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Application of the Travel Cost Method to Estimate the Tourism Value of Dao Co Ecological Tourism Area, Hai Duong, Vietnam

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Abstract

Purpose: This study aims to estimate the recreational value of the Dao Co Ecological Tourism Area in Hai Duong Province, Vietnam, and to provide empirical evidence supporting sustainable management and conservation strategies. **Research design, data, and methodology:** The research employs the Zonal Travel Cost Method (ZTCM) using both primary and secondary data. A total of 420 structured questionnaires were distributed to domestic tourists between January and March 2024, with 398 valid responses. Additional statistics from 2021–2023 were collected from the management board. Tourists were grouped into five zones to estimate travel costs, opportunity costs of time, and related expenditures. The demand function was derived through OLS regression, revealing a significant negative relationship between travel cost and visitation rate ($R^2 = 0.732$, $p < 0.05$). **Results:** The Dao Co Ecological Tourism Area generates an estimated annual recreational use value of approximately VND 49.49 billion, with a consumer surplus of VND 3.72 billion. These results indicate that the site provides significant economic and recreational benefits to visitors and contributes substantially to local development. **Conclusion:** The findings highlight the importance of integrating economic valuation into environmental decision-making and community-based ecotourism management. This study contributes to the empirical understanding of ecosystem service valuation in Vietnam and offers methodological and policy insights for sustainable tourism and resource management.

Keywords : Zonal Travel Cost Method (ZTCM), Ecotourism Valuation, Dao Co Ecological Tourism Area, Vietnam, Sustainable Tourism, Tourism Supply Chain Management, Retailing and Service Distribution, Visitor Behavior

JEL Classification Code: Q26, Q51, Q57, L83

1. Introduction

Ecotourism has evolved as a central paradigm in the discourse of sustainable development (Stronza et. al. 2019), offering a unique balance between economic advancement, cultural preservation, and ecological conservation. Defined as responsible travel to natural areas that conserves the environment and improves the well-being of local people (Ceballos-Lascuráin, 1987), ecotourism is particularly relevant in developing countries where tourism not only creates employment opportunities but also mobilizes communities for conservation-oriented activities (Weaver, 2001).

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Additionally, Ecotourism has emerged as a key strategy in responding to climate change, environmental degradation, and biodiversity loss, while also promoting sustainable development. By integrating economic growth, cultural preservation, and environmental protection, ecotourism aligns well with global sustainable development goals (Dittmar, 2022; Seervi, 2023). This model not only creates employment opportunities for local communities but also encourages active participation in conservation efforts, thereby reducing reliance on unsustainable resource extraction activities (Patil & Pattanshetti, 2024).

Empirical evidence suggests that ecotourism generates substantial socio-economic benefits through job creation, market diversification, and enhanced local enterprise development, while also providing crucial financing for conservation programs and promoting cultural exchange (Vo & Nguyen, 2015; Huy et al., 2023). Additionally, it stimulates the development of local enterprises by directing tourist spending toward local services and products (Patil & Pattanshetti, 2024). Environmentally, ecotourism often incorporates financial mechanisms to support conservation projects and raises visitors' awareness of environmental issues (Dittmar, 2022). Culturally, it plays a role in preserving traditional identities and practices, while fostering interaction between tourists and local communities (Rakhmonov, 2024). However, despite its many benefits, poorly managed ecotourism can also create negative outcomes, including habitat degradation, wildlife disturbance, and the commodification of local culture. These risks highlight the importance of effective governance, capacity building, and participatory management (Dung et al., 2019). Therefore, effective governance and community involvement are essential to maximizing the positive impacts of ecotourism (Patil & Pattanshetti, 2024).

Vietnam is particularly well positioned to benefit from ecotourism given its rich biodiversity, multiple UNESCO biosphere reserves, and diverse cultural heritage. The government has increasingly recognized tourism as a strategic sector, reflected in the National Tourism Development Strategy and recent legislation aimed at fostering sustainability (Asia., 2020). Yet, despite its promise, ecotourism in Vietnam faces significant challenges, including fragmented institutional frameworks, uneven distribution of infrastructure investment, weak enforcement of conservation regulations, and limited integration of local communities into tourism planning (Le et al., 2025). A key gap lies in the economic valuation of ecotourism resources, which is essential to justify conservation investments, guide policy decisions, and ensure the equitable distribution of tourism benefits. Non-market valuation methods, particularly the Travel Cost Method (TCM), offer a practical means of quantifying the recreational and welfare benefits of natural destinations by inferring visitors' willingness to pay from their travel expenditures.

The TCM has been widely applied in various studies in Vietnam, such as at the Tra Su Cajuput Forest (Huy et al., 2023) and Phu Quoc Island (Ngo-Hoang, 2024) as well as in many other regions around the world, including Agrowisata Tuur Ma'asering (Arie et al., 2024) and Rammang-Rammang (Juardi & Ertimi, 2024), demonstrating its effectiveness in quantifying the economic contributions of ecotourism. Factors influencing TCM estimates include travel costs, income, distance, and visitor group size (Arie et al., 2024; Laili et al., 2023). These variables not only reflect consumer behavior but also help determine consumer surplus and the economic impact on local communities (Ayu Novita Sari et al., 2023). TCM-based valuation results can serve as a foundation for setting reasonable entrance fees, planning infrastructure investment, and developing sustainable management policies (Cañez-Cota et al., 2023).

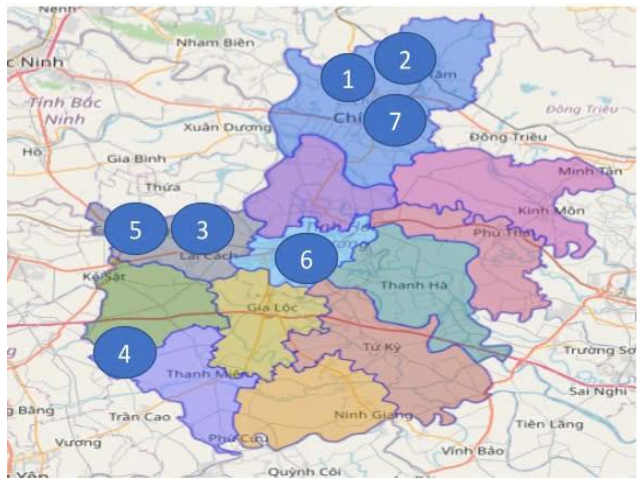

Figure 1: Tourism map of Hai Duong Province (Dao Co is located at position No. 4)

From a business and distribution perspective, ecotourism destinations such as Dao Co can be viewed as nodes within a broader tourism supply chain, involving transportation, accommodation, retail services, and local product distribution. Understanding visitors' travel costs and spending behavior therefore provides valuable insights into retailing patterns, logistics flows, and the efficiency of service distribution. The valuation of ecotourism not only informs environmental management but also supports channel management and local market development, enabling stakeholders to optimize resource allocation and strengthen linkages between producers, service providers, and consumers within the tourism ecosystem. Against this backdrop, the Dao Co Ecological Tourism Area in Hai Duong Province represents a compelling case for non-

market valuation. Hosting approximately 55,000 visitors annually, Dao Co is valued for its unique wetland ecosystems and cultural traditions. Yet, growing tourist influxes, coupled with pressures such as illegal hunting of herons and egrets, have begun to threaten ecological integrity and reduce the site's attractiveness. Understanding the economic contribution of Dao Co is thus critical for designing conservation strategies, deterring unsustainable practices, and optimizing visitor management. This study applies the ZTCM to estimate both the tourism-use value and consumer surplus of Dao Co. By doing so, it contributes to the academic discourse on ecotourism valuation in Vietnam and provides actionable evidence for policymakers, managers, and local stakeholders seeking to harmonize conservation objectives with socio-economic development.

2. Literature Review

According to the United Nations World Tourism Organization (UNWTO), ecotourism refers to tourism activities conducted in natural areas with minimal human disturbance, with the primary goal of observing and learning about local wildlife species. It also emphasizes minimizing and preventing negative environmental impacts in the visited areas. Furthermore, ecotourism should contribute to the conservation of natural areas and the sustainable development of local communities, while enhancing environmental awareness and conservation efforts among both residents and visitors. Meanwhile, Ziffer (1989) describes ecotourism as a form of tourism primarily inspired by a region's natural history, including its indigenous culture. According to (Silva, 2015) ecotourism is often considered a sustainable strategy that does not consume resources and yields benefits in terms of conservation and support for local communities.

(i) International applications of the Travel Cost Method (TCM/ZTCM)

Internationally, the Travel Cost Method (TCM) and its zonal variant (ZTCM) have been extensively applied to measure the recreational value of natural resources. According to (Deely et al., 2022), it is projected that marine and coastal tourism will become a major global economic sector by 2030, which spurred efforts towards recovery of the tourism industry. The study focused on marine tourism in Ireland, employing economic modeling to understand tourist behavior and duration of stay, aiming to inform policy and marketing strategies for post-pandemic tourism recovery. Data were collected from 610 tourists visiting Ireland who participated in marine and coastal tourism, with their stay patterns analyzed across multiple coastal regions. The Travel Cost Method (TCM) was used to estimate consumer surplus an additional value gained by a person beyond the cost of each trip estimated at €295 per day or €1,031 annually for coastal tourism. Studies in South and Southeast Asia, including (Hakim Muttaqim, M. Rasyidin, & M. Saleh, 2021) focused on two main objectives in their study. First, they measured the economic value of tourism in Western Indonesia (Aceh Province) following the 2004 tsunami and examined the effects of travel costs, income, age, and education on the economic value of coastal tourism. The Travel Cost Method (TCM) was applied to assess the economic value of tourism, while multivariate linear regression was used to test the influence of these determining factors. The study utilized a questionnaire containing 100 items, with data collected from 803 tourists in 2018 using a random sampling technique. The results showed a willingness to pay (WTP) of VND 5,464,420 per visitor, indicating a growing trend in visitor numbers, with an average of 168,129 tourists per year. Moreover, the Travel Cost Method estimated the annual consumer surplus, placing the total economic value of coastal tourism at VND 2,159,632,360 per year. The findings indicate a significant potential from visitor contributions to local revenue (PAD), suggesting that local governments should prioritize enhancing comprehensive management - particularly infrastructure across all tourist destinations - to boost local economic income. Similarly, (Dehlavi & Ali Iftikhar, 2021). According to Global 200, which scientifically ranks outstanding terrestrial and aquatic ecosystems in 238 ecoregions worldwide, the Indus Ecoregion is one of the 40 priority Ecoregions. Keenjhar lake, Pakistan's largest freshwater lake and a Ramsar site, is located in the Lower Indus Basin of the Indus Ecoregion. This study applies a single-site truncated count data travel cost model to estimate the value visitors place on recreation in Keenjhar. The study estimated the recreational use value associated with Keenjhar lake to be PKR 3.46 billion (or USD 42.2 million). This estimate is based on an annualized mean consumer surplus per visit of PKR 9,500 (or USD 116) and assumes average daily visits of 1,000. Changing the model specification reduces consumer surplus only by about 5%. Policy makers can use these estimates of the recreational value of the lake to assess the returns to conservation investments.

Besides, Md. Sajib and A K M Nazrul (2016) applied the Zonal Travel Cost Method (ZTCM) to evaluate the recreational benefits of Kuakata Beach, one of Bangladesh's promising yet underutilized natural tourist destinations. It was estimated that the beach generates approximately 29.55 million BDT annually in recreational benefits for visitors. Additionally, the study indicated that enhancing the overall environmental quality of the beach, along with improvements in road infrastructure and transportation amenities, could further increase both recreational value and visitor turnout. Shammin (1999) used the Travel Cost Method (TCM) to determine the willingness to pay for the

services provided by the Dhaka Zoo. Each year, between 3 and 4 million people visit the zoo for recreation and leisure. A questionnaire survey was conducted to gather information about visitors and their associated travel costs. The data were analyzed to understand visitors' origins, travel distances, income groups, and travel expenditures. Visitors were categorized into concentric zones based on their distance from the zoo. The willingness to pay per day for visitors was calculated from the sample data. The results indicated that people's willingness to pay for the services and attributes of the zoo was $7.46 per day.

(ii) Empirical applications in Vietnam

In Vietnam, TCM and ZTCM have been applied to a range of ecotourism destinations, from cultural heritage sites to wetlands and coastal ecosystems. Bui Dai Dung, Nguyen An Thinh, and Nguyen Thi Vinh Ha (2019) focused their research on valuing cultural heritage using non-market valuation methods. The authors argued that heritage is truly a public good, not a private one, and that using the demand curve for public goods yields more accurate valuation results. This paper presents arguments in favor of the superiority of the public good demand curve and applies the zonal travel cost method to value Hội An, a world heritage site in Central Vietnam, to substantiate this perspective. The evidence indicated that: (1) the relationship between visitation and travel cost is more accurately represented by the demand curve for public goods rather than private goods; (2) to construct a demand curve for a world heritage site (with heterogeneous visitors), additional techniques must be employed to minimize potential distortions, including the use of purchasing power parity (PPP) adjustments to account for inconsistencies in actual travel costs; and (3) Hội An was valued at USD 3,581,607,970 based on the public good demand curve 73.85% higher than the value calculated using the private good demand curve. Study by (Nguyen Van Hoa, 2020) assessed the landscape value of mangrove forests in Cu Lao Dung, Tran De, and Vinh Chau districts of Soc Trang Province using the travel cost method. The results showed that the tourism value of the mangrove forests was VND 327 billion, with a consumer surplus of VND 36 billion and benefits accrued by tourism service providers in Cu Lao Dung reaching VND 291 billion.

Nguyet (2017) conducted a study on the tourism value of Phu Quoc using the zonal travel cost method, constructing a recreational demand curve and estimating tourist consumer surplus. The study employed a quantitative analysis combined with descriptive statistics, based on interviews with 400 tourists both domestic and international visiting Phu Quoc. From the collected data, an OLS regression model was employed to construct the tourism demand curve. The results revealed that travel costs had an inverse effect on visitation rates, while income had no significant impact on recreational demand in Phu Quoc. The estimated consumer surplus was approximately VND 792 billion, and the projected recreational value reached around VND 19,930 billion, indicating Phu Quoc's substantial natural resource value and tourism potential. Based on these findings, the study proposed measures to attract international tourists, maintain and expand domestic tourism, and improve infrastructure and human resources for the sustainable development of tourism in Phu Quoc. Luu Tien Thuan (2017) conducted a study on the landscape value of the Cái Răng Floating Market for domestic tourists in 2016. They applied the zonal travel cost method and linear regression analysis to quantify the market's landscape value and construct a tourism demand curve. The results showed that the tourism value of the Cai Rang Floating Market in 2016 was VND 373,747 billion, with a tourist surplus of VND 116,003 billion and business revenues from tourist spending totaling VND 257,743 billion. The demand curve for domestic tourists was expressed as $VR = 15{,}916 - 8{,}961\times10^{-6} \times TC$. This study provided further evidence supporting the theory of landscape value and the travel cost method by applying it to the specific case of the Cai Rang Floating Market in Can Tho City. These studies collectively confirmed the economic importance of natural and cultural attractions, showing that travel costs are negatively correlated with visitation, while also quantifying the considerable tourism value of such destinations. However, most applications remain site-specific, and comparative or integrative analyses across different ecosystems are limited.

Although the Travel Cost Method (TCM) and the Zonal Travel Cost Method (ZTCM) have been widely employed to assess the economic value of numerous ecotourism destinations in both Vietnam and abroad - ranging from Tra Su cajeput forest, Phu Quoc, Cu Lao Dung, and Cai Rang floating market to the beaches of Bangladesh and Keenjhar Lake in Pakistan - most of these studies have primarily concentrated on large-scale and well-branded tourist sites. By contrast, small- and medium-scale local ecological sites, which are directly confronted with increasing tourist influx, ecosystem degradation, and the absence of sustainable governance mechanisms, have rarely been systematically valued. Notably, to date, no study has applied TCM to quantify the tourism value of Dao Co (Hai Duong, Vietnam) - a distinctive wetland area with both ecological significance and ecotourism potential. This research gap not only constrains academic understanding but also hinders policy formulation for conservation aligned with sustainable development. Furthermore, from a methodological perspective, many previous studies have tended to adopt a simplified approach, calculating solely travel expenditures while overlooking critical components such as the opportunity cost of time, ancillary expenditures, and regression analyses for deriving the tourism demand function. Such limitations risk producing underestimations

of consumer surplus as well as the overall economic value generated by ecotourism.

This study distinguishes itself in three key respects. First, it extends the academic scope to a previously unvalued destination, thereby providing scientific evidence for local ecological sites—an area of research that remains underexplored. Second, it employs a more comprehensive calculation of travel costs, encompassing both the opportunity cost of time and supplementary expenditures, thus yielding a more accurate reflection of tourists' spending behavior. Third, the study applies Ordinary Least Squares (OLS) regression to construct a tourism demand function with a high explanatory power, ensuring reliable valuation results that serve as a meaningful reference for policymaking. With these contributions, the study not only fills an academic void but also reinforces methodological rigor, thereby laying the groundwork for broader applications of TCM in advancing the sustainable development of ecotourism in Vietnam.

3. Research Methodology

To quantify the recreational value of the Dao Co Ecological Tourism Area, this study employed the Zone Travel Cost Method (ZTCM), a statistical and economic approach used to estimate the value of tourist destinations. The ZTCM formula is as follows:

$$\frac{\boldsymbol{Vi}}{\boldsymbol{Pi}} = \boldsymbol{f(TCi, Si)}$$

Vi is the number of visits from zone *i* to the destination; **Pi** is the population of zone *i*; **TCi** is the travel cost from zone *i* to the destination; Si includes socio-economic variables such as average income, age, gender, education level, etc.

The ratio Vi/Pi is calculated as the number of visits per 1,000 people and is commonly denoted as VR (Visitation Rate).

Steps for valuing the tourism site:

Step 1: Classify visitors by regional group.

Step 2: Prepare a survey questionnaire for visitors, asking about the distance from their departure point to the tourist site and how many times they have visited. The number of visits from zone *i* is calculated using:

$$Vi = V(TCi , Pi , Si)$$

Vi is the number of visits from zone i to the tourist site; TCi is the cost of the i-th visit; Pi is the population of zone i; Si includes variables such as age, gender, education level, income, etc.

Step 3: Calculate the VR (Visitation Rate), which is the number of visits per 1,000 residents in each zone. VR is determined by dividing the total number of visitors to the destination in a year by the total population of that zone (in thousands).

Step 4: Calculate the total travel cost by zone of origin, including transportation costs, opportunity costs of time, and other expenses (in-site travel costs, meals, souvenirs, local specialties, storage, etc.).

Step 5: Use regression analysis to determine the relationship between visitation rate and total travel cost by zone of origin. The functional form is as follows:

$$VRi = a + b*TCi + e$$

VRi is the visitation rate of tourists from origin zone i; TCi is the total travel cost for tourists from origin zone i; e is the random error term in the function; i refers to the i-th region; a is the coefficient representing other factors (besides total cost) that influence the visitation rate; b is the coefficient representing the degree to which cost affects the visitation rate;

Step 6: Construct the tourism demand curve based on the results of the regression analysis using SPSS software, applying the OLS (Ordinary Least Square) method (Figure 2).

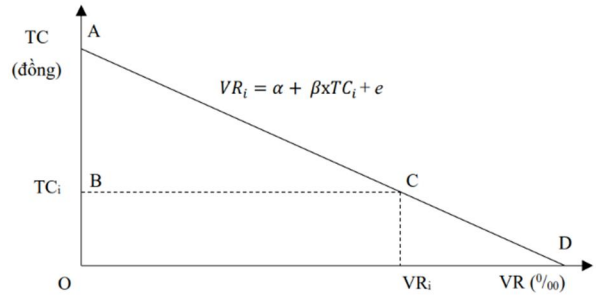

Figure 2: Demand Curve for Recreational Activitie

Figure 2 illustrates the inverse relationship between travel cost (TC) and visitation rate (VR) in the Zonal Travel Cost Method (ZTCM) framework. The line AD represents the theoretical tourism demand curve, expressed by the equation $VR_i = \alpha + \beta * TC_i + e_i$, where the negative coefficient β indicates that visitation decreases as travel cost increases. Points B (TCi) and C (VRi) denote the travel cost and visitation rate of zone *i*, which are used to estimate the consumer surplus (CS)—the net recreational benefit tourists gain beyond their actual expenditures. The triangular area OAC beneath the demand curve represents the recreational use value, reflecting tourists' willingness to pay and serving as a quantitative basis for assessing the non-market economic value of Tourism Area.

Step 7: Calculate the area under the demand curve and the consumer surplus.

This study was conducted in accordance with the ethical standards of social science research. Participationin the survey was entirely voluntary, and informed consent was obtained after respondents were clearly informed about the research objectives. No personally identifiable information was collected; all data were anonymized and used solely for

academic purposes. The study involved no potential risks to participants.

In the application of the Zonal Travel Cost Method (ZTCM), the division of the study area into zones oforigin is essential for estimating the demand function, as it allows for systematic variation in travel costs and visitation rates. In this study, five zones were established based on both geographical distance and administrative boundaries: (1) less than 30 km (Hai Duong and Hung Yen); (2) between 30 and 90 km (Ha Noi, Hai Phong, and Thai Binh); (3) between 90 and 120 km (Ha Nam, Ninh Binh, Bac Ninh, Bac Giang, and Nam Dinh); (4) between 120 and 200 km (Quang Ninh, Hoa Binh, Thanh Hoa, and Phu Tho); and (5) between 200 and 350 km (Son La, Lang Son, Yen Bai, Bac Can, and Nghe An).

The rationale for this classification is threefold. First, the distance thresholds reflect distinct gradients of travel cost, which is the core explanatory variable in ZTCM. Second, the use of provincial administrative boundaries ensures compatibility with official population statistics, facilitating the calculation of visitation rates. Third, limiting the number of zones to five provides a balance between capturing meaningful variation in travel costs and ensuring feasibility in data collection and analysis. Moreover, this five-zone design is consistent with international practices, where studies typically employ four to eight zones depending on geographical scale and data availability. Hence, the chosen classification is both methodologically robust and contextually appropriate for the case of Dao Co.

4. Research Results and Discussion

4.1. Collecting Primary and Secondary Data

Primary data sources include information gathered through surveys using questionnaires. The sample size is determined by the author using the following Slovin's formula:

$$n = \frac{N}{(1+N*e^2)}$$

n: Sample size; N: Population size; e: Acceptable margin of error, typically ranging from 1% to 10% (the commonly used level is e = 5%) (Table 1).

Table 1: Number of Tourists Visiting the Ecotourism Site Dao Co from 2022 to 2024

Year	2022	2023	2024	Average
Number of tourists (thousand)	52,500	55,000	60,000	55,834

Source: Department of Culture and Society – Chi Lang Nam Commune

A total of 420 questionnaires were collected, of which 12 were unusable. 408 valid responses remained; however, after further screening for completeness and consistency, only 398 were selected for use in the analysis. The survey was conducted directly with tourists using a convenience sampling method at the site. Participants were informed about the research objectives, assured that the data would be used solely for academic purposes, and guaranteed confidentiality with no disclosure of personal identities. After completing the survey, the questionnaires were processed and data were entered. The author used excel software to analyze and calculate frequency, average values and other descriptive statistics. SPSS software was employed to perform Ordinary Least Squares (OLS) regression analysis to determine the tourism demand function (Table 2).

Table 2: Tourist Activity Participation

	Number of Visitors	Percentage (%)
Tourist Visit Frequency		
1 time	268	67.34
2 times	79	19.85
3 times	19	4.77
More than 3 times	32	8.04
Travel Type		
Solo travel	89	22.36
Group of 2–4 people	113	28.4
Group of 5–10 people	113	28.4
Group of 10–20 people	71	17.83
Group of 20–30 people	9	2.26
Group of more than 30 people	3	0.75
Preferred Activities		
Enjoying natural scenery	203	51
Exploring stork species and boat tours	150	37.69
Fishing	16	4.02
Enjoying local cuisine	29	7.29
Aspects Tourists Were Dissatisfied With		
Infrastructure	170	42.7
Services	113	28.4
Natural landscape	20	5.03
Environmental quality	80	20.1
Other	15	3.77
Scenic Quality at Dao Co		
Very satisfied	148	37.19
Satisfied	165	41.46
Neutral	58	14.57
Dissatisfied	18	4.52
Very dissatisfied	9	2.26

Source: Processed from survey data

The results presented in Table 2 indicate that the majority of visitors to Dao Co are first-time tourists (67%), while the proportion of repeat visitors exceeding three visits remains relatively low at around 8%, reflecting limited visitor loyalty. Most tourists travel in small groups of two to ten people (accounting for nearly 57%), which is consistent with the characteristics of family or friend-based tourism. In terms of activities, the most preferred options are sightseeing (51%) and bird-watching combined with boat trips (38%), underscoring the destination's core value in its natural landscape and unique ecological system. Nevertheless,

visitors expressed dissatisfaction primarily with infrastructure (43%) and service quality (28%), revealing notable constraints in meeting the increasingly diverse demands of tourists. Despite these limitations, the overall evaluation of the scenery remains highly positive, with nearly 79% of visitors reporting satisfaction or high satisfaction, reaffirming Dao Co's outstanding potential for the development of ecological tourism.

General information about the location and characteristics of the site was obtained from the official electronic portal of Chi Lang Nam Commune – Thanh Mien District. Information regarding natural features, ecosystems, current management status, the number of stork and heron individuals on the island, total revenue in 2022, 2023, and 2024, and the number of tourists was provided by the Management Board of the Dao Co Ecotourism Area and the People's Committee of Chi Lang Nam Commune.

4.2. Zoning of Tourist Points of Origin

Tourists visiting Dao Co mainly come from the Northern region of Vietnam, motivated by the desire to explore biodiversity or simply enjoy the natural landscape at a reasonable cost. Based on visitor interviews and the collection of secondary data about their points of origin, the author divided the origin regions into five zones, according to their distance from the Dao Co Ecotourism Area. Following the zoning, it was observed that the zone closest to the site had the highest visitor frequency (Table 3).

Table 3: Tourist Zoning

Region	Average Distance (km)	Province	Total Population in the Region (thousand people)	Frequency	Percentage (%)
1	Less than 30 km	Hai Duong, Hung Yen	2,705.9	98	24.62
2	Between 30 and 90 km	Ha Noi, Hai Phong, Thai Binh	10,500.53	140	35.17
3	Between 90 and 120 km	Ha Nam, Ninh Binh, Bac Ninh, Bac Giang, Nam Dinh	6,834.14	66	16.58
4	Between 120 and 200 km	Quang Ninh, Hoa Binh, Thanh Hoa, Phu Tho	7,293.6	65	16.33
5	Between 200 and 350 km	Son La, Lang Son, Yen Bai, Bac Can, Nghe An	5,418.6	29	7.28

Source: Processed from survey data

The results in Table 3 indicate that most visitors come from local areas and nearby provinces, while the proportion of tourists from more distant regions remains limited. This reflects Dao Co's heavy reliance on the short-distance domestic market, with little expansion into long-distance segments. While this proximity-based market structure facilitates accessibility, it also poses risks regarding stability should local demand fluctuate. Therefore, broader marketing strategies are needed to enhance the destination's attractiveness to interprovincial and potentially international visitors.

4.3. Visitation Rate by Region

To calculate the visitation rate for each region, it is necessary to determine the average number of visitors from that region to Dao Co over the course of one year. This average is obtained by multiplying the total number of visitors to Dao Co by the percentage of visitors from each region, as determined through sample survey data.

According to the Management Board of the Dao Co Ecotourism Area, the average number of tourists from 2022 to 2024 was 55,834 visitors per year. Based on this, the visitation rate for each of the five regions was calculated (Table 4).

Table 4: Average Annual Number of Visitors from Each Region

Region	Percentage (%)	Average number of visitors per year (Vi)
1	24.62	13,746
2	35.17	19,636
3	16.58	9,257
4	16.33	9,117
5	7.28	4,064

Source: Processed from survey data

Table 4 presents both the percentage shares and the absolute numbers of visitors across five regions: region 1 accounts for 24.62% (13.746 visitors/year), region 2 for 35.17% (19,636 visitors/year), Region 3 for 16.58% (9,257 visitors/year), region 4 for 16.33% (9,117 visitors/year), and region 5 for 7.28% (4,064 visitors/year). Although region 2 contributes the largest number of visitors in absolute terms, a proper interpretation requires controlling for population size in each region. Presenting both absolute and relative figures allows us to distinguish between regions that contribute large flows of visitors and those with high visit density relative to their population.

The regional visitation rate refers to the number of people from region i who visited the tourist site within one year. It is calculated as follows:

$$VRi = Vi / Pi$$

VR_i: Visitation rate of region I; V_i: Average annual number of visitors from region I; P_i: Total population of region i

Based on the number of visitors from each region per year and the 2022 population statistics (from the General Statistics Office of Vietnam), the visitation rate for each region is summarized in the following (Table 5)

Table 5: Regional Visitation Rates of Tourists

Region	Number of visitors in a year Vi	Total population of the region (thousand people) Pi	Tourism rate (number of trips per 1,000 people) VRi = Vi/Pi
1	13,746	2,705.9	5.08
2	19,636	10,500.53	1.87
3	9,257	6,834.14	1.45
4	9,117	7,293.6	1.25
5	4,064	5,418.6	0.75

Source: Processed from survey data

Table 5 shows the visitation rates per 1,000 residents for each region: Region 1 records the highest rate at 5.08 visits/1,000 residents, while Region 5 has the lowest at only 0.75 visits/1,000 residents. Comparing this with Table 4 reveals that although Region 2 produces the largest absolute number of visitors, Region 1 the closest in distance exhibits the highest visitation density. This finding demonstrates that geographical distance is a decisive factor shaping travel behavior. The results support the hypothesis that travel cost and distance exert a strong influence on visitation rates.

For tourists living nearby, traveling to the Dao Co Ecotourism Area is more convenient and incurs lower costs compared to visitors from farther regions. Meanwhile, provinces located at greater distances may opt for alternative destinations such as Cuc Phuong National Park (Ninh Binh) or Ba Be National Park (Bac Kan), which also offer rich ecosystems and attractive recreational activities

4.4. Determining Travel Costs

(i) Transportation Costs

In the survey, tourists reported their travel expenses, which included fuel or vehicle rental costs. Parking fees, which were standardized as follows for calculation, were also accounted for: Bicycle: 2,000 VND; Motorbike: 4,000 VND; 4–8 seat car: 15,000 VND; 8–16 seat car: 20,000 VND; Car with more than 16 seats: 25,000 VND. (Table 6)

Table 6: Transportation Costs of Tourists to Dao Co Ecotourism Area

Unit: VND (Vietnamese Dong)

Region	Number of tourists	Average travel cost per person (CP1)
1	98	15,357
2	140	55,471
3	66	82,727
4	65	10,727
5	29	121,923

Source: Processed from survey data

Table 6 reports the average transportation costs (CP1) per visitor by region: Region 1 = 15,357 VND; Region 2 = 55,471 VND; Region 3 = 82,727 VND; Region 4 = 102,727 VND; and Region 5 = 121,923 VND, confirming a clear increasing trend with distance. The strong cost–distance correlation reflects the significantly higher burden borne by visitors from distant regions compared to nearby ones. Combined with the visitation rate results in Table 5, this pattern illustrates how rising travel costs suppress visitation—a critical element in formulating the zonal demand curve.

(ii) Opportunity Cost of Time

Previous studies have shown that opportunity costs for the time each tourist spends at the site can be estimated based on average daily wages. Since all tourists in this study spent time from 7:00 AM to 6:00 PM, equivalent to a typical working day, prior research has concluded that time cost can be estimated as one-third of the average daily wage.

As there is currently no wage data available by region, the author used Vietnam's nominal GDP per capita, reported by the World Bank, which is 4,284 USD. The exchange rate used is 25,000 VND/USD.

Thus, the opportunity cost (CP2) incurred by tourists per day at the ecotourism site is calculated as:

CP2 = 4,284 (USD) × 25,000 (VND/USD) / (3×26×12)
= 114,423 (VND/person/day)

(iii) Other Costs

Other costs include intra-site transportation, food, accommodation, souvenirs, specialty products, storage, etc. Intra-site transportation: Includes entrance fees and boat ride fees. (Table 7)

Table 7: Intra-site Transportation Costs, Average Food Expenses of Tourists, Average amount Spent on Souvenirs, Local Specialties, and Storage Services

Unit: VND (Vietnamese Dong)

Region	Number of tourists	Average travel cost within the tourist area (CP3)	Average food and beverage cost within the tourist area (CP4)	Average cost of purchasing specialties, souvenirs, shipping services, etc., within the tourist area (CP5)	Total other costs (CP6)
1	98	23,265	10,632	6,194	40,091
2	140	39,192	32,892	8,513	80,597
3	66	28,939	67,045	26,909	122,893
4	65	30,545	102,618	29,309	162,472
5	29	33,846	111,426	38,538	183,810

Source: Processed from survey data

Table 7 summarizes within-site expenditures (CP3: local transport; CP4: food and beverage; CP5: souvenirs; CP6: other costs) and reveals an upward trend in spending by more distant visitors: CP6 values rise from 40,091 VND in Region 1 to 183,810 VND in Region 5. This suggests that

visitors from farther regions tend to spend more once at the site, possibly due to longer stays or greater consumption of on-site services, in contrast to local visitors who incur low transport costs but spend less at the destination. From an economic perspective, this pattern is significant because on-site expenditures are more likely to generate local economic benefits than travel costs paid externally.

4.5. Demand Function for Recreational Activities

Based on the calculated results for transportation costs, opportunity cost of time, and other expenses, the author compiled the total cost per tourist by region in the following (Table 8).

Table 8: Summary of Costs and Regional Visitation Rates

Region	Tourism cost per region (VND) (TC = CP1 + CP2 + CP6)	Tourist rate per region (VR) (number of trips per 1,000 residents)
1	169,871	5.08
2	250,491	1.87
3	320,043	1.45
4	379,622	1.25
5	420,156	0.75

Source: Processed from survey data

Table 8 integrates transportation, opportunity, and ancillary costs to compute total trip cost (TC = CP1 + CP2 + CP6), and compares it with visitation rates. TC values rise consistently with distance, ranging from 169,871 VND in Region 1 to 420,156 VND in region 5, while VR declines correspondingly from 5.08 to 0.75 visits/1,000 residents. This reveals a strong negative correlation between total cost and visitation rate: the closer regions exhibit both lower costs and higher visitation, whereas distant regions face higher costs and lower visitation.

According to case studies on ZTCM (Beal, 1995; Nillesen et al., 2005) the socio-economic variables of tourists were found to have no statistically significant effect, not even at the 10% significance level. Therefore, the number of visits is assumed to depend primarily on the cost of the trip. Accordingly, it is assumed that there is a linear relationship between the visitation rate and travel costs across regions. In this model, the visitation rate (VR) per region is the dependent variable, and the travel cost (TC) per region is the independent variable. Thus, the demand function model is as follows:

VRi = a + bTCi (a, b are the coefficients to be estimated)

The regression analysis conducted by the author shows that the R value = 0.894, indicating a strong relationship between the independent and dependent variables in the model. The coefficient of determination R^2 = 0.799 demonstrates that the model explains 79.9% of the variation in the visitation rate across regions based on the travel cost in each region (Table 9)

Table 9: Regression Analysis Results Model Summaryb

Model	R	Coefficient of determination (R^2)	Adjusted R	Standard error of the estimate	Durbin-Watson
1	0.894[a]	0.799	0.732	0.89295	2.020

a. Predictors: (constant), TC
b. Dependent Variable: VR
Source: Processed from survey data

Additionally, the adjusted R^2 provides a more accurate measure of the model's fit to the overall population. The adjusted R^2 value is 0.732, which means that 73.2% of the variation in the dependent variable (VR – "regional visitation rate") is explained by the independent variable (TC – travel cost per region), while the remaining 26.8% is due to other factors outside the model and random error.

The overall fit of the regression model was tested using the F-statistic in the ANOVA table (Table 10). The F-value = 11.923 with a significance level of sig = 0.041 < 0.05 initially confirms that the linear regression model is appropriate for the collected dataset and can be reliably used. (Table 10, Table 11)

Table 10: ANOVA (Analysis of Variance) Table

Model	Sum of squares	df	Mean Square	F	sig
Regression	9.507	1	9.507	11.923	0.041[b]
Resudual	2.392	3	0.797		
Total	11.899	4			

Source: Processed from survey data

Table 11: Regression Results of the Demand Function for Recreational Activities

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std.Error	Beta		
(Constant)	6.815	1.428		4.772	.017
TC	-1.537E-5	.000	-.894	-3.453	.041

Source: Processed from survey data

Thus, the regression equation for the demand function for recreational activities is:

VR = 6,815 - 0,00001537*TC

B = -0.00001537 < 0, meaning that for every increase of 1,000 VND in the cost of a trip to Dao Co, the visitation rate per 1,000 people per year decreases by 0.00001537 units.

a = 6.815 represents other factors not included in the model, such as education level, tourist income, etc.

Based on the above equation, the author constructed the recreational demand curve as follows:

When the visitation rate is VR = 0, then TC = 6.815 / 0.00001537 = 443,396.23 VND. Conversely, when TC = 0, VR = 6.815. The tourism demand curve is expressed as Figure 2.

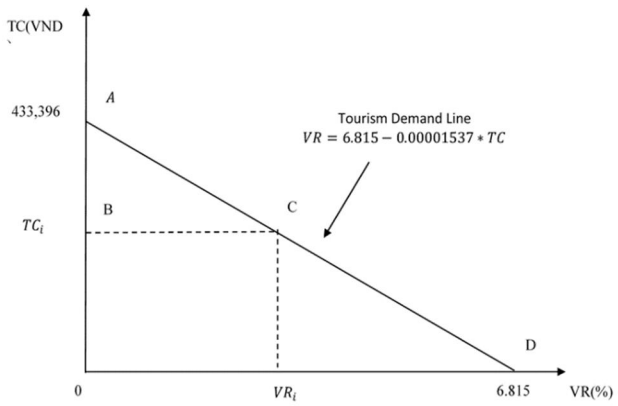

Figure 3: Tourism Demand Line at Dao Co Ecotourism Area

Figure 3 illustrates the inverse relationship between travel cost (TC) and visitation rate (VR) through the estimated demand function $VR = 6.815 - 0.00001537 * TC$. The downward-sloping linear demand curve reflects a fundamental economic principle: as travel costs increase, the number of tourist visits decreases. When travel cost equals zero, the potential maximum visitation rate reaches 6.815 trips per 1,000 residents, whereas at the critical cost level of 443,396 VND, the visitation rate falls to zero. The coefficient of determination ($R^2 = 0.732$) indicates that 73.2% of the variation in tourist visitation can be explained by travel costs, confirming cost as the dominant factor influencing destination choice. The area under the demand curve represents the consumer surplus the net recreational benefit that tourists receive beyond their actual expenditure estimated to correspond to an annual recreational value of approximately VND 49.49 billion, including a consumer surplus of VND 3.72 billion. These results confirm the substantial economic value of Dao Co and provide empirical evidence for formulating sustainable ecotourism management policies that balance economic benefits with environmental conservation objectives.

The area under the demand curve represents the tourism value of the Dao Co Ecotourism Area. It is calculated using the formula for the area of a triangle:

S = ½ × 443.396,23 x 6.815

= 1,510,872.65 (Thousand Dong/1.000 people)

In the Zone Travel Cost Method (ZTCM), the scenic value is calculated based on the consumer surplus of tourists visiting Dao Co, using the travel cost (TC_i) and visitation rate (VR_i) for each region. The formula for calculating consumer surplus is based on the area of the triangle formed between the demand curve and the cost line:

CS = ½ × VR × (443.396,23 - TC)

From the table 12, it can be seen that the net potential tourism value of the Dao Co Ecotourism Area reaches 49,485.27 million VND. Thus, in 2024, Dao Co generated 49,485.27 million VND in value for the economy. This includes the consumer surplus (benefit) gained by tourists when visiting the island, as well as the travel-related expenditures they incurred for transportation and tourism services at the destination.

Table 12: Tourism Value and Consumer Surplus of Tourists by Region

Model	Pi (thousand people)	Estimated Total Willingness to Pay per Region 1.510.872,65 x Pi (million VND)	Tourist Surplus CSi = Pi x CS (million VND)	Expenditure CSi (million VND)
1	2,705.9	4,088.27	1,879.93	2,208.34
2	10,500.53	15,865	1,893.94	13,971.06
3	6,834.14	10,325.5	611.184	9,714.31
4	7,293.6	11,019.7	290.714	10,728.98
5	5,418.6	8,186.8	47.223	8,139.57
Total		49,485.27	3,722.99	44,762.26

Source: Processed from survey data

It is notable that a large portion of this total value, specifically the expenditures (44,762.26 million VND), goes to transportation companies and local tourism service providers such as restaurants, homestays, and entertainment services at Dao Co. This total cost level suggests that the destination's tourism appeal is still relatively modest, with most visitors coming from rural or urban areas nearby.

5. Conclusions

This study applied the Zonal Travel Cost Method (ZTCM) to estimate the recreational use value of the Dao Co Ecological Tourism Area. The findings indicate that Dao Co generates an annual economic value of approximately VND 49.49 billion, with an estimated consumer surplus of VND 3.72 billion. The demand function revealed a significant negative relationship between travel costs and visitation rates, confirming that cost is a critical determinant of tourist behavior. The analysis further highlights several management concerns that require attention. Visitor expenditures are concentrated in transportation and service providers, raising issues of uneven benefit distribution for local communities. In addition, rising visitor numbers combined with ecological pressures, such as illegal hunting, suggest potential risks of exceeding the site's carrying capacity. These insights underscore the importance of embedding ecotourism development within an integrated governance framework. Upgrading infrastructure and rationalizing entrance fees should be accompanied by policies that ensure equitable benefit-sharing and strengthen community participation in conservation. By aligning economic valuation with management strategies, Dao Co can serve as a model for sustainable ecotourism in Vietnam,

where biodiversity protection and local welfare are pursued in tandem.

From a distribution and supply chain perspective, the findings also highlight the economic linkages between tourism flows and local retailing and service networks. The spending behavior of visitors - particularly in transport, food services, and souvenirs - demonstrates the role of Dao Co as a distribution hub connecting ecological assets with market activities. By improving logistics, retail infrastructure, and marketing channels, local authorities can enhance the efficiency of value transmission along the ecotourism supply chain, thereby promoting both conservation and local business development. These distribution-related insights add further value to the research by positioning ecotourism not only as an environmental strategy but also as a driver of regional trade and sustainable retail systems.

Limitations of the study: Despite providing valuable quantitative insights intro the recreational demand, the zonal travel cost method (ZTCM) applied in the study is subject to several methodological and conceptual limitations. From a methodological perspective, this study is based on a cross-sectional survey with a limited time frame and geographic coverage, which may not fully reflect seasonal variations or the diversity of visitor preferences across different periods. The sampling approach, though practical, relied partly on convenience, potentially introducing selection bias and limiting the generalizability of the results. Moreover, the assumptions embedded in the ZTCM such as treating travel time as a uniform opportunity cost, or considering trips as single-purpose may not accurately represent the complex decision-making behavior of all tourists. Beyond these methodological concerns, the ZTCM primarily captures use values and does not account for non-use values, such as existence or bequest values, which are particularly important in biodiversity-rich areas like Dao Co.

Future research: Building upon the findings of the present study, future research should aim to expand beyond the current scope by integrating alternative valuation approaches such as the Contingent Valuation Method (CVM) or Choice Experiments (CE). These methods would enable the estimation of both use values (e.g., recreation, tourism expenditure) and non-use values (e.g., existence, bequest), thereby providing a more comprehensive assessment of the ecological and socio-economic importance of Dao Co. In addition, longitudinal surveys conducted across different seasons would help capture temporal variations in visitor demand, while comparative analyses between distinct visitor groups (e.g., domestic versus international tourists; short-stay versus long-stay visitors) would shed light on the heterogeneity of preferences, spending behaviors, and willingness to pay. Finally, interdisciplinary research that integrates perspectives from economics, ecology, and sociology could generate practical insights into governance models. Such a holistic approach would support the design of management strategies that simultaneously safeguard ecological integrity, ensure community participation and welfare, and promote the sustainable development of eco-tourism at Dao Co.

Overall, the findings of this study demonstrates that Dao Co Ecological Tourism Area holds a significant tourism value, reflecting both its ecological uniqueness and its role as an emerging ecotourism destination. However, as emphasized in the research objectives, valuing this resource is not merely an academic exercise but a foundation for informing sustainable management strategies. The sustainability of Dao Co's tourism potential will ultimately depend on governance choices that balance ecological conservation with socio-economic benefits. If managed strategically through community engagement, ecological safeguards, and equitable benefit-sharing Dao Co could transcend its local importance to become a national exemplar of conservation-oriented ecotourism in Vietnam. This would not only preserve its biodiversity but also generate long-term livelihoods and cultural identity for surrounding communities. Conversely, if development is driven primarily by short-term economic gains, the very ecological assets that underpin its value risk being degraded or irreversibly compromised. In this sense, Dao Co represents more than a regional attraction; it highlights the broader challenge of aligning conservation and development goals, underscoring the critical need for an evidence-based and inclusive policy approach to achieve sustainable ecotourism environment in Vietnam.

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