be treated as default welfare benchmarks when sampling occurs at the destination.

The strong and consistent effect of perceived agricultural landscape attractiveness suggests that repeat visitation is fundamentally quality-driven. This aligns closely with the descriptive findings, where visitors emphasized learning, scenic beauty, calmness, and photo-worthy moments as central parts of the experience. In this setting, attractiveness should not be read as a superficial visual rating. It likely captures a broader experiential judgment that includes the visible order of terraces, crop mosaics, comfort at stopping points, the sense of rural atmosphere, and the overall coherence of the working landscape. This interpretation is consistent with the cultural ecosystem services literature, which links recreation value to visitor-perceived quality and to the structural attributes of agricultural scenery (Assandri et al., 2018; Plieninger et al., 2013, 2015; Tieskens et al., 2018; van Berkel & Verburg, 2014). It is also compatible with evidence that social-media dynamics can amplify aesthetic demand by turning particular viewpoints and landscape configurations into widely shared visual icons, thereby accelerating visitation and intensifying pressures even where sites were not originally planned as destinations (Gosal & Ziv, 2020; Nyelele et al., 2023; Siegel et al., 2023; Tieskens et al., 2018). In this sense, visitors are not simply consuming "nature" in the abstract; they are responding to a managed agricultural environment whose recreational appeal depends on how land is cultivated, maintained, and experienced.

The consistently negative substitute-site effect further indicates that this destination operates within a broader regional portfolio of informal outdoor experiences. Visitors reduce repeat trips when substitutes are salient, implying that welfare should be interpreted in a choice context rather than as demand for a monopolistic site. This result aligns with evidence that CES benefits are spatially clustered around accessible nodes and viewpoints rather than evenly distributed across farmland, and that recreation behavior reflects a menu of alternatives shaped by travel constraints and perceived quality (Cetin et al., 2021; van Berkel & Verburg, 2014). For governance, the substitution pattern underscores that maintaining comparative advantage through stewardship and basic visitor-support functions (e.g., viewpoint upkeep, cleanliness, safety) can be as important as expanding facilities, especially where visitation is organized around scenic pull-offs and short walks. Since visitors' sort among comparable sites, the magnitude of welfare is inherently model-dependent and must be interpreted alongside the sampling and distributional assumptions embedded in the econometric specification.

In this context, the welfare estimates show that methodological choices translate into policy-relevant differences in benefit magnitudes. Moving from TP to TSNB reduces consumer surplus per trip from 625 to 435 thousand IDR and consumer surplus per individual from 2,169 to 1,517 thousand IDR, while TSNB also provides the strongest fit (highest log-likelihood and lowest AIC). Given the on-site intercept design, a conservative and well-justified reporting approach is to emphasize TSNB as the primary welfare benchmark because it simultaneously addresses zero truncation, endogenous stratification (avidity), and overdispersion. The remaining specifications (TP, TNB, and TSP) are best interpreted as sensitivity checks that transparently show how welfare magnitudes vary when key assumptions are relaxed or imposed. Although the bootstrap intervals are relatively wide—as expected under nonlinear transformations and a modest sample—welfare remains positive and substantively meaningful across models and confidence limits.

Overall, the welfare evidence supports two closely related findings. First, volcanic-slope agricultural landscapes generate measurable and non-trivial recreational benefits even when tourism remains informal, and access is not structured through an official fee system. Second, the estimated size of those benefits depends materially on whether the analyst correctly models the sampling process inherent in on-site data collection. For that reason, the preferred TSNB estimate provides the most credible basis for subsequent discussion of stewardship, benefit-sharing, and local governance. Rather than treating welfare valuation as an abstract numerical exercise, Table 5 shows that the recreational benefits associated with maintaining terraces, ground cover, and scenic agricultural mosaics are large enough to matter for practical decisions about how such landscapes are managed and by whom.

These welfare magnitudes are not merely accounting results; they help clarify what is at stake when land-use practices and local management affect the visitor experience. In volcanic-slope farming landscapes, steep gradients, recurrent disturbance, and management-dependent mosaics shape both regulating functions and the visible features that visitors consume (De Bauw et al., 2016; Purwaningsih et al., 2020; Saputra et al., 2022; Suprayogo et al., 2020). The strong quality effect therefore supports a co-benefits interpretation: stewardship practices that maintain terraces, ground cover, and landscape coherence likely reinforce both erosion regulation and recreation quality—an interdependence that becomes more consequential as horticultural intensity rises and soil-quality tradeoffs accumulate (Kashyap et al., 2023; Moeskops et al., 2010, 2012). This linkage also helps reconcile production-focused and recreation-focused perspectives: the same management choices that support agricultural performance and landscape resilience can shape the scenic heterogeneity and legibility that visitors value.

The findings also reinforce the analytical importance of informality for outdoor recreation settings embedded in productive rural landscapes. When destination functions are distributed across multiple actors—such as parking provision, small food stalls, informal guiding, and "photo-spot" upkeep—service quality and maintenance incentives may be uneven, and the distribution of benefits can reflect unequal access to capital and bargaining power (Çakmak et al., 2018). In rural Indonesia, community strategies and customary institutions may partially substitute for formal destination management in coordinating shared resources and socially embedded rules (Rosalina et al., 2023). Against this institutional background, welfare estimates provide more than a valuation metric. They offer an empirical basis for discussing how stewardship costs and tourism-derived benefits could be shared among farmers, micro-entrepreneurs, and local communities, particularly when social-media exposure accelerates visitation and increases pressures on viewpoints and access corridors.

Taken together, the results extend the broader valuation literature that treats managed agroecosystems as joint producers of marketed outputs and nonmarket benefits. Evidence from agricultural landscape valuation suggests that recreation benefits can be economically meaningful rather than marginal to rural land-use decisions (Bera & Nag, 2025; Fleischer & Tsur, 2000; Kaleji et al., 2025; Mameno et al., 2024; Song et al., 2020), and travel-cost methods are well suited to reveal these values where entrance fees are absent or unenforced (Blaine et al., 2015; Mäntymaa et al., 2021; Menendez-Carbo et al., 2020; Qiu & Fan, 2016; Tyllianakis, 2024; Van Sandt & McFadden, 2022). In practical terms, the demand and welfare evidence indicate that maintaining perceived landscape quality is not only an aesthetic concern: it is a determinant of visitation frequency and a channel through which stewardship generates public recreational benefits.

5. Conclusions

This study not only quantifies the recreational value of volcanic agricultural landscapes but also empirically demonstrates that, within informal tourism settings, the visual quality and ecosystem stewardship of "working landscapes" are key assets driving leisure demand. It thereby provides a case study supporting the closer integration of leisure economics with sustainable landscape management theory.

The research demonstrates that volcanic-slope farming landscapes can function as significant informal tourist destinations, generating substantial recreational value alongside agricultural production. By applying an on-site travel-cost framework, we establish that visitation patterns are governed by two key economic forces: sensitivity to generalized travel costs and a strong positive response to perceived landscape attractiveness. This confirms that in open-access settings, both accessibility constraints and experienced landscape quality are central drivers of visitation frequency. The findings reinforce the perspective that working agricultural landscapes provide welfare-relevant cultural ecosystem services (CES), where variations in perceived scenery translate into meaningful differences in recreation demand.

From a methodological standpoint, the study shows that welfare estimates derived from on-site surveys are sensitive to the sampling process and the assumed count-data distribution. Correcting for endogenous stratification (avidity bias) and overdispersion—as implemented in the preferred truncated and endogenously stratified negative binomial (TSNB) model—improves model fit and yields more conservative consumer surplus benchmarks. This underscores that simpler truncated Poisson estimates should not be treated as default welfare measures in destination-sampled studies. Presenting models that explicitly address on-site sampling mechanisms provides a more credible basis for policy interpretation and for comparing welfare estimates across studies of emerging, informally managed destinations.

The results substantiate a co-benefits perspective for volcanic uplands. Stewardship practices that maintain terraces, ground cover, and landscape coherence likely reinforce regulating ecosystem services (e.g., soil and water regulation) while simultaneously sustaining the scenic attributes that motivate visitation. Recognizing these non-market benefits strengthens the economic rationale for soil-conserving land management and can inform the design of benefit-sharing arrangements that include farmers and local micro-entrepreneurs. This is particularly relevant in institutionally informal settings where social-media exposure can rapidly intensify visitation pressures.

5.1. Policy Implications: From Recreational Value to Community Benefits

The estimated consumer surplus of approximately IDR 435 thousand per trip provides a tangible economic basis for policy and local governance. This value could, for instance, help partially offset terrace maintenance costs for farmers, supporting practical initiatives such as "ecological compensation" schemes where visitors contribute to conservation through small fees. In informal destinations like Selo and Cepogo, the quantified recreational benefit justifies creating community-based tourism funds to ensure that the economic benefits generated by visitation are shared more equitably among farmers and micro-entrepreneurs. Integrating these non-market values into land-use planning and local development strategies enables stakeholders to promote sustainable landscape stewardship while enhancing local livelihoods.

5.2. Recommendations for Future Research

Several limitations of the current study point to valuable priorities for future research. First, inference is conditional on an on-site sample; complementary off-site sampling would improve the representativeness of the visitor profile and support more defensible aggregation of benefits to the broader population. Second, landscape attractiveness is measured via self-reported ratings; integrating these subjective assessments with objective landscape metrics (e.g., heterogeneity indices, terrace density) and digital trace data could sharpen the causal interpretation of how landscape structure influences perceived quality and demand. Third, the destination is modeled as a single site; employing multi-destination choice frameworks could better capture the substitution patterns, route choices, and trip clustering typical of recreational travel in regional volcanic uplands. Finally, longitudinal or repeated measurement across seasons and following disturbance events (e.g., heavy rainfall, ashfall) would clarify how dynamic risk signals and evolving landscape conditions shape recreation demand and welfare in these dynamic socio-ecological systems.

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IRB Statement: According to the guidelines of Institute for Research and Community Service, Universitas Sebelas Maret, formal ethical review was not required for this study because it consisted of minimal-risk survey research involving adults and did not collect sensitive personal data.

Informed Consent Statement: The study was conducted in accordance with accepted ethical standards for social research. All participants were informed about the purpose of the study, their voluntary involvement, and their right to decline participation or withdraw at any time. Informed consent was obtained prior to data collection, and all responses were anonymized and kept confidential.

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Abbreviations

The following abbreviations are used in this manuscript:

CES	Cultural ecosystem services
IDR	Indonesian rupiah
TP	Zero-truncated Poisson
TNB	Zero-truncated negative binomial
TSP	Truncated endogenously stratified Poisson
TSNB	Truncated endogenously stratified negative binomial

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